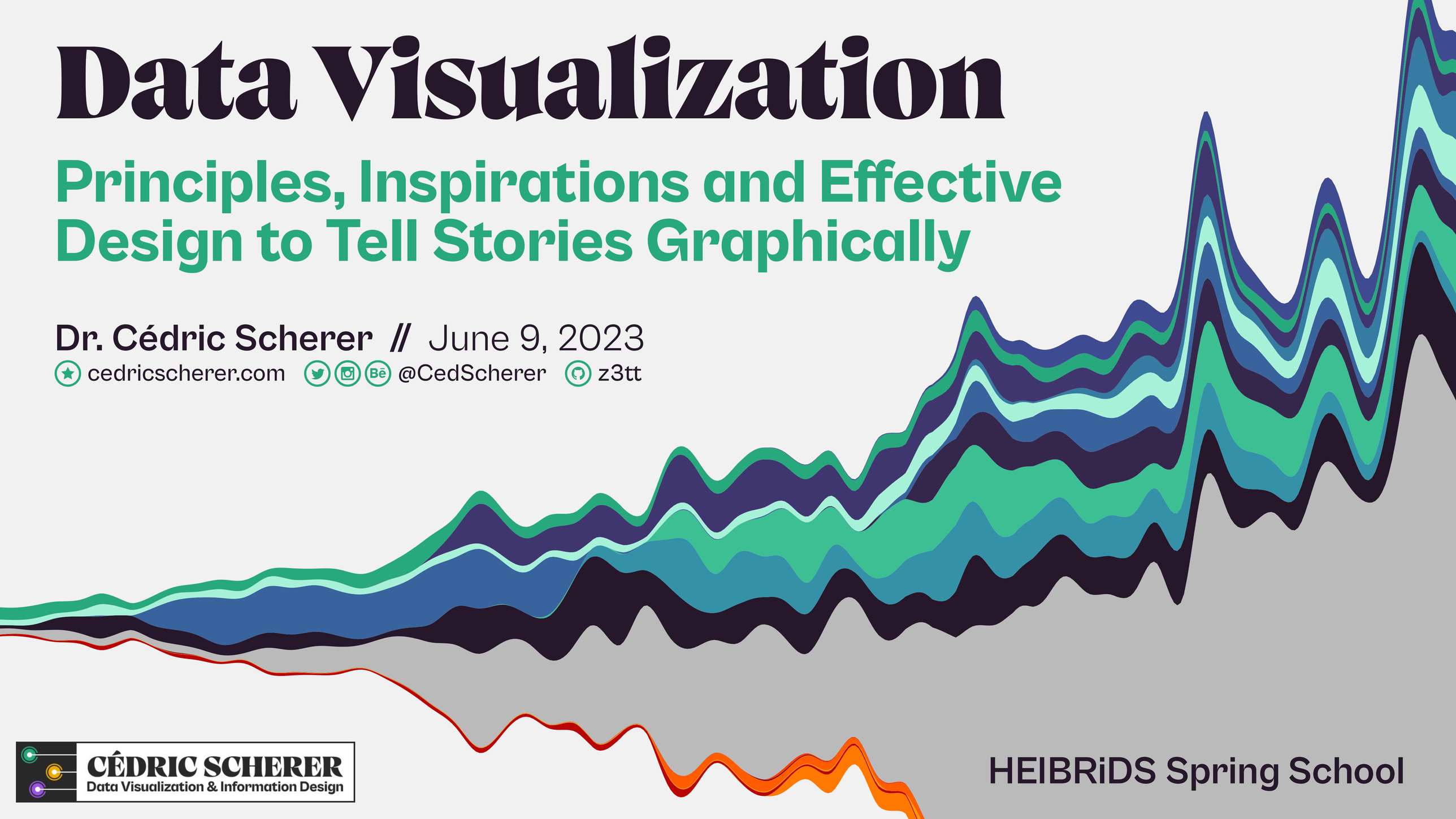
Data Visualization

Principles, Inspirations and Effective Design to Tell Stories Graphically

Dr. Cédric Scherer // June 9, 2023
cedricscherer.com @CedScherer z3tt



CÉDRIC SCHERER
Data Visualization & Information Design

HEIBRiDS Spring School

CÉDRIC SCHERER

Data Visualization & Information Design

Consulting **Coaching** **Coding**

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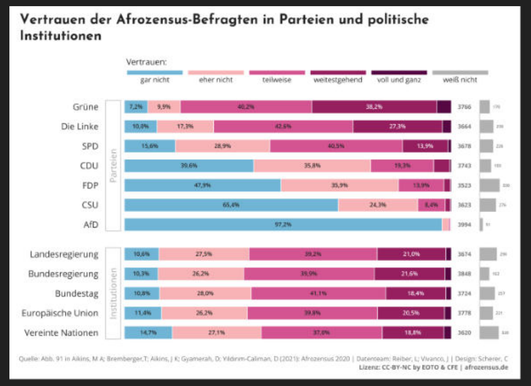
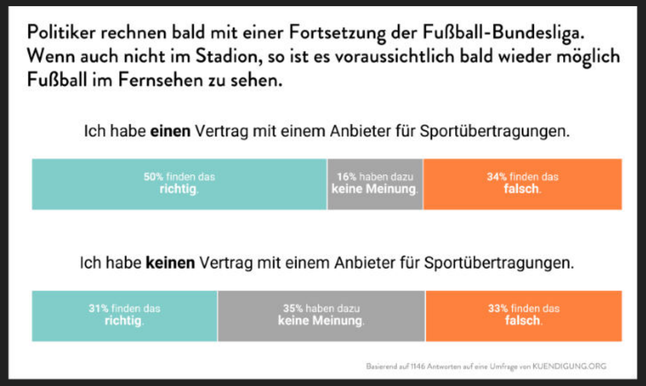
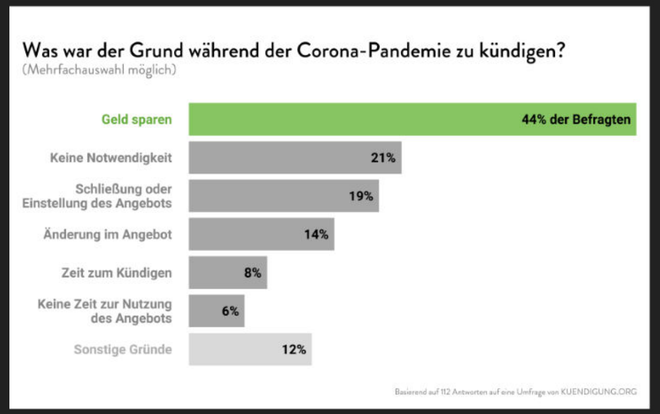
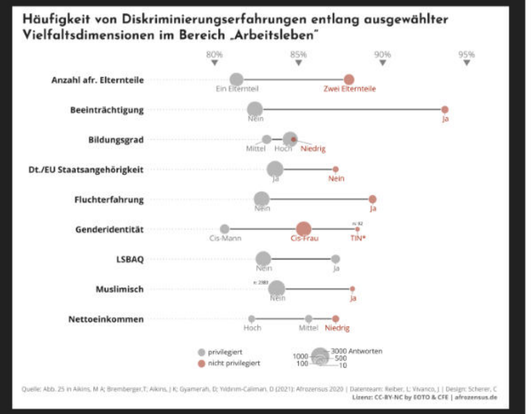
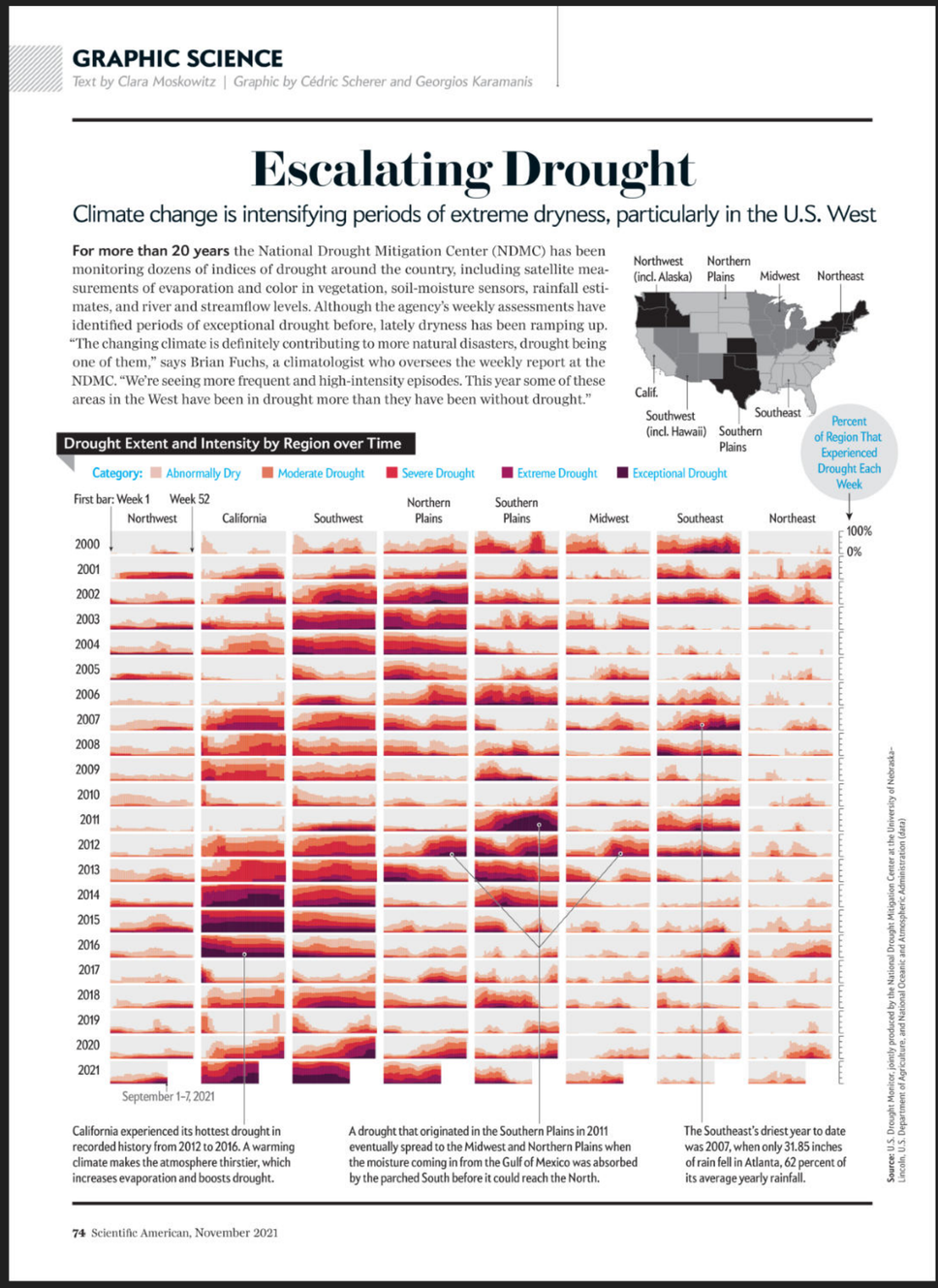

Vertrauen der Afrozensus-Befragten in Parteien und politische Institutionen
Vertrauen:
gar nicht
eher nicht
teilweise
weitestgehend
voll und ganz
weiß nicht
Grüne
Die Linke
SPD
CDU
FDP
CSU
AfD
Parteien
Landesregierung
Bundesregierung
Bundestag
Europäische Union
Vereinte Nationen
Institutionen

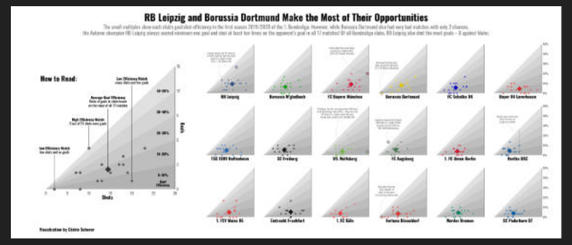

Politiker rechnen bald mit einer Fortsetzung der Fußball-Bundesliga. Wenn auch nicht im Stadion, so ist es voraussichtlich bald wieder möglich Fußball im Fernsehen zu sehen.
Ich habe einen Vertrag mit einem Anbieter für Sportübertragungen.
50% finden das richtig.
16% haben dazu keine Meinung.
34% finden 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

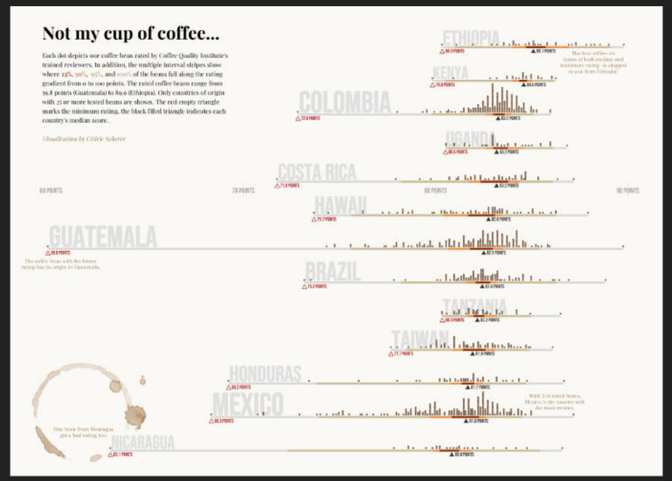

Was war der Grund während der Corona-Pandemie zu kündigen?
(Mehrfachauswahl möglich)
Geld sparen
44% der Befragten
Keine Notwendigkeit
21%
Schließung oder Einstellung des Angebots
19%
Änderung im Angebot
14%
Zeit zum Kündigen
8%
Keine Zeit zur Nutzung des Angebots
6%
Sonstige Gründe
12%
Basierend auf 112 Antworten auf eine Umfrage von KUENDIGUNG.ORG

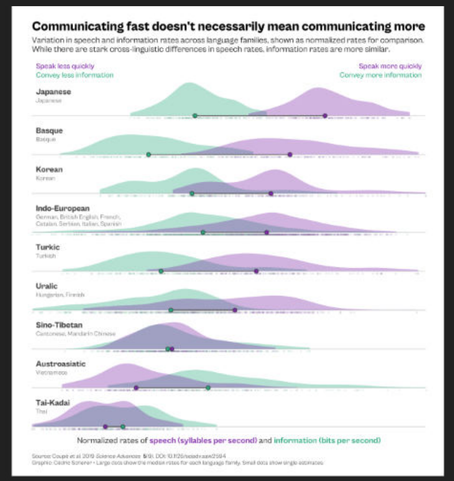

Häufigkeit von Diskriminierungserfahrungen entlang ausgewählter Vielfaltsdimensionen im Bereich „Arbeitsleben"
Anzahl afr. Elternteile
Beeinträchtigung
Bildungsgrad
Dt./EU Staatsangehörigkeit
Fluchterfahrung
Genderidentität
LSBAQ
Muslimisch
Nettoeinkommen
privilegiert
nicht privilegiert
3000 Antworten

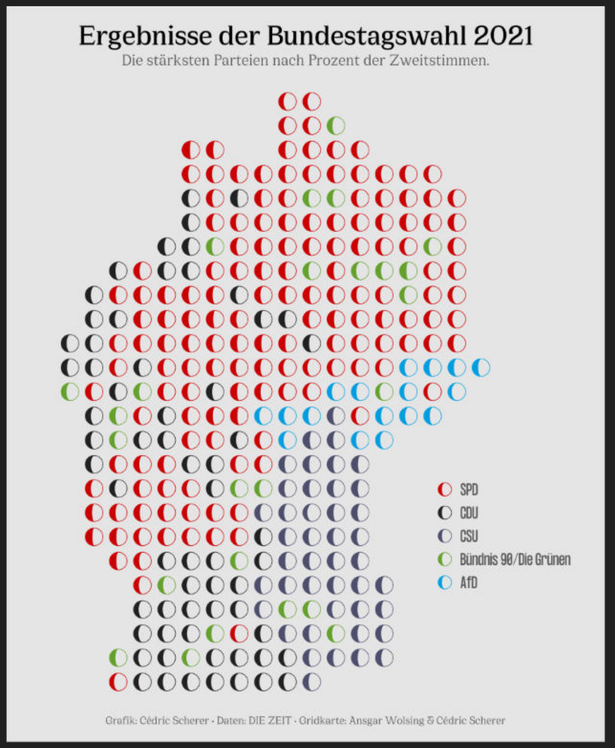

Die Kommunikation der deutschsprachigen QAnon-Szene konzentriert sich spätestens seit der Pandemie auf Telegram. Insgesamt konnten wir 115 Kanäle und 84 Gruppen identifizieren, in denen über die Jahre 346.006 Accounts aktiv waren. Die Aktivität der Gruppen und Kanäle veränderte sich über die Zeit. Diese Grafik veranschaulicht die Aktivität der Szene – und zeigt, dass sie immer noch sehr aktiv ist.

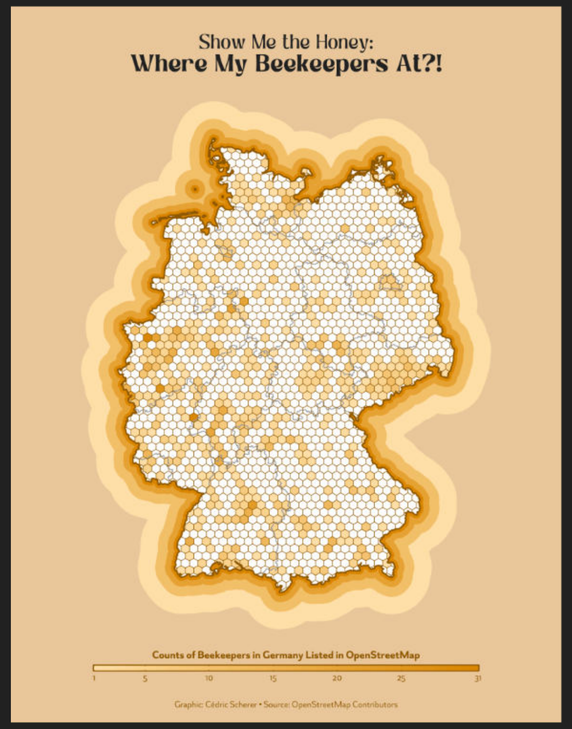

GRAPHIC SCIENCE
Text by Clara Moskowitz | Graphic by Cédric Scherer and Georgios Karamanis
Escalating Drought
Climate change is intensifying periods of extreme dryness, particularly in the U.S. West
For more than 20 years the National Drought Mitigation Center (NDMC) has been monitoring dozens of indices 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."
Northwest (incl. Alaska)
Northern Plains
Midwest
Northeast
Calif.
Southwest (incl. Hawaii)
Southern Plains
Southeast
Drought Extent and Intensity by Region over Time
Category: Abnormally Dry Moderate Drought Severe Drought Extreme Drought Exceptional Drought
Percent of Region That Experienced Drought Each Week
100%
0%
First bar: Week 1
Week 52
Northwest
California
Southwest
Northern Plains
Southern Plains
Midwest
Southeast
Northeast
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
September 1–7, 2021
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.
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)
74 Scientific American, November 2021

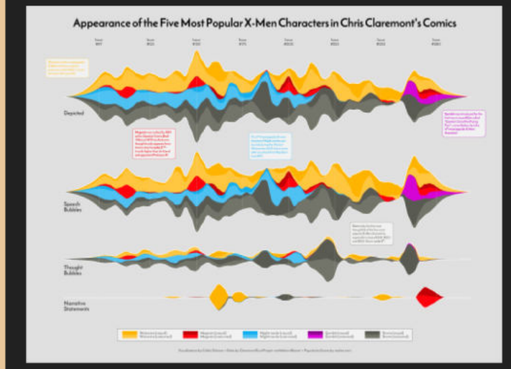

RB Leipzig and Borussia Dortmund Make the Most of Their Opportunities
How to Read:

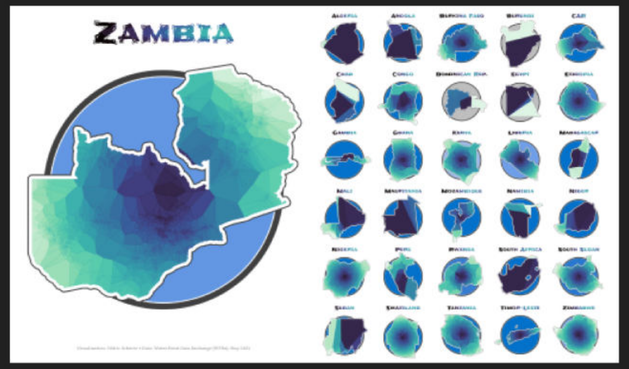

Not my cup of coffee...
ETHIOPIA
KENYA
COLOMBIA
UGANDA
COSTA RICA
HAWAII
GUATEMALA
BRAZIL
TANZANIA
TAIWAN
HONDURAS
MEXICO
NICARAGUA

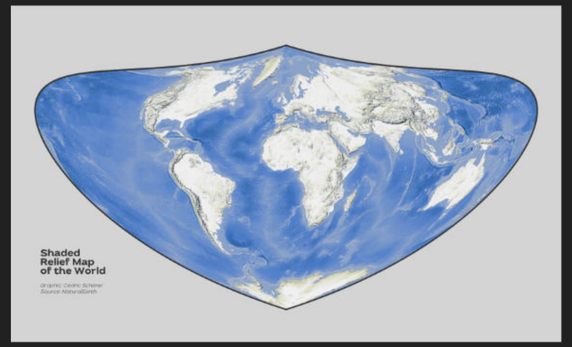

Communicating fast doesn't necessarily mean communicating more
Japanese
Basque
Korean
Indo-European
Turkic
Uralic
Sino-Tibetan
Austroasiatic
Tai-Kadai

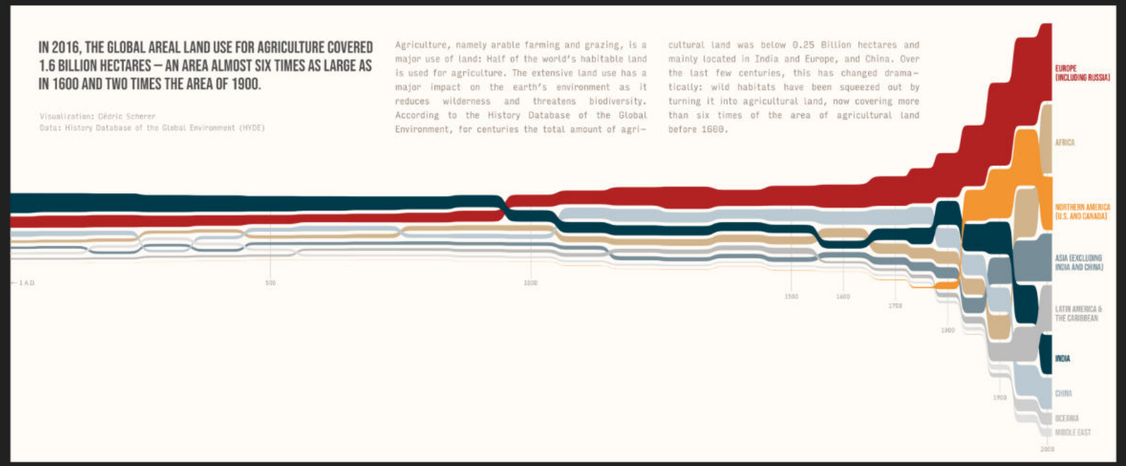

Ergebnisse der Bundestagswahl 2021
Die stärksten Parteien nach Prozent der Zweitstimmen.
SPD
CDU
CSU
Bündnis 90/Die Grünen
AfD
Grafik: Cédric Scherer · Daten: DIE ZEIT · Gridkarte: Ansgar Wolsing & Cédric Scherer

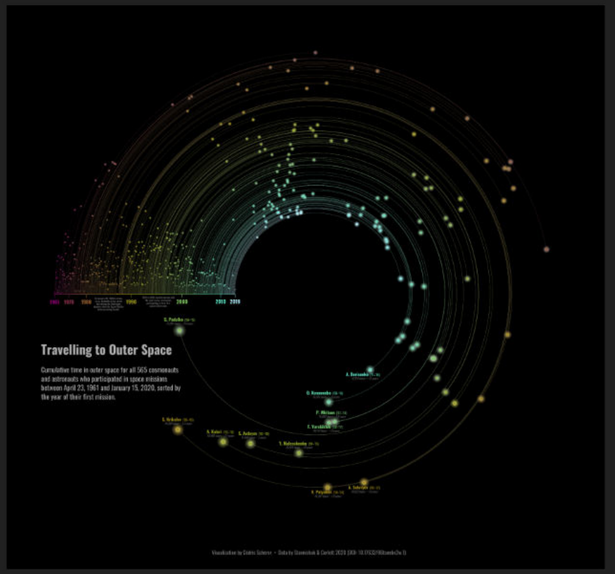

Show Me the Honey:
Where My Beekeepers At?!
Counts of Beekeepers in Germany Listed in OpenStreetMap
Graphic: Cédric Scherer • Source: OpenStreetMap Contributors


Appearance of the Five Most Popular X-Men Characters in Chris Claremont's Comics

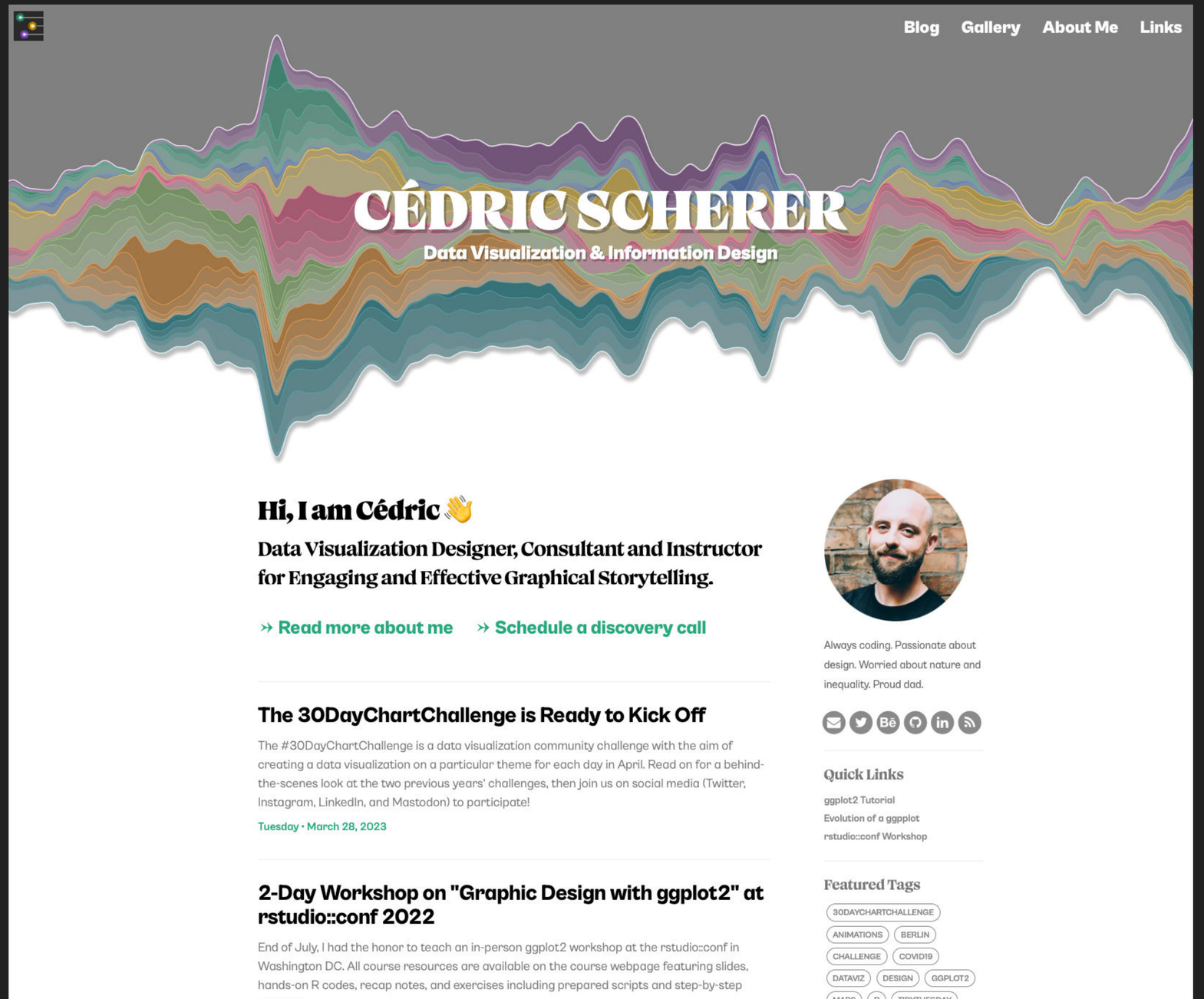

ZAMBIA


Shaded
Relief Map
of the World


IN 2016, THE GLOBAL AREAL LAND USE FOR AGRICULTURE COVERED 1.6 BILLION HECTARES — AN AREA ALMOST SIX TIMES AS LARGE AS IN 1600 AND TWO TIMES THE AREA OF 1900.
Agriculture, namely arable farming and grazing, is a major use of land: Half of the world's habitable land is used for agriculture. The extensive land use has a major impact on the earth's environment as it reduces wilderness and threatens biodiversity. According to the History Database of the Global Environment, for centuries the total amount of agricultural land was below 0.25 Billion hectares and mainly located in India and Europe, and China. Over the last few centuries, this has changed dramatically: wild habitats have been squeezed out by turning it into agricultural land, now covering more than six times of the area of agricultural land before 1600.
Visualization: Cédric Scherer
Data: History Database of the Global Environment (HYDE)
EUROPE (INCLUDING RUSSIA)
AFRICA
NORTHERN AMERICA (U.S. AND CANADA)
ASIA (EXCLUDING INDIA AND CHINA)
LATIN AMERICA & THE CARIBBEAN
INDIA
CHINA
OCEANIA
MIDDLE EAST


Travelling to Outer Space

cedricscherer.com



Hi, I am Cédric 👋

Data Visualization Designer, Consultant and Instructor for Engaging and Effective Graphical Storytelling.

↠ Read more about me ↠ Schedule a discovery call

The 30DayChartChallenge is Ready to Kick Off

The #30DayChartChallenge is a data visualization community challenge with the aim of creating a data visualization on a particular theme for each day in April. Read on for a behind-the-scenes look at the two previous years' challenges, then join us on social media (Twitter, Instagram, LinkedIn, and Mastodon) to participate!

Tuesday • March 28, 2023

2-Day Workshop on "Graphic Design with ggplot2" at rstudio::conf 2022

End of July, I had the honor to teach an in-person ggplot2 workshop at the rstudio::conf in Washington DC. All course resources are available on the course webpage featuring slides, hands-on R codes, recap notes, and exercises including prepared scripts and step-by-step

Always coding. Passionate about design. Worried about nature and inequality. Proud dad.

Quick Links

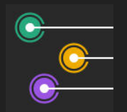
ggplot2 Tutorial
Evolution of a ggplot
rstudio::conf Workshop

Featured Tags

30DAYCHARTCHALLENGE
ANIMATIONS
BERLIN
CHALLENGE
COVID19
DATAVIZ
DESIGN
GGPLOT2

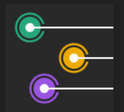
Data Visualization

is any graphical representation
of information and data.



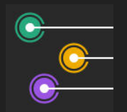
Data Visualization

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



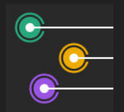
Data Visualization

converts information into visual forms as quantifiable features.

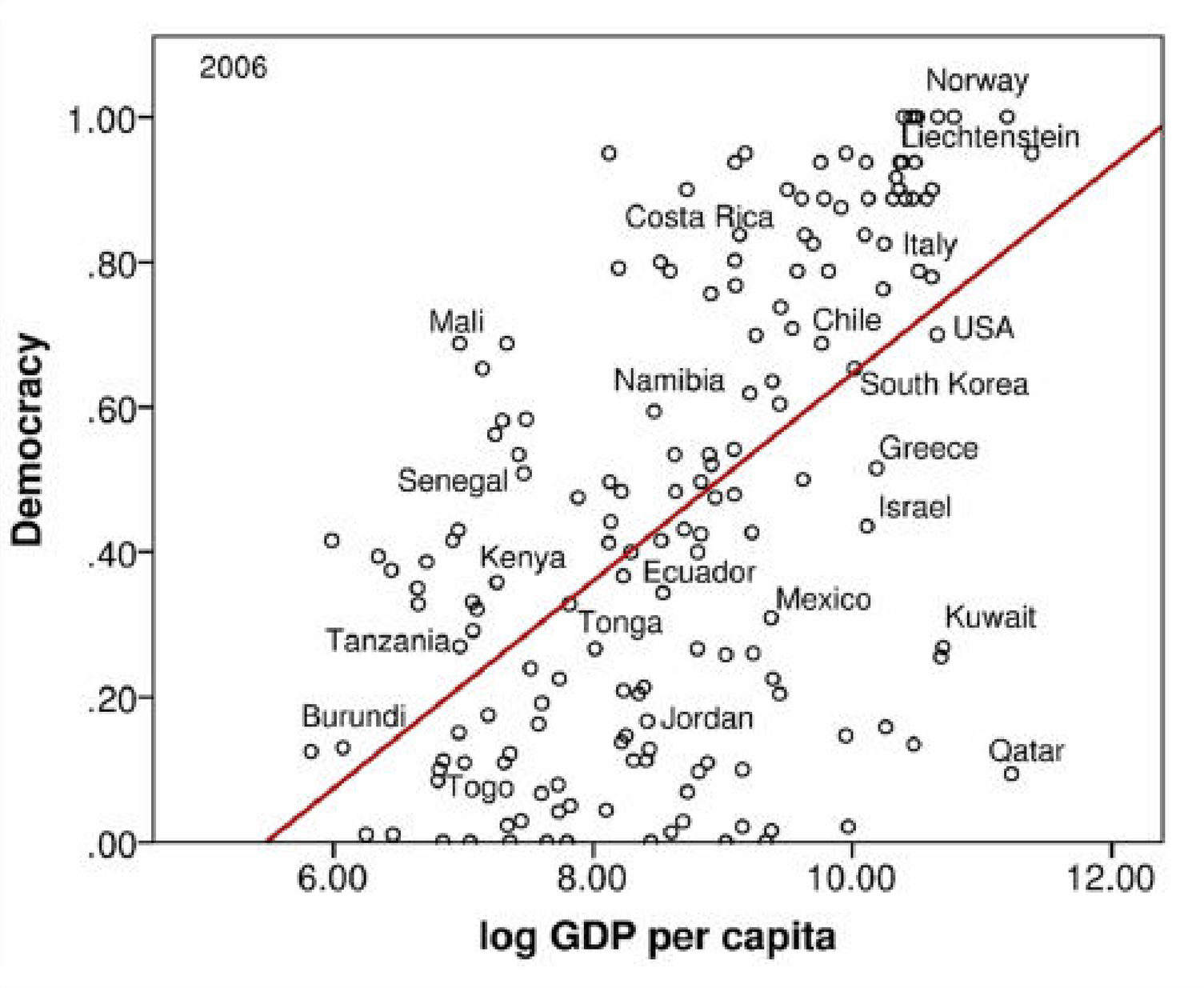


Data Visualization

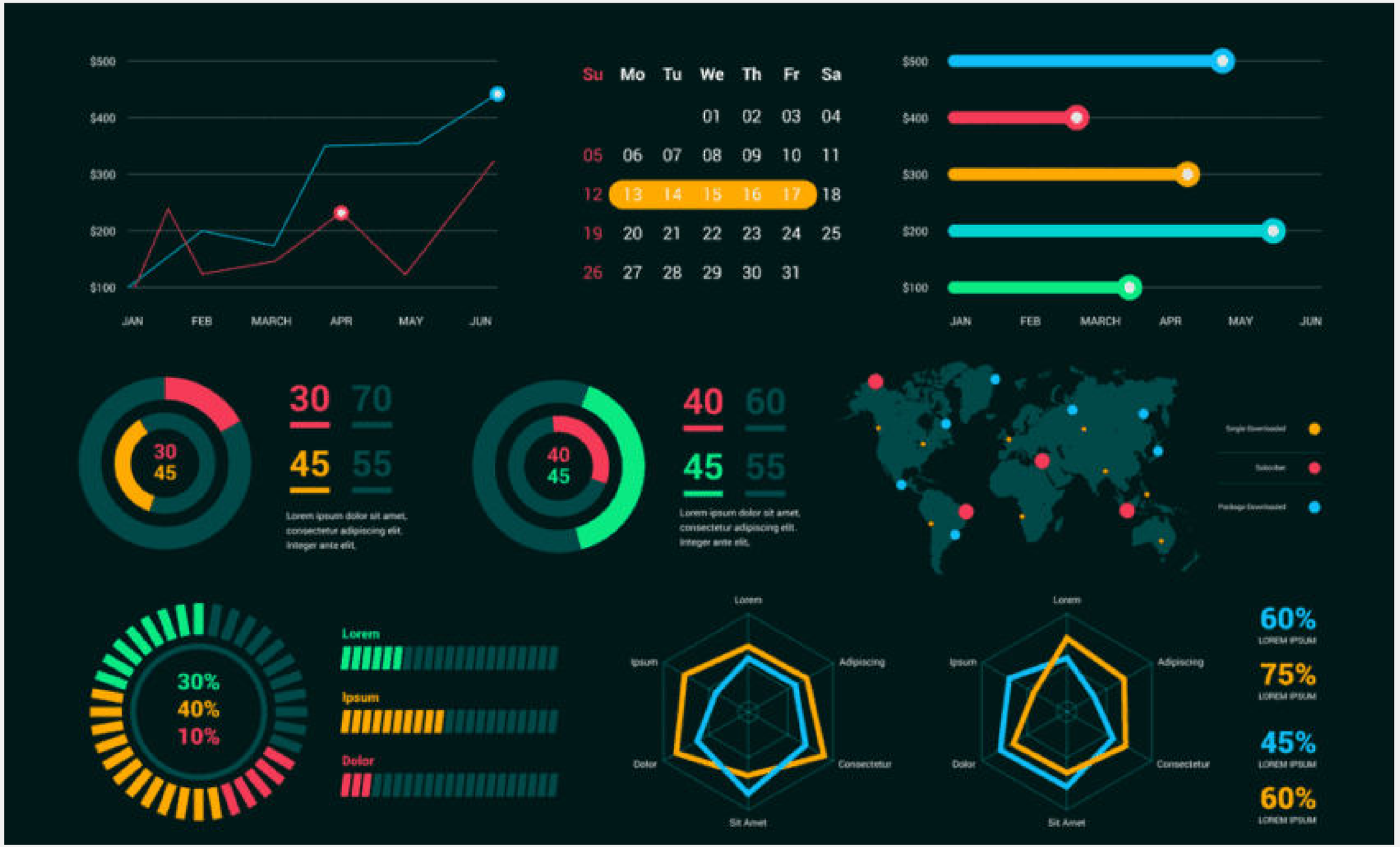
is part art and part science.



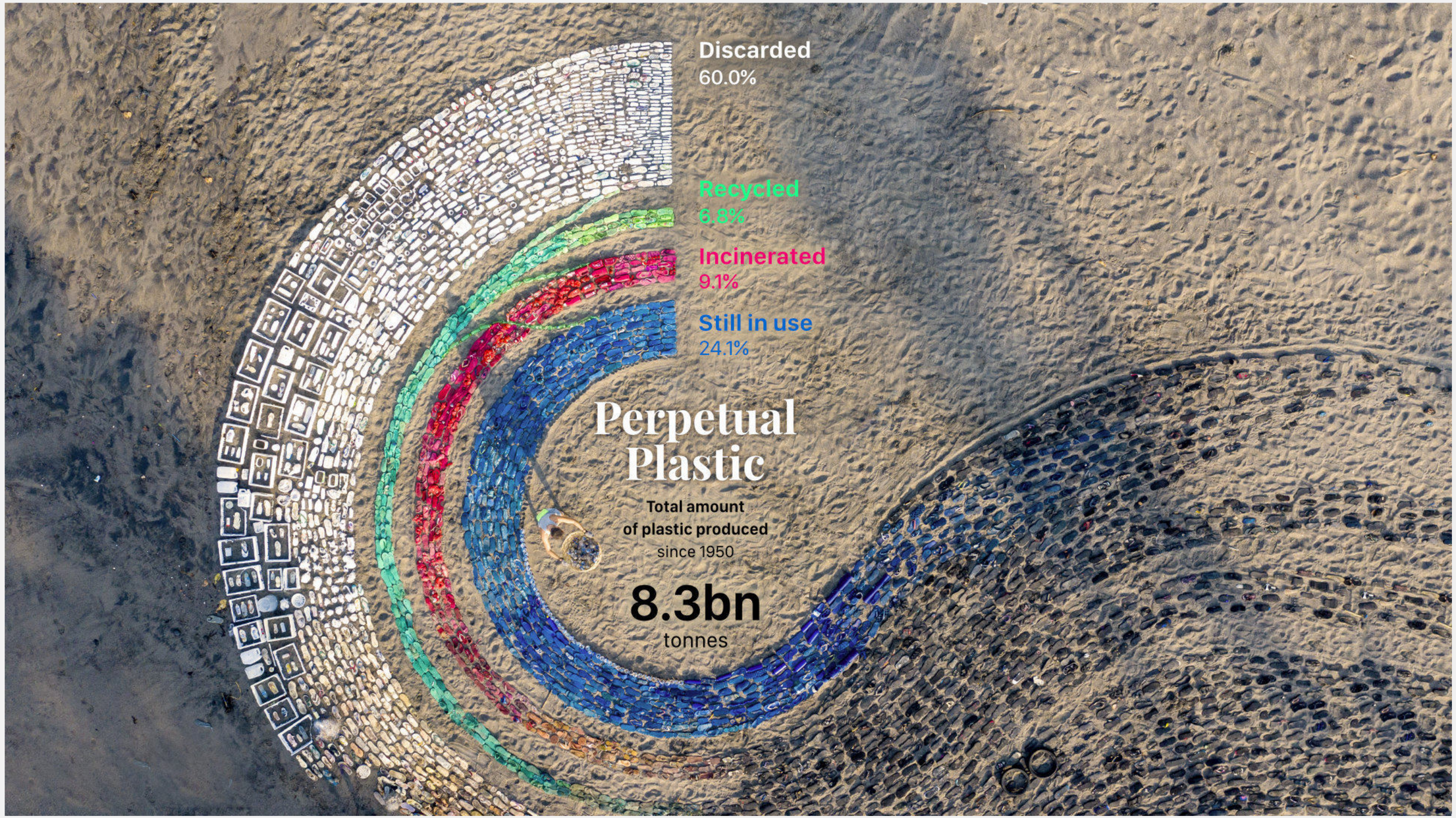
Quelle: eazybi.com



Source: Ranganathan et al. 2014

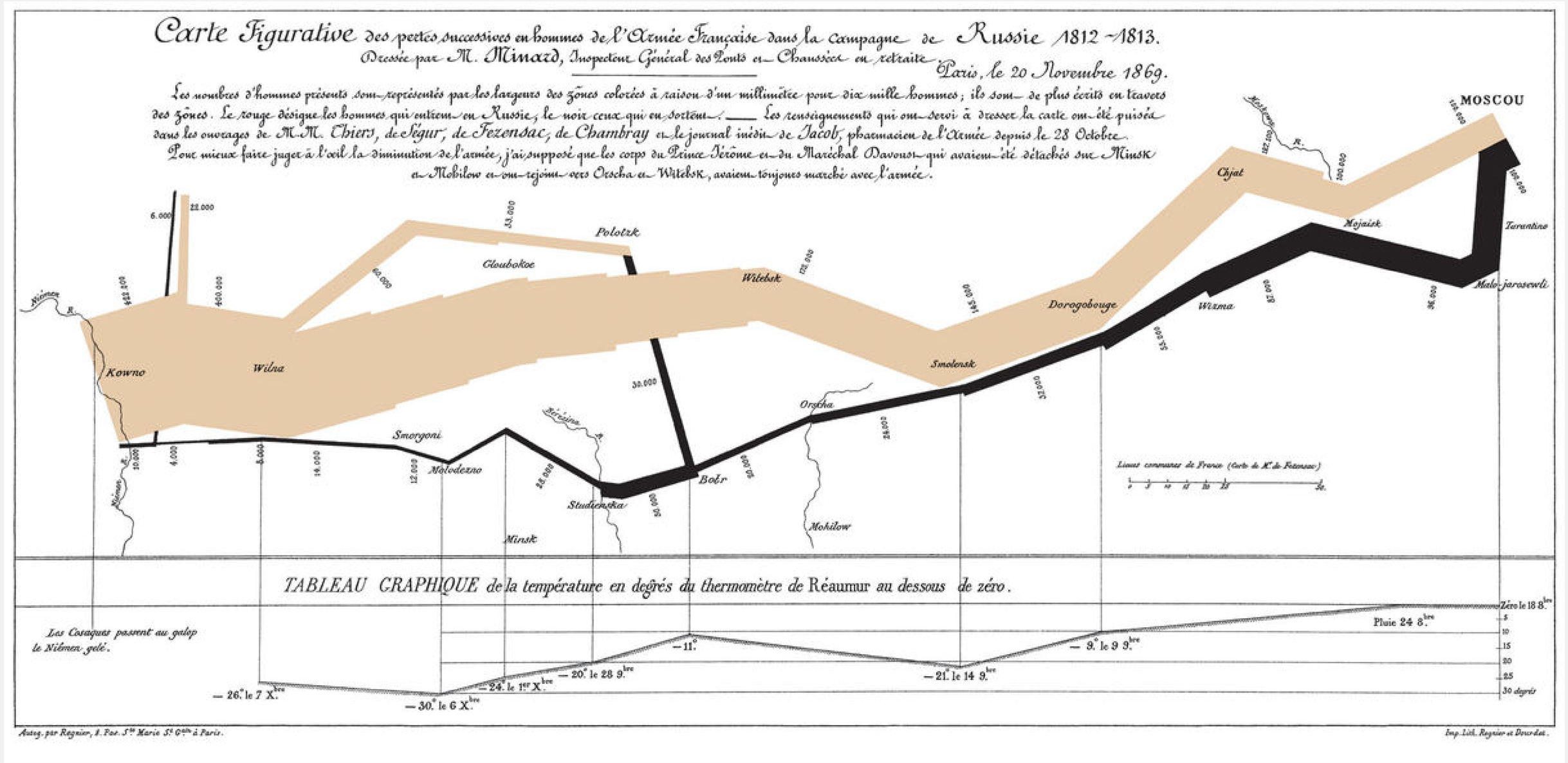


Source: datameer.com

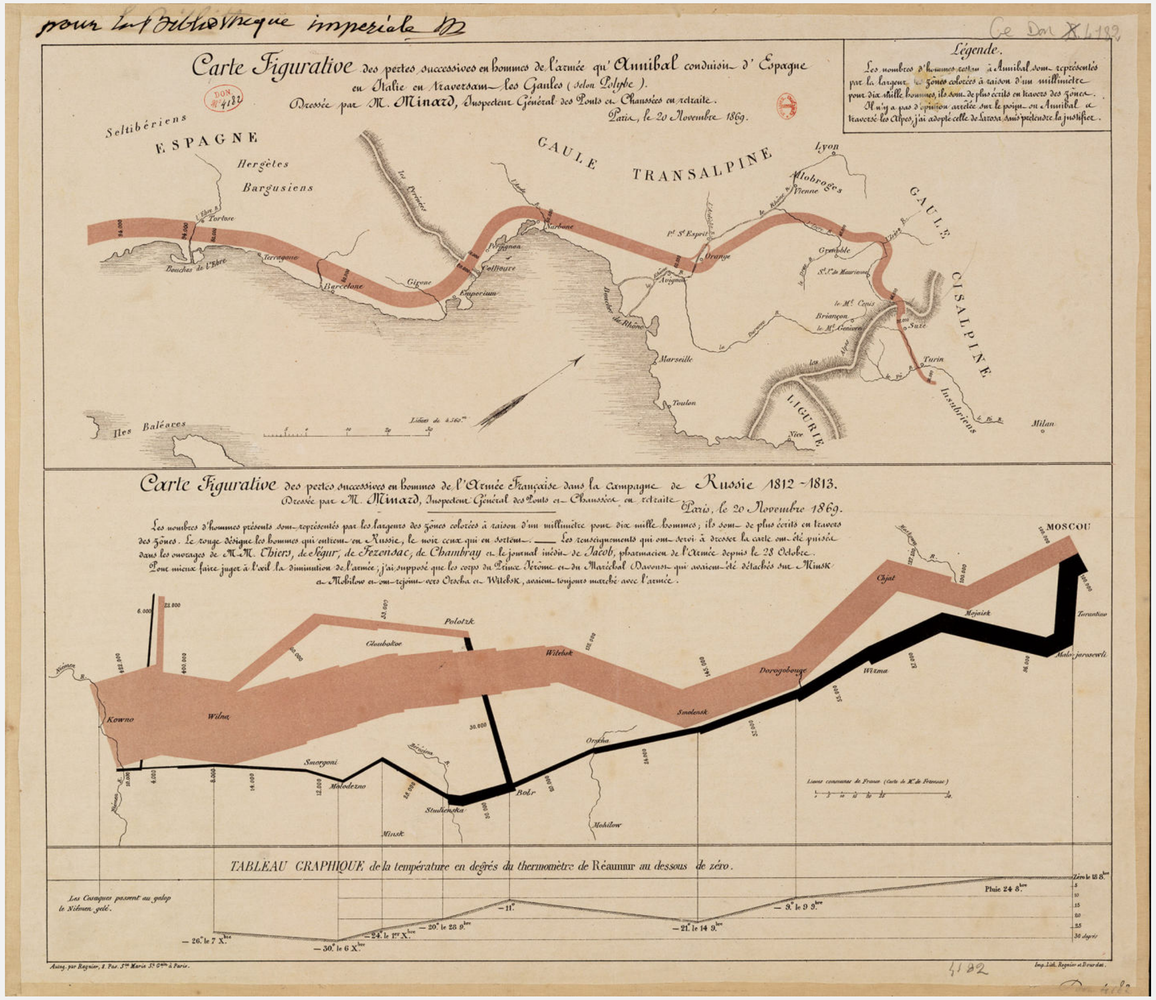


Source: "Perpetual Plastic" by Liina Klauss, Skye Morét and Moritz Stefaner

Source: “Patchwork Kingdoms” by Nadieh Bremer

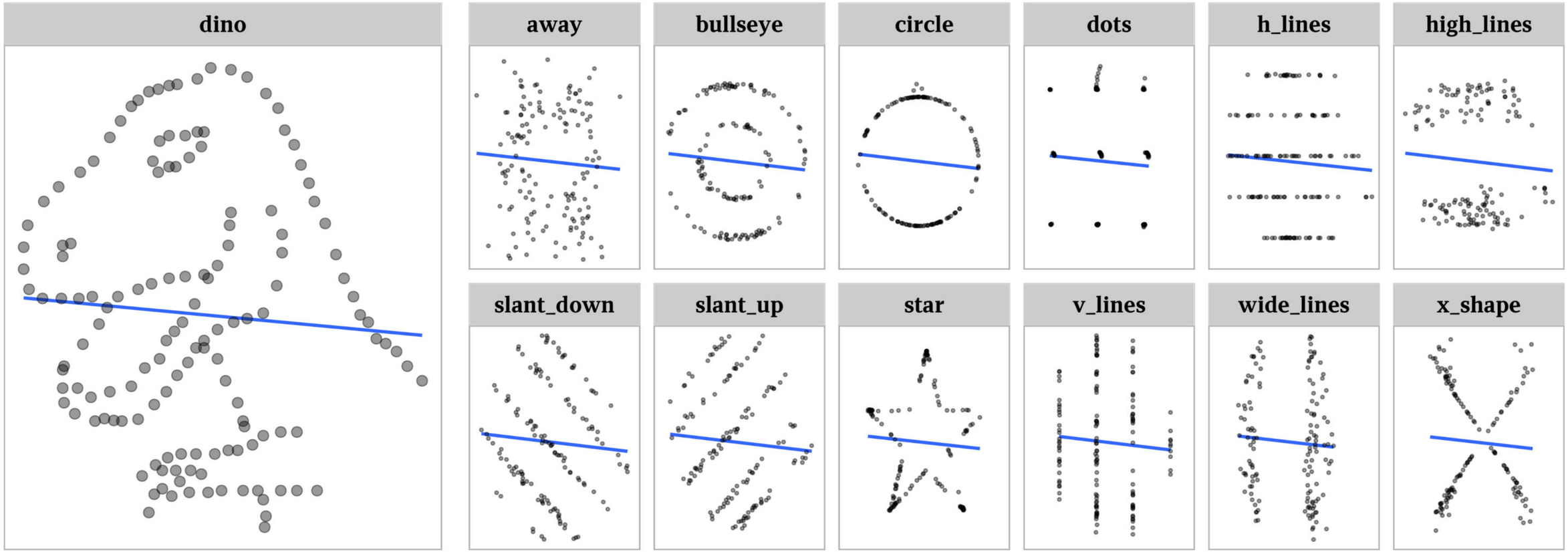


Carte figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812–1813 von Charles Joseph Minard



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) von Charles Joseph Minard

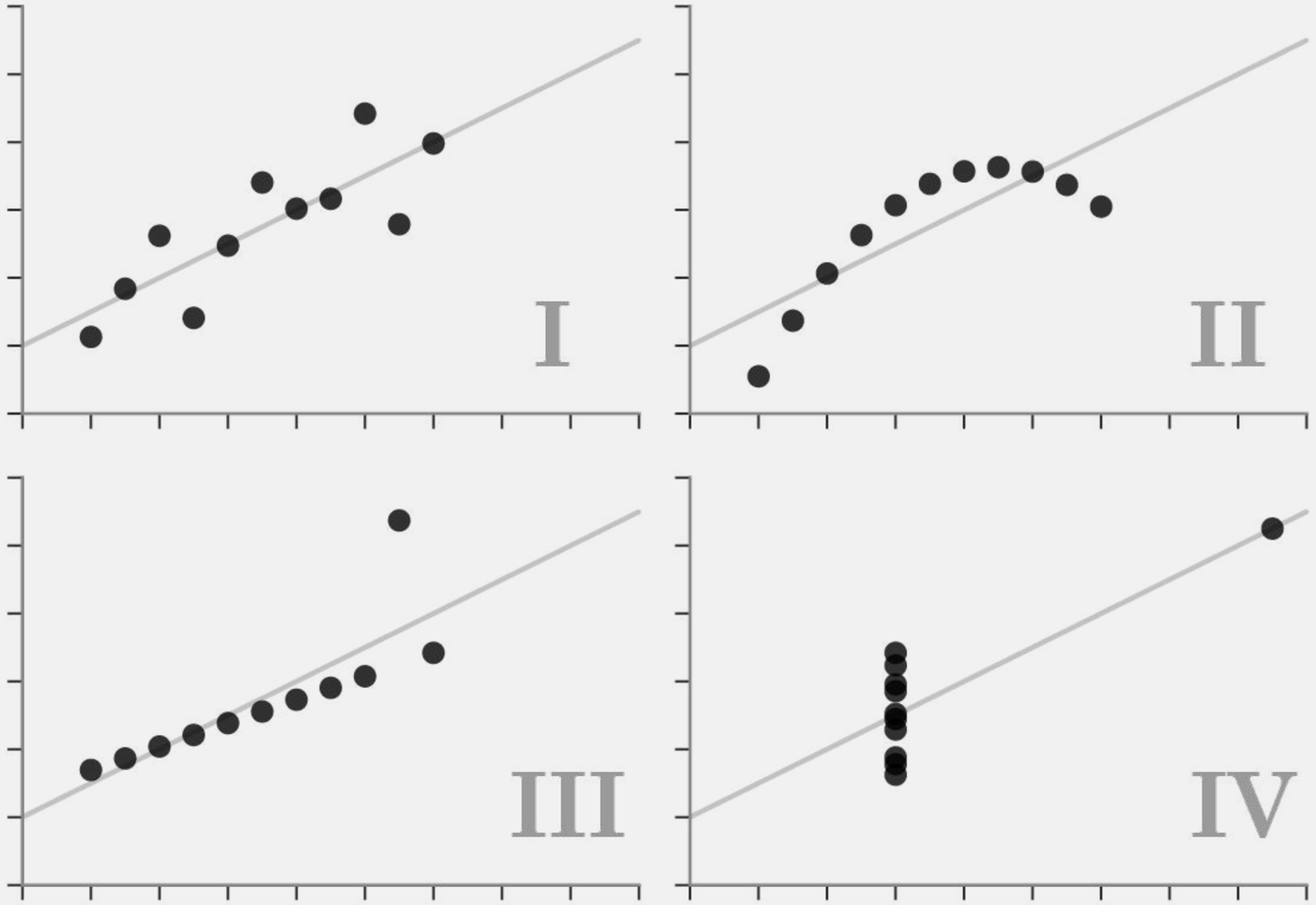
- zeigt das Vorrücken der Truppen von **Hannibal** (218 v. Chr.) und **Napoleon** (1812-1813)
- wird oft als **die beste jemals gezeichnete statistische Grafik** bezeichnet



“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
mean, standard deviation, and correlation
but are visually distinct.



"Same Stats, Different Graphs: Generating Datasets with Varied Appearance and Identical Statistics through Simulated Annealing"
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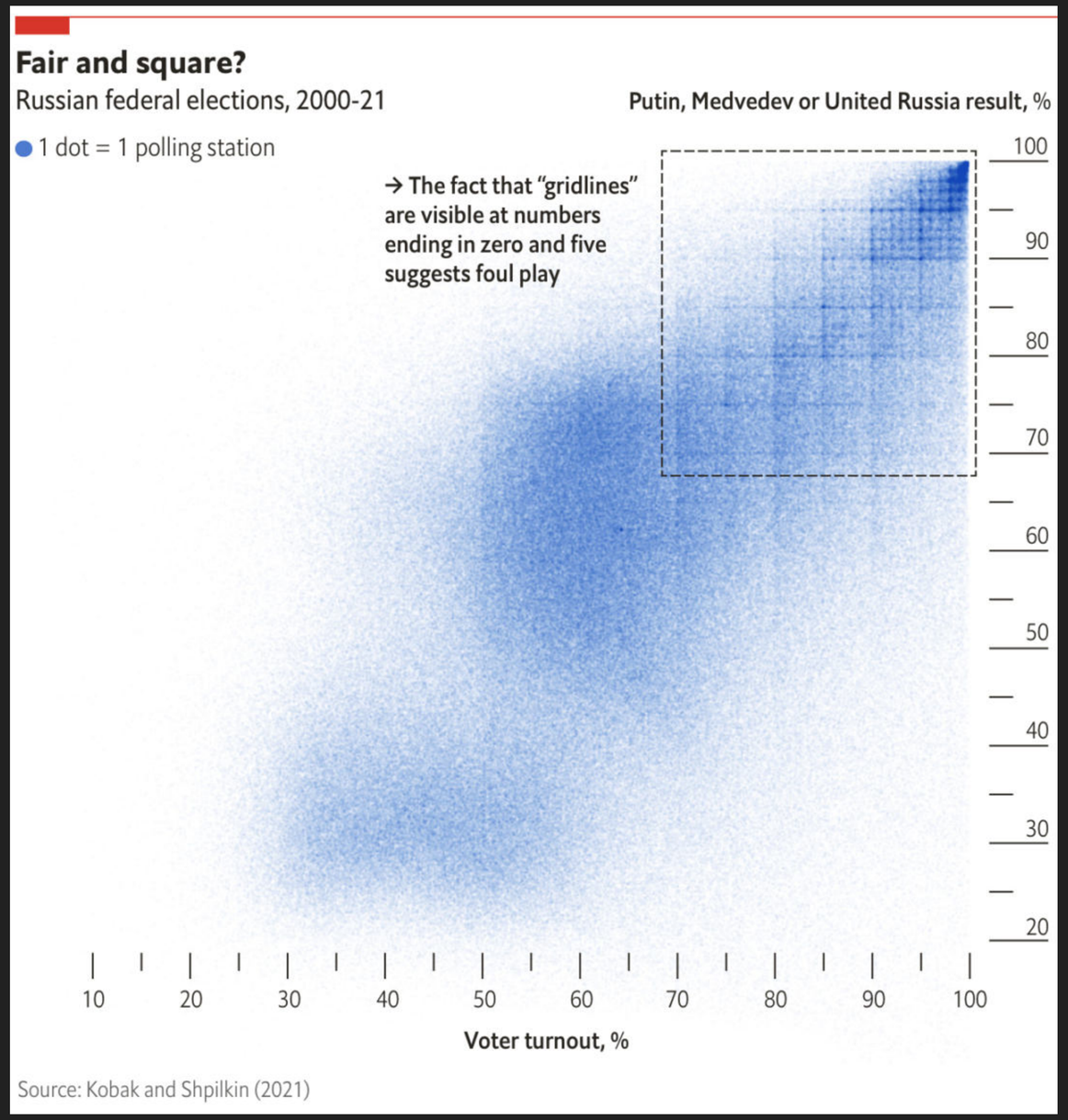
Visualize Your Data

"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**."



Visualize Your Data

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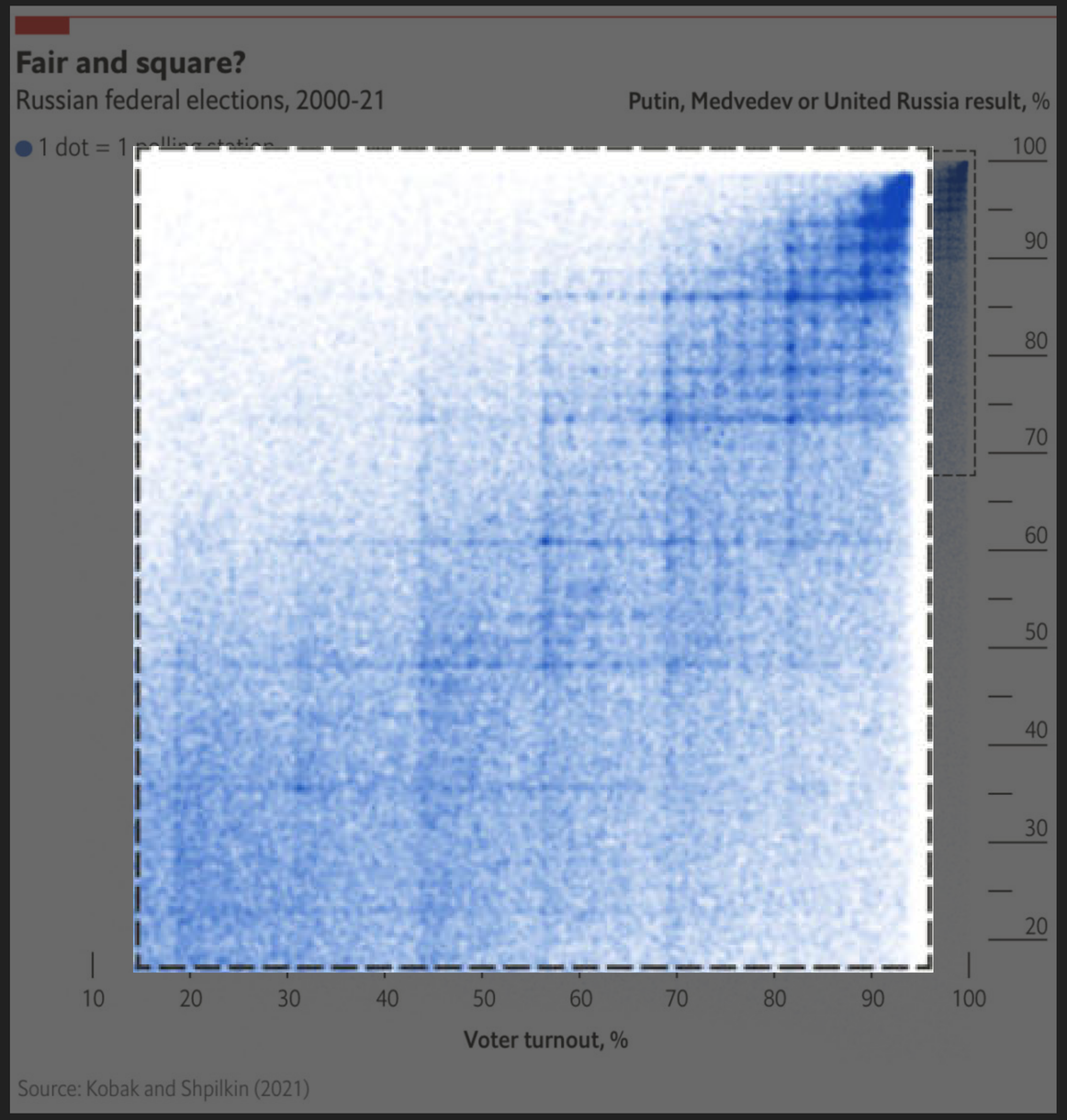
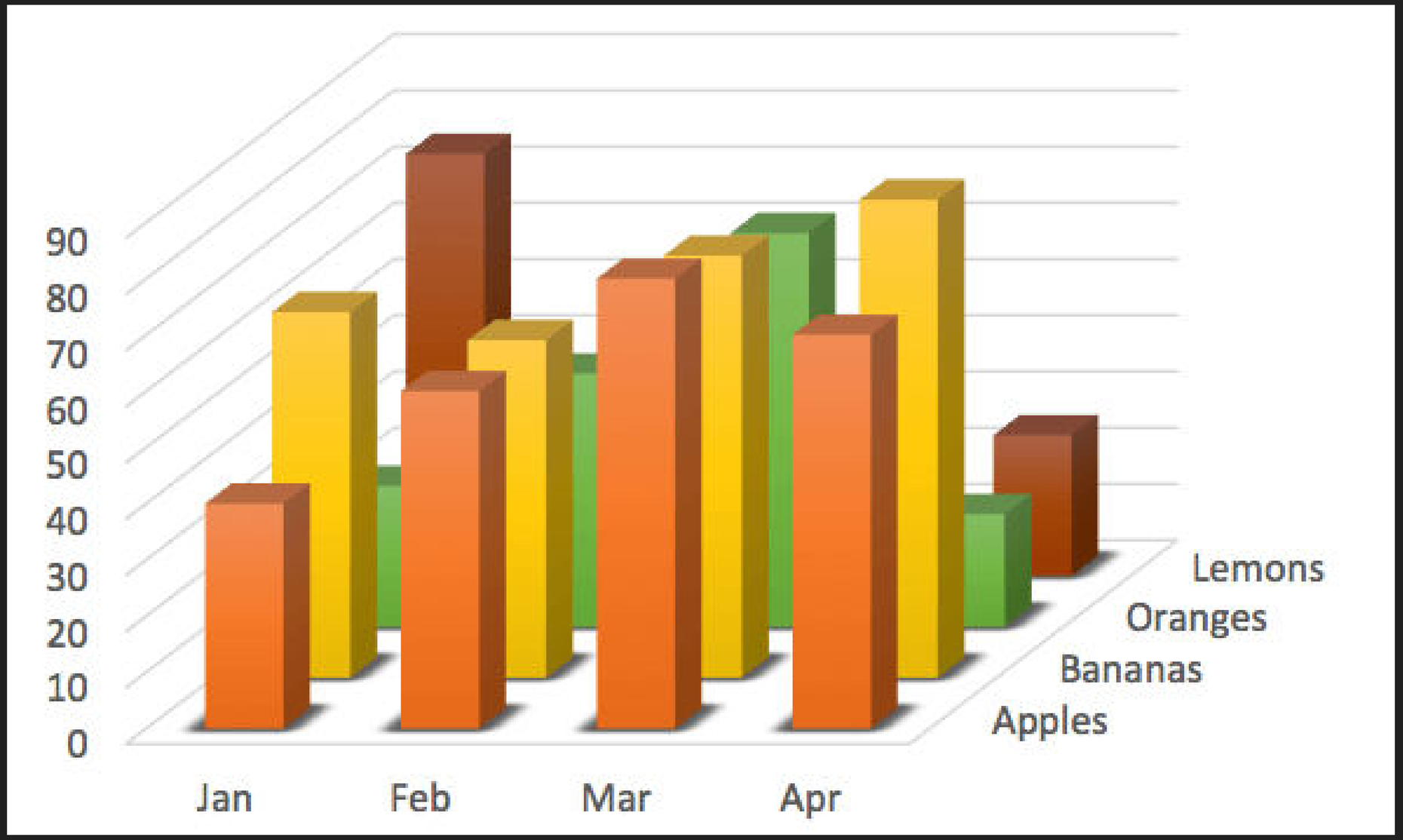
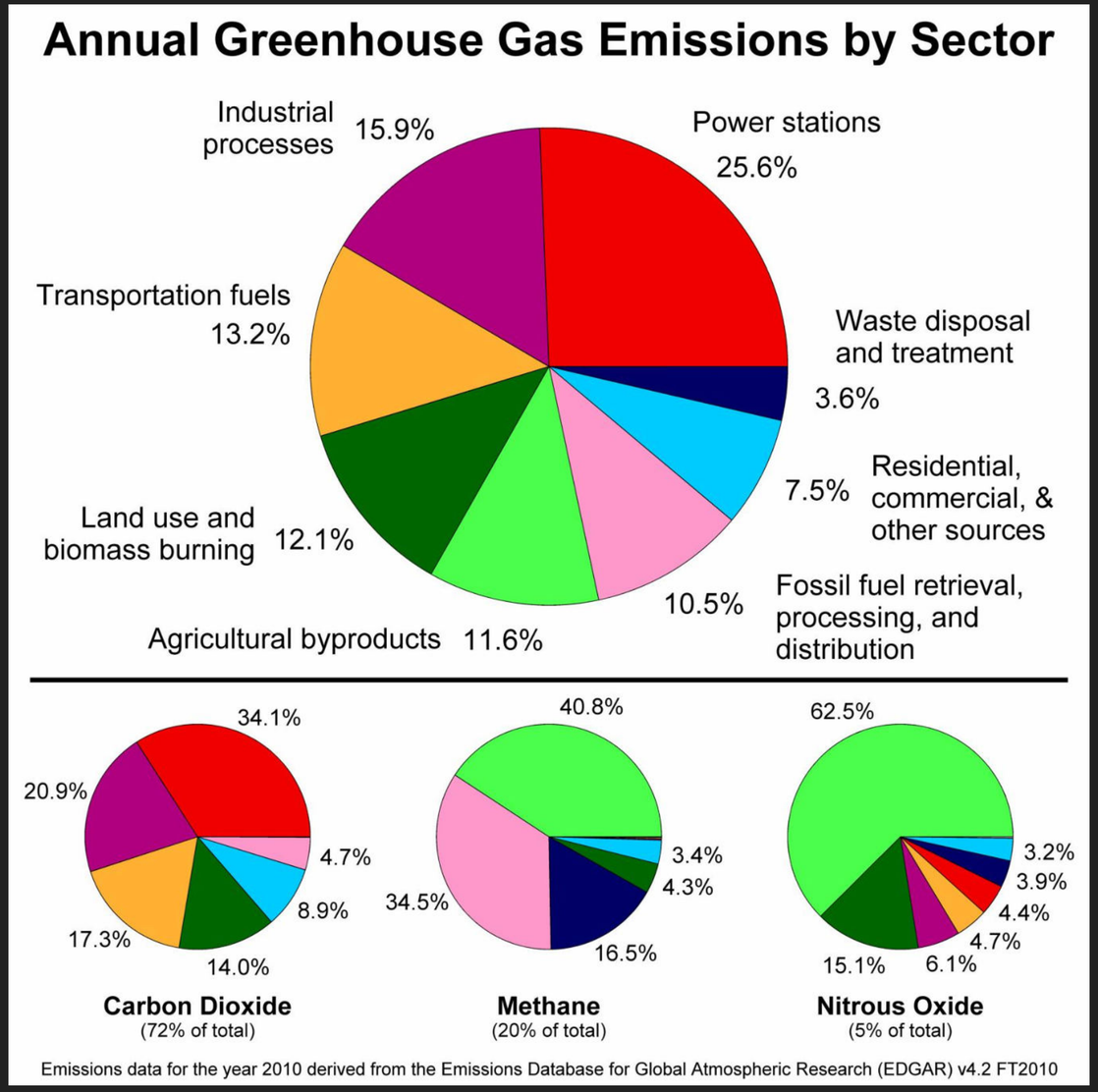


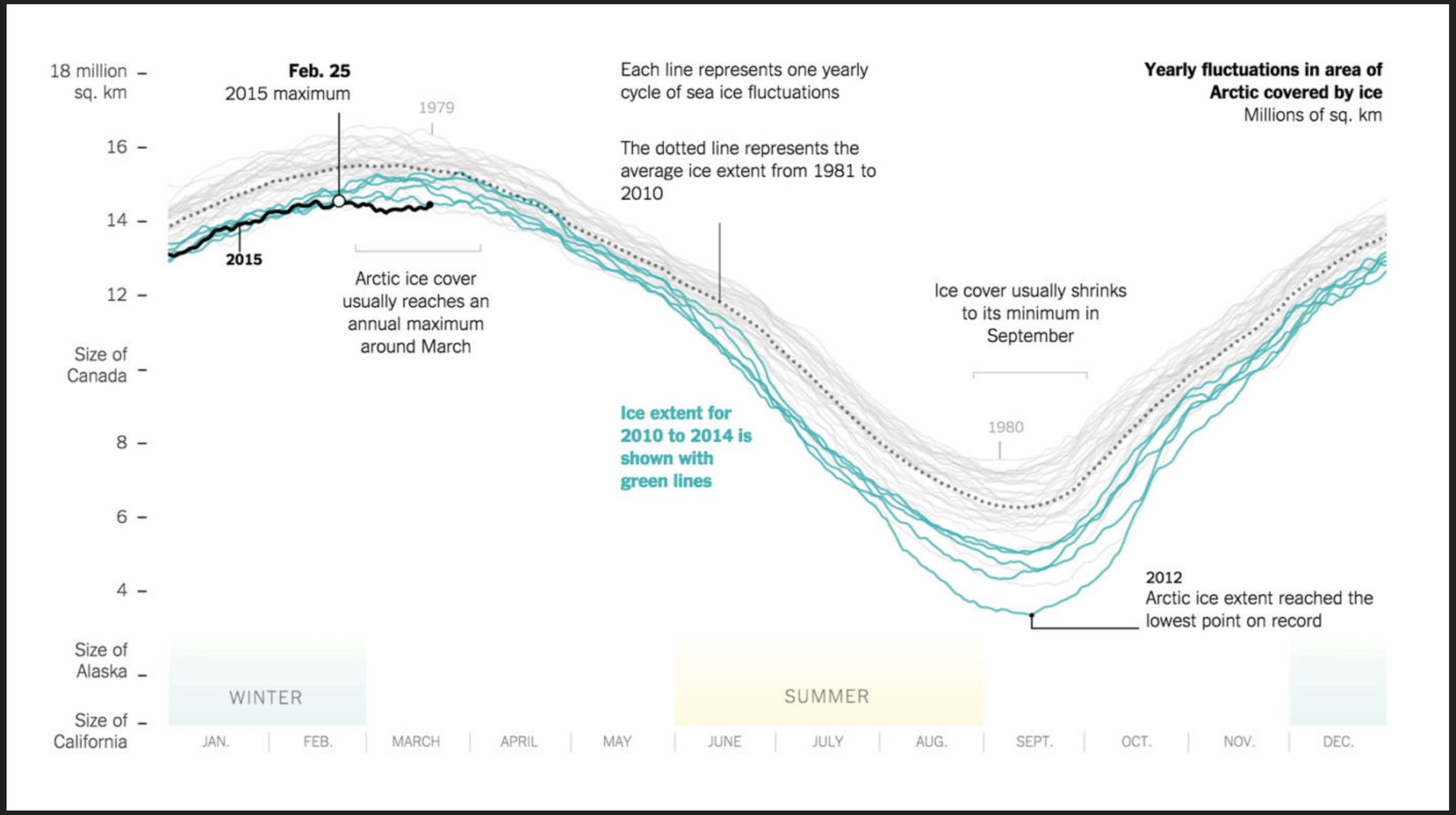
What makes it a bad data visualization?



What makes it a bad data visualization?



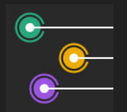
What makes it a good data visualization?



"Yearly Fluctuations in Area of Arctic Covered by Ice" by Derek Watkins (New York Times)

What makes it a good data visualization?

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



Typology of Information Graphics

nach Juuso Koponen & Jonatan Hildén, "Data Visualization Handbook" (2020), Seite 25

Is the **information** conceptual or measurable?

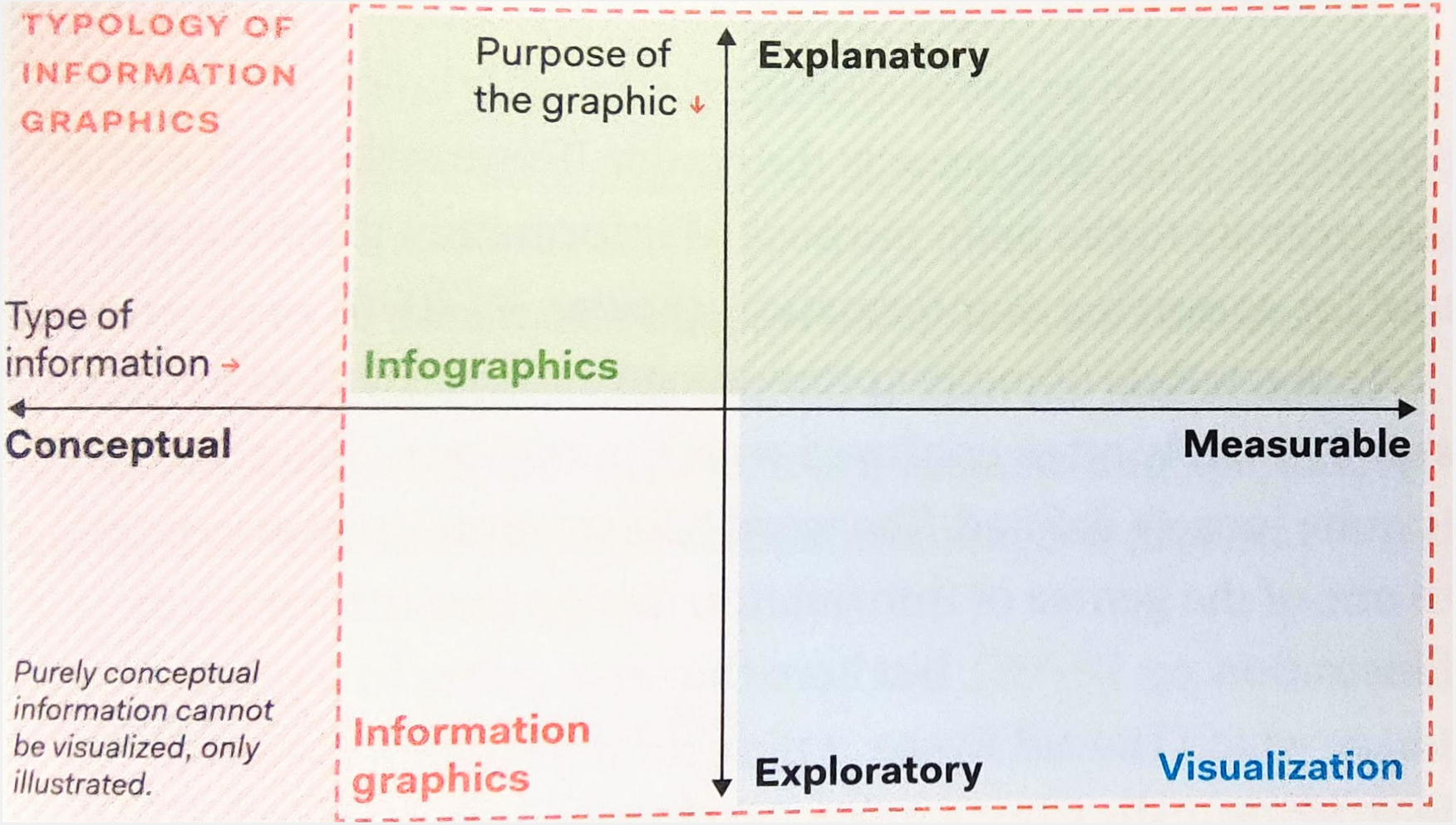
☞ **Type of information**: depict conceptual information <> convert information into visual forms

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

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

Typology of Information Graphics

nach Juuso Koponen & Jonatan Hildén, "Data Visualization Handbook" (2020), Seite 25



”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.”**

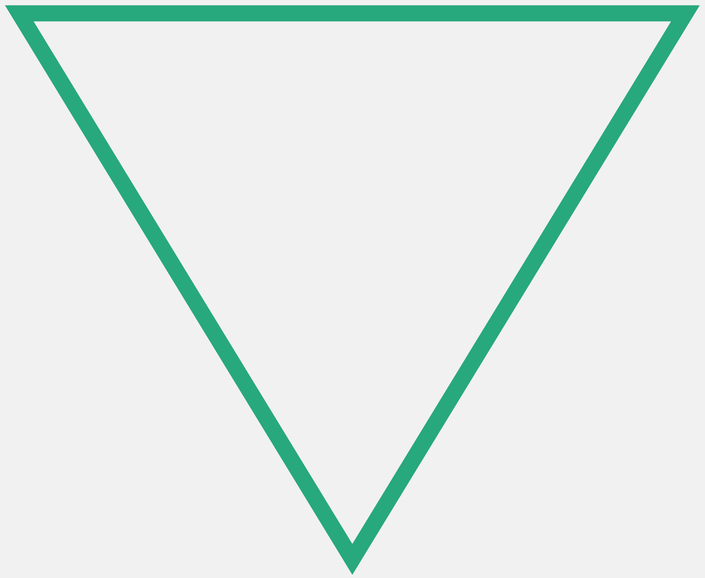
Alberto Cairo

Auszug aus dem Vorwort zu “Data Sketches” von Nadieh Bremer & Shirley Wu (CRC Press 2021)

What is the purpose?

Exploratory
Discovery

Explanatory
Communication



Affective
Emotion

The “Vertices of Visualization” by Alberto Cairo, personal communication (modified version)

What is the purpose?

Exploratory
Discovery

Explanatory
Communication

Affective
Emotion

Priority:
efficienct + effective

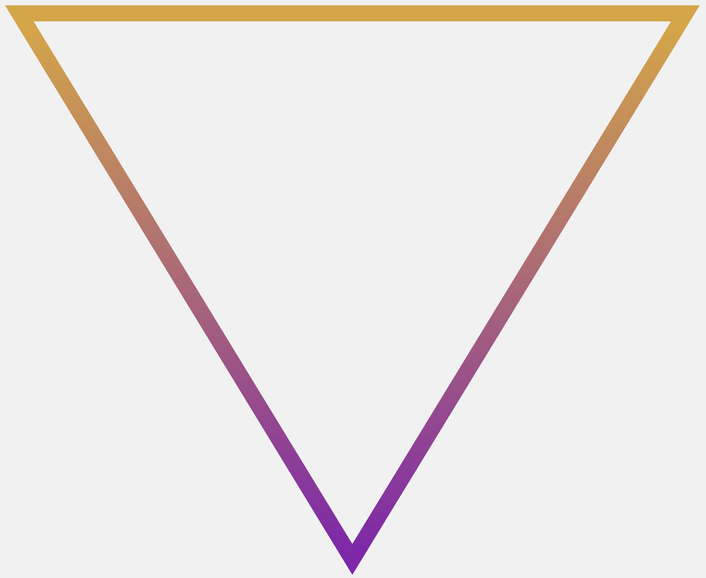
Aim:
functional

The “Vertices of Visualization” by Alberto Cairo, personal communication (modified version)

What is the purpose?

Exploratory
Discovery

Explanatory
Communication



Affective
Emotion

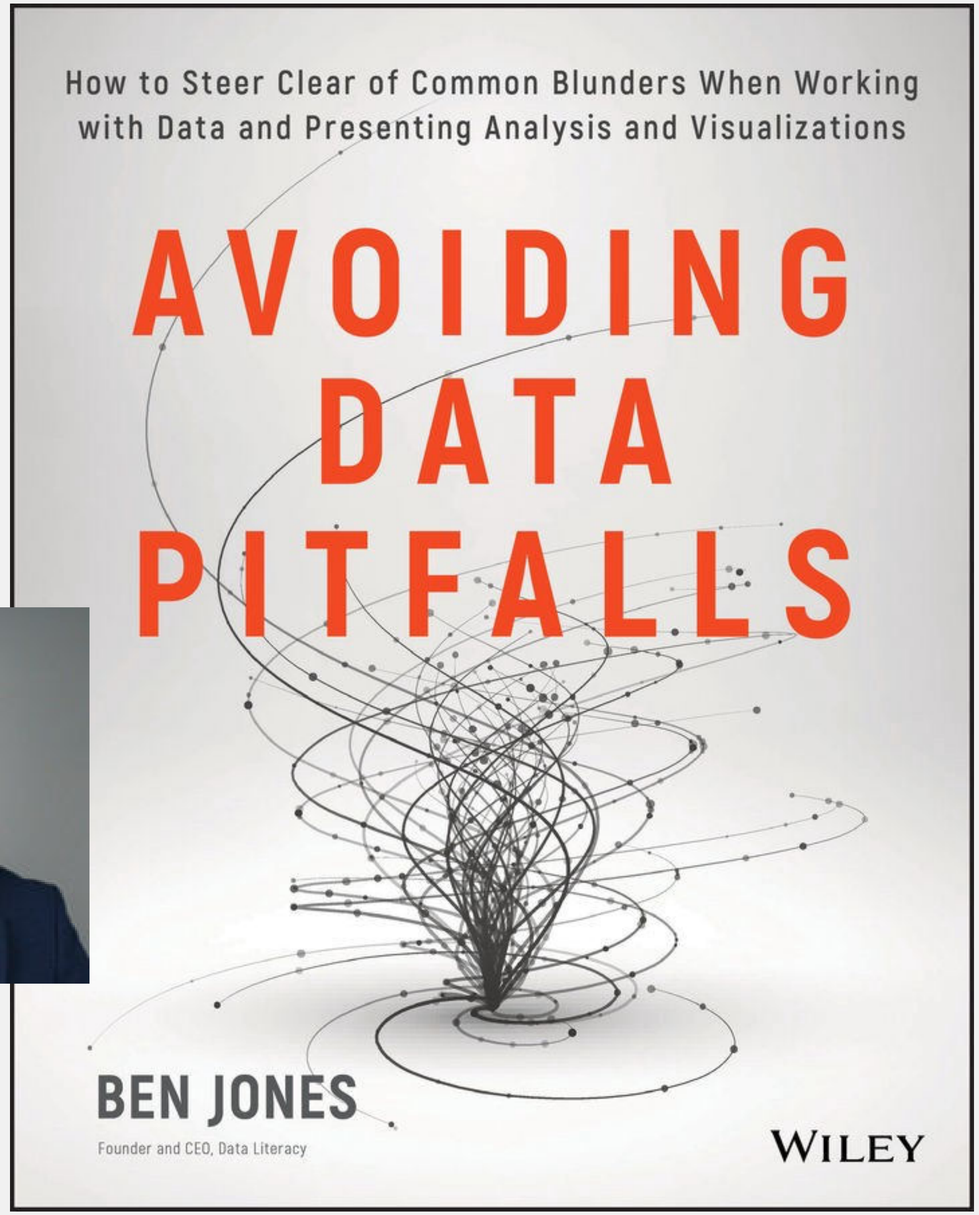
Priority:
efficienct + effective

Response:
functional

Priority:
creative + novel

Response:
emotional

The “Vertices of Visualization” by Alberto Cairo, personal communication (modified version)

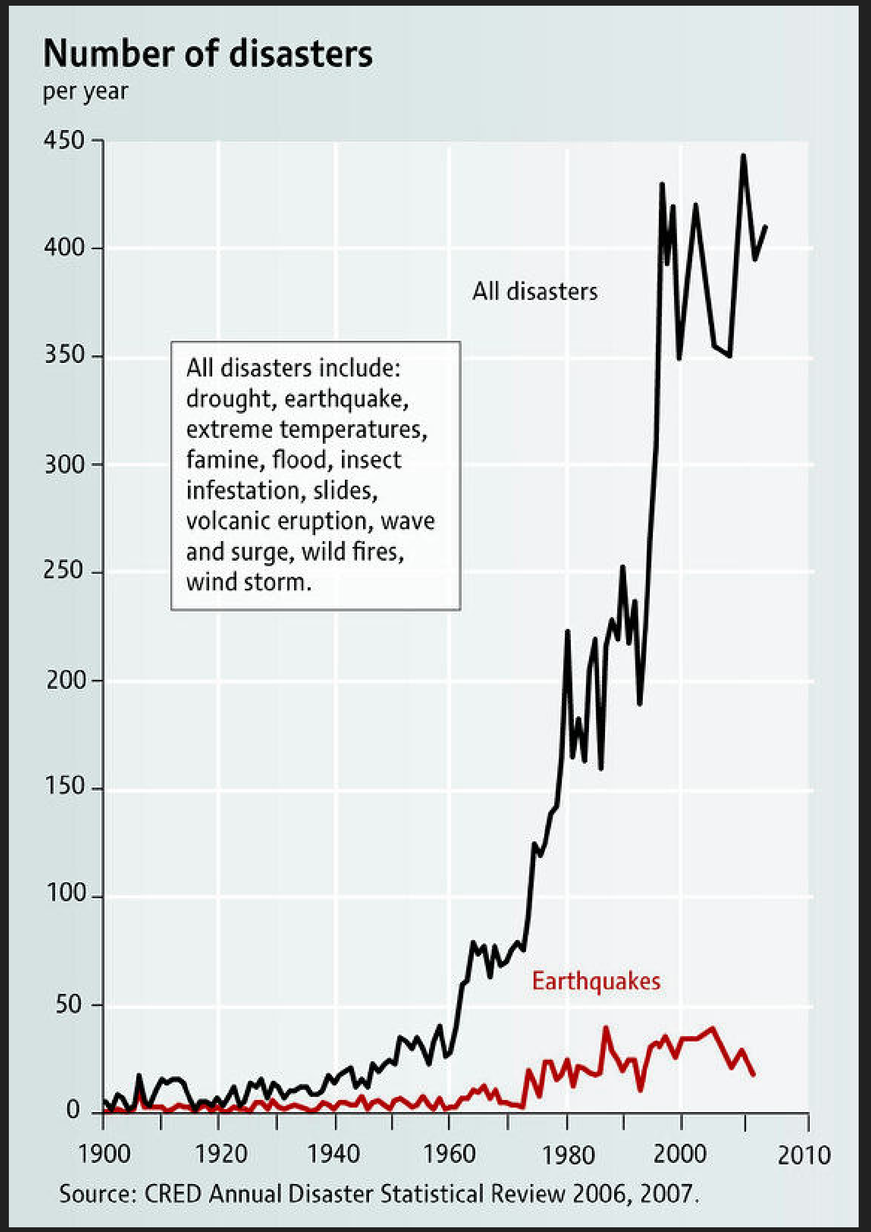

How to Steer Clear of Common Blunders When Working with Data and Presenting Analysis and Visualizations
AVOIDING DATA PITFALLS
BEN JONES
Founder and CEO, Data Literacy
WILEY

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

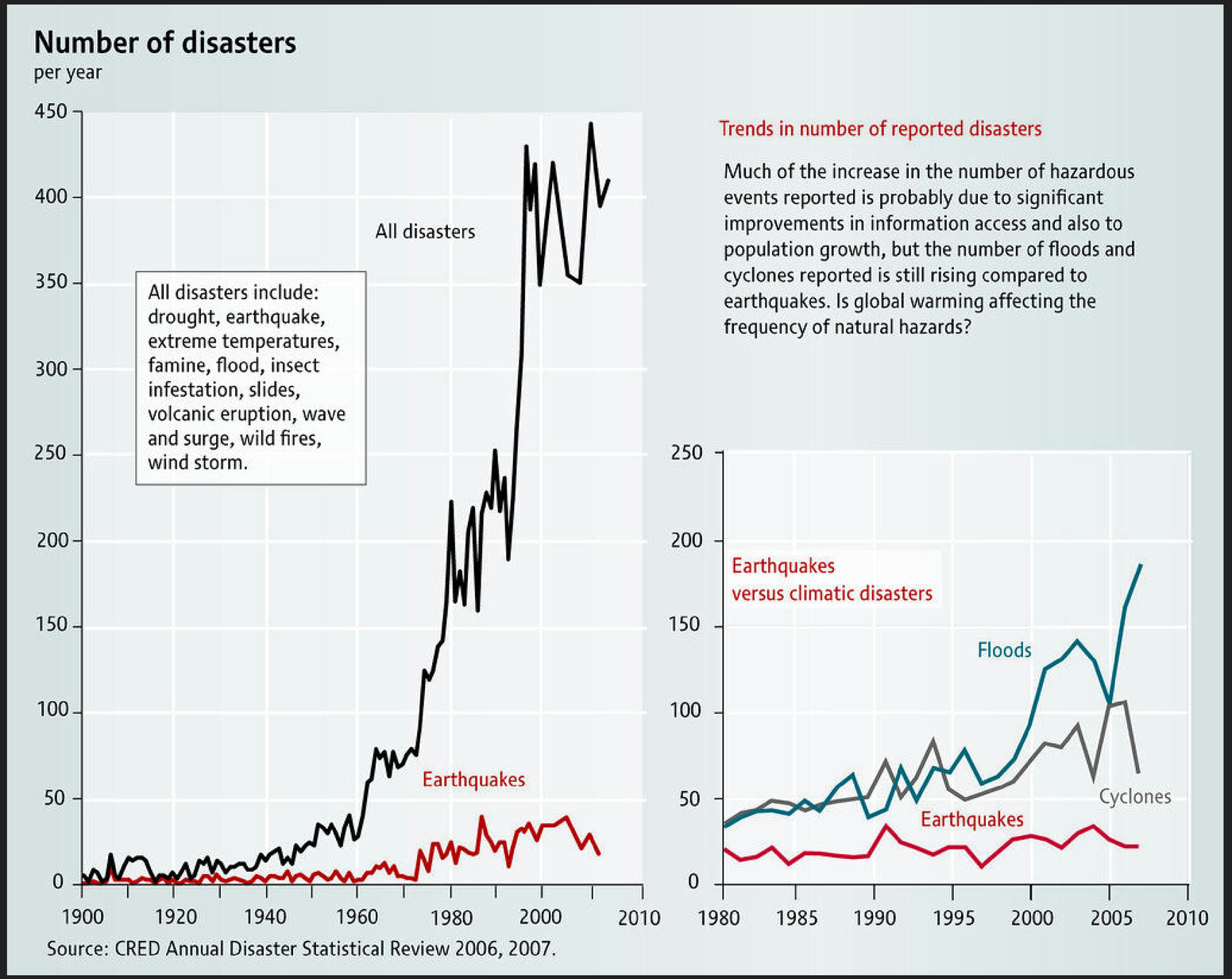
→ **only a subset:** not crime but reported crime

→ **collected by humans:** guesstimation, precision and errors

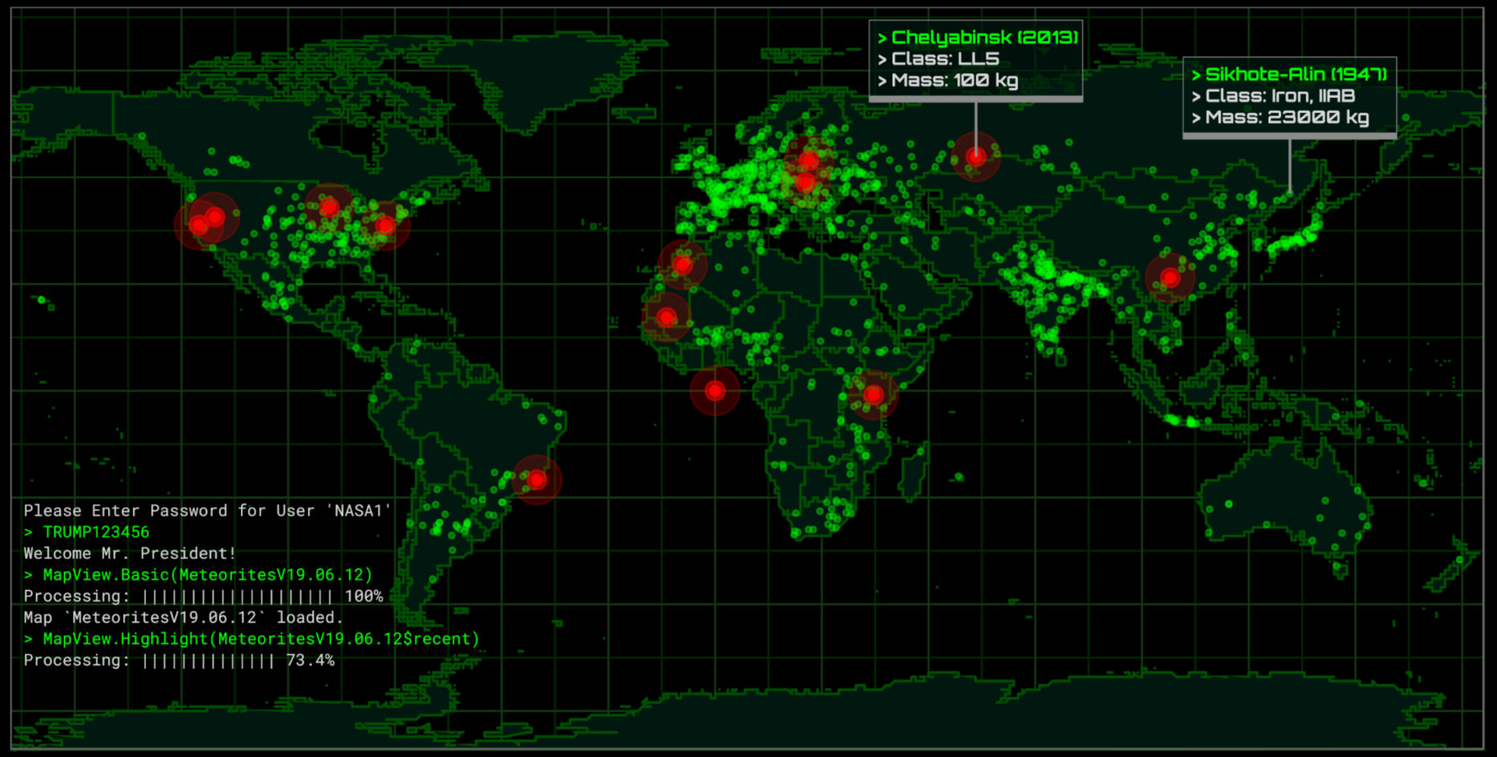
→ **collected by machines:** precisions and errors


Number of disasters
per year
450
400
350
300
250
200
150
100
50
0
All disasters
All disasters include: drought, earthquake, extreme temperatures, famine, flood, insect infestation, slides, volcanic eruption, wave and surge, wild fires, wind storm.
Earthquakes
1900
1920
1940
1960
1980
2000
2010
Source: CRED Annual Disaster Statistical Review 2006, 2007.

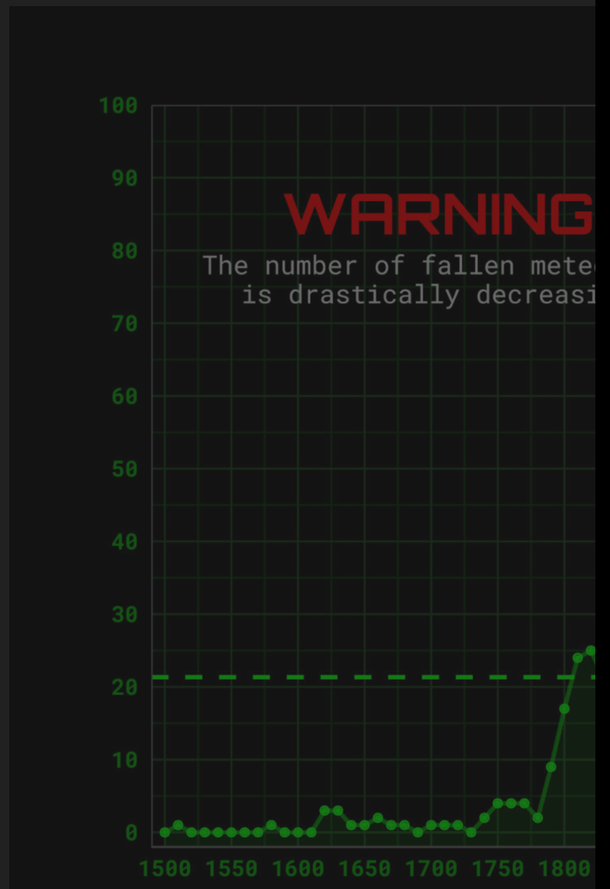
“Much of the increase of **hazardous events reported** is probably due to significant **improvements in information access**”



SPACE OBSERVER 3000 X V3.5.1



Provided by Cédric Scherer & National Aeronautics and Space Administration (NASA)


WARNING
The number of fallen mete
is drastically decreasi
100
90
80
70
60
50
40
30
20
10
0
1500 1550 1600 1650 1700 1750 1800


WARNING!
The number of fallen meteorites
is drastically decreasing!
100
90
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30
20
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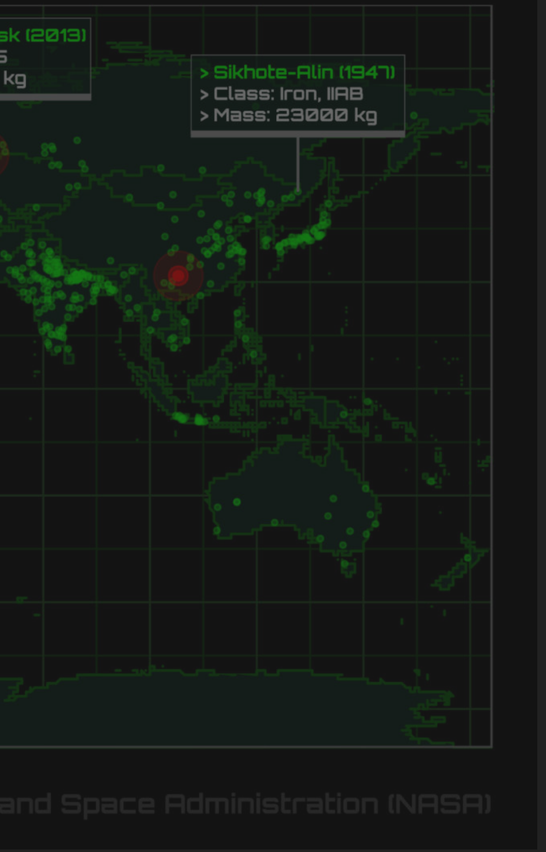
0
1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000 2050


> Sikhote-Alin (1947)
> Class: Iron, IIAB
> Mass: 23000 kg
and Space Administration (NASA)

The best use of data is to teach us what isn't true.

→ don't formulate a single statement

→ confront yourself with a **falsifiable universal statement**

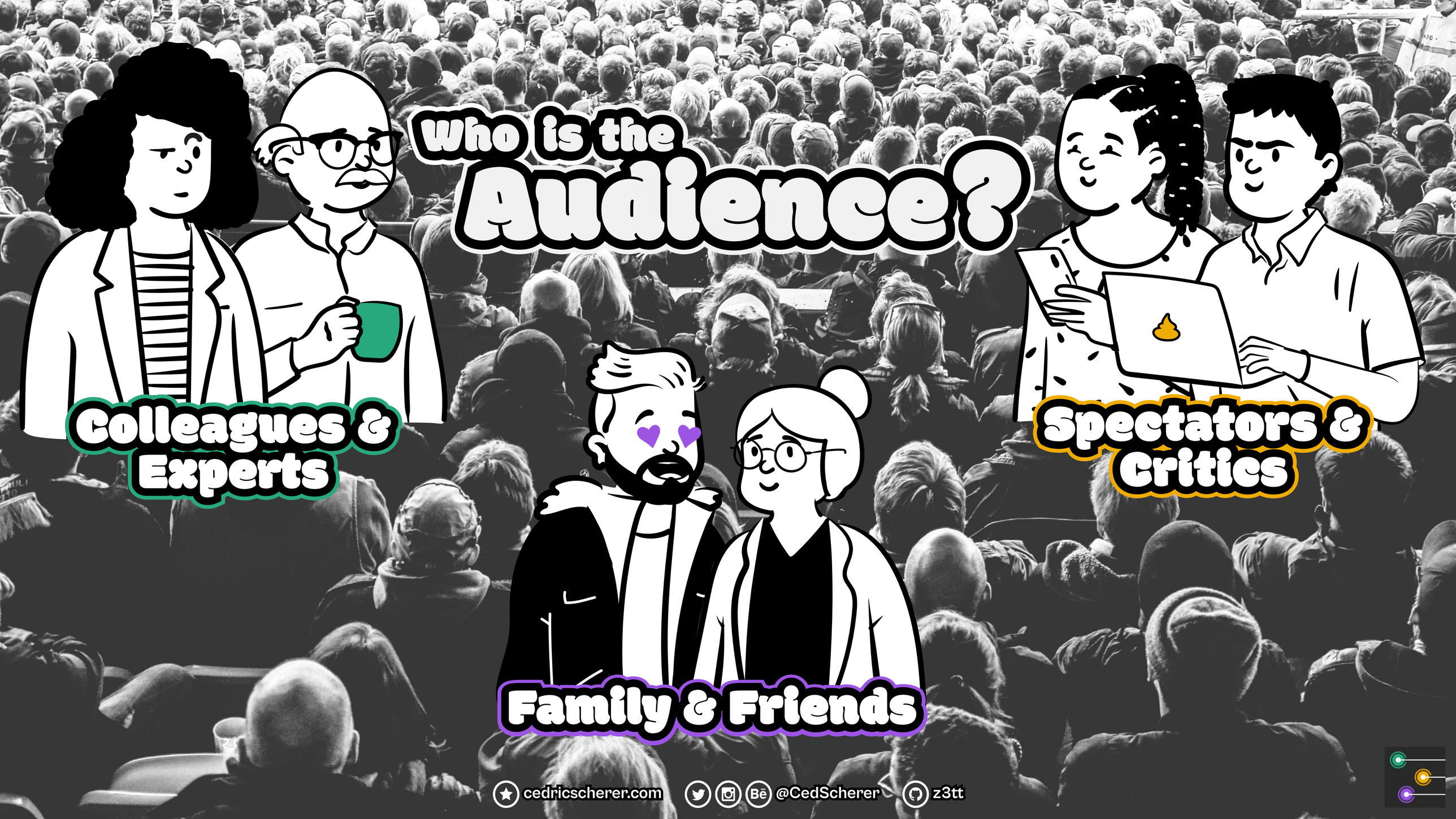
The best use of data is to teach us what isn't true.

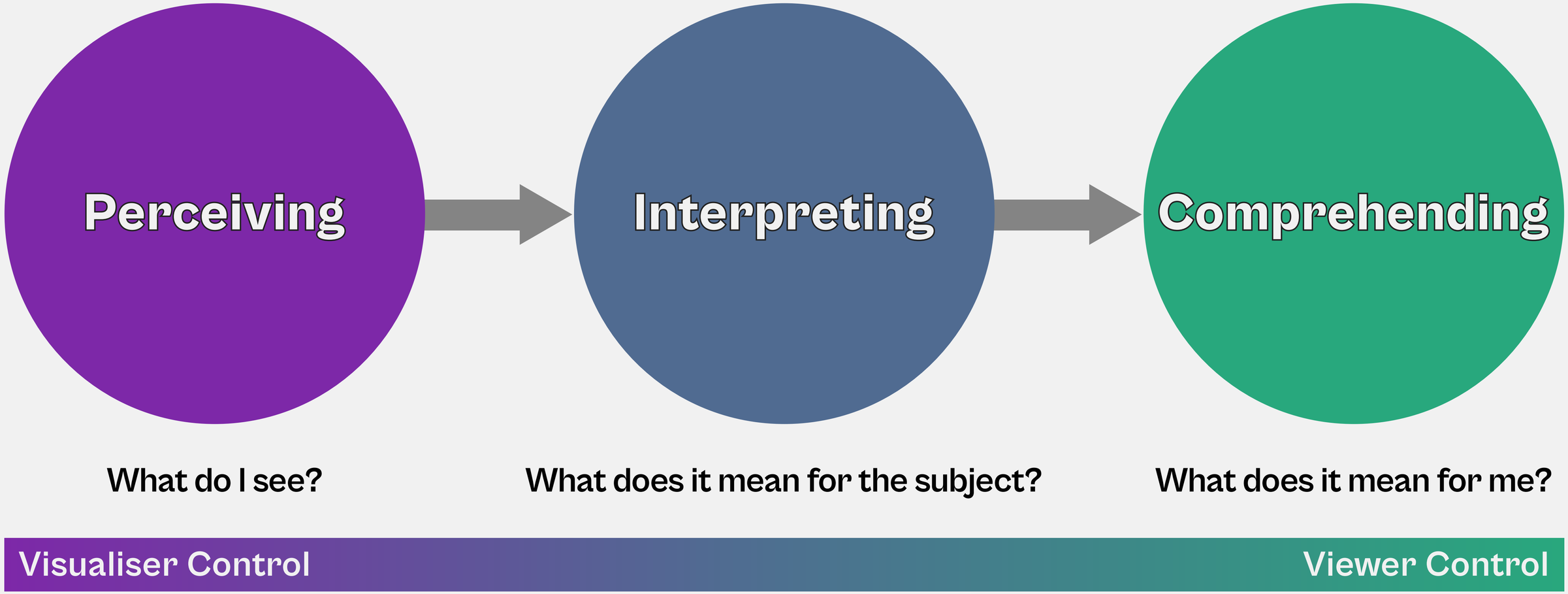
→ single statement: "The swan is white."

→ **falsifiable universal statement: "All swans are white."**

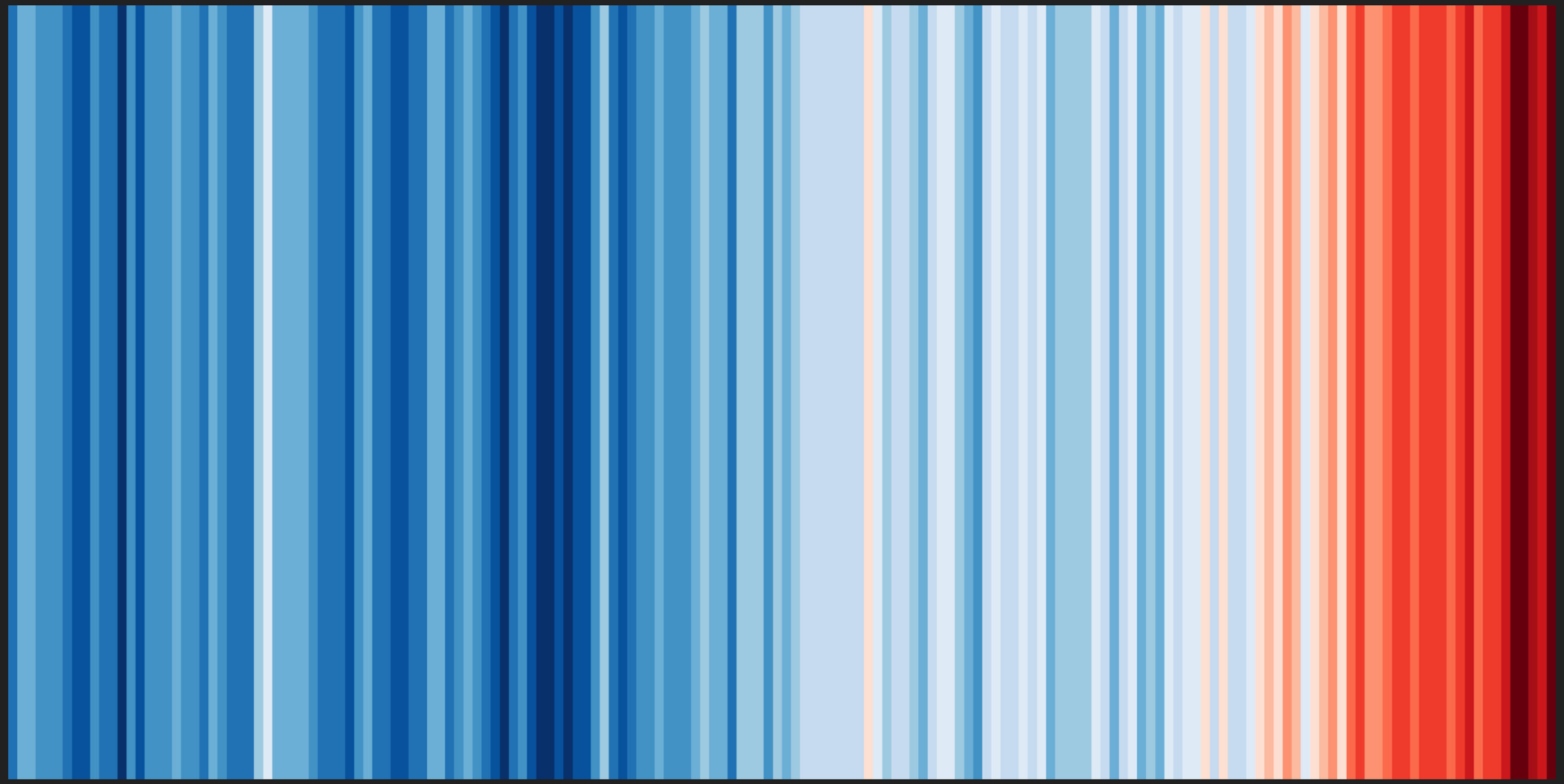

the
Audience
cedricscherer.com
@CedScherer
z3tt


Who is the
Audience?
cedricscherer.com
@CedScherer
z3tt


Who is the Audience?
Colleagues & Experts
Spectators & Critics
Family & Friends
cedricscherer.com
@CedScherer
z3tt

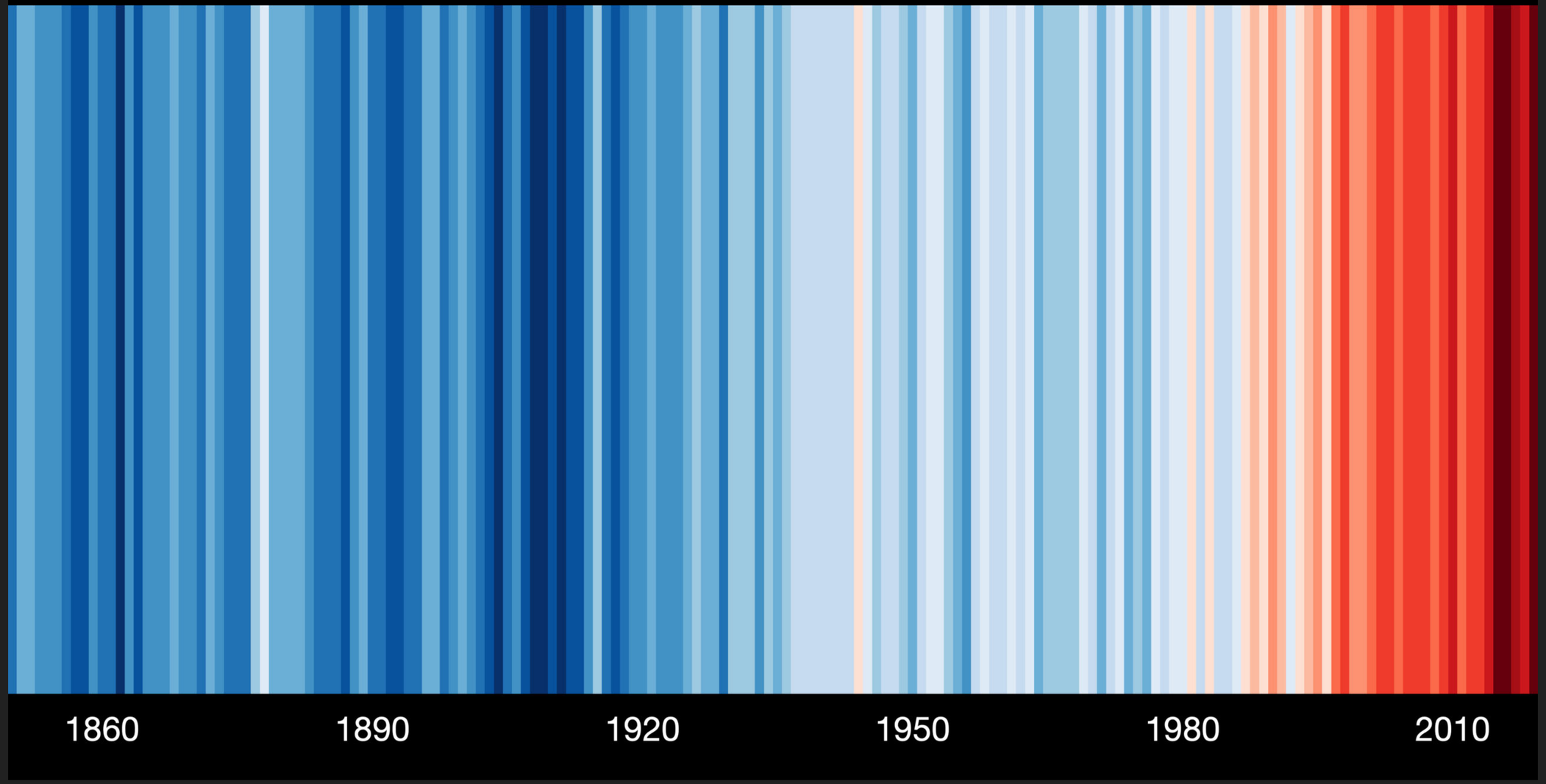


Scheme by Andy Kirk

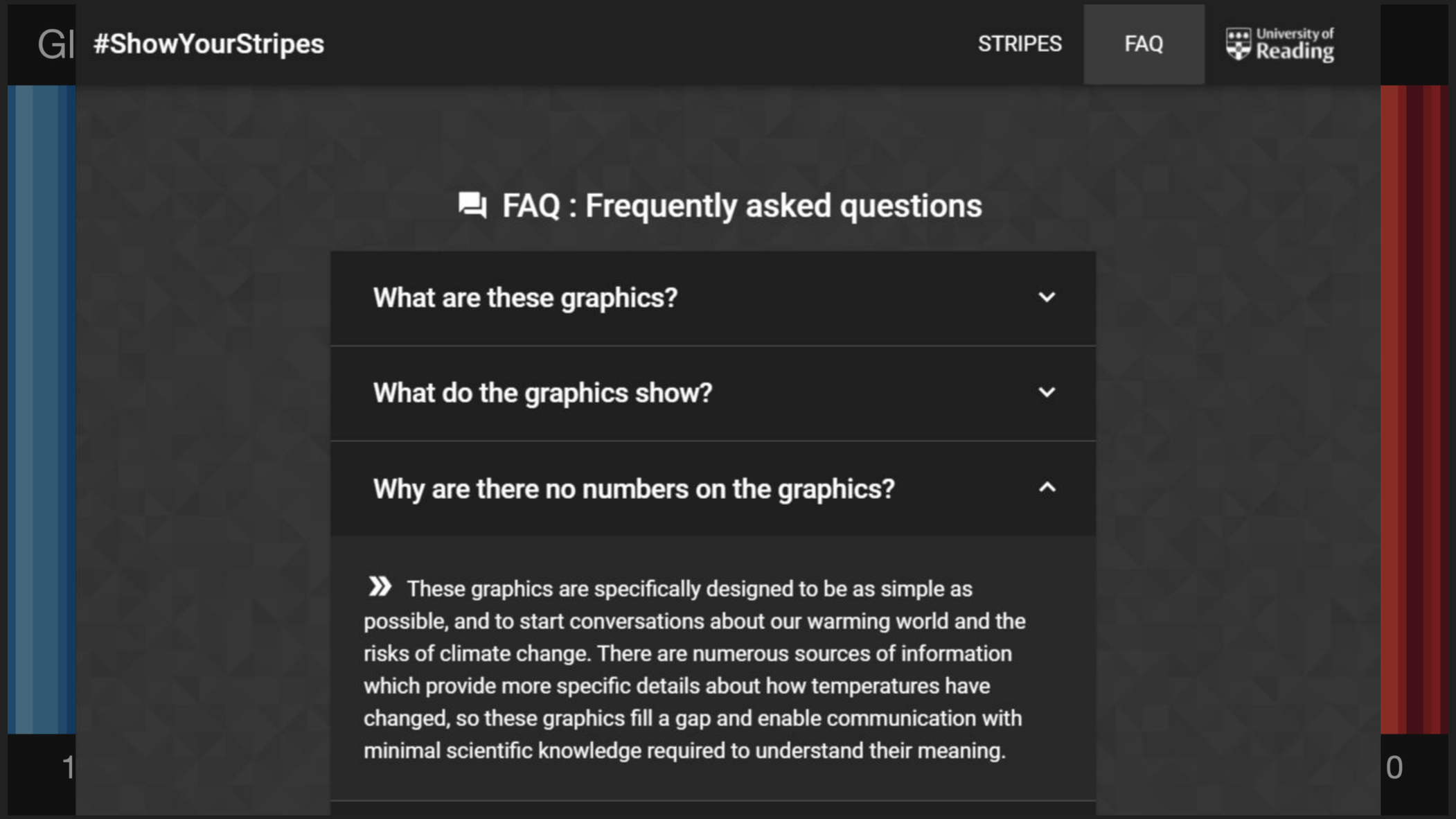


Warming Stripes by Ed Hawkins

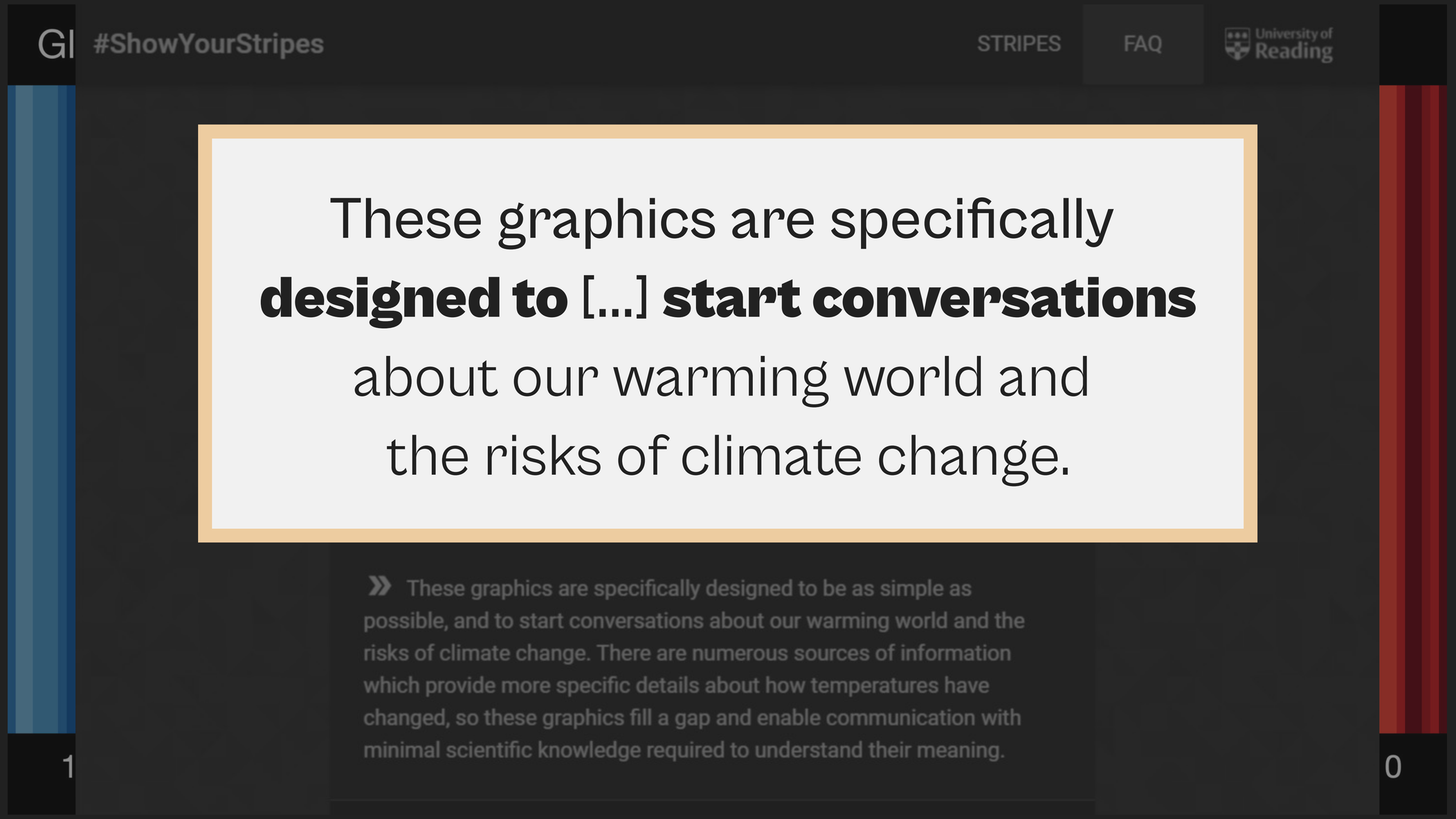
Global temperature change (1850-2019)



Warming Stripes by Ed Hawkins

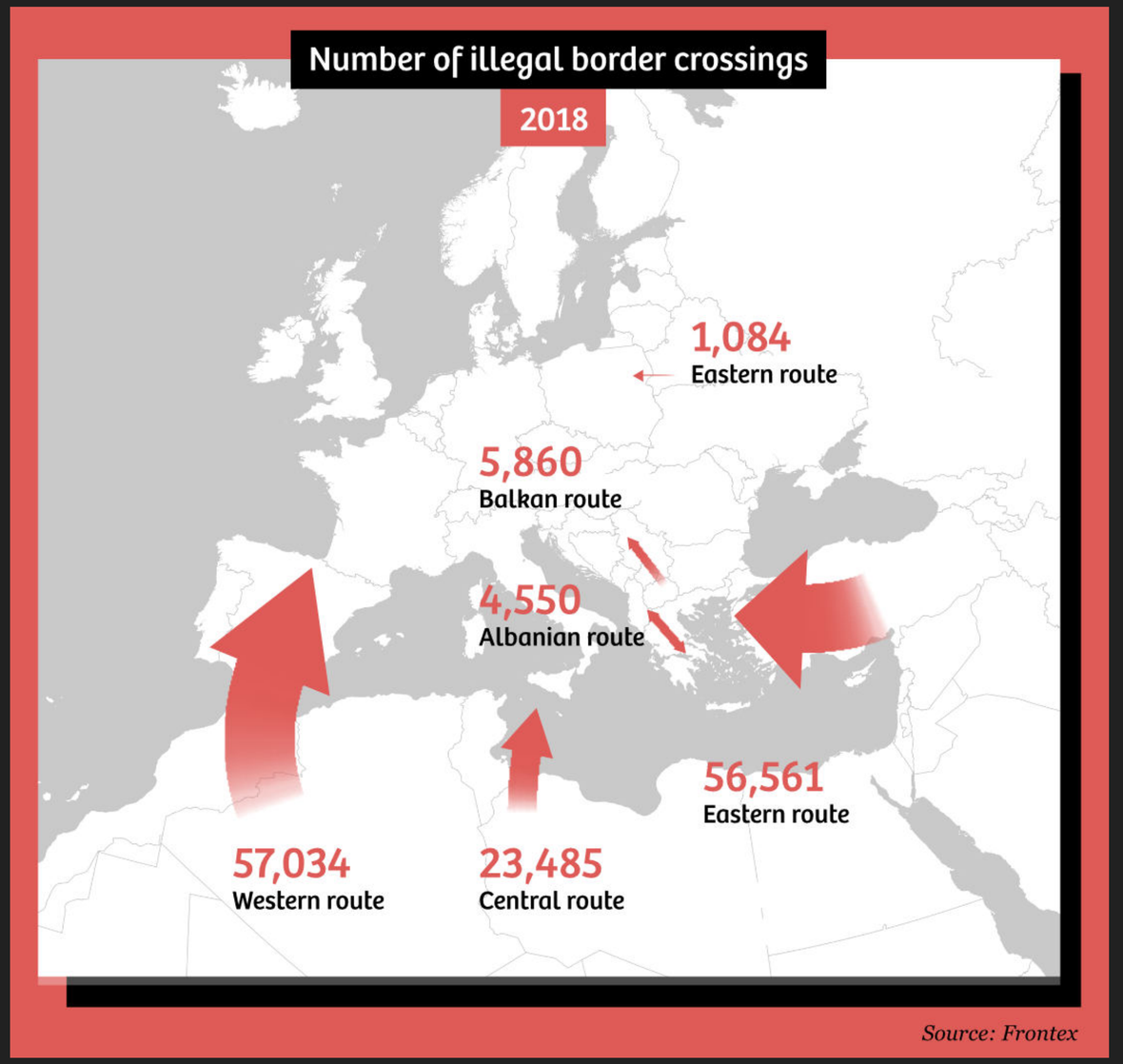


showyourstripes.info/faq

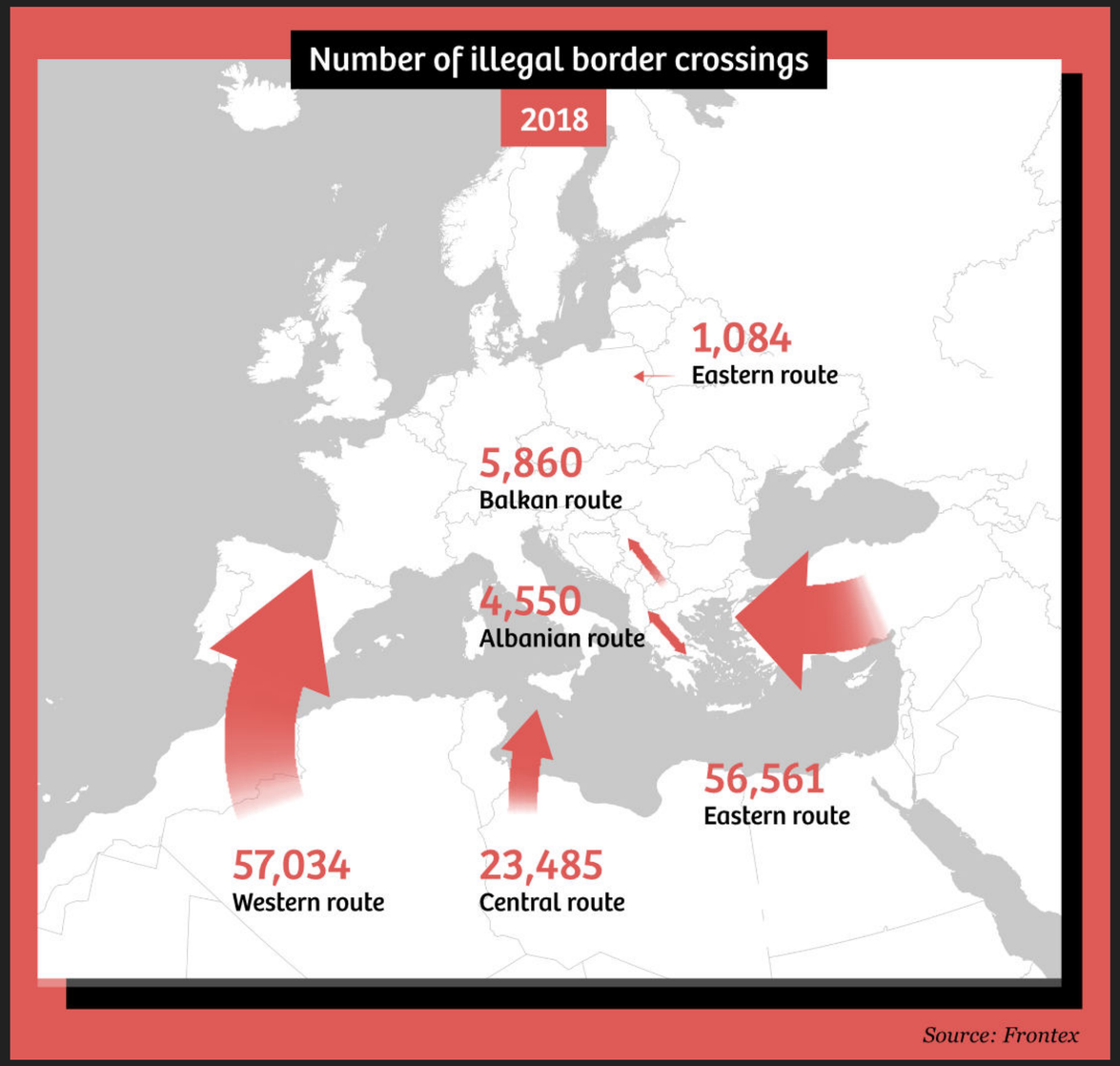


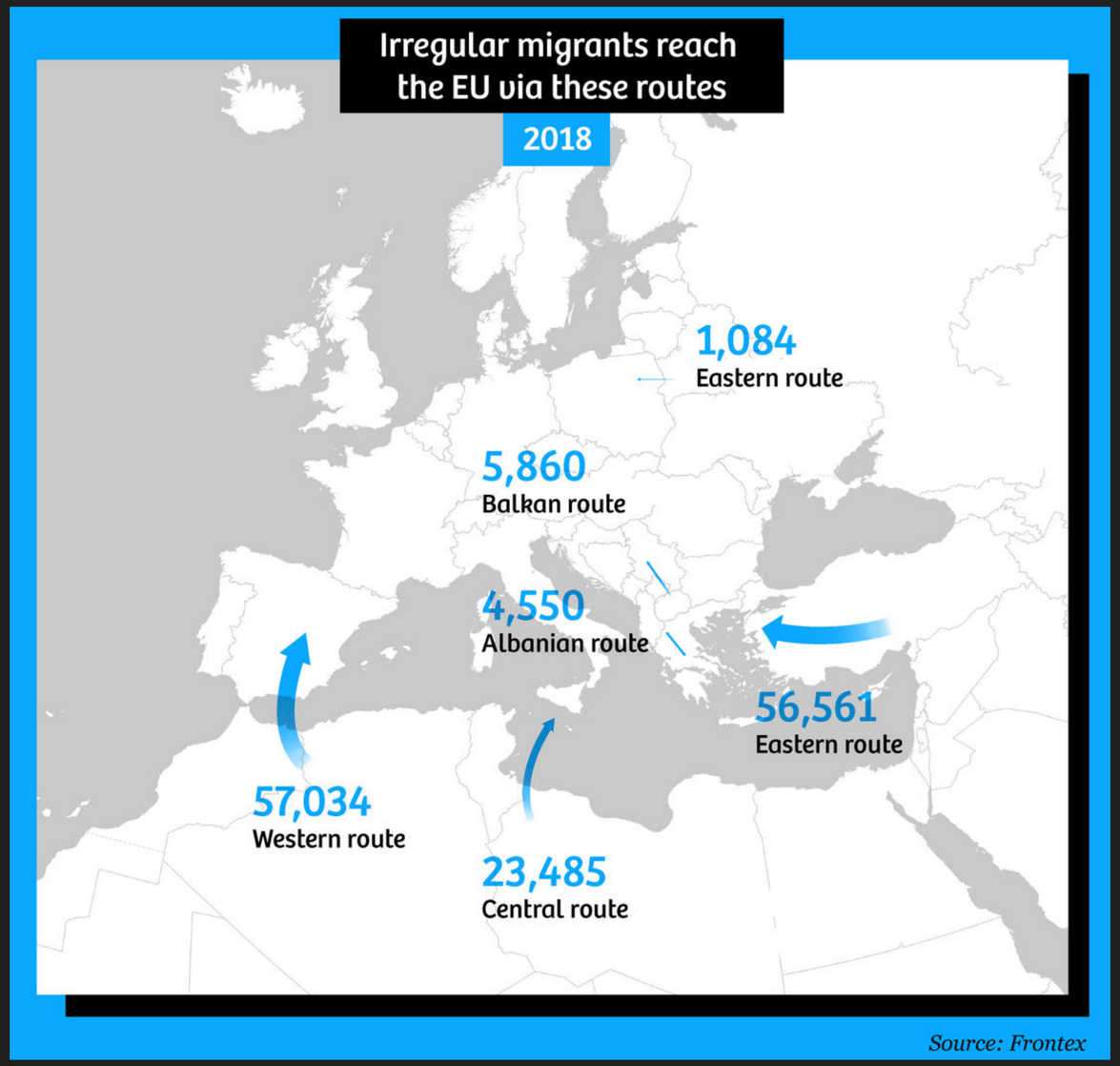
These graphics are specifically
designed to [...] **start conversations**
about our warming world and
the risks of climate change.

showyourstripes.info/faq



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





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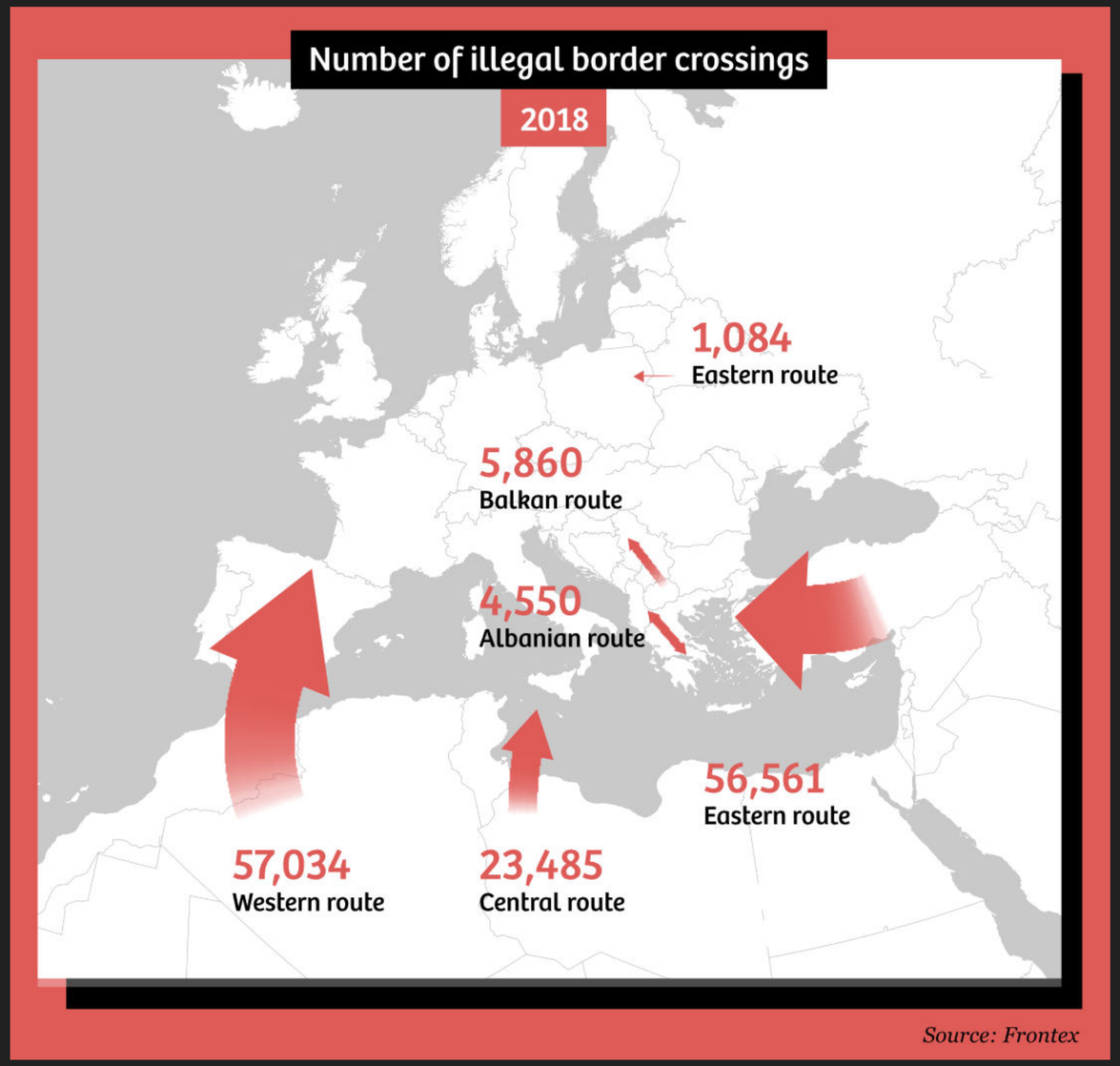

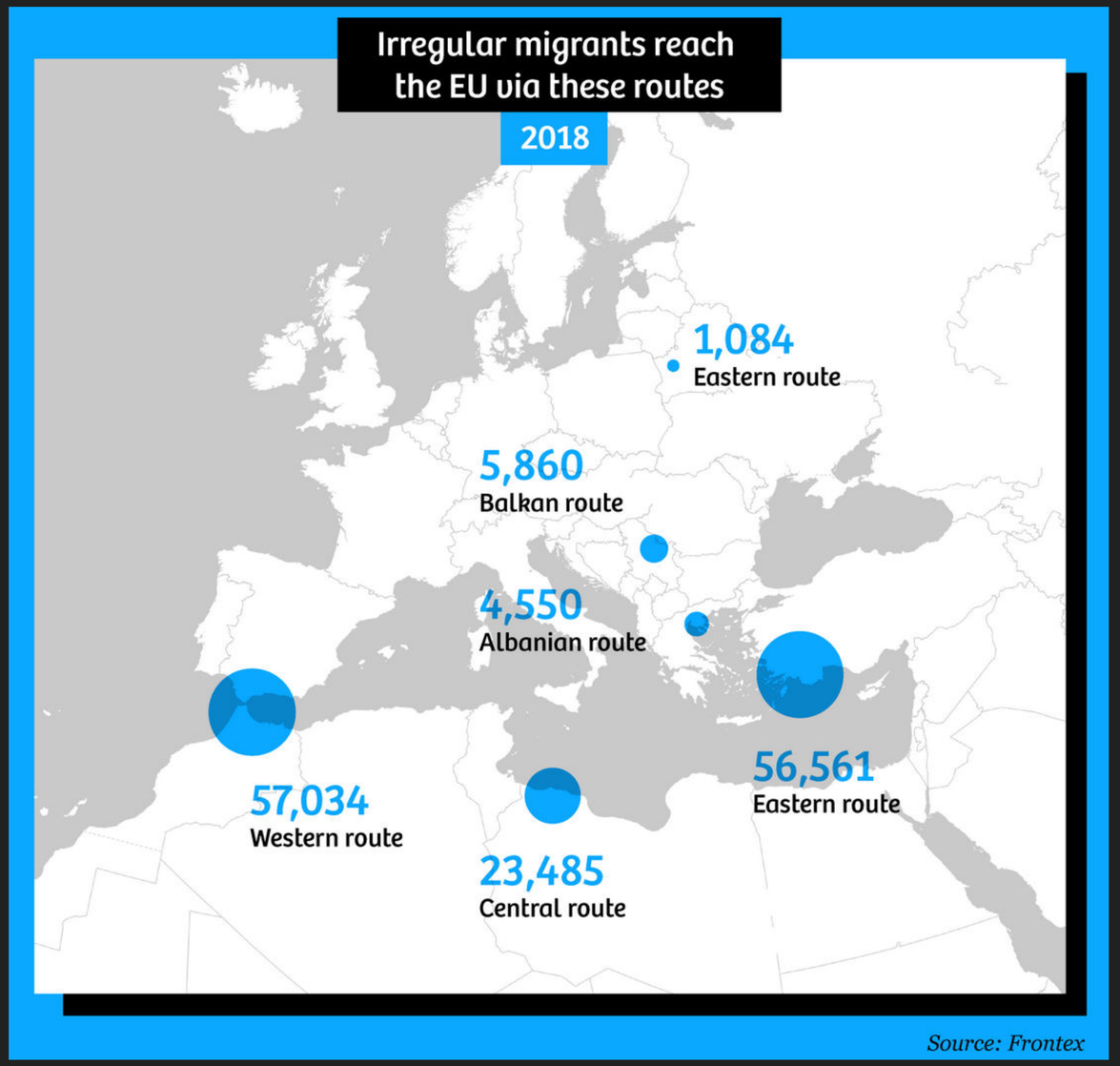

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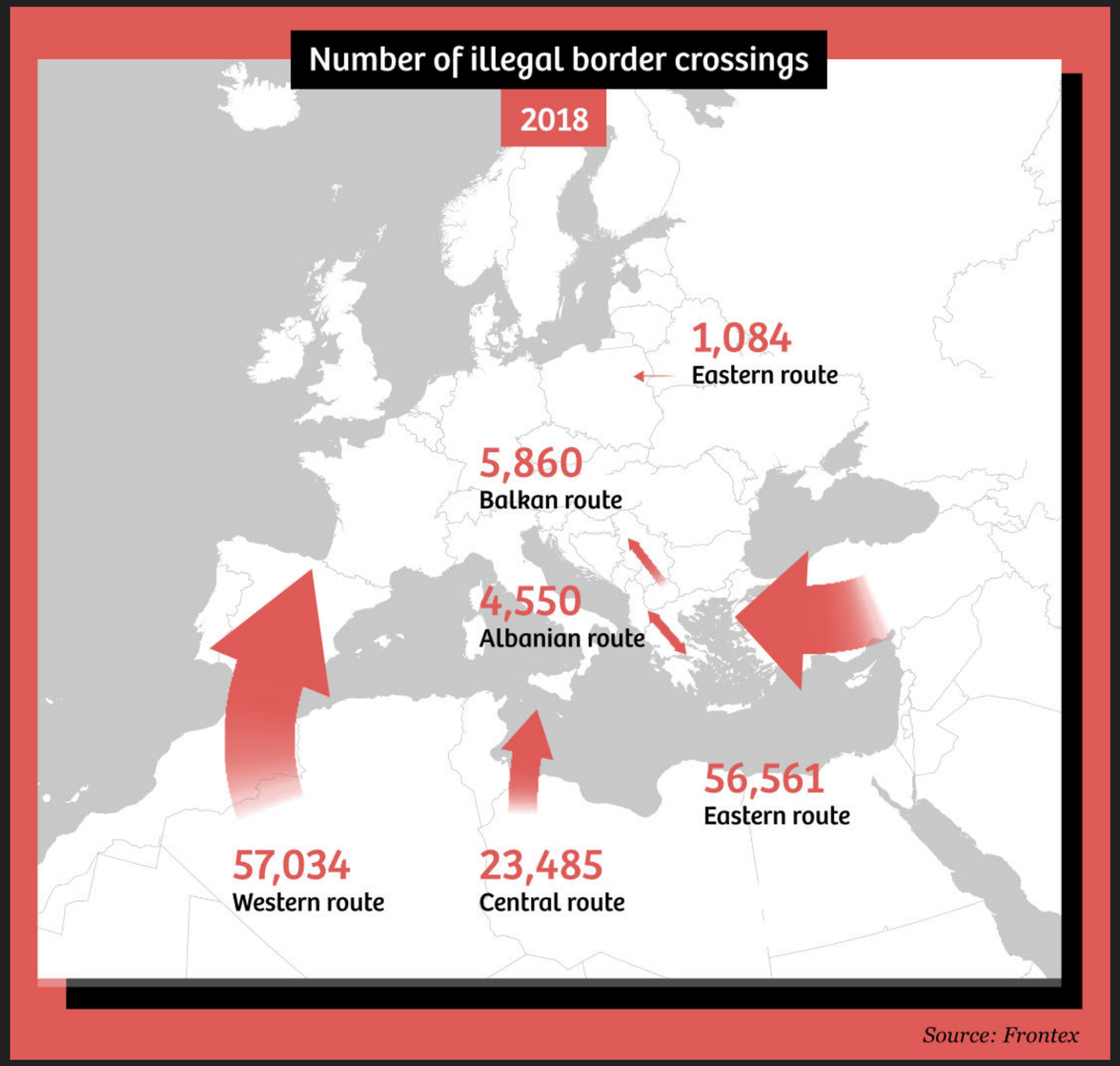

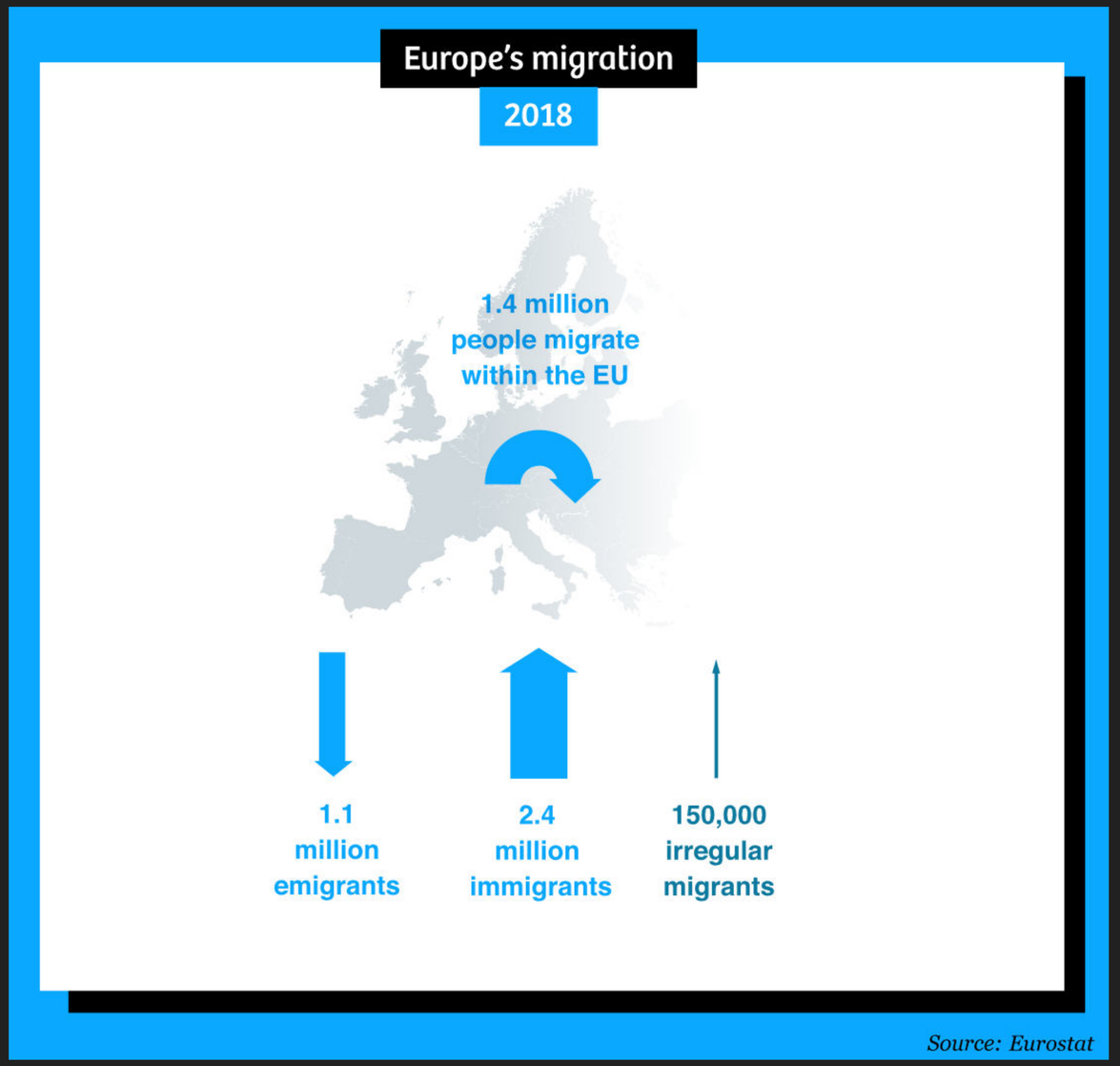

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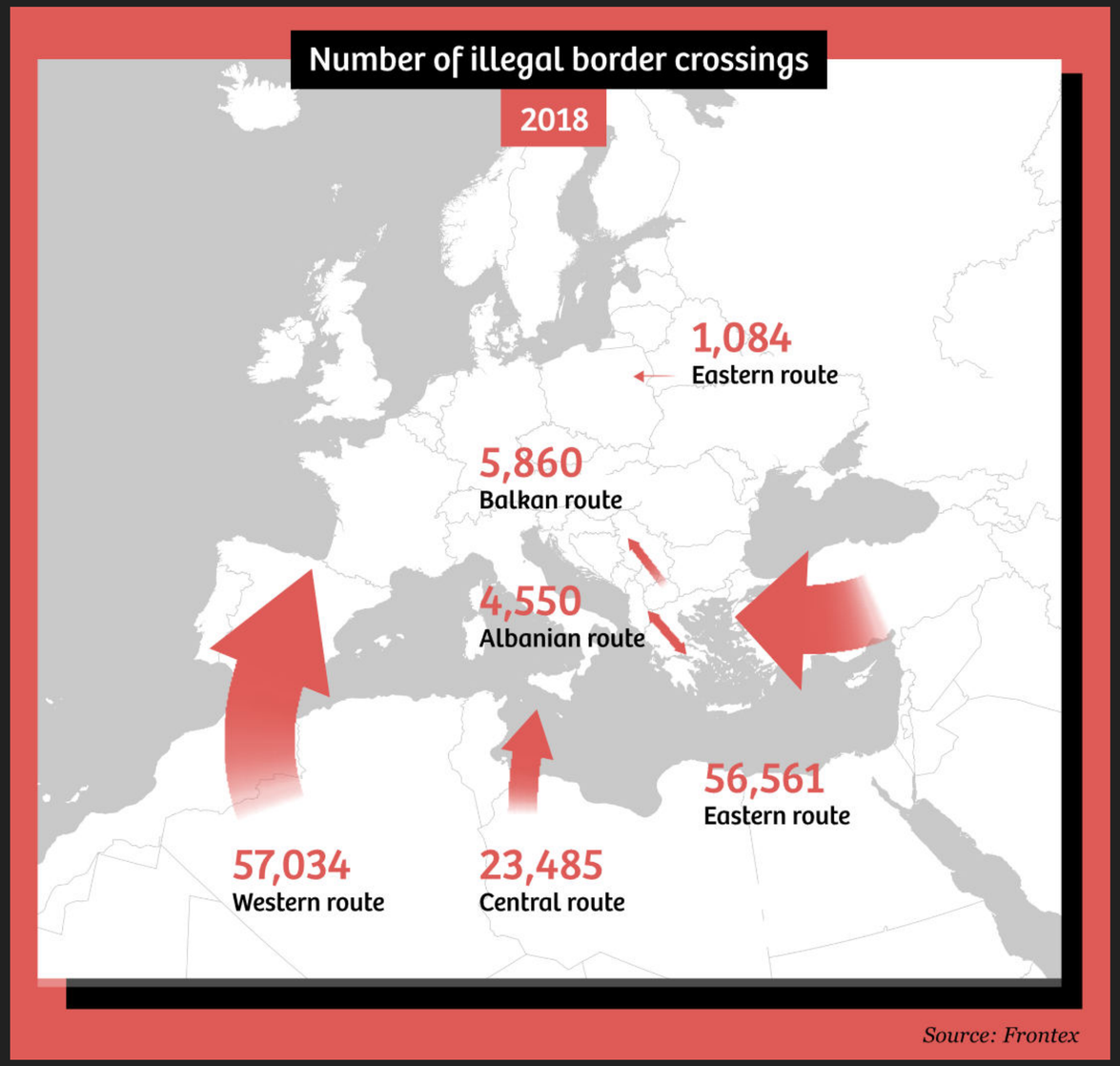

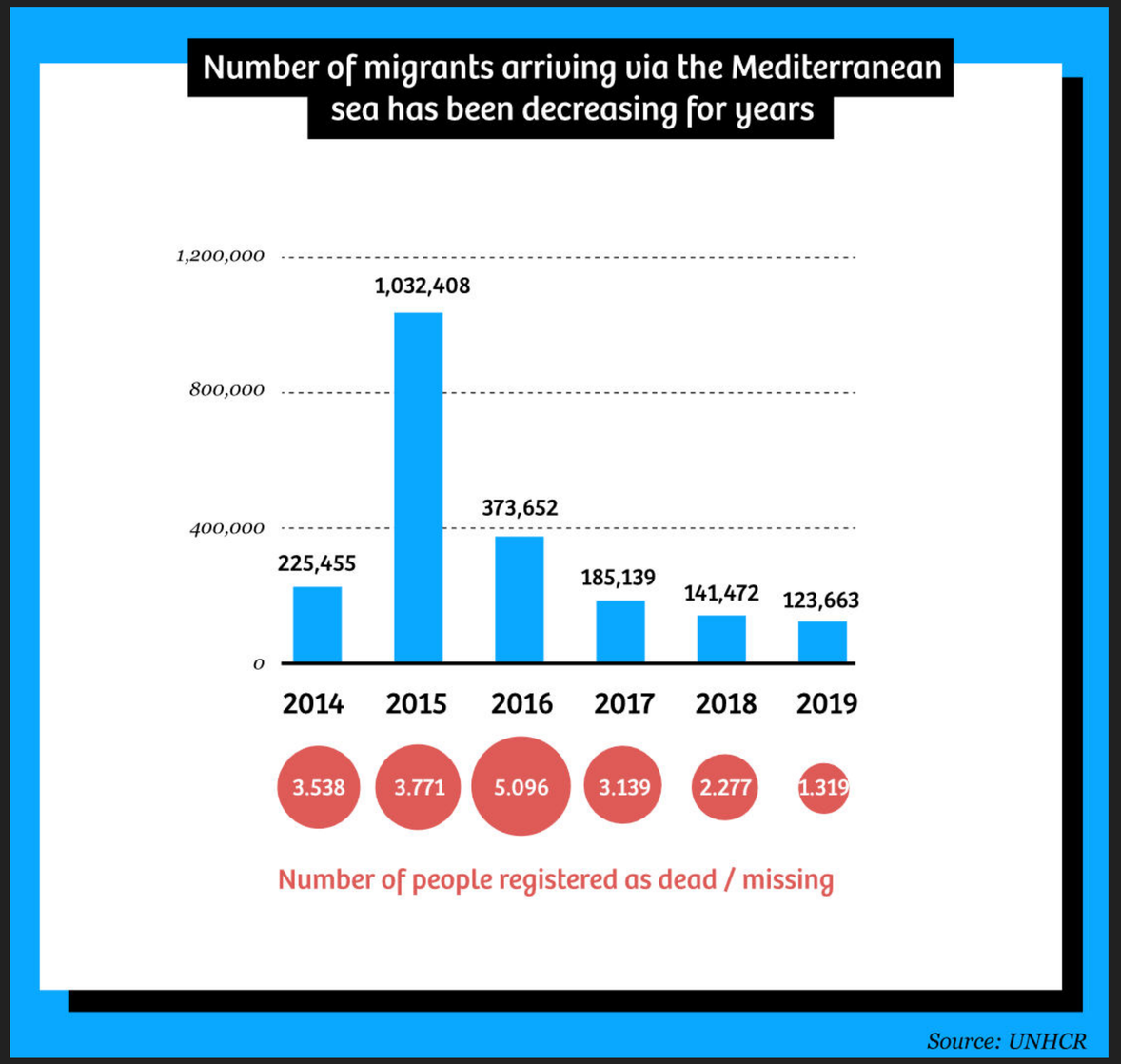

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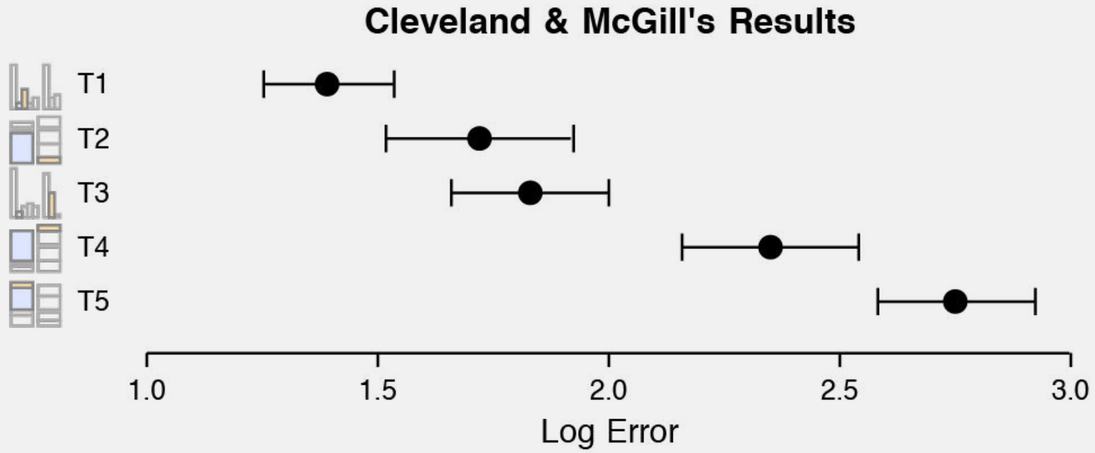
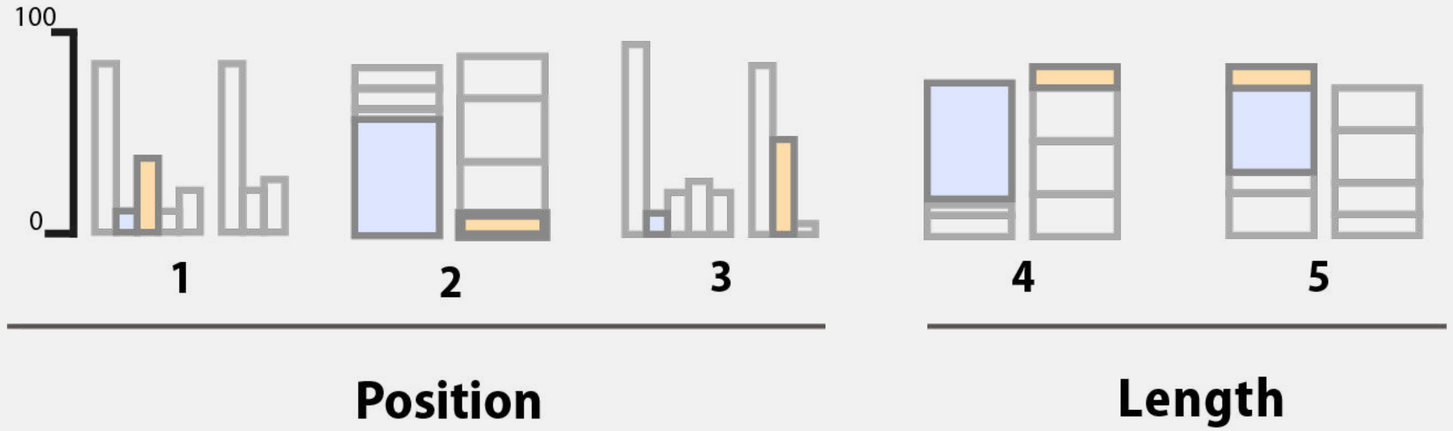
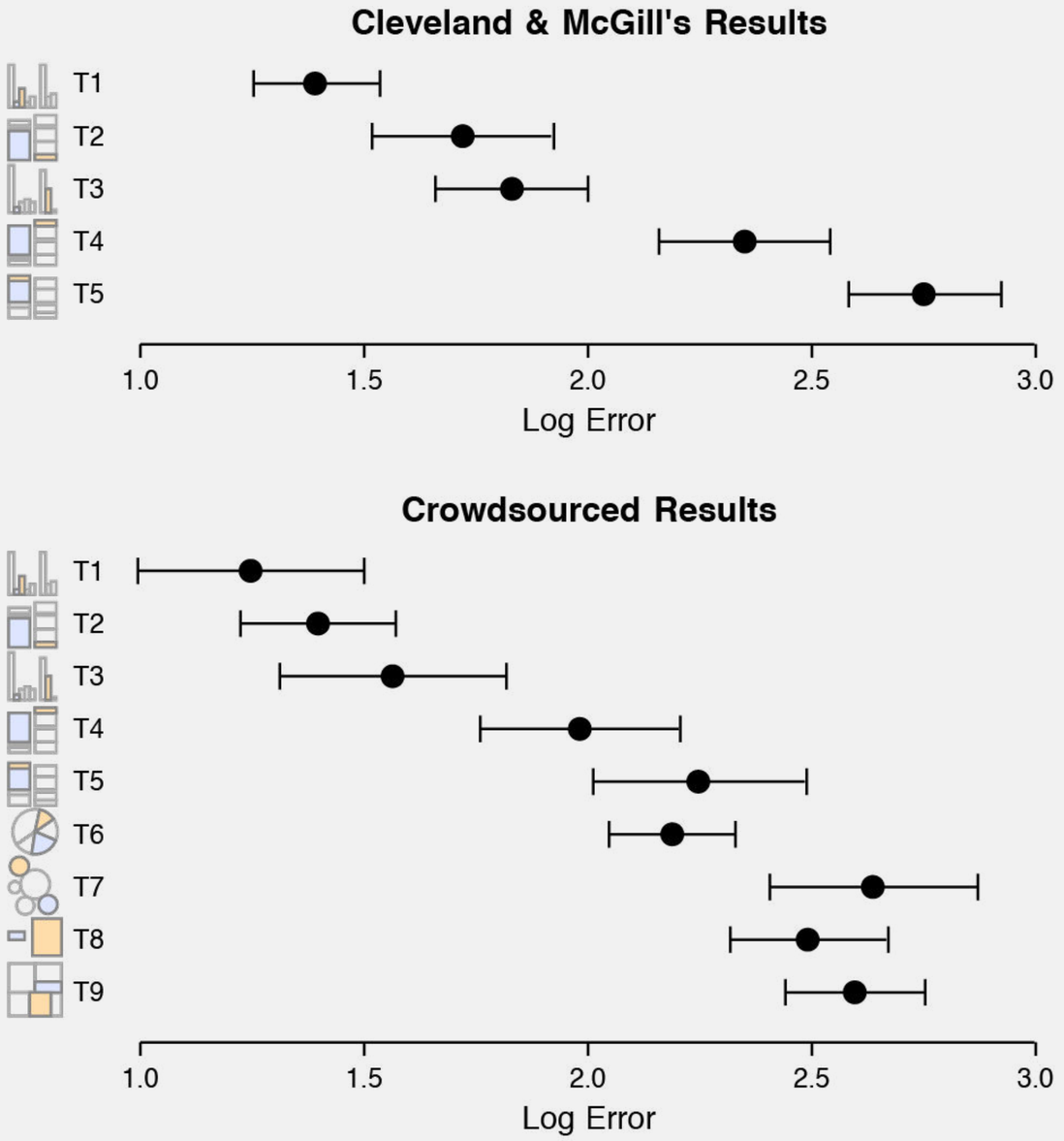


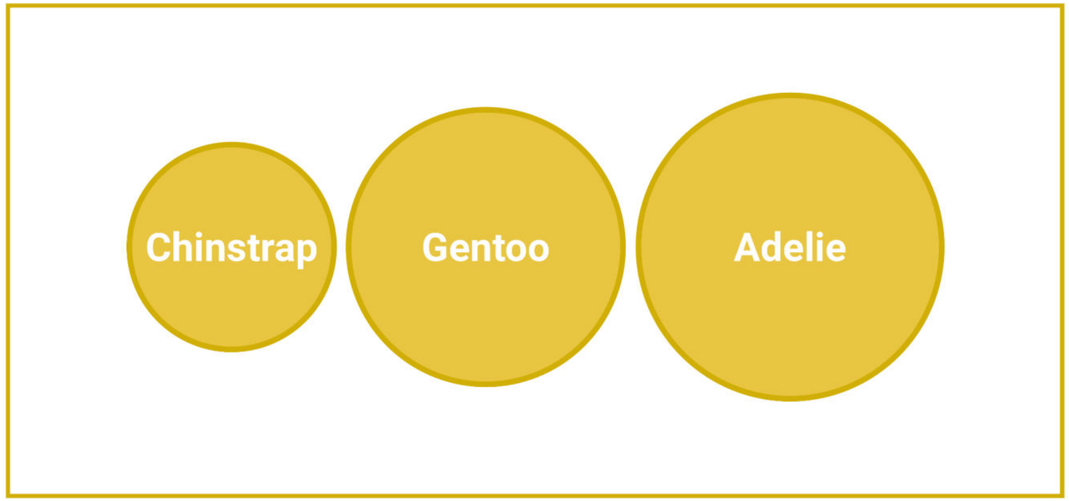


*Quelle: Kieran Healys **“Data Visualization: A Practical Introduction”***
Ergebnisse basierend auf Heer & Bostock sowie Cleveland & McGill

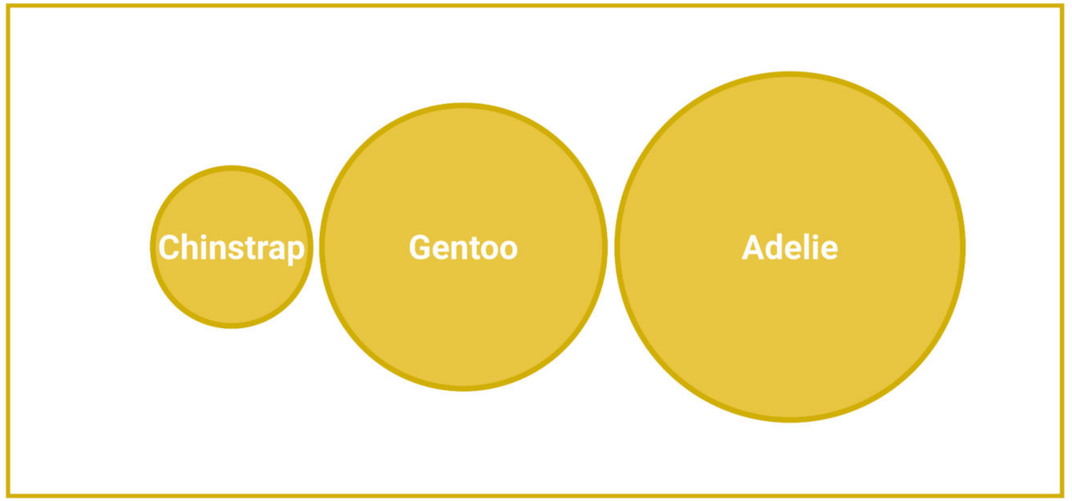


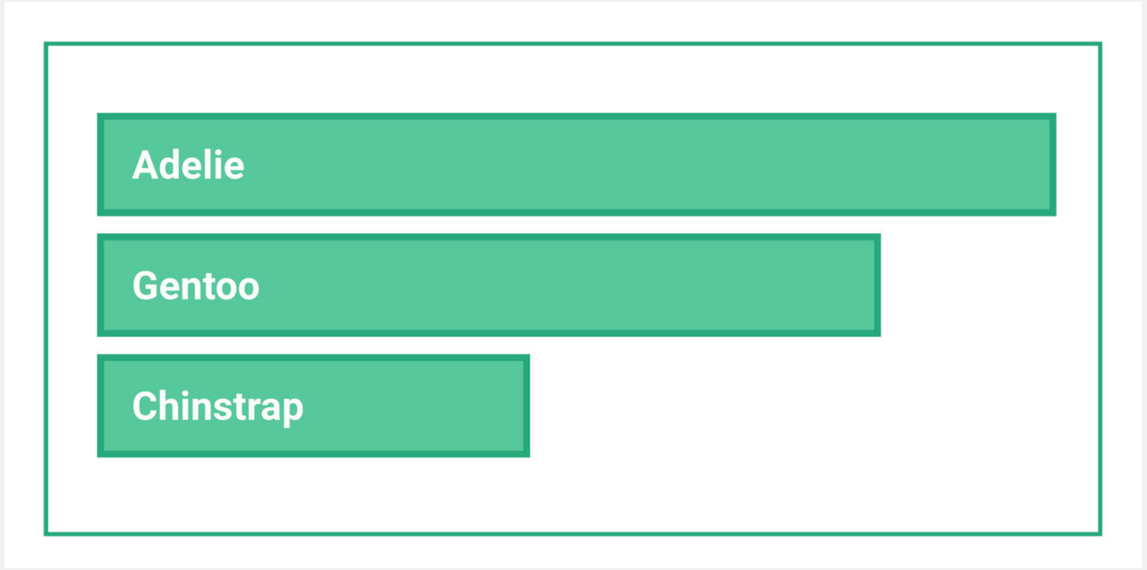
*Quelle: Kieran Healys **"Data Visualization: A Practical Introduction"***
Ergebnisse basierend auf Heer & Bostock sowie Cleveland & McGill

Use area.



Not radius!

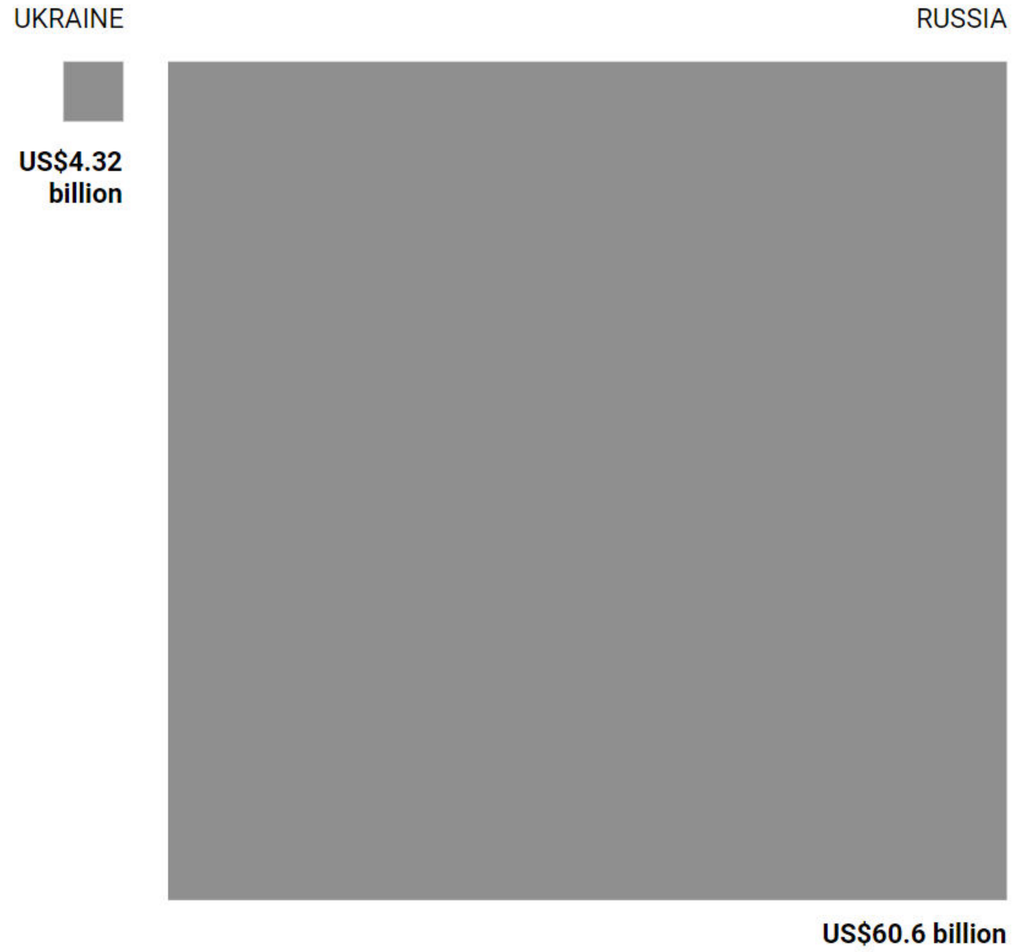




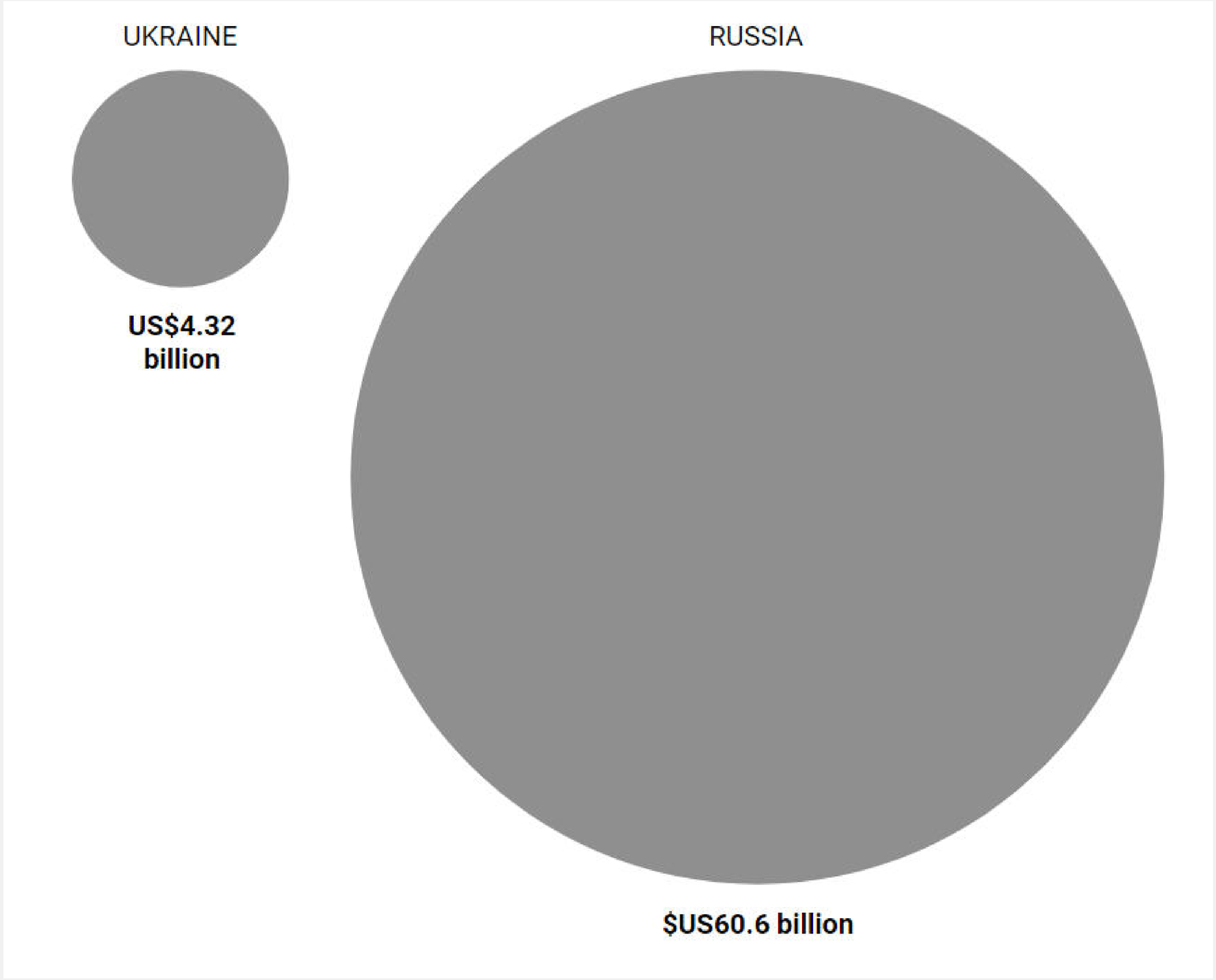
or: bars!

DEFENCE BUDGETS: RUSSIA VS UKRAINE (2020)

The national balance of forces is overwhelmingly in Russia's favour. Russian military spending in 2020 amounted to US$60.6 billion in 2020. Ukraine's was less than a 10th of that amount.

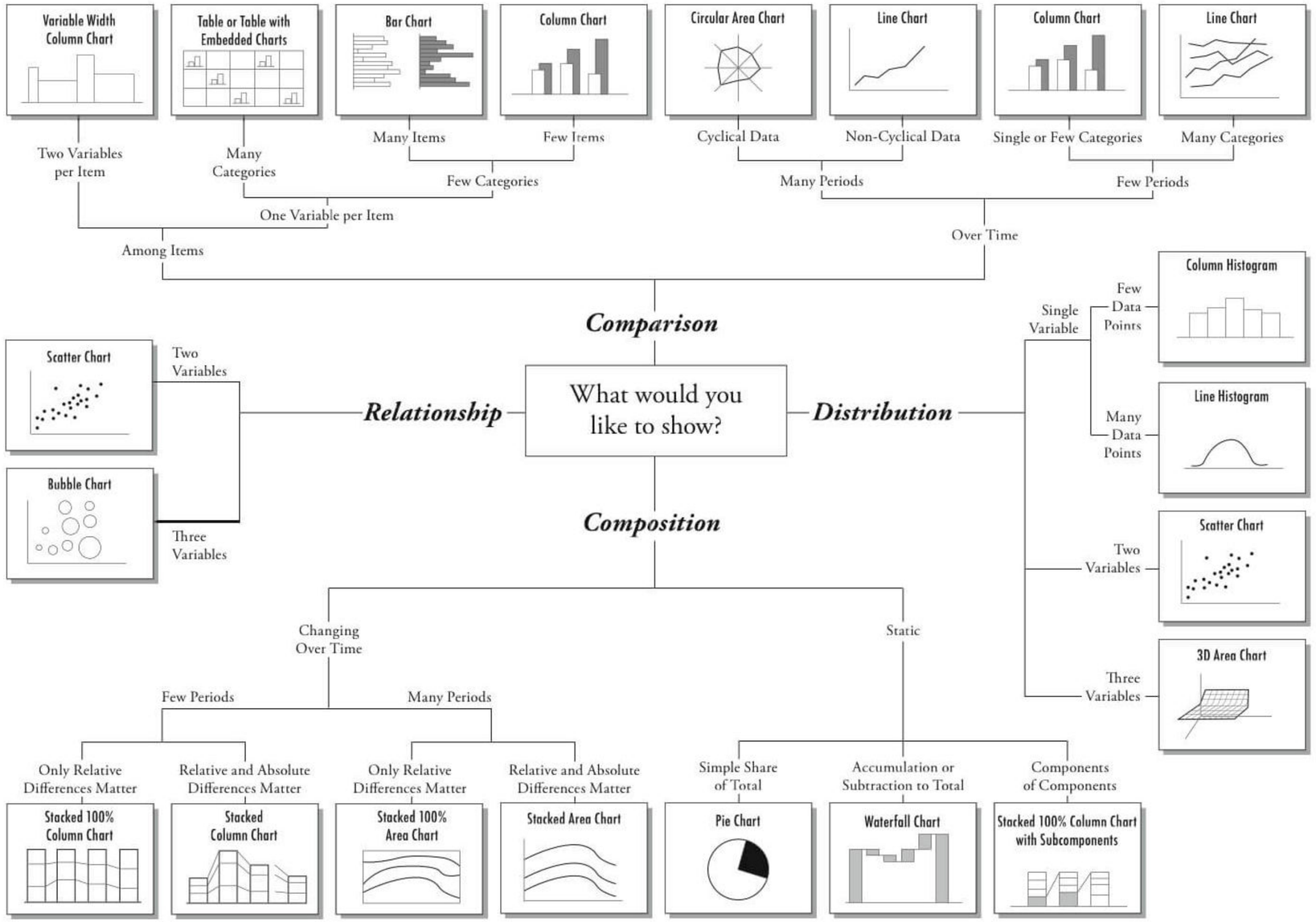


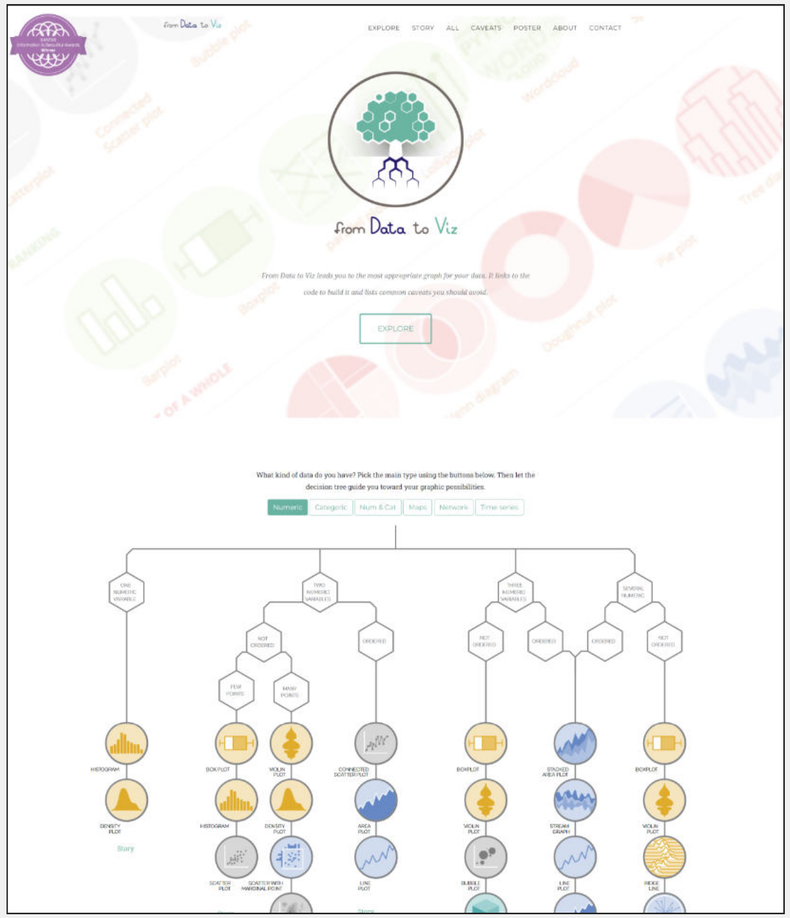
"Russia attacks Ukraine" von SCMP Graphic (South China Morning Post)



“Russia attacks Ukraine” von SCMP Graphic (South China Morning Post)

Chart Suggestions—A Thought-Starter



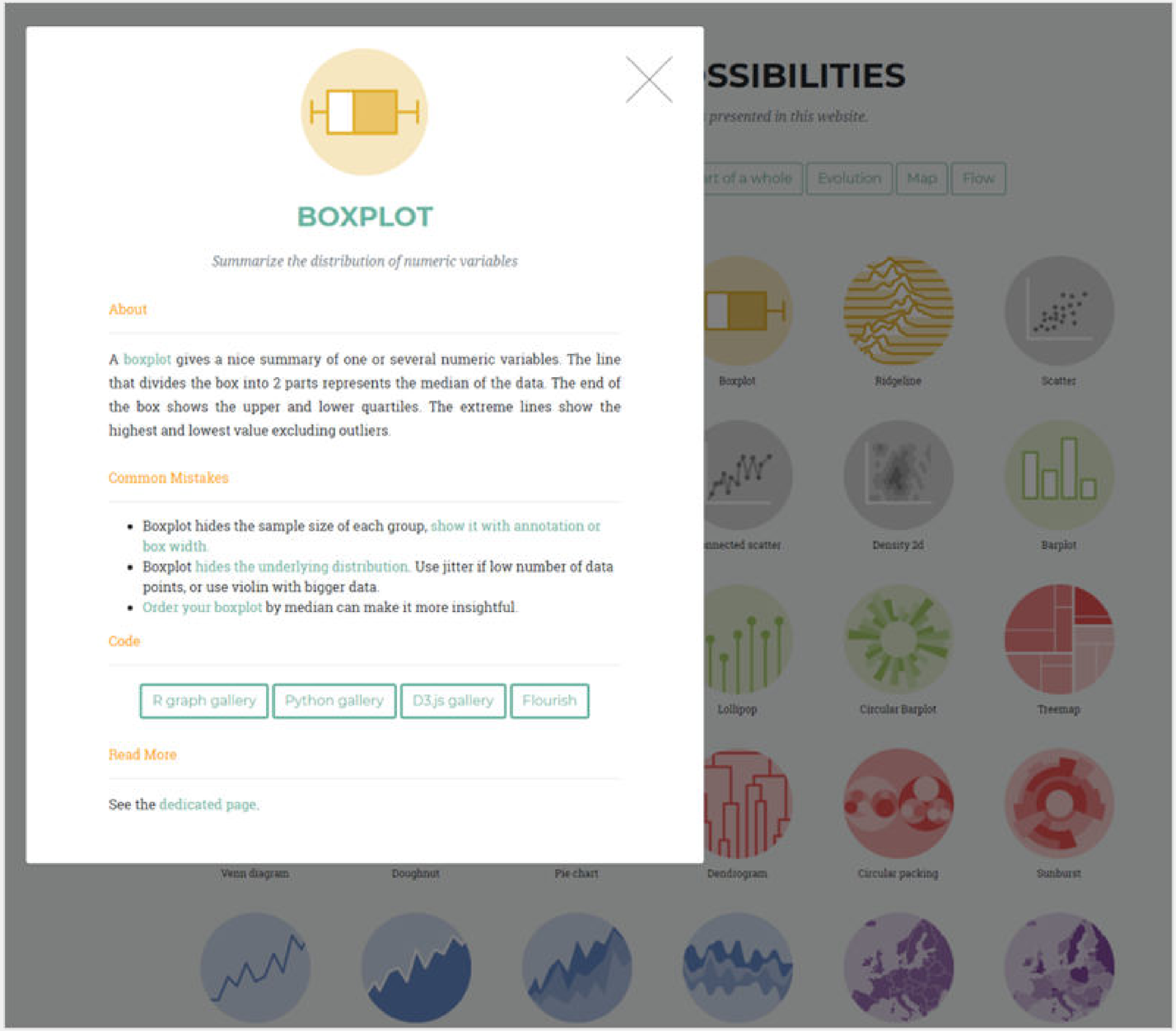


data-to-viz.com

datavizproject.com

visualizationuniverse.com

Source: data-to-viz.com



Source: data-to-viz.com

Group Exercise

Have a look at the “Chart of Charts” poster

☛ Fill one dot for each chart type you have used already to communicate your data

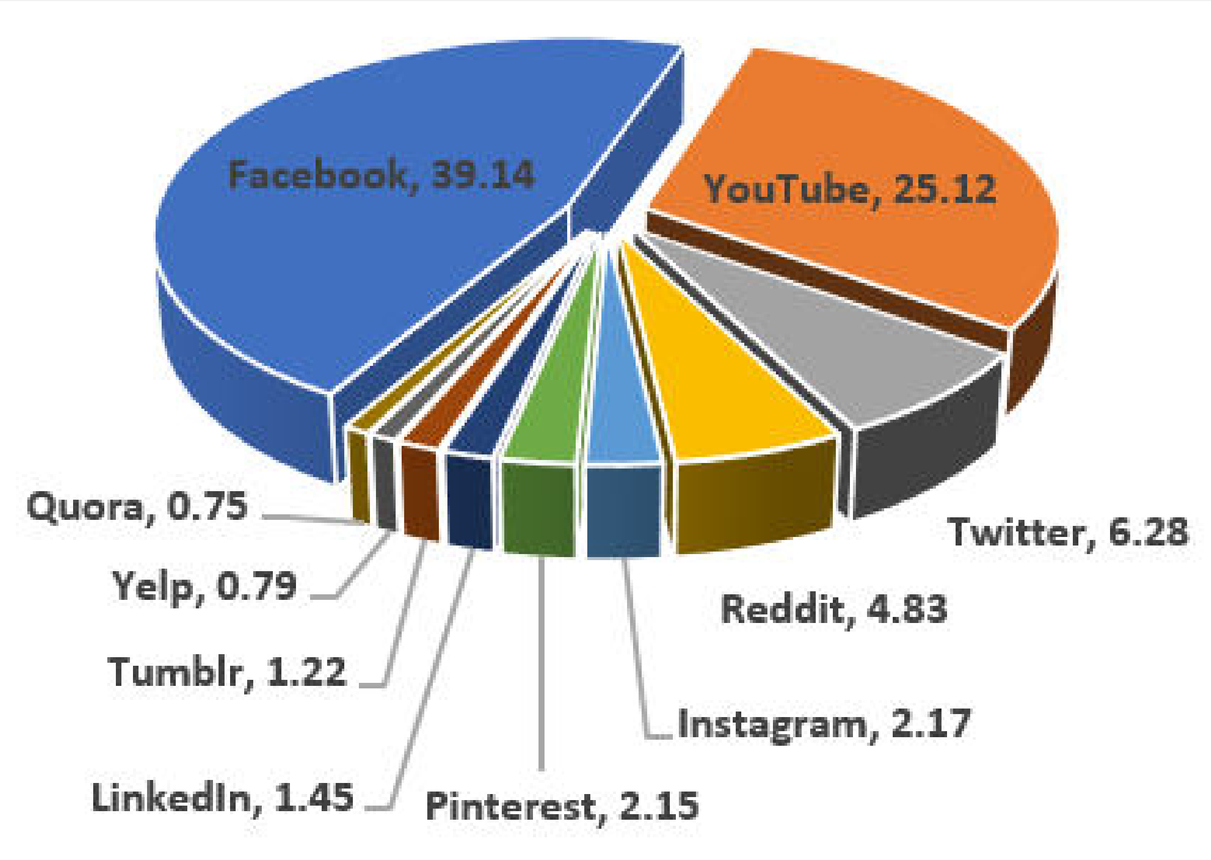
Have a look at the “Chart Choice Helpers”

☛ Explore and discuss potential chart types for future data visualizations

☛ Look up the chart types on the poster you didn’t know

☛ Are there chart types you find hard to read / understand?

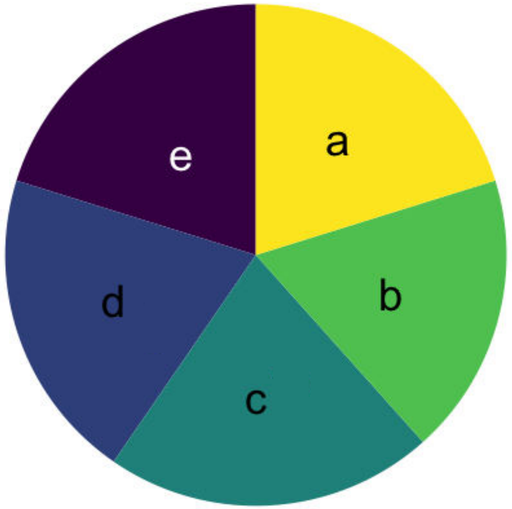
Group Exercise



Discuss this graphic

- ☛ What is the main message?
- ☛ Does the chart type work?
- ☛ Is there a better chart type?
- ☛ **Draw an alternative version using a chart type that is more suitable!**


e
a
b
d
c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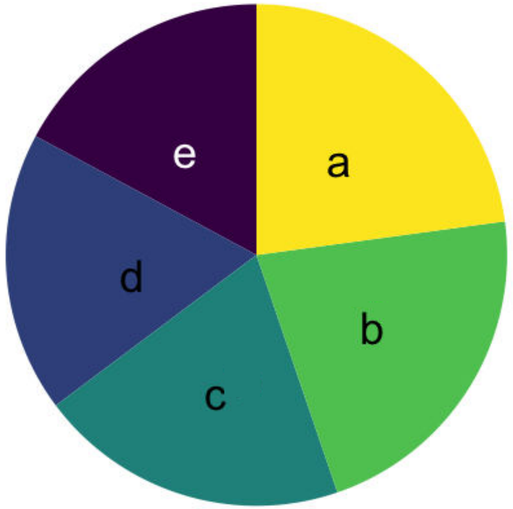
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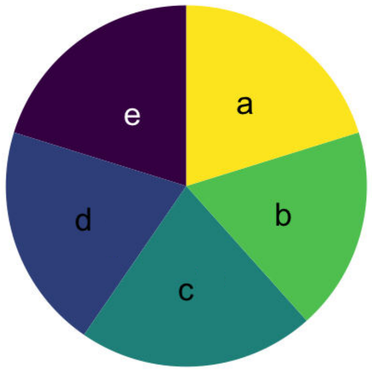
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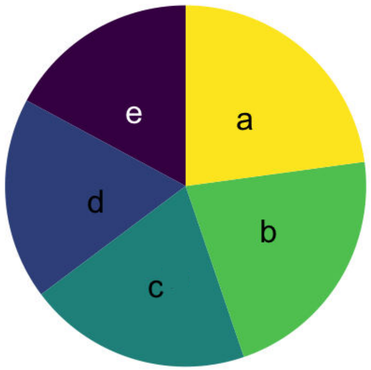
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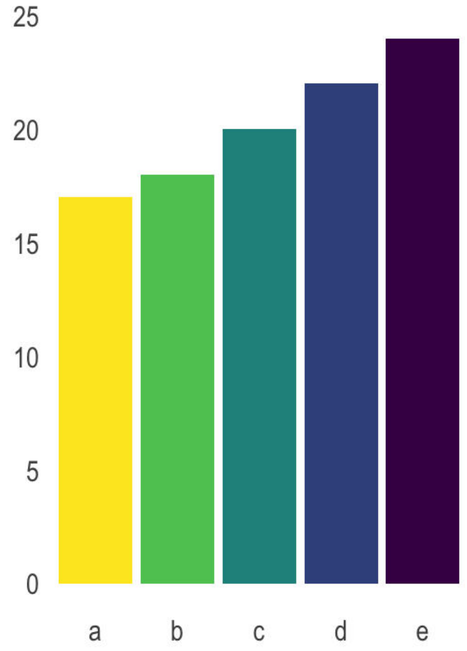
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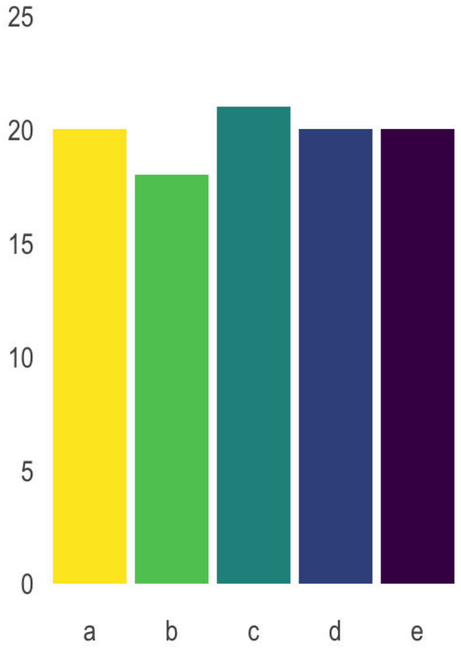
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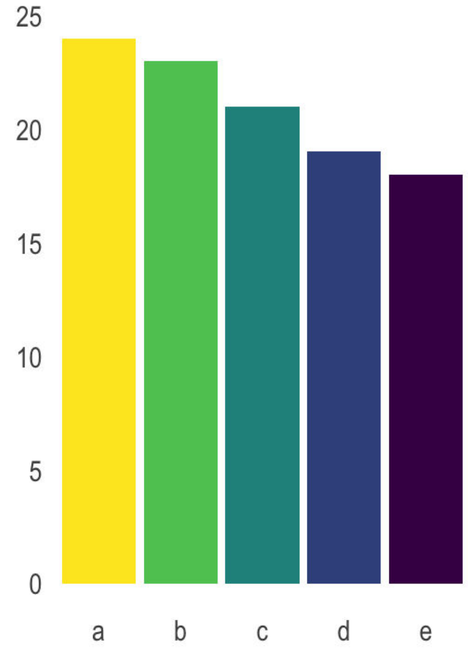
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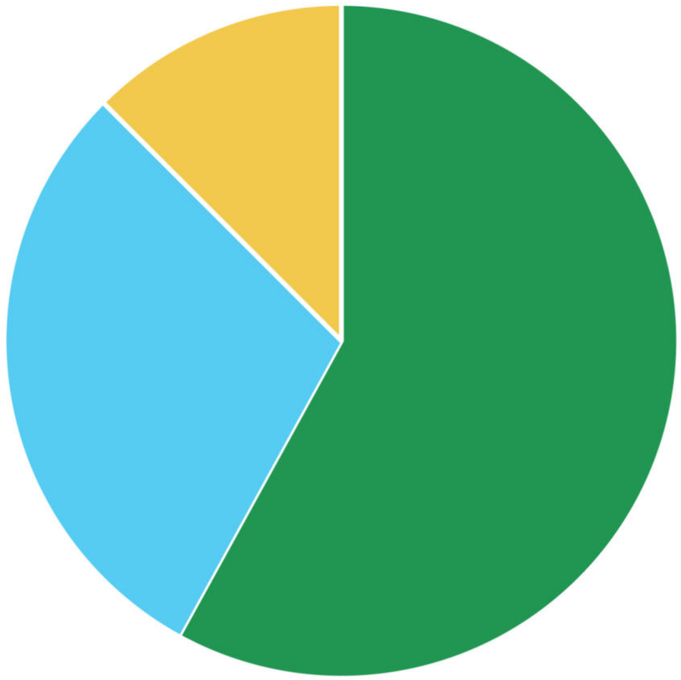
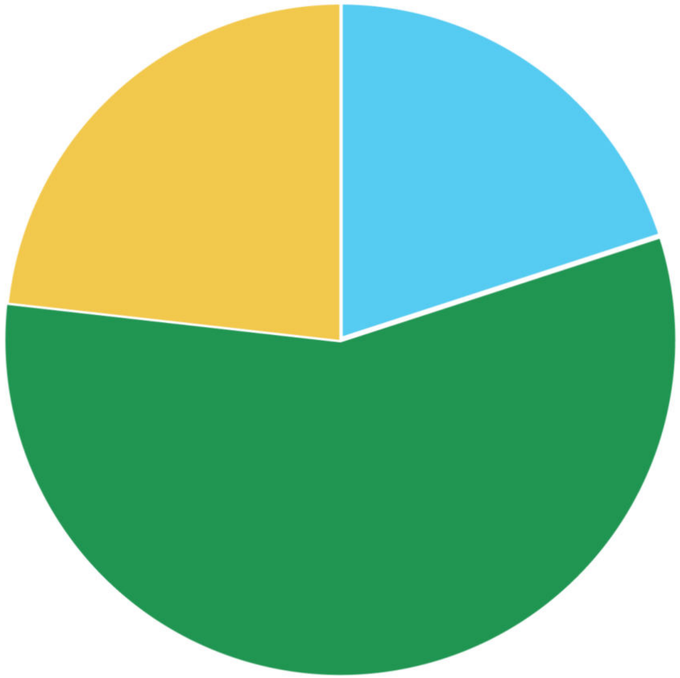
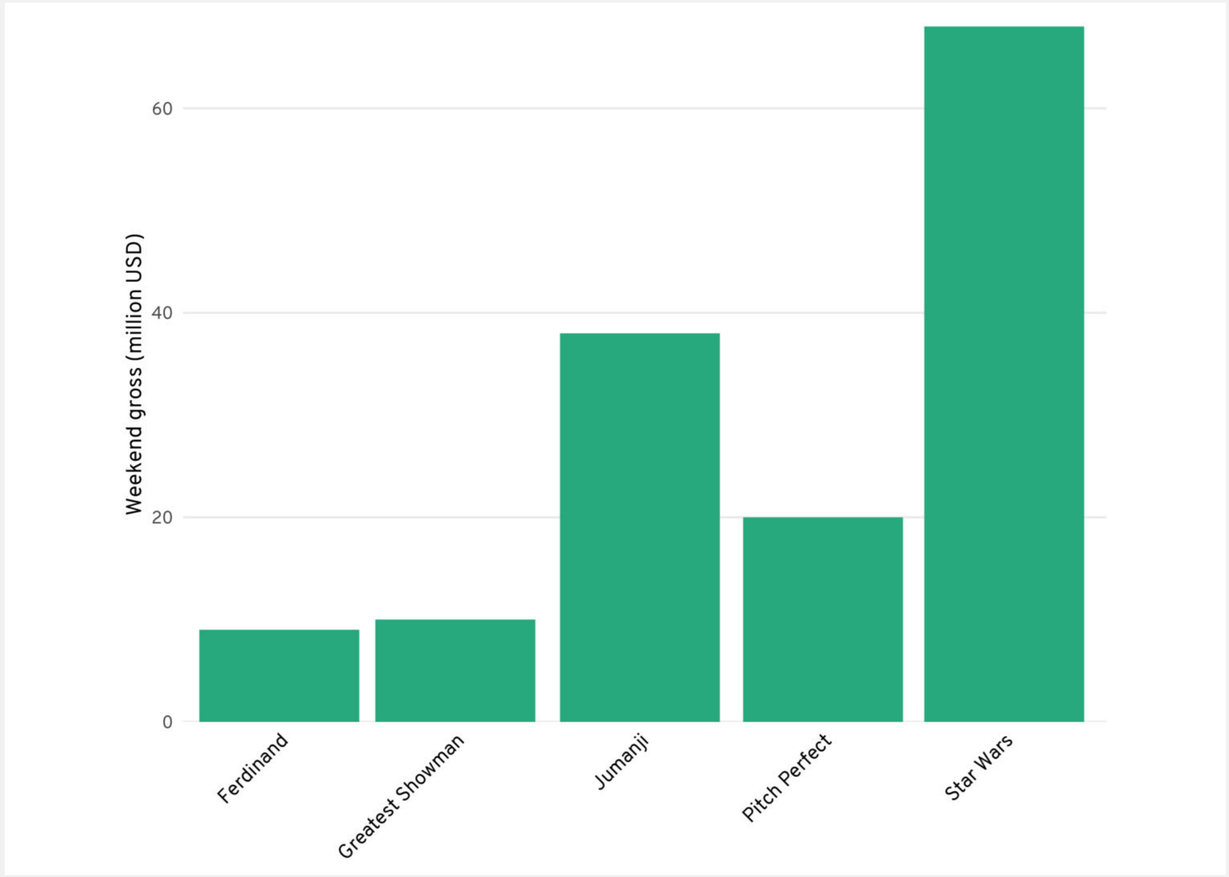
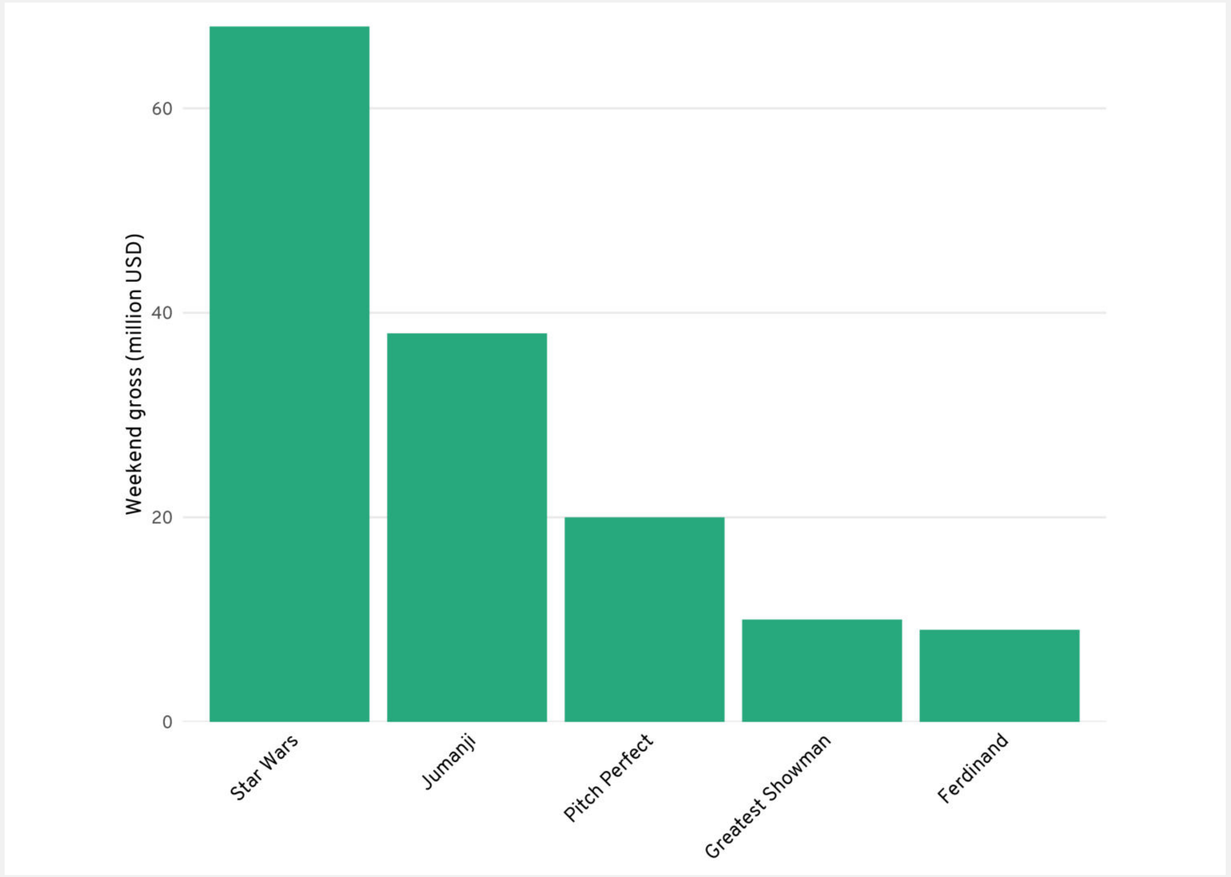


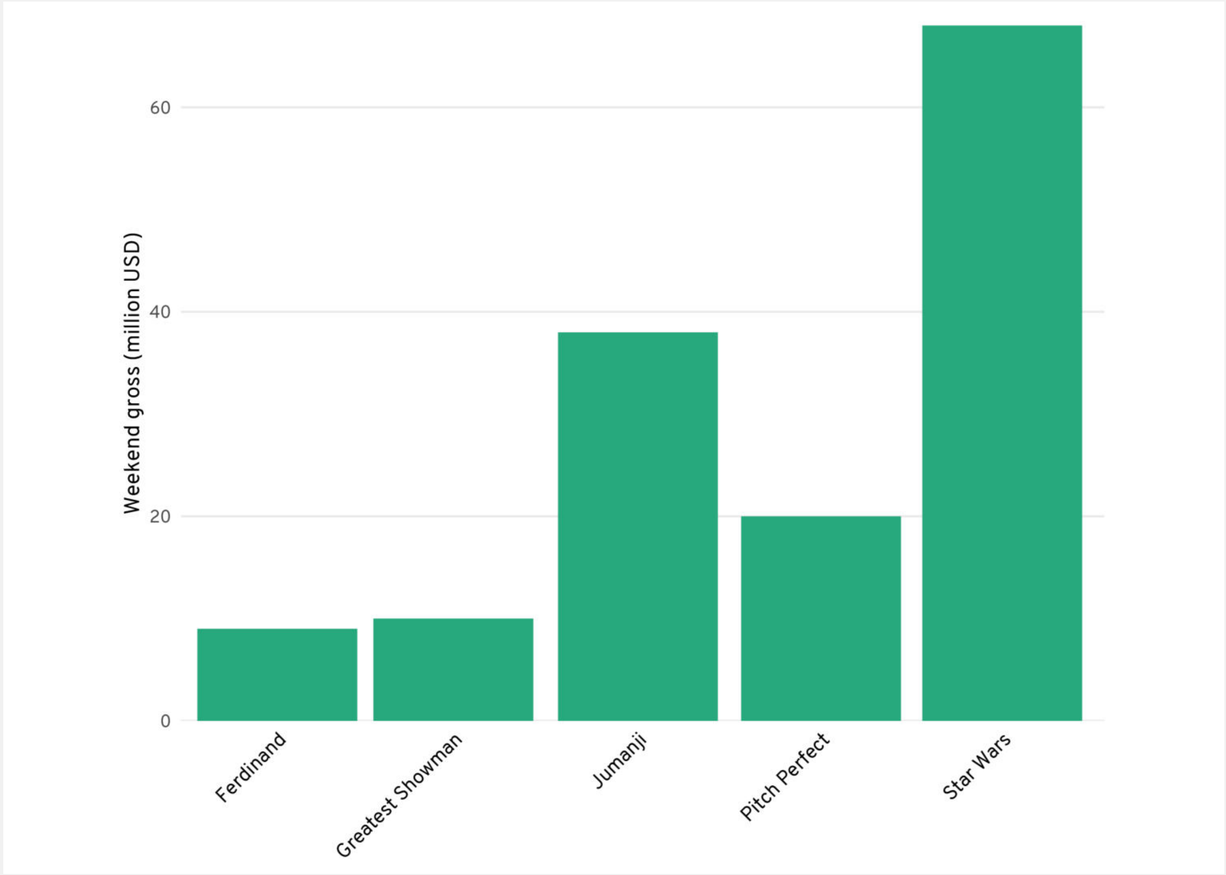


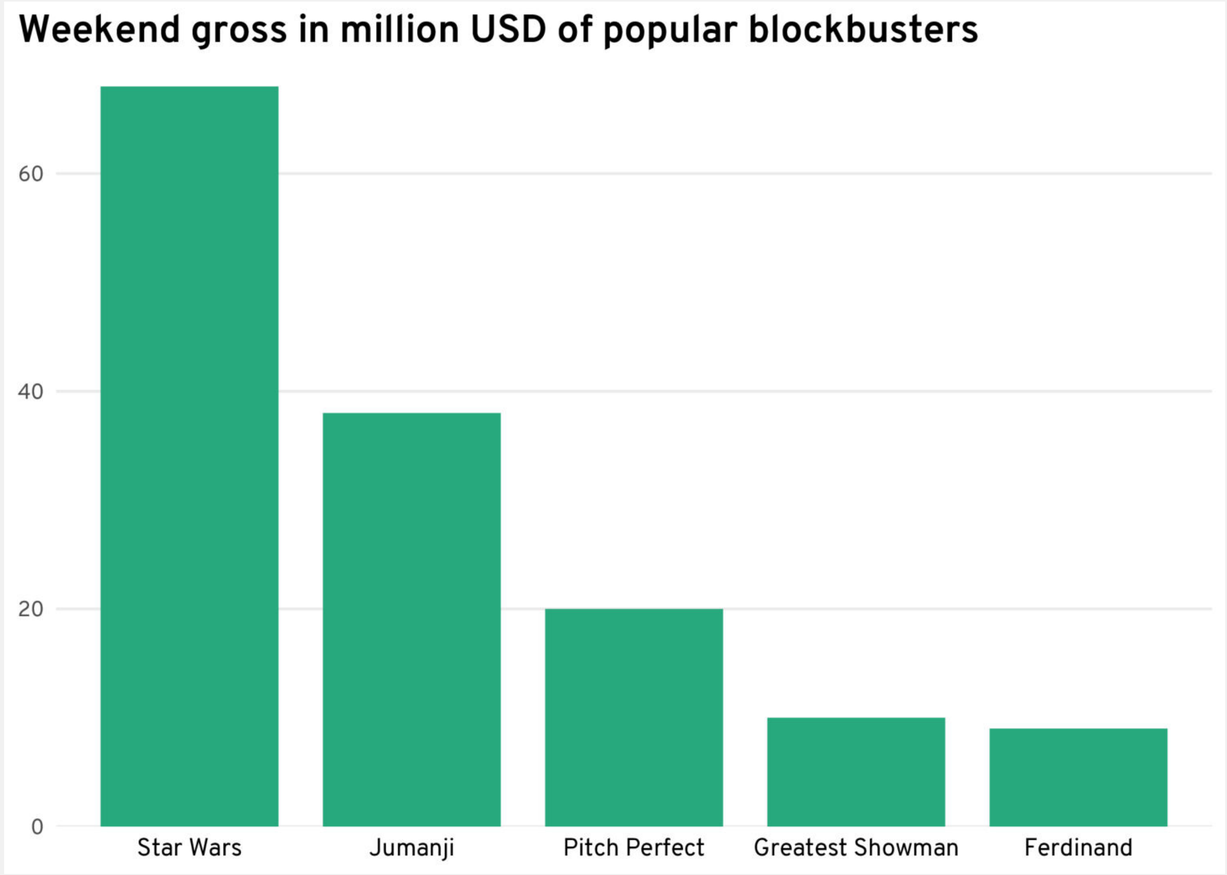
Sort Your Data



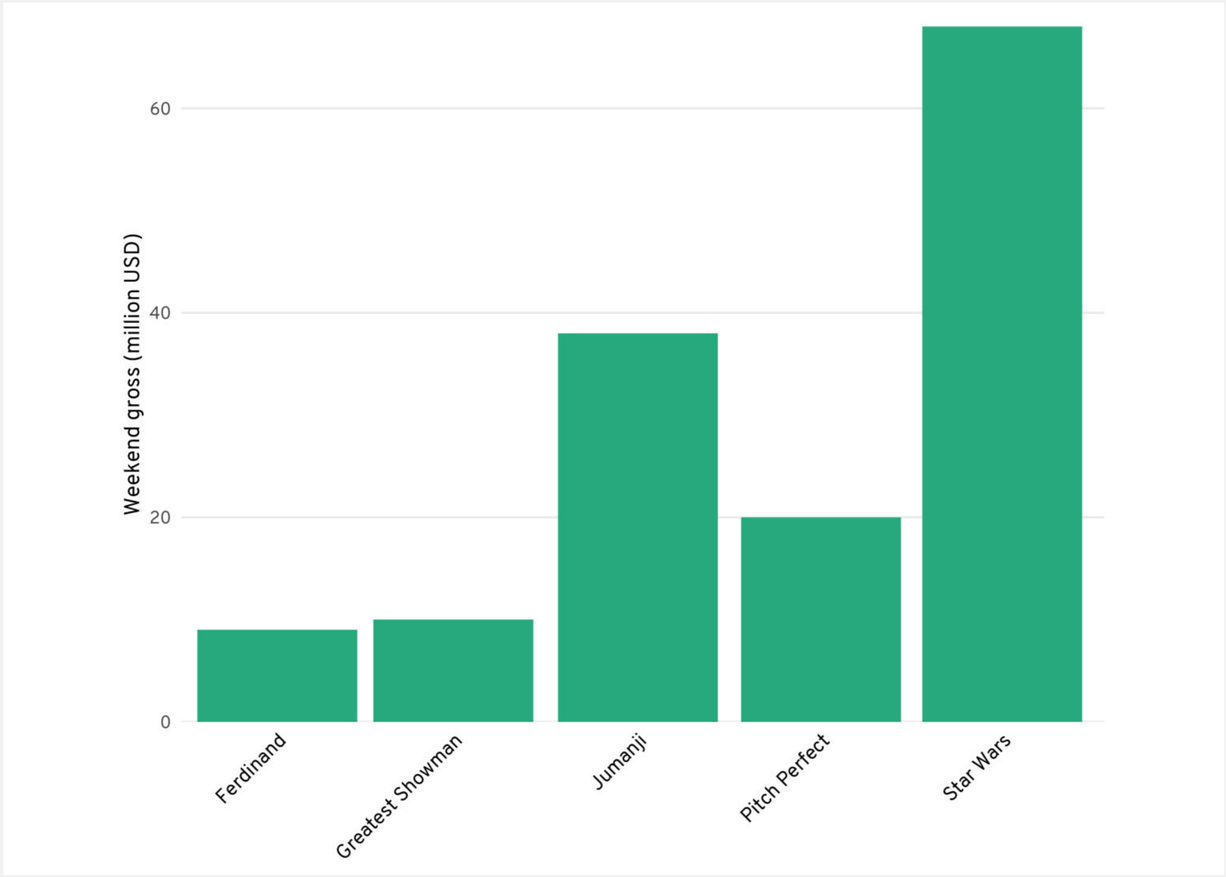


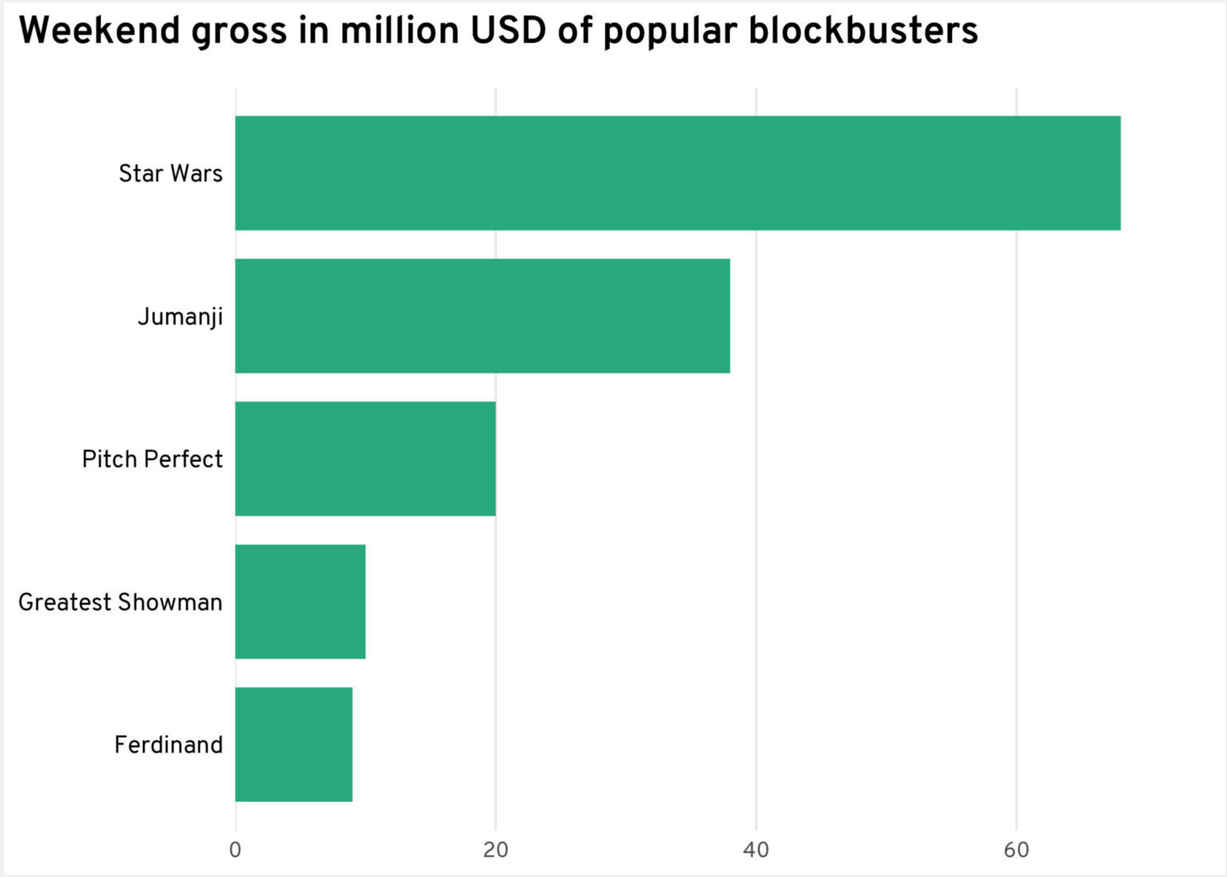
Avoid Rotated Text



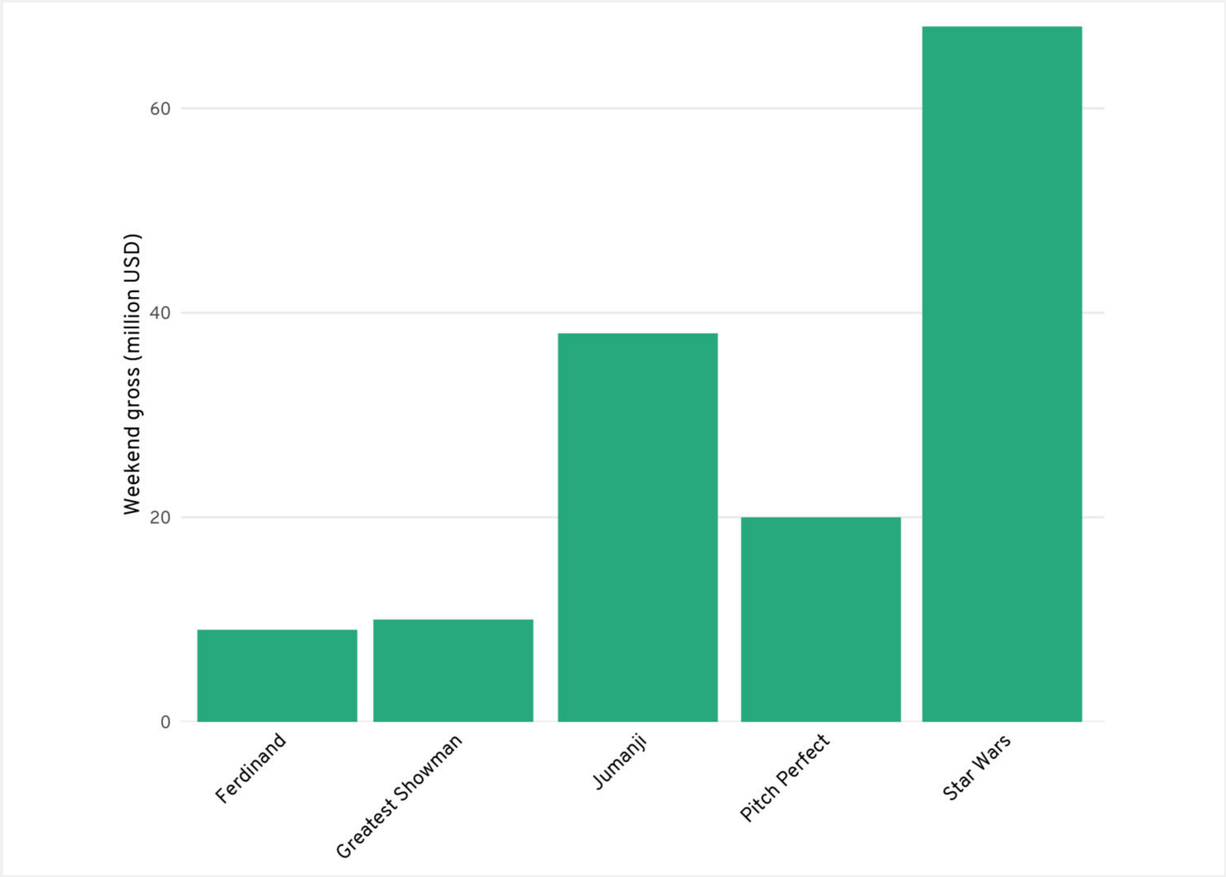


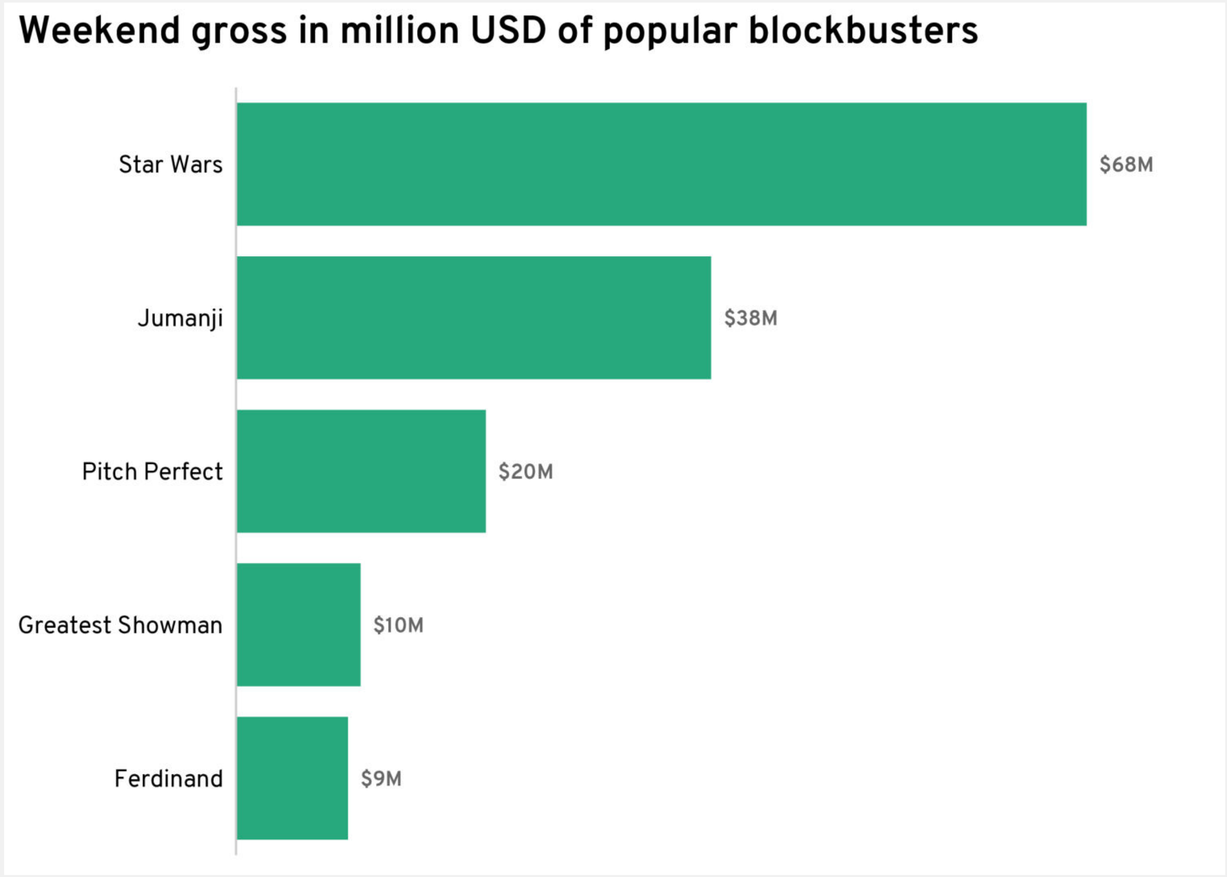
Avoid Rotated Text



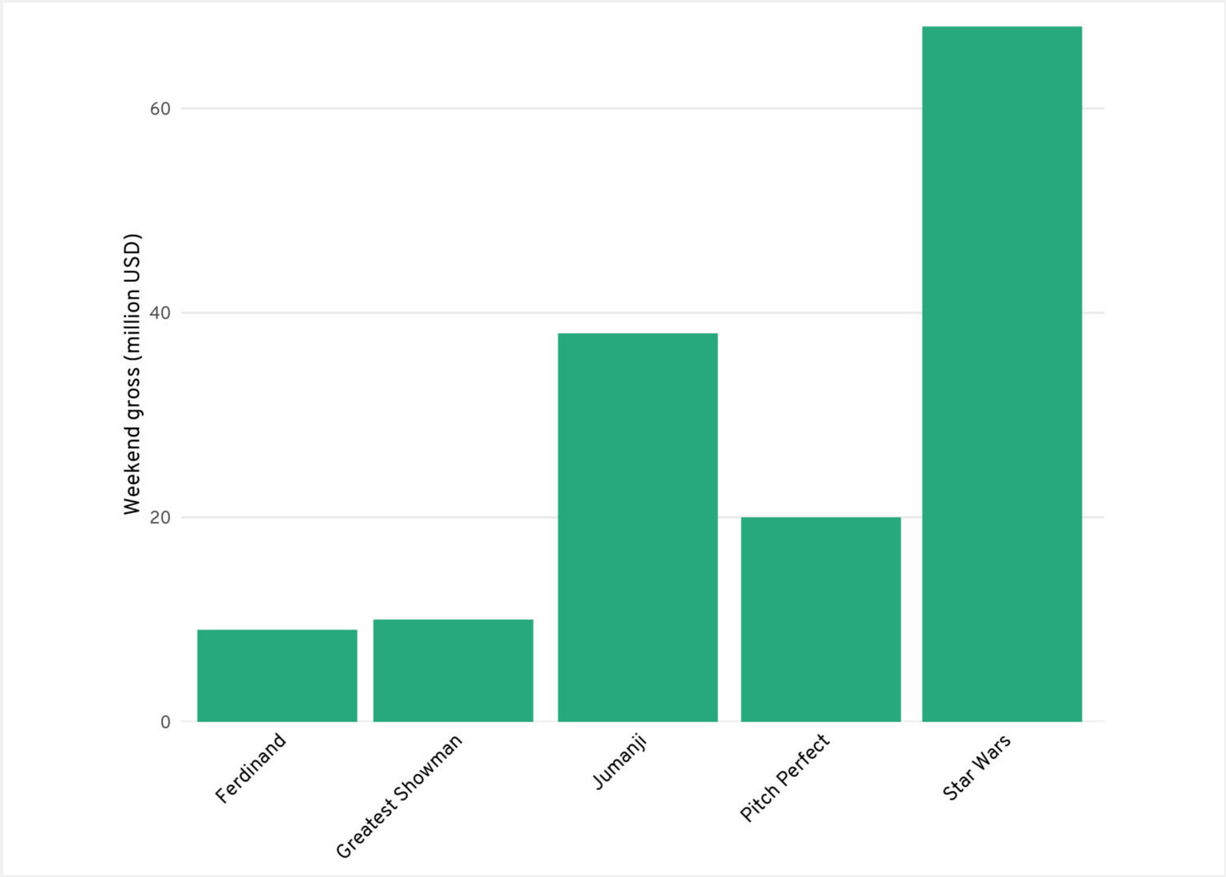


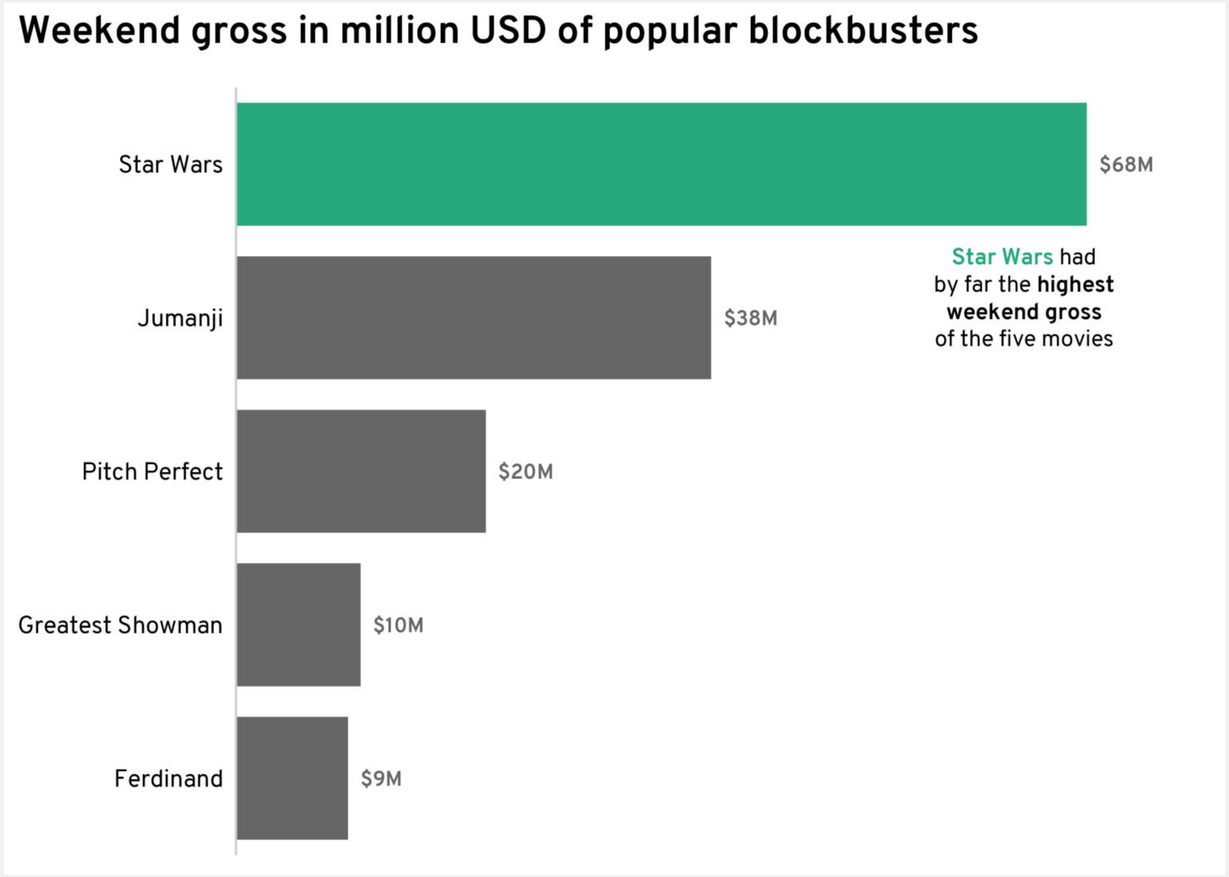
Add Direct Labels



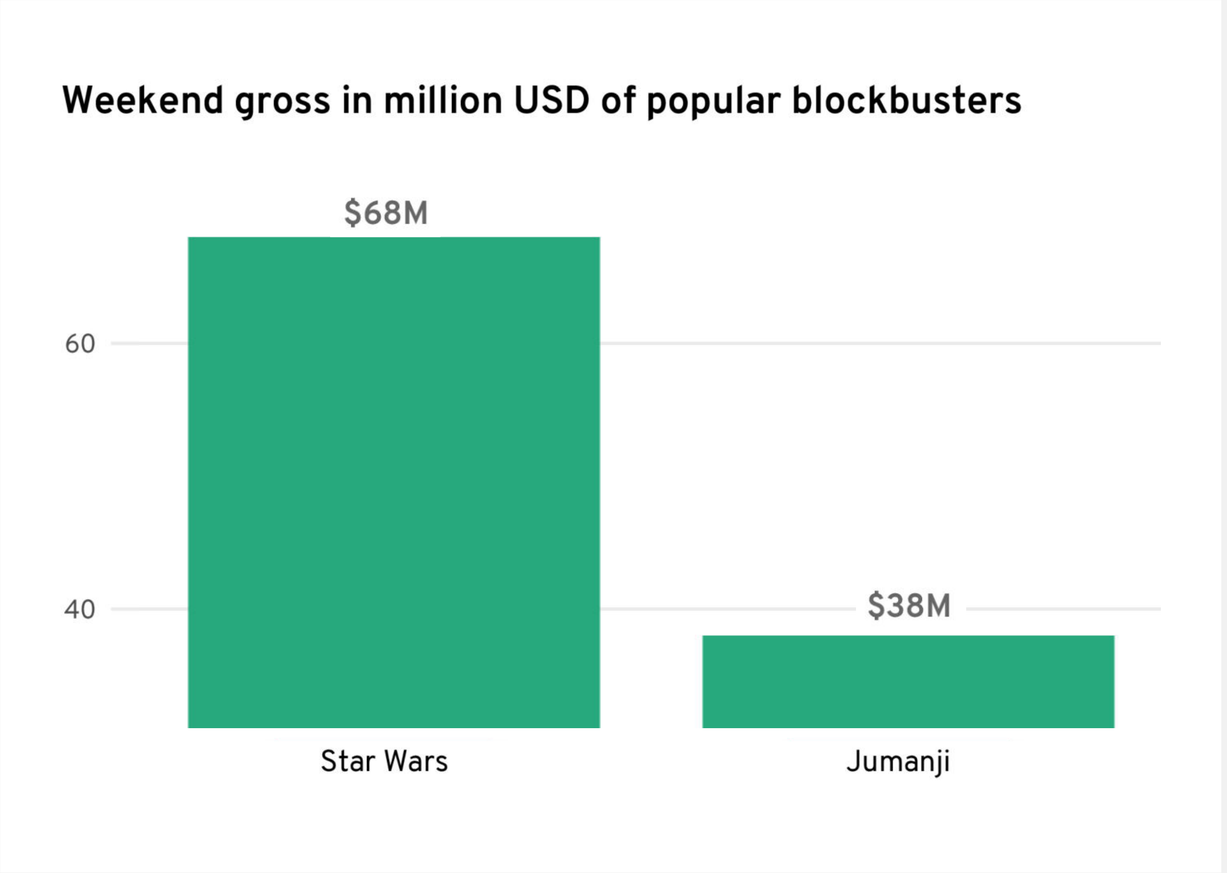


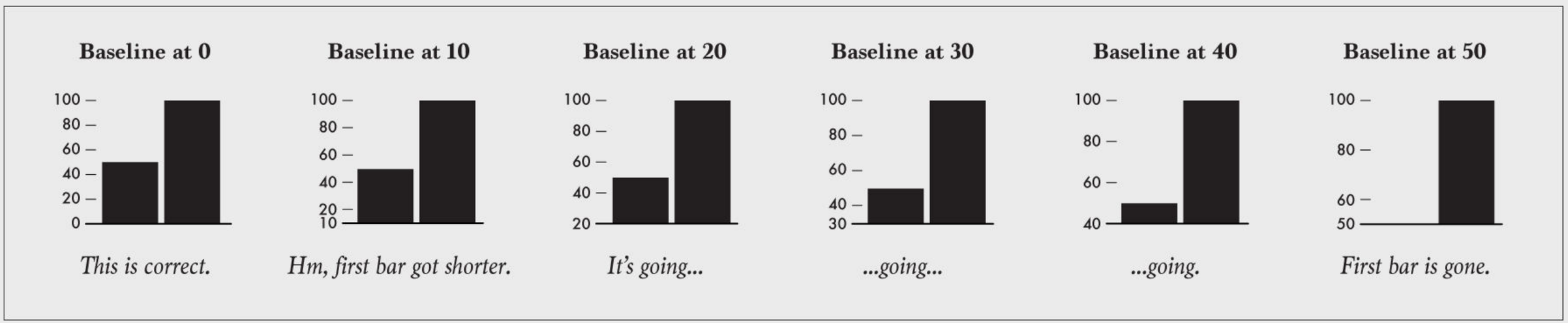
Set Highlights



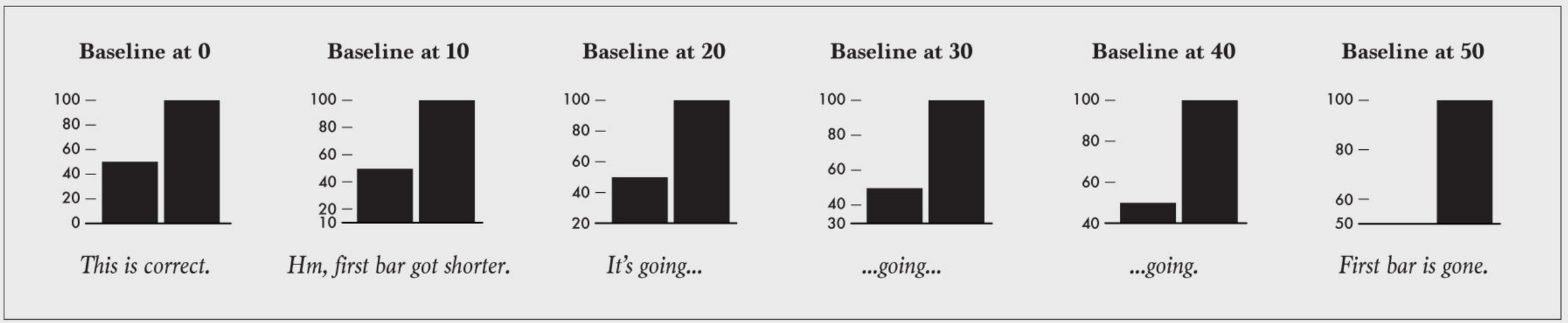


Always Stat at Zero

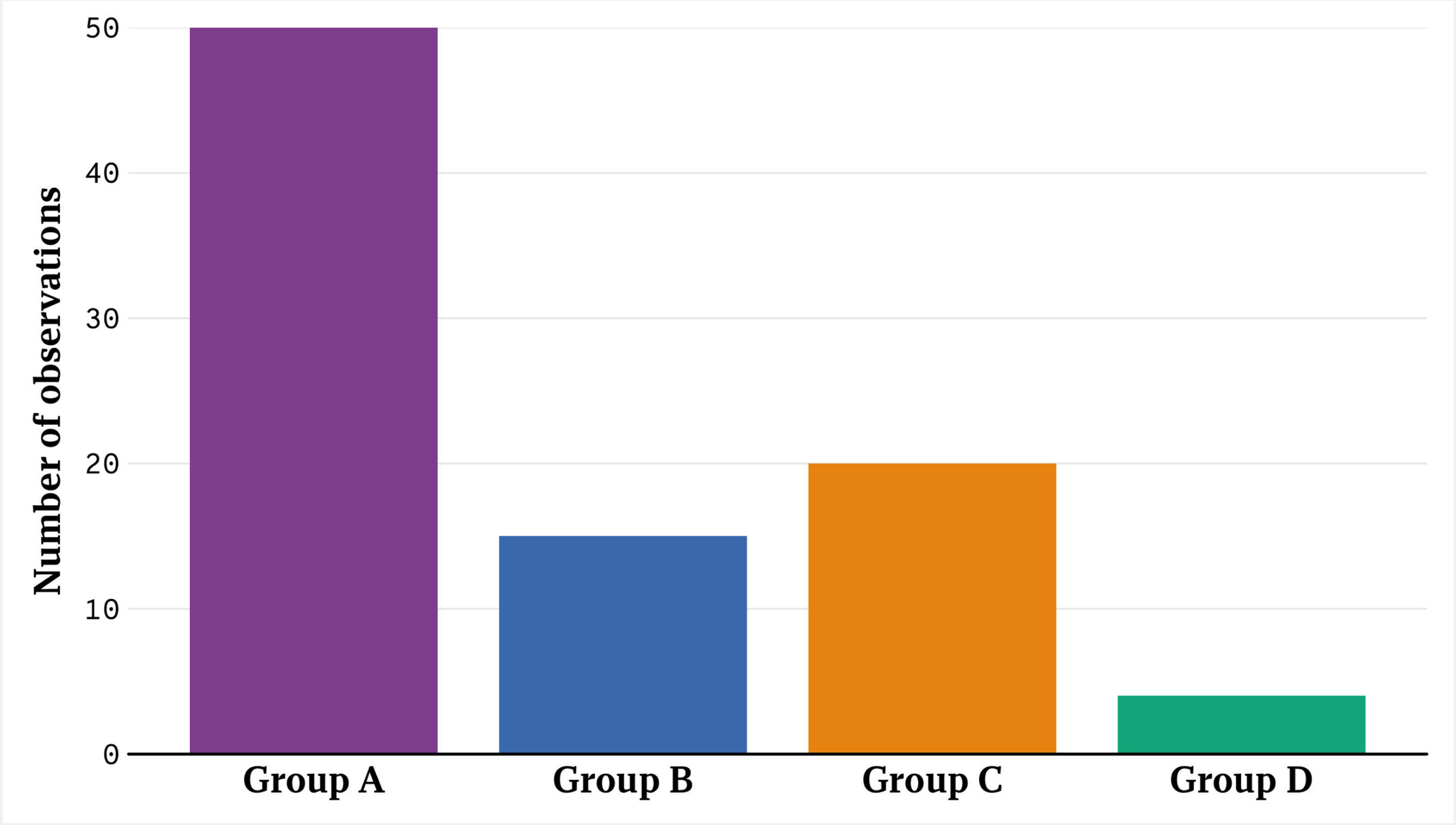




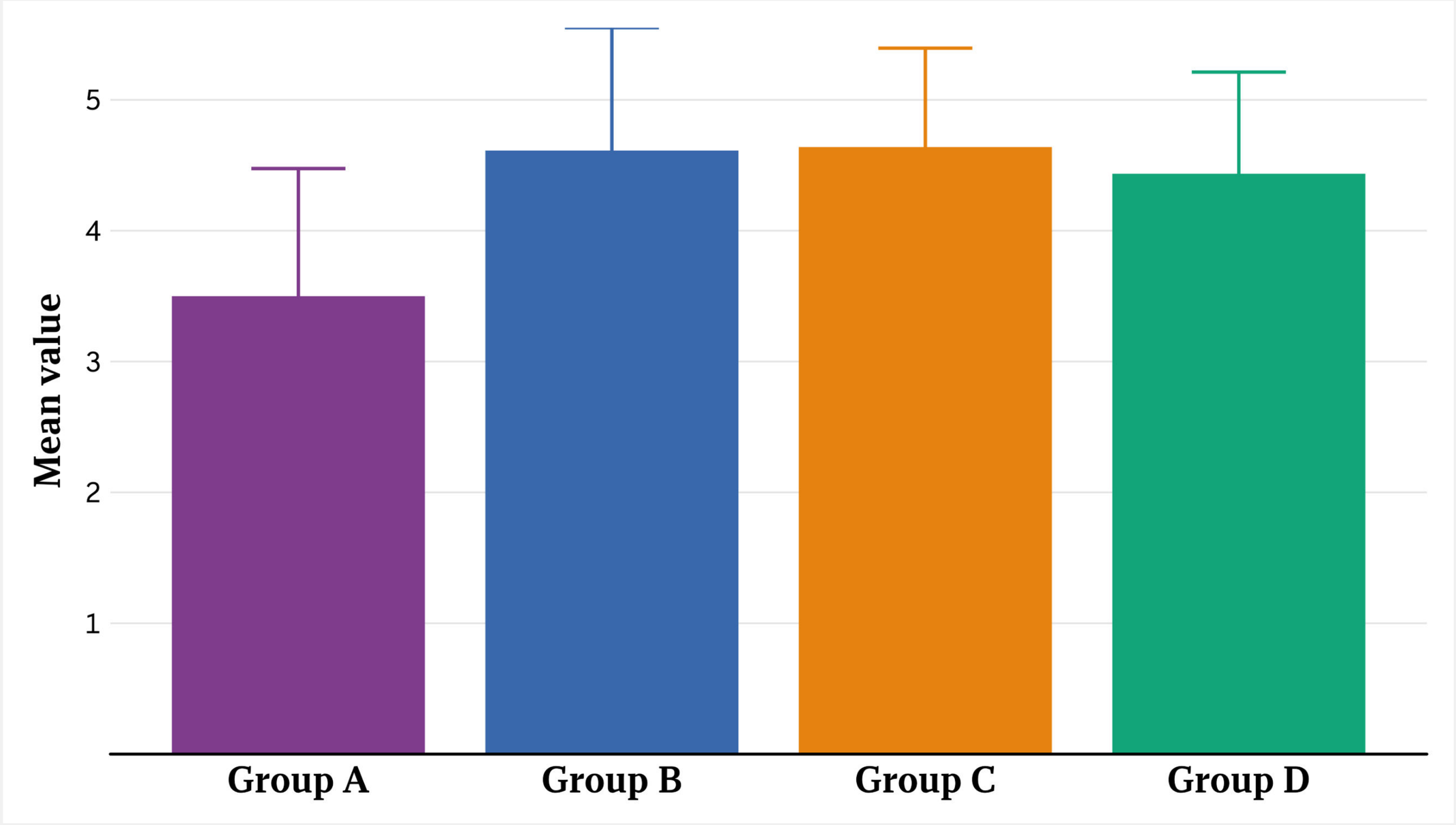
Source: Nathan Yau (flowingdata.com)



Source: Nathan Yau (flowingdata.com)



*My webinar "**Beyond Bar and Box Plots**" for USGS Data Science [Slides | Recording]*



*My webinar **"Beyond Bar and Box Plots"** for USGS Data Science [Slides | Recording]*

PLOS | BIOLOGY

PERSPECTIVE

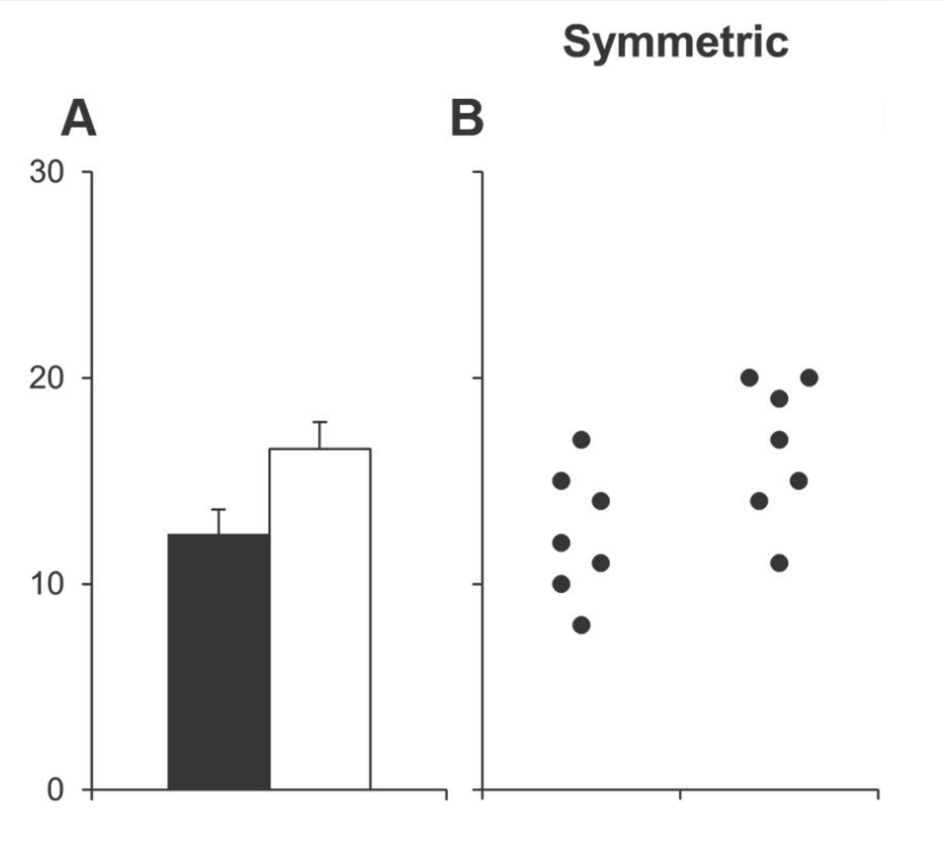
Beyond Bar and Line Graphs: Time for a New Data Presentation Paradigm

Tracey L. Weissgerber[1]*, Natasa M. Milic[1,2], Stacey J. Winham[3], Vesna D. Garovic[1]

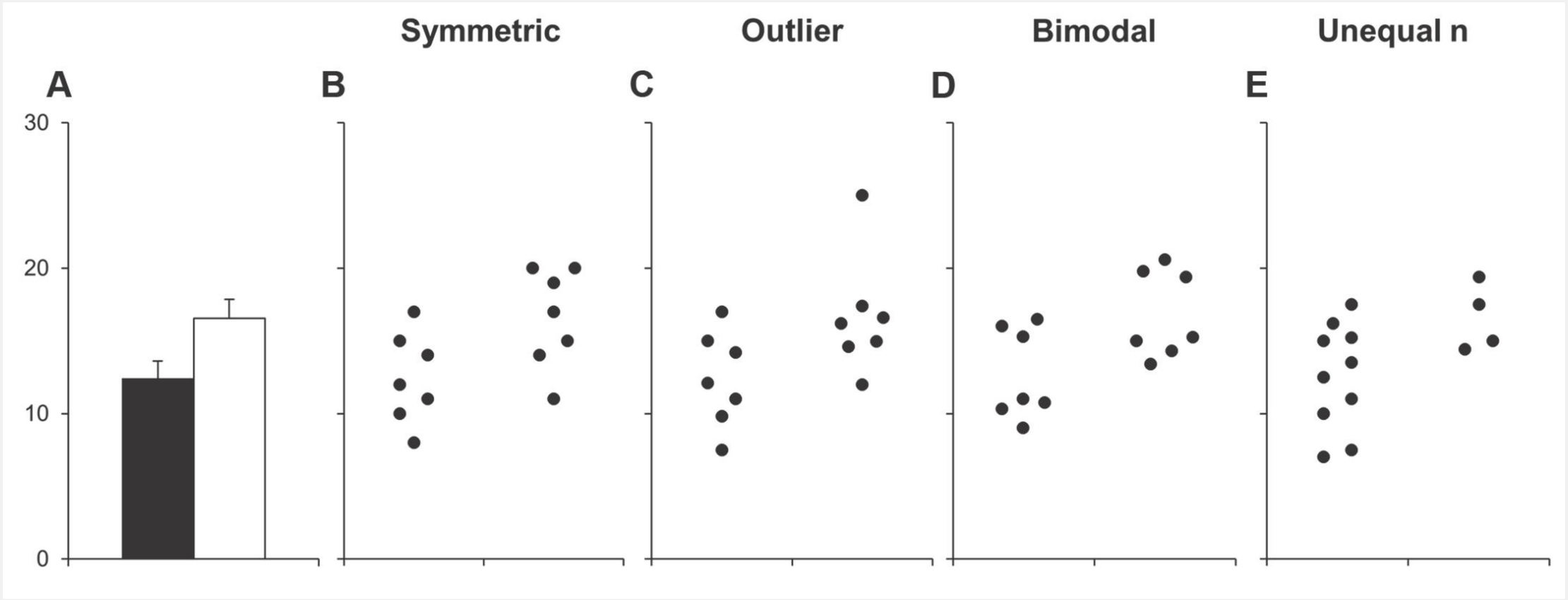
1 Division of Nephrology & Hypertension, Mayo Clinic, Rochester, Minnesota, United States of America, **2** Department of Biostatistics, Medical Faculty, University of Belgrade, Belgrade, Serbia, **3** Division of Biomedical Statistic and Informatics, Mayo Clinic, Rochester, Minnesota, United States of America

* weissgerber.tracey@mayo.edu

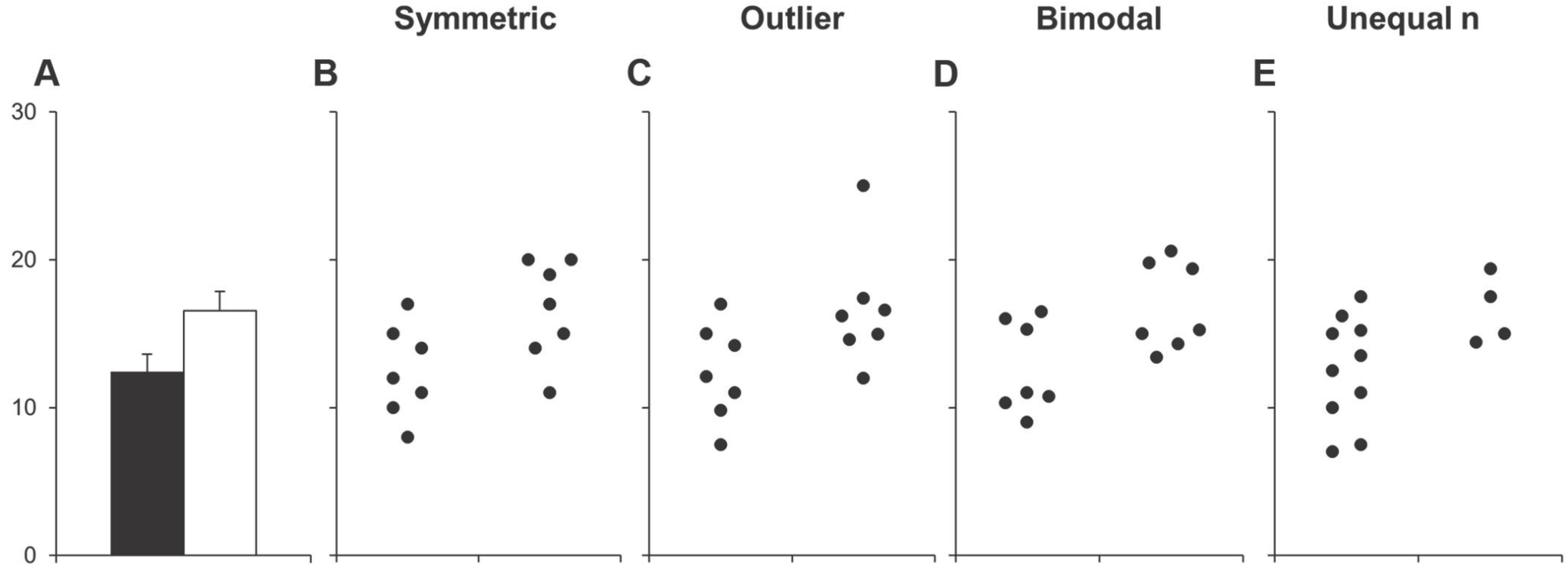
Weissgerber et al. (2015) PLoS Biology



Weissgerber et al. (2015) PLoS Biology

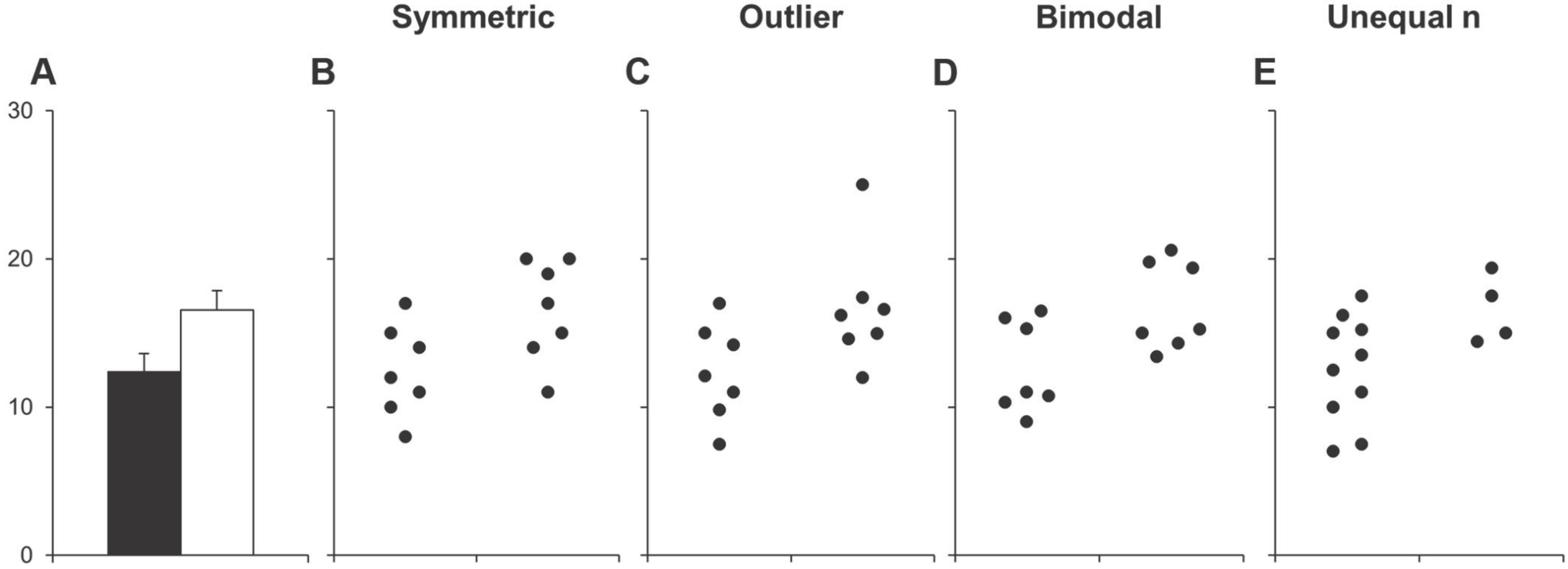


Weissgerber et al. (2015) PLoS Biology



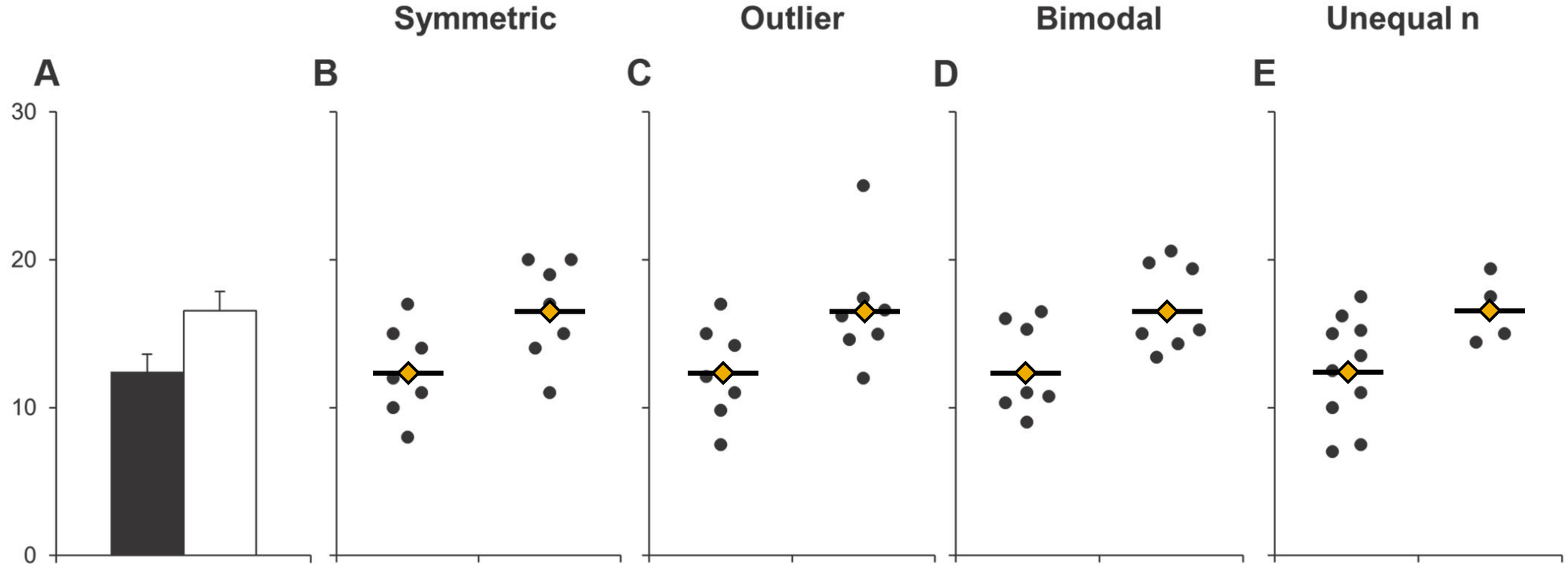
Test	p value			
T-test: Equal var.	0.035 🟢	0.050 🟢	0.026 🟢	0.063 🟡
T-test: Unequal var.	0.035 🟢	0.050 🟢	0.026 🟢	0.035 🟢
Wilcoxon	0.054 🟡	0.073 🟡	0.128 🟡	0.103 🟡

Modified from Weissgerber et al. (2015) PLoS Biology



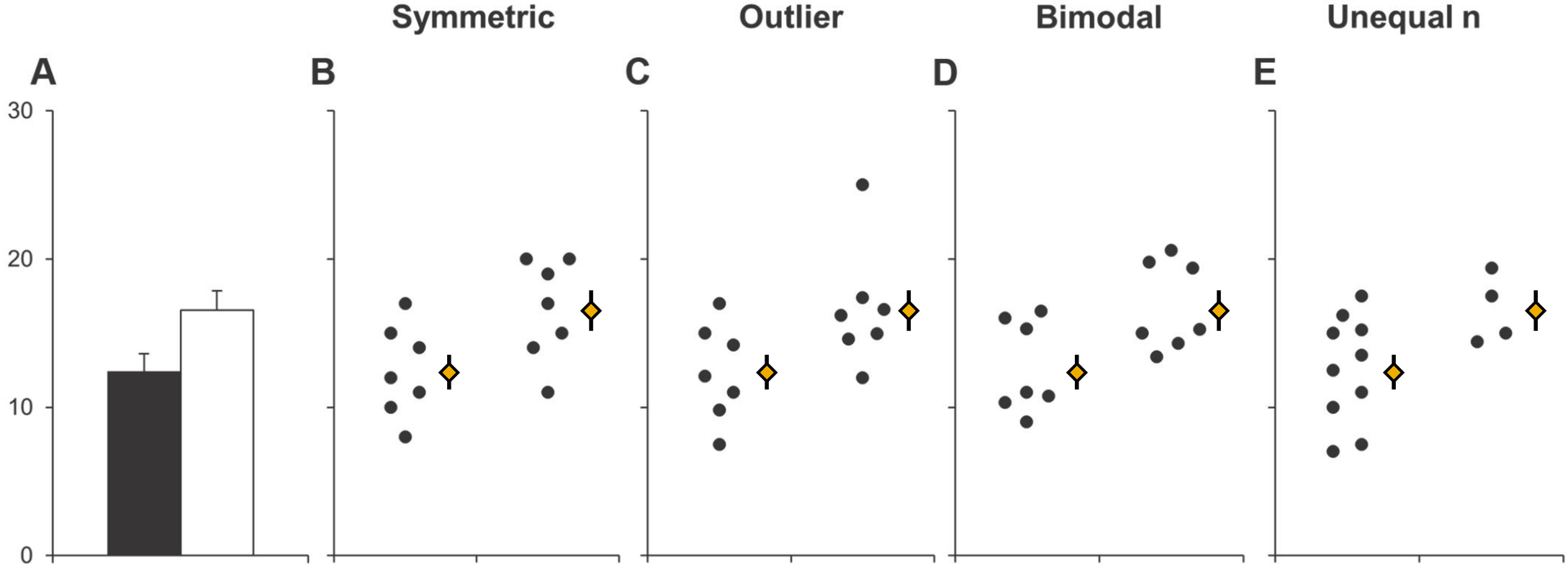
Test	p value			
T-test: Equal var.	0.035	0.050	0.026	0.063
T-test: Unequal var.	0.035	0.050	0.026	0.035
Wilcoxon	0.054	0.073	0.128	0.103

Modified from Weissgerber et al. (2015) PLoS Biology



Test	p value			
T-test: Equal var.	0.035	0.050	0.026	0.063
T-test: Unequal var.	0.035	0.050	0.026	0.035
Wilcoxon	0.054	0.073	0.128	0.103

Modified from Weissgerber et al. (2015) PLoS Biology



Test	p value			
T-test: Equal var.	0.035	0.050	0.026	0.063
T-test: Unequal var.	0.035	0.050	0.026	0.035
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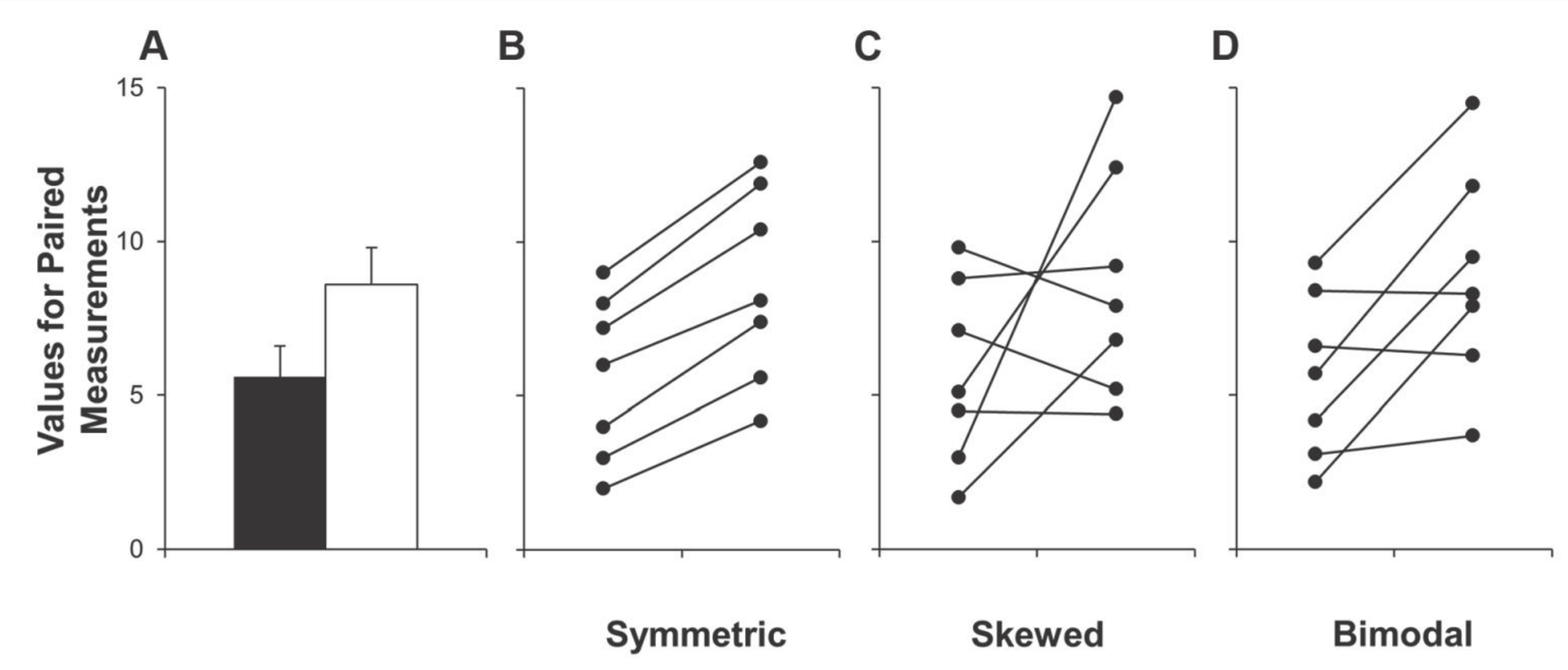
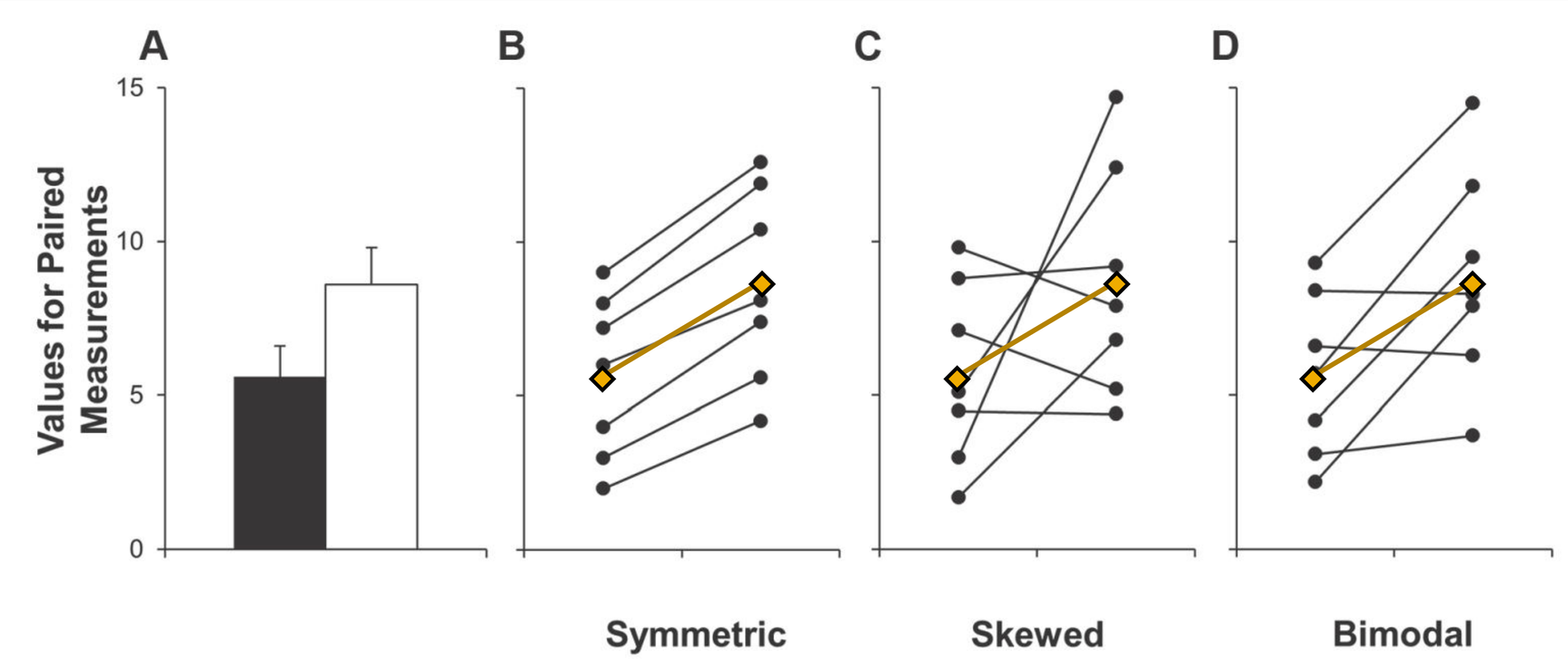
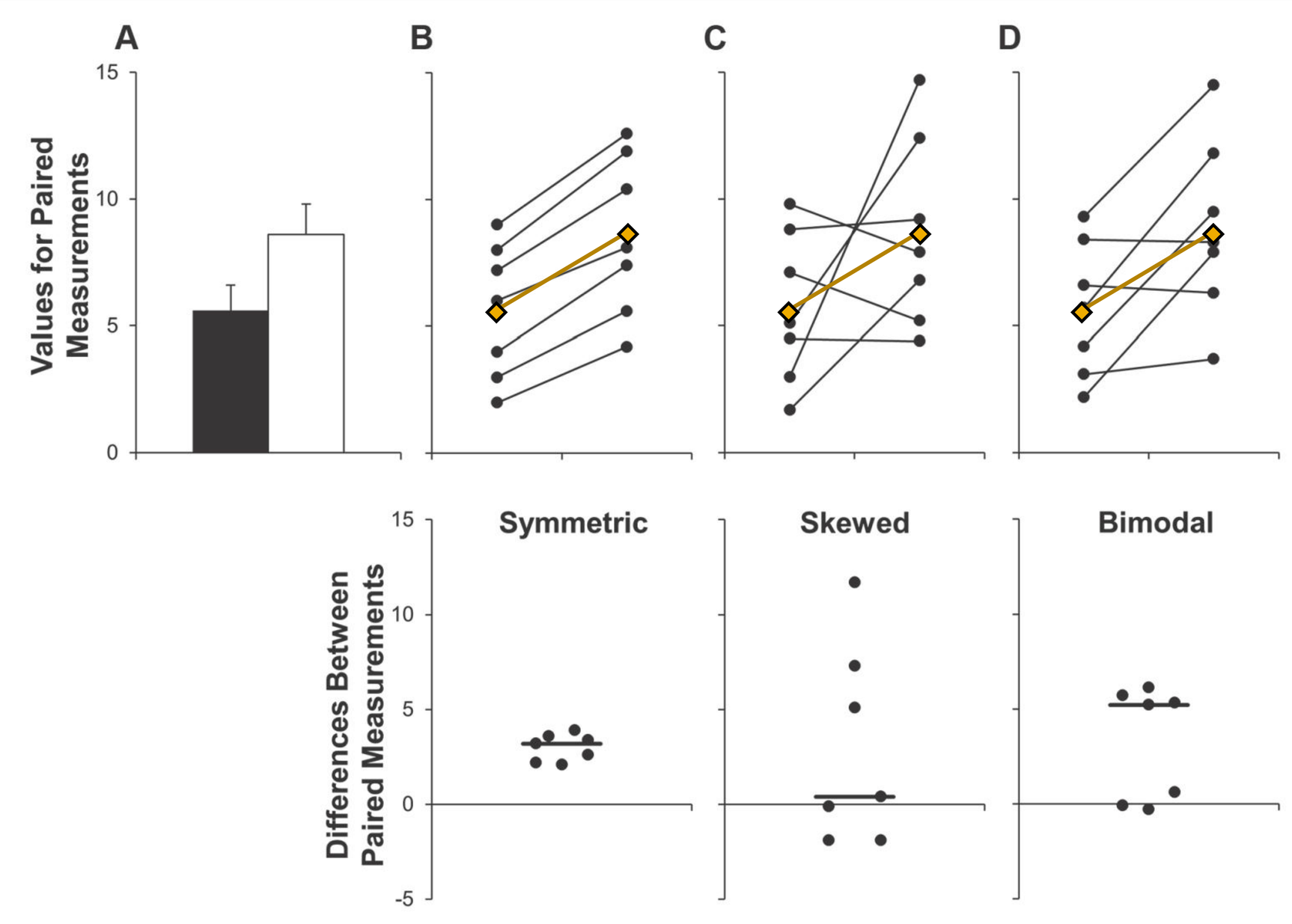
Modified from Weissgerber et al. (2015) PLoS Biology



Weissgerber et al. (2015) PLoS Biology



Modified from Weissgerber et al. (2015) PLoS Biology

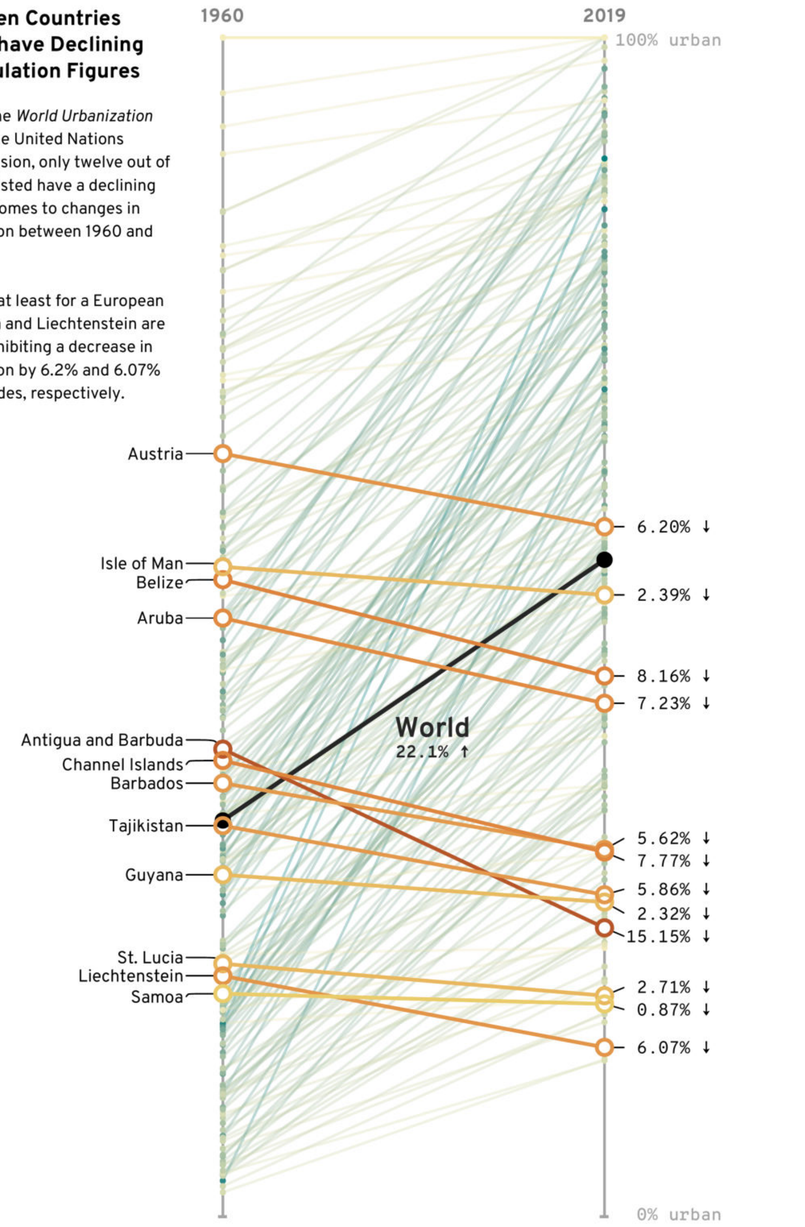


Modified from Weissgerber et al. (2015) PLoS Biology

Only a Dozen Countries Worldwide have Declining Urban Population Figures

According to the *World Urbanization Prospects* by the United Nations Population Division, only twelve out of 218 countries listed have a declining trend when it comes to changes in urban population between 1960 and 2019.

Surprinsingly—at least for a European citizen—Austria and Liechtenstein are amog these exhibiting a decrease in urban population by 6.2% and 6.07% within six decades, respectively.

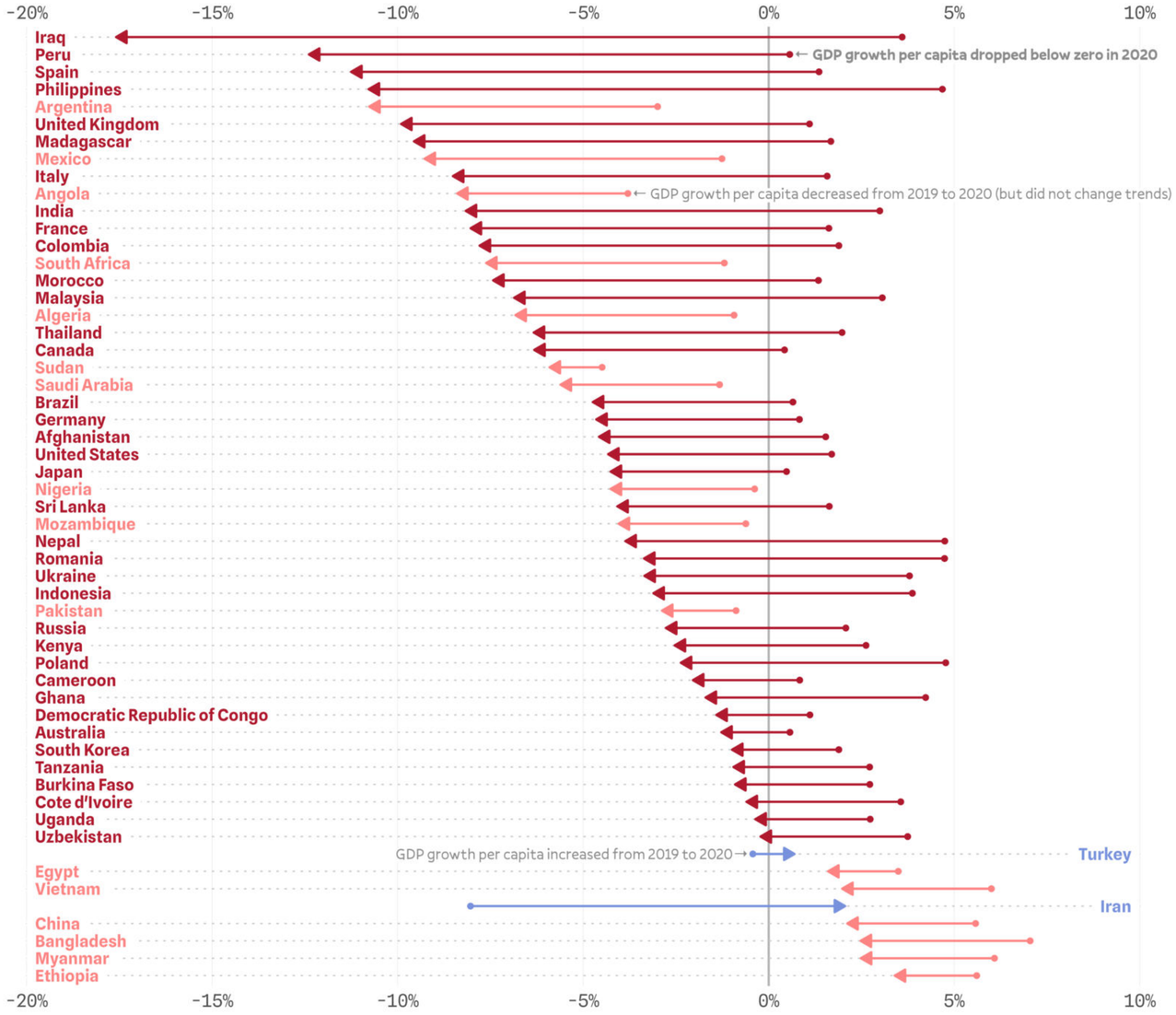


Visualization by Cédric Scherer | Data: United Nations Population Division. World Urbanization Prospects: 2018 Revision. | #30DayChartChallenge 2021 Day 5: Slope

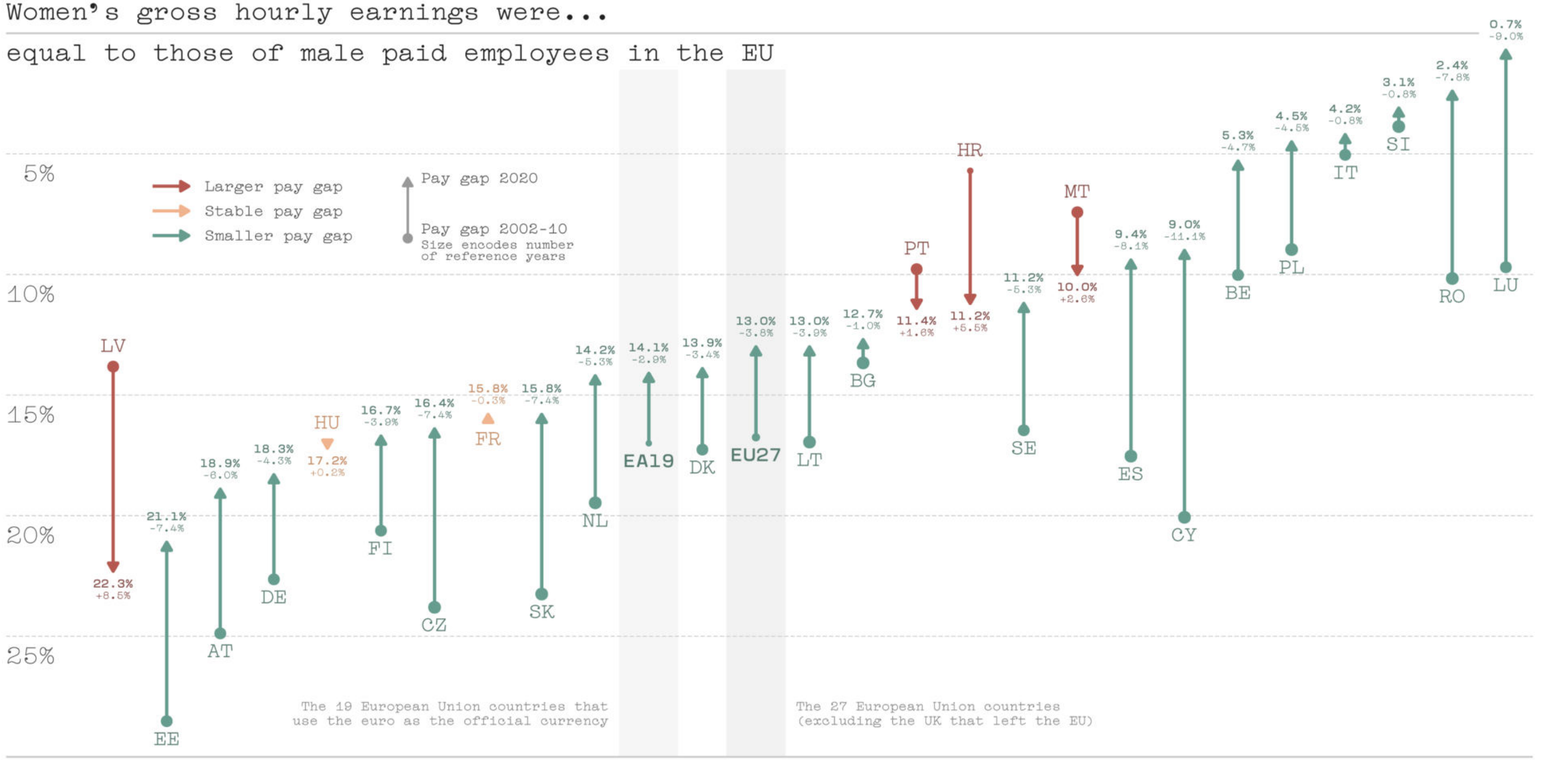
Average income has decreased in 185 countries from 2019 to 2020, with GDP per capita growth turning negative in 72% of these cases.

Graphic: Cédric Scherer • Data: World Bank and OECD via OurWorldInData

Average income has decreased in almost all countries from 2019 to 2020, with GDP per capita growth turning from positive to negative in most cases.



Graphic: Cédric Scherer • Data: World Bank and OECD via OurWorldInData • The graphic contains countries that inhabit more than 20M people.



In 2020, women's gross hourly earnings were on average 13% below those of men in the EU.

Many countries were able to **decrease the pay gap** between male and female employees: most notably **Luxembourg** with the smallest gap in 2020 of 0.7% and **Romania** with a decrease of 13.6% within 18 years to 2.4%, ranking second. However, in several countries the pay gap was almost **stable (Hungary and France)** or even **increased (Latvia, Portugal, Croatia, and Malta)** compared to the gap in the reference period from 2002 to 2010 for all years available via Eurostat.

As an unadjusted indicator, the gender pay gap gives an overall picture of the differences between men and women in terms of earnings and measures – a concept which is broader than discrimination in the sense of: *equal pay for work of equal value.*

Graphic: Cédric Scherer • Data: Eurostat (SDG_05_20; no data for Greece and Ireland) • #InternationalWomensDay2022

"The Pay Gap in Europe", persönliches Projekt zum Internationalen Frauentag 2022

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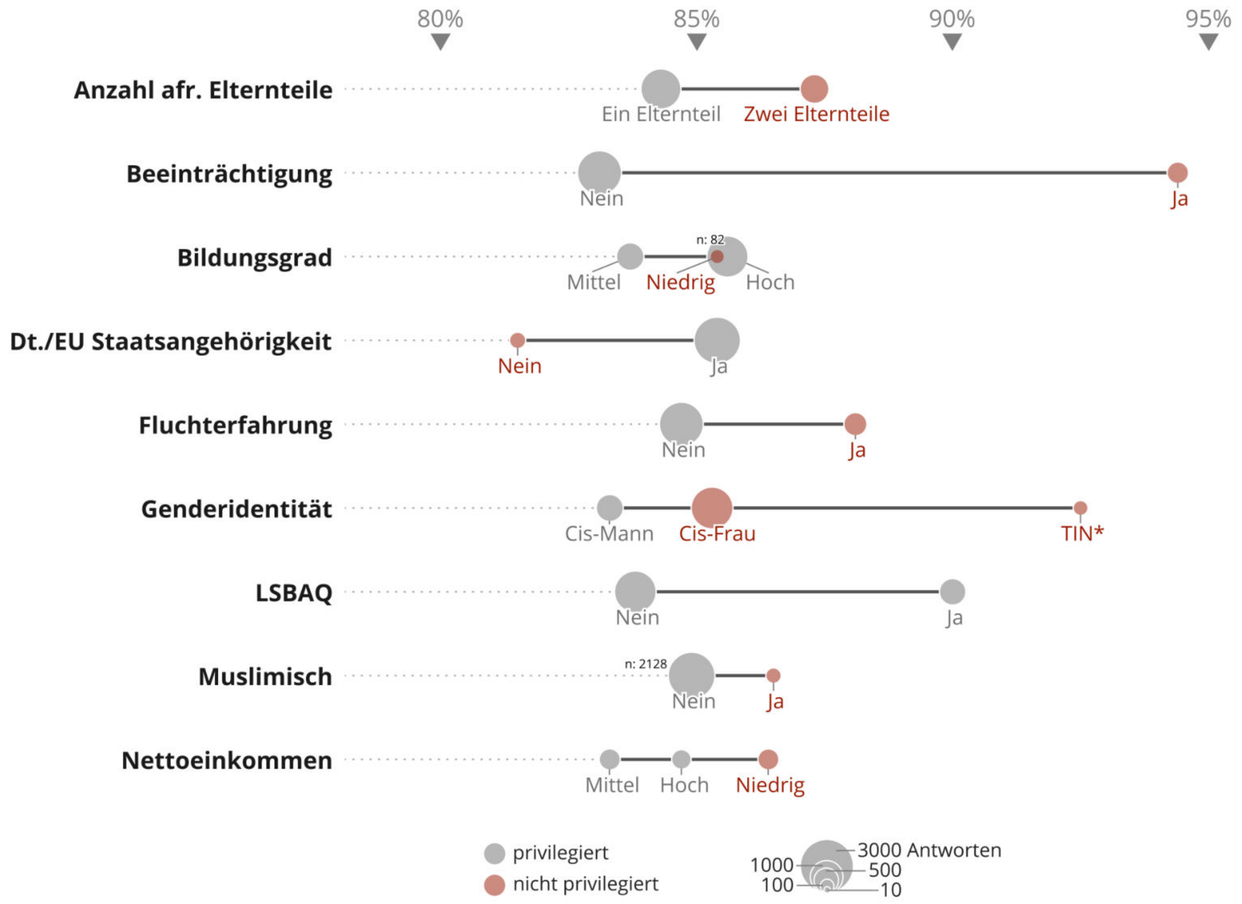
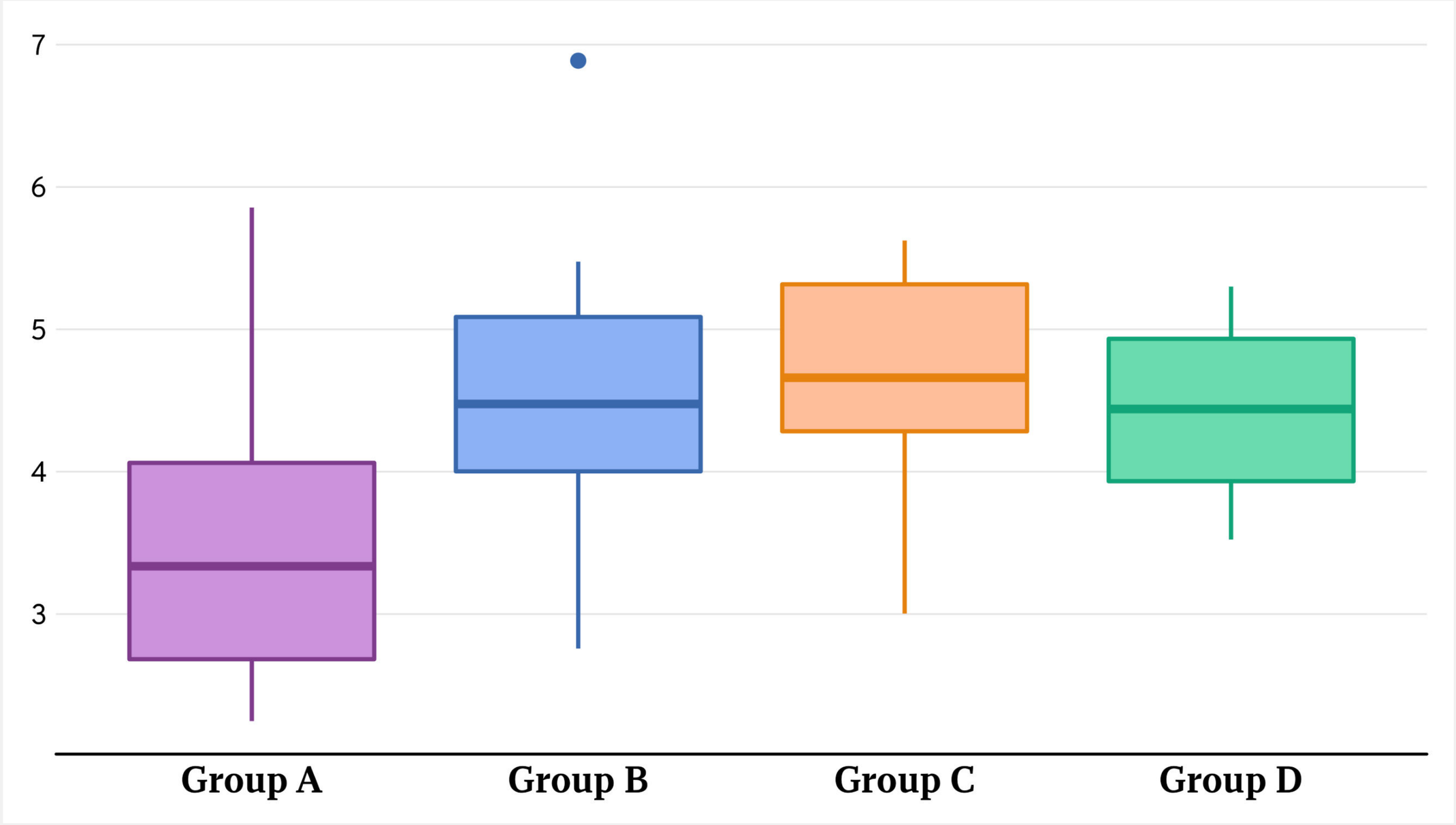
Häufigkeit von Diskriminierungserfahrungen entlang ausgewählter Vielfaltsdimensionen im Lebensbereich „Medien und Internet"



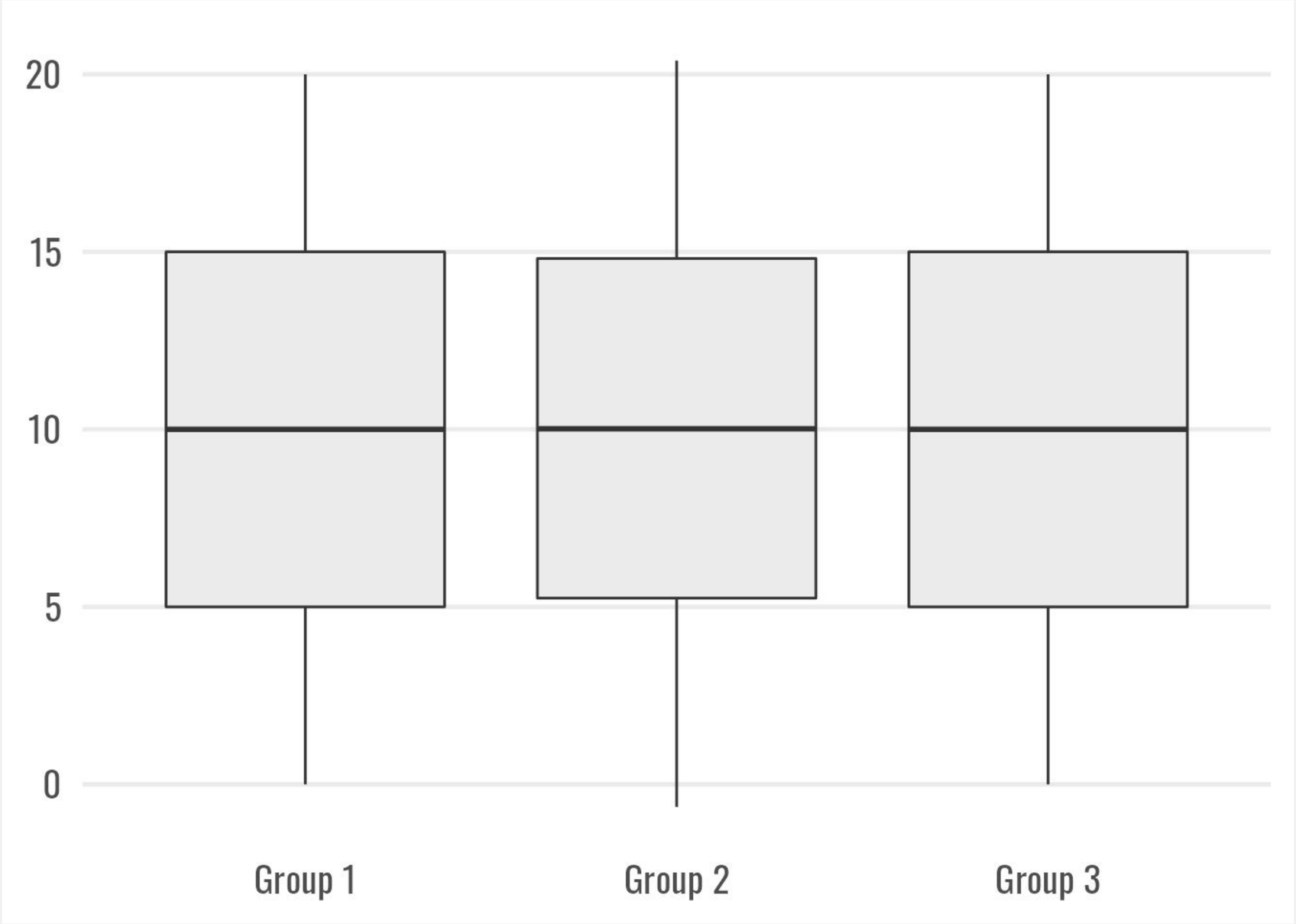
Lesebeispiel: *LSBAQ-Befragte des Afrozensus geben im Vergleich mit heterosexuellen Afrozensus-Befragten häufiger an, im Lebensbereich „Medien und Internet" in den letzten zwei Jahren Diskriminierung erlebt zu haben.*

Quelle: Abb. 46 in Aikins, M A; Bremberger,T; Aikins, J K; Gyamerah, D; Yıldırım-Caliman, D (2021): Afrozensus 2020 | Datenteam: Reiber, L; Vivanco, J | Design: Scherer, C

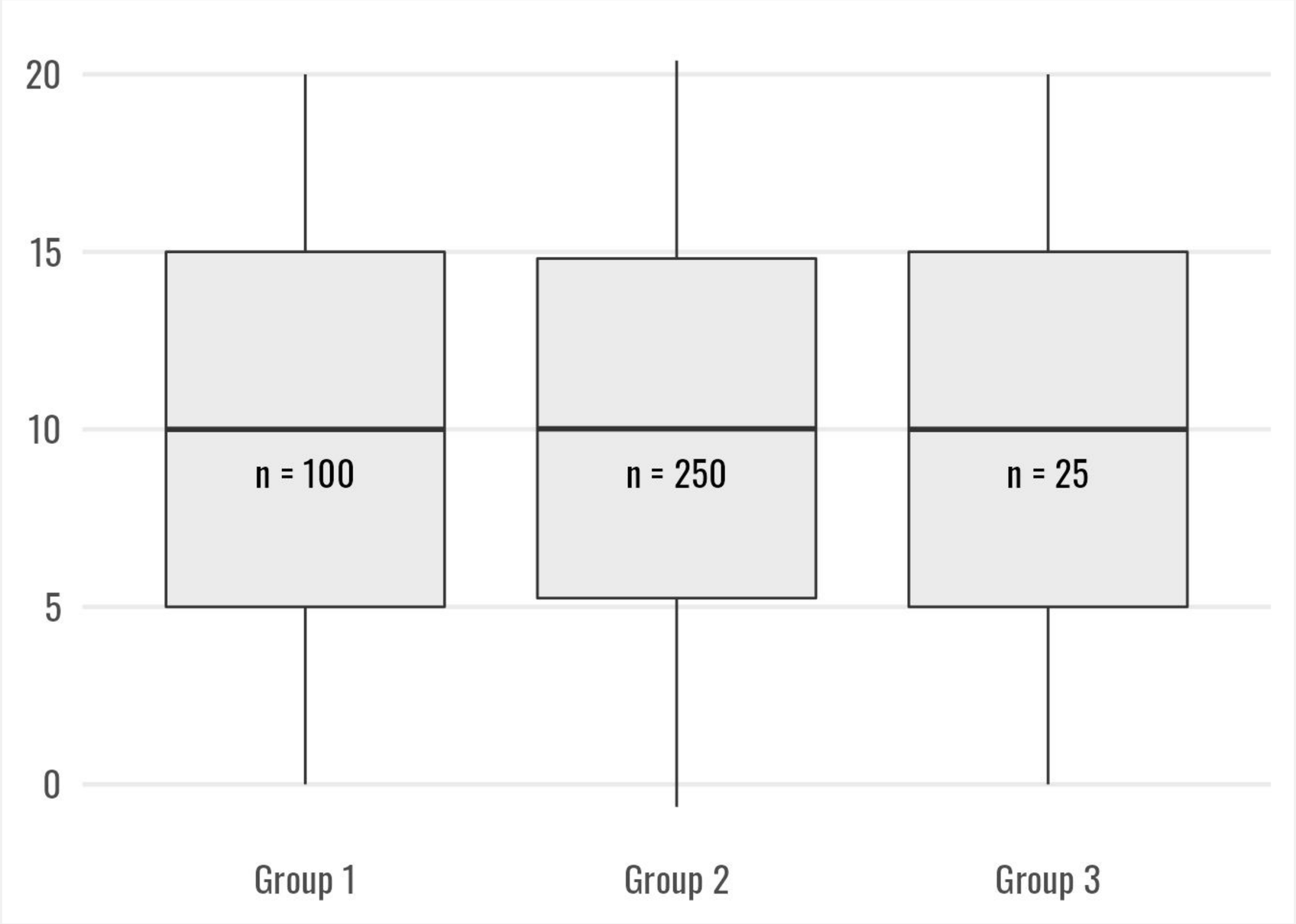
Abb. 46 "Afrozensus 2020" von Citizens For Europe & EOTO e.V.



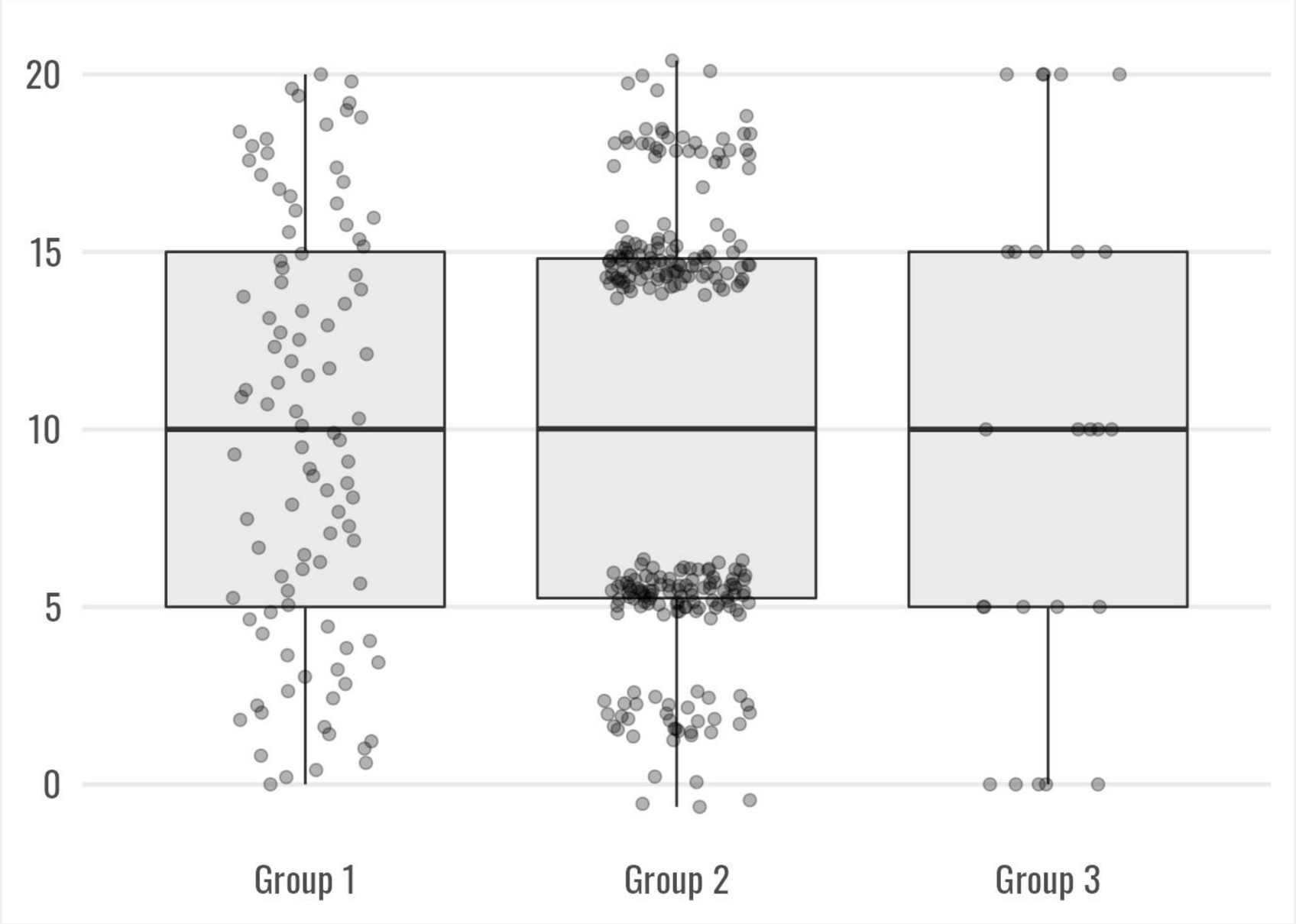
*My webinar **"Beyond Bar and Box Plots"** for USGS Data Science [Slides | Recording]*



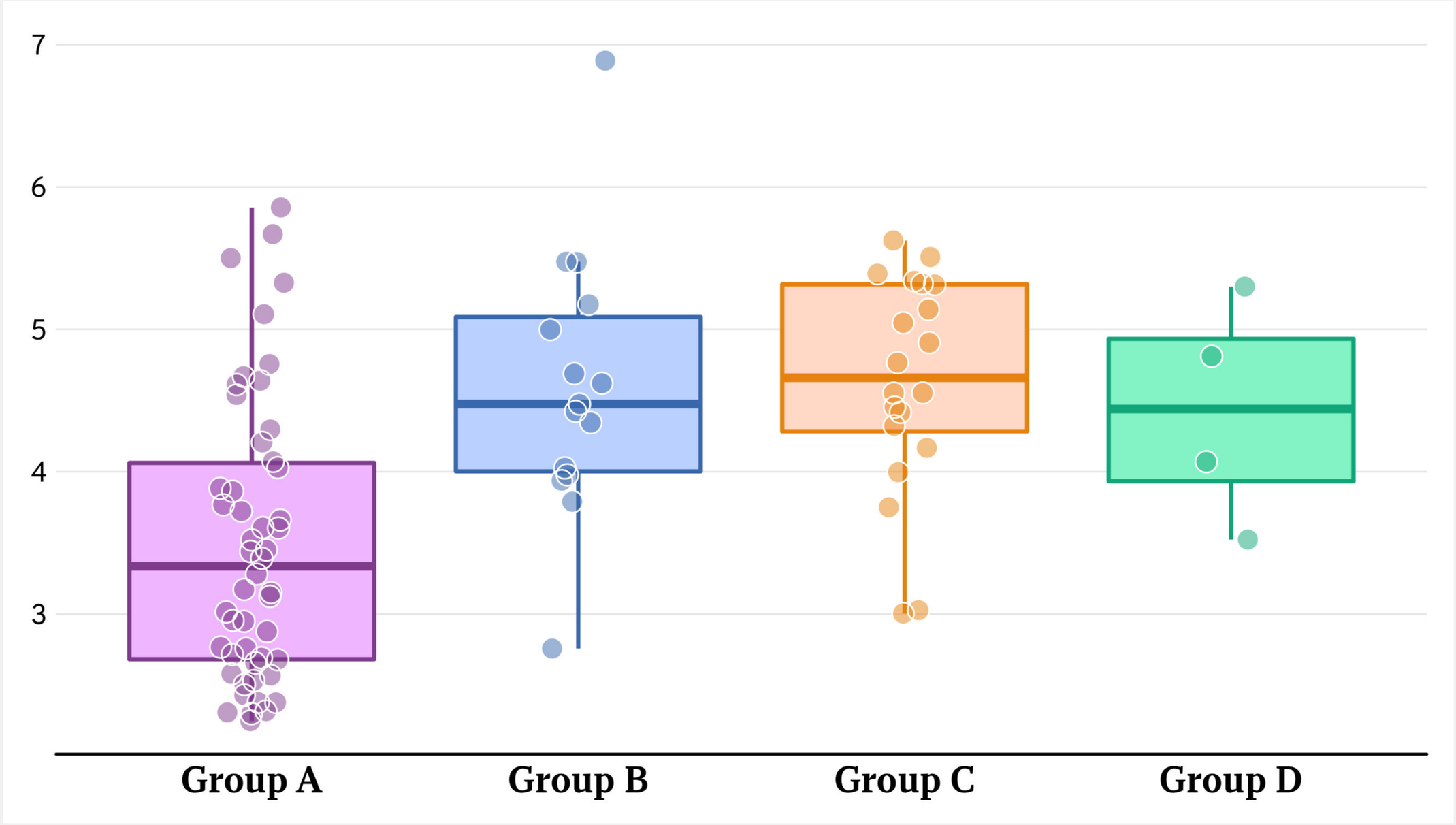
From my blog post "Visualizing Distributions with Raincloud Plots (and How to Create Them with ggplot2)"



From my blog post "Visualizing Distributions with Raincloud Plots (and How to Create Them with ggplot2)"



From my blog post "Visualizing Distributions with Raincloud Plots (and How to Create Them with ggplot2)"



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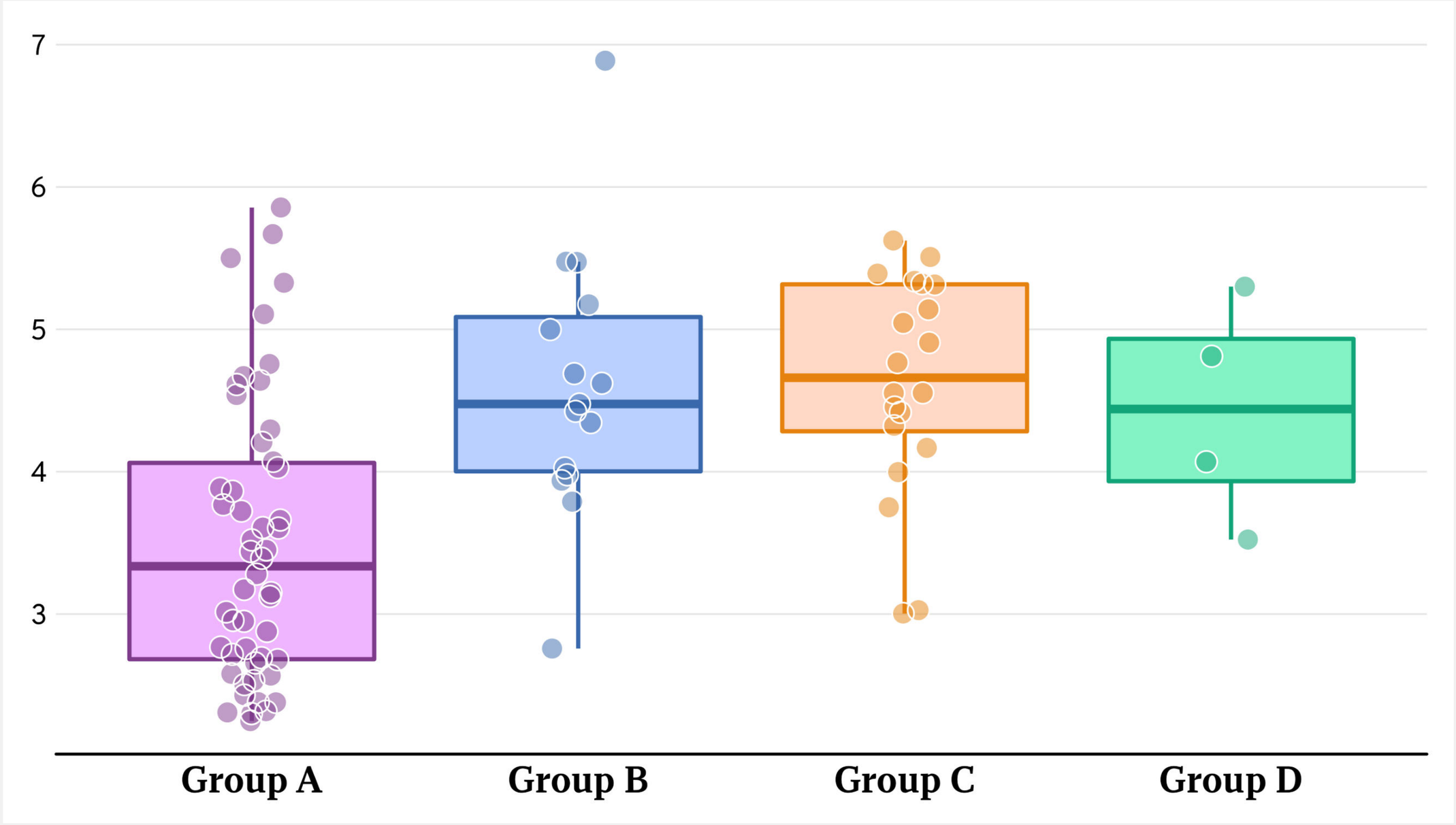

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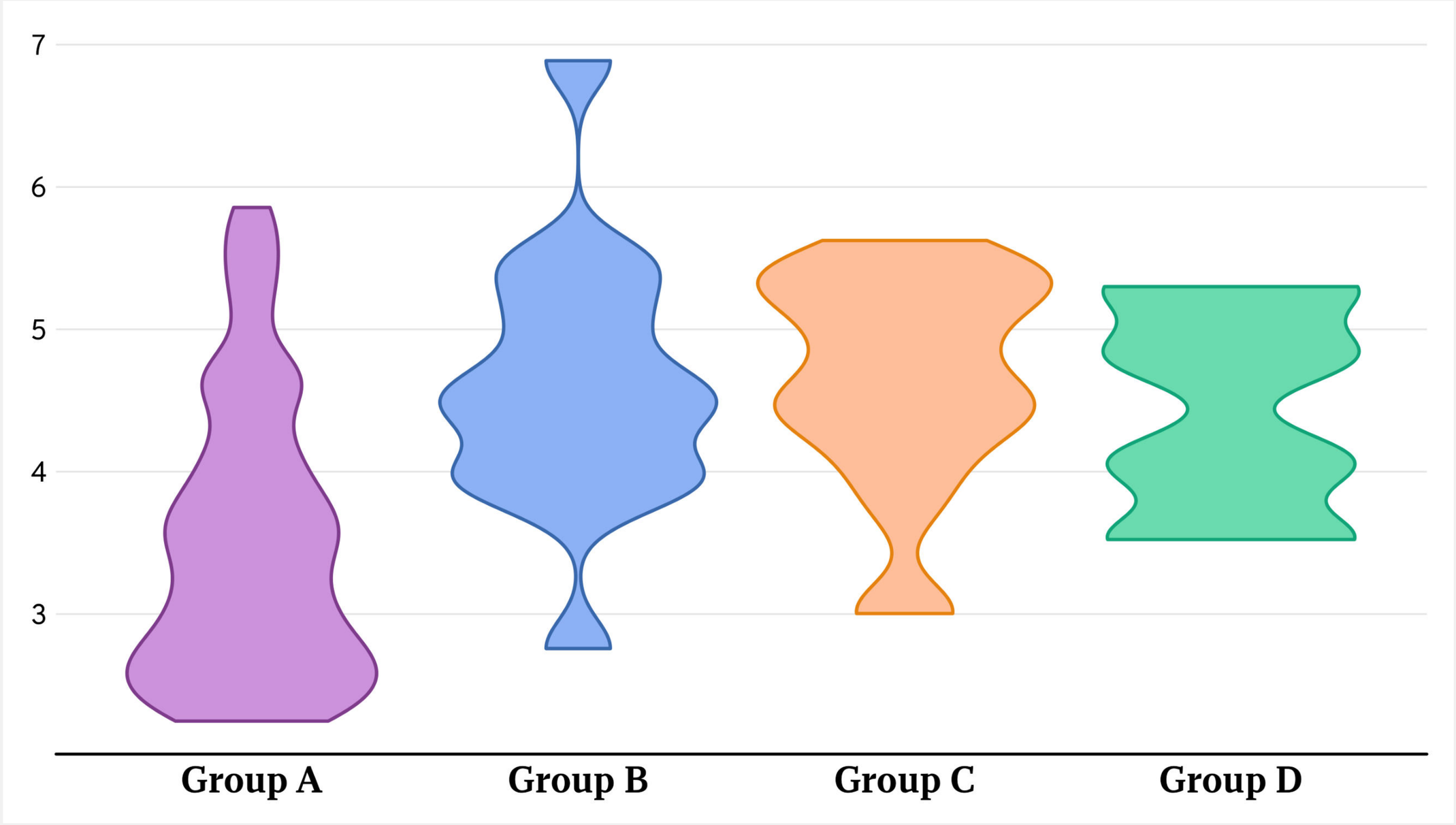

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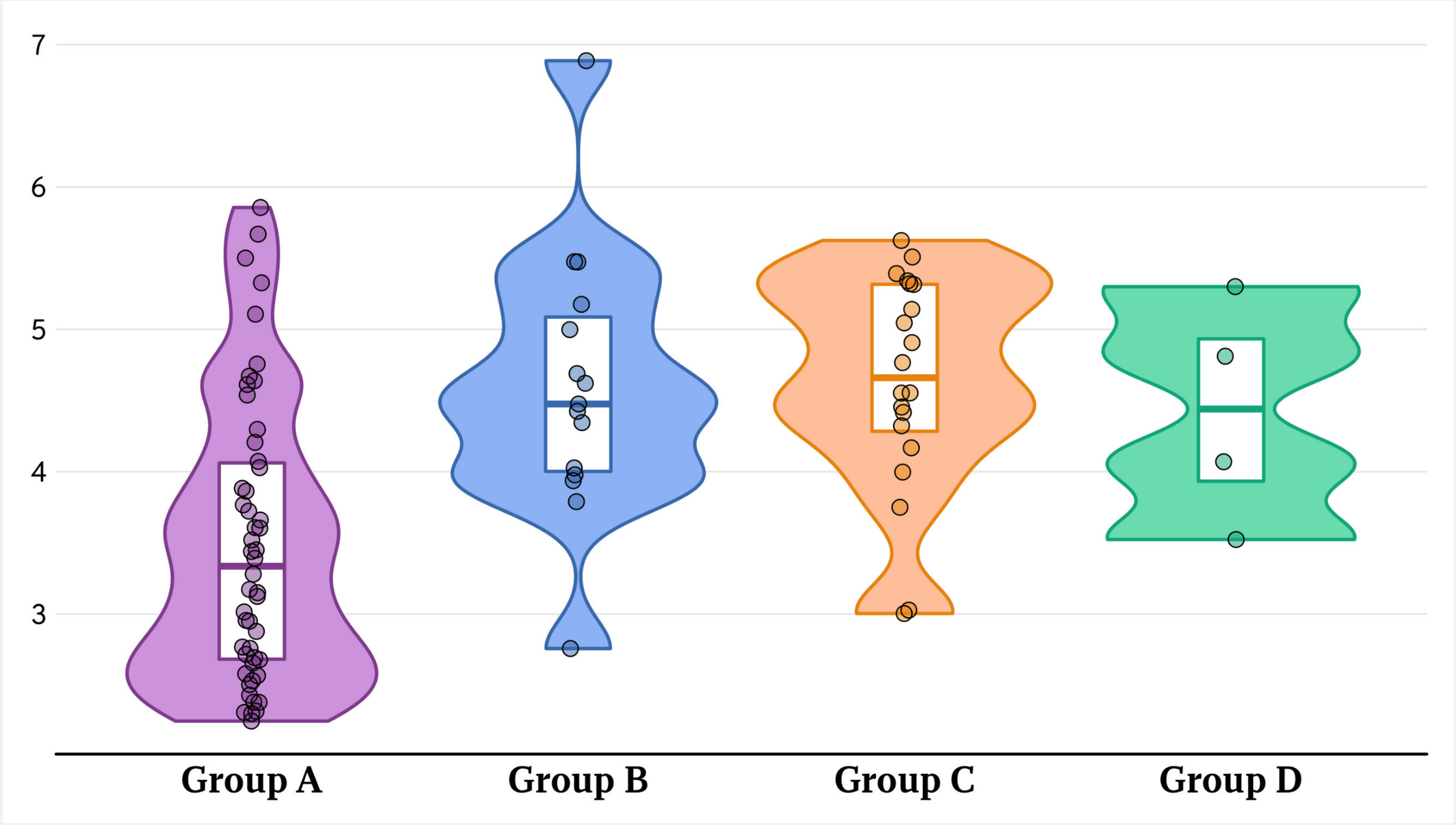

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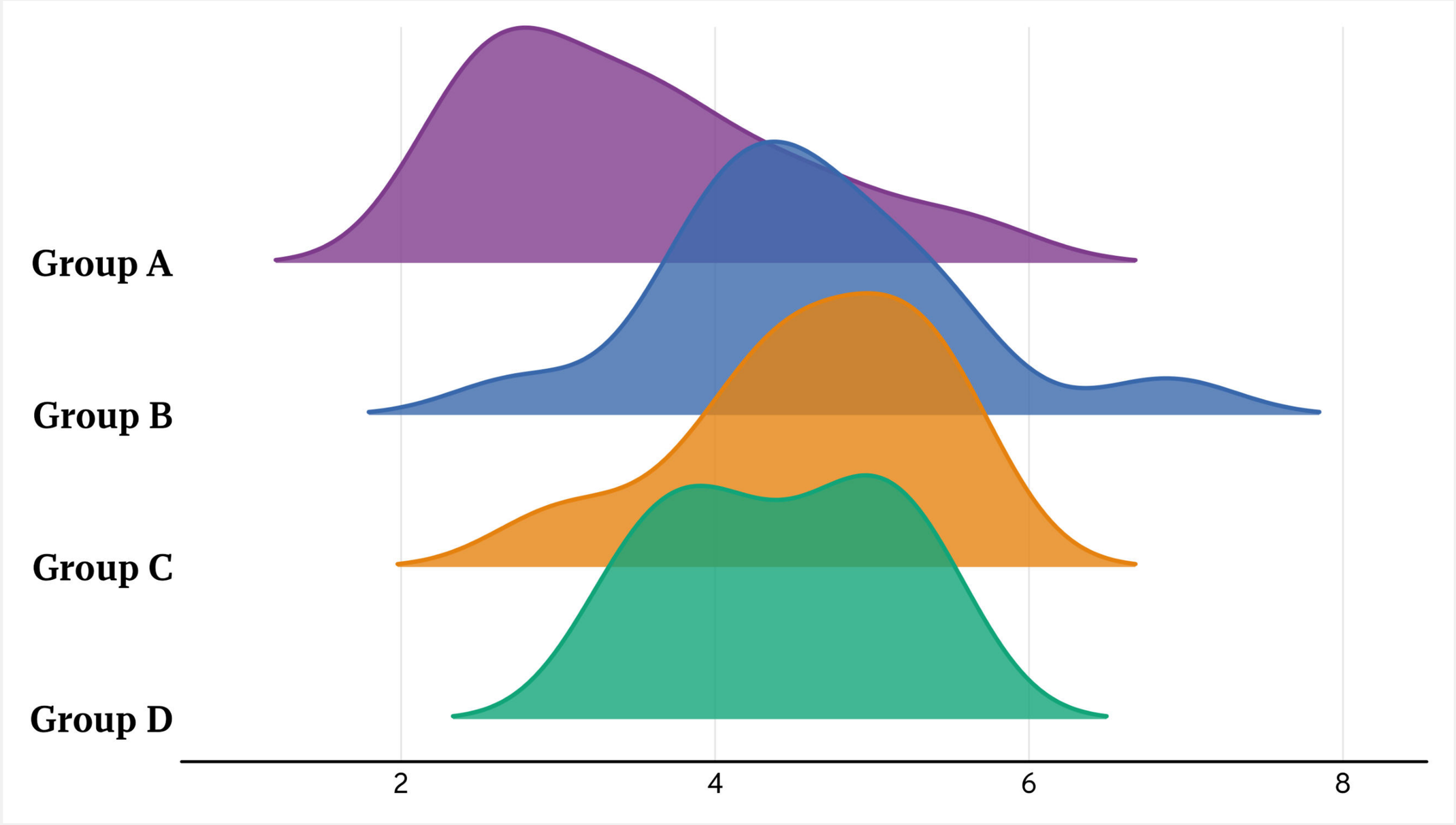

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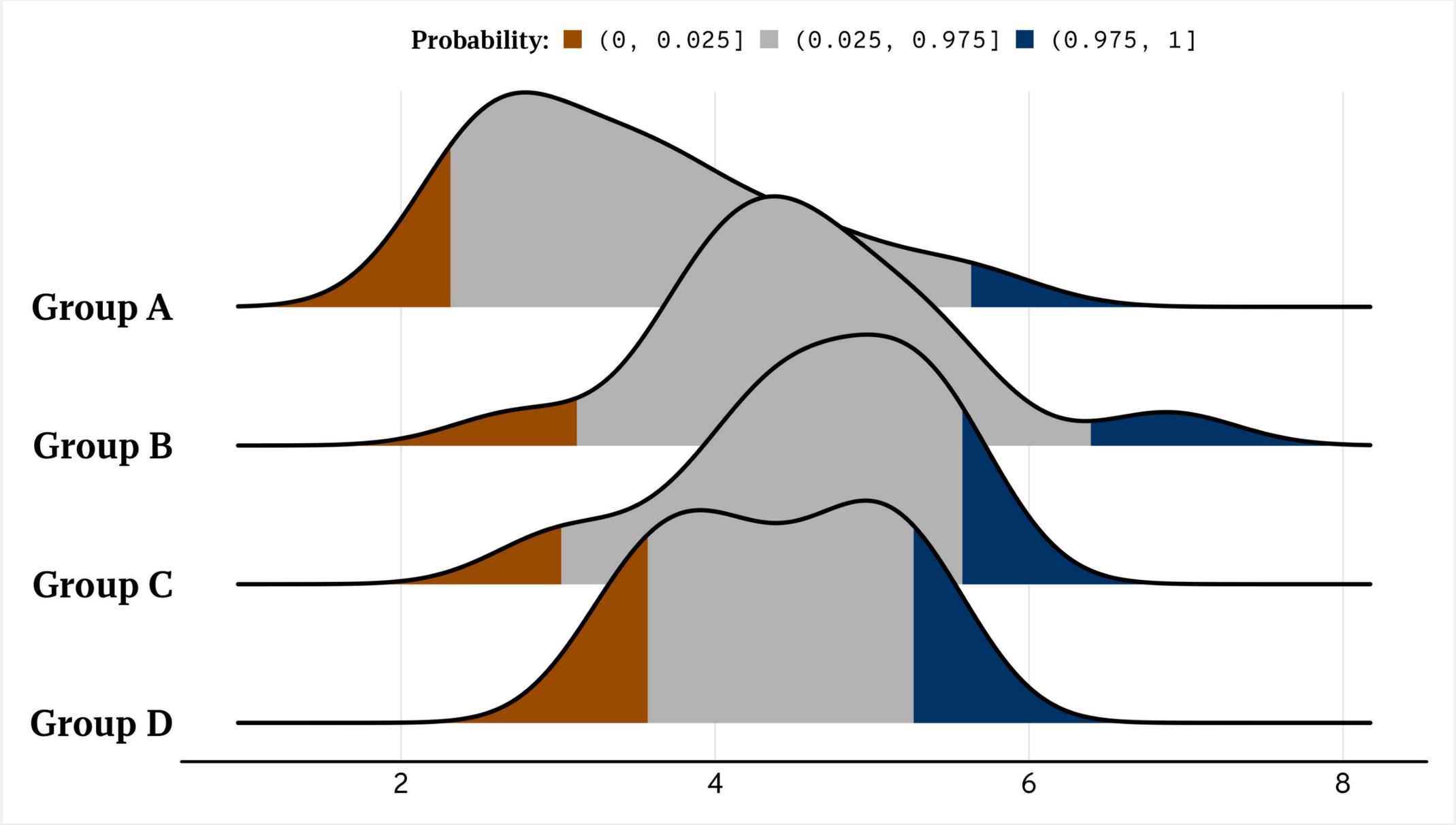

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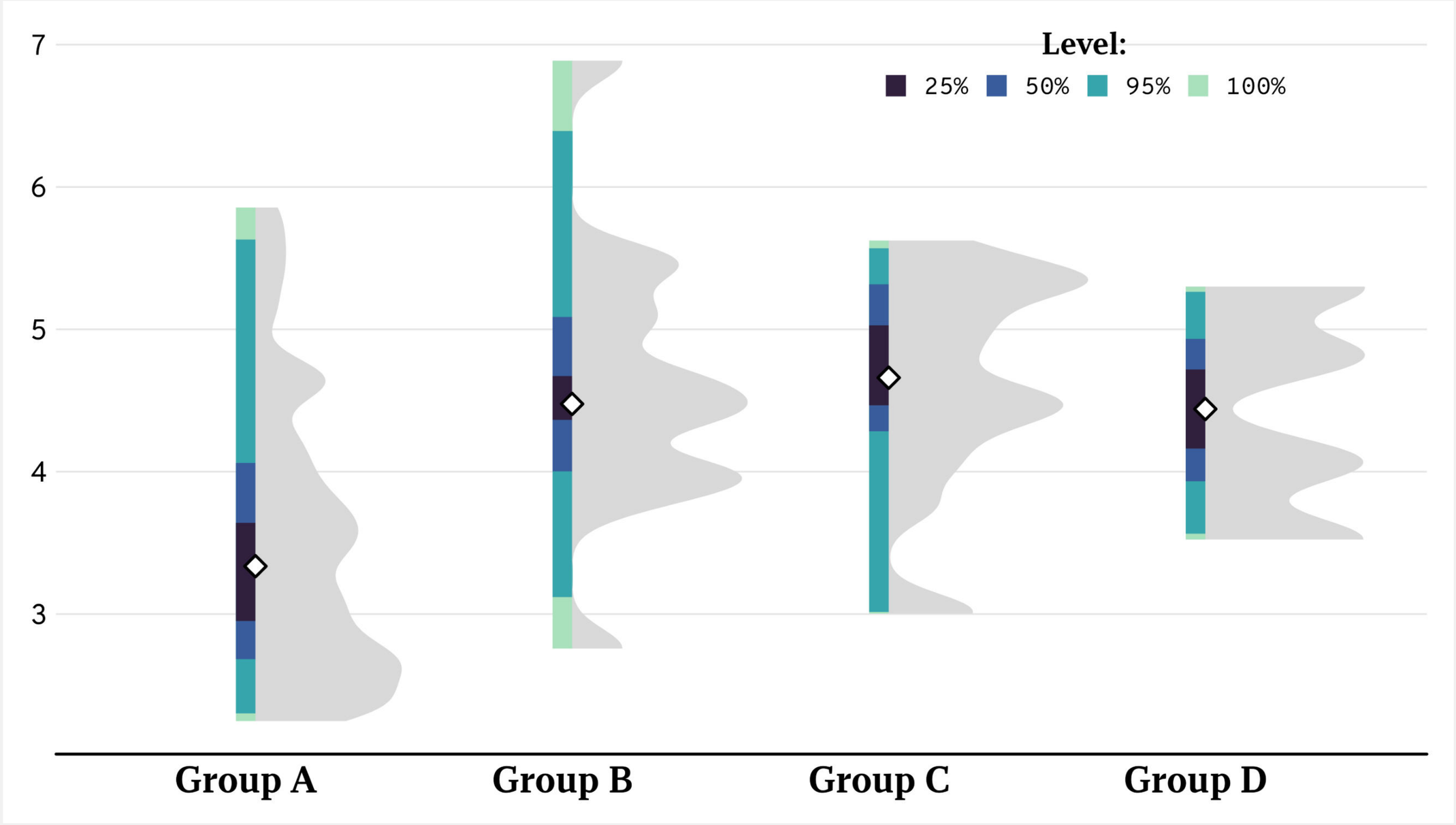

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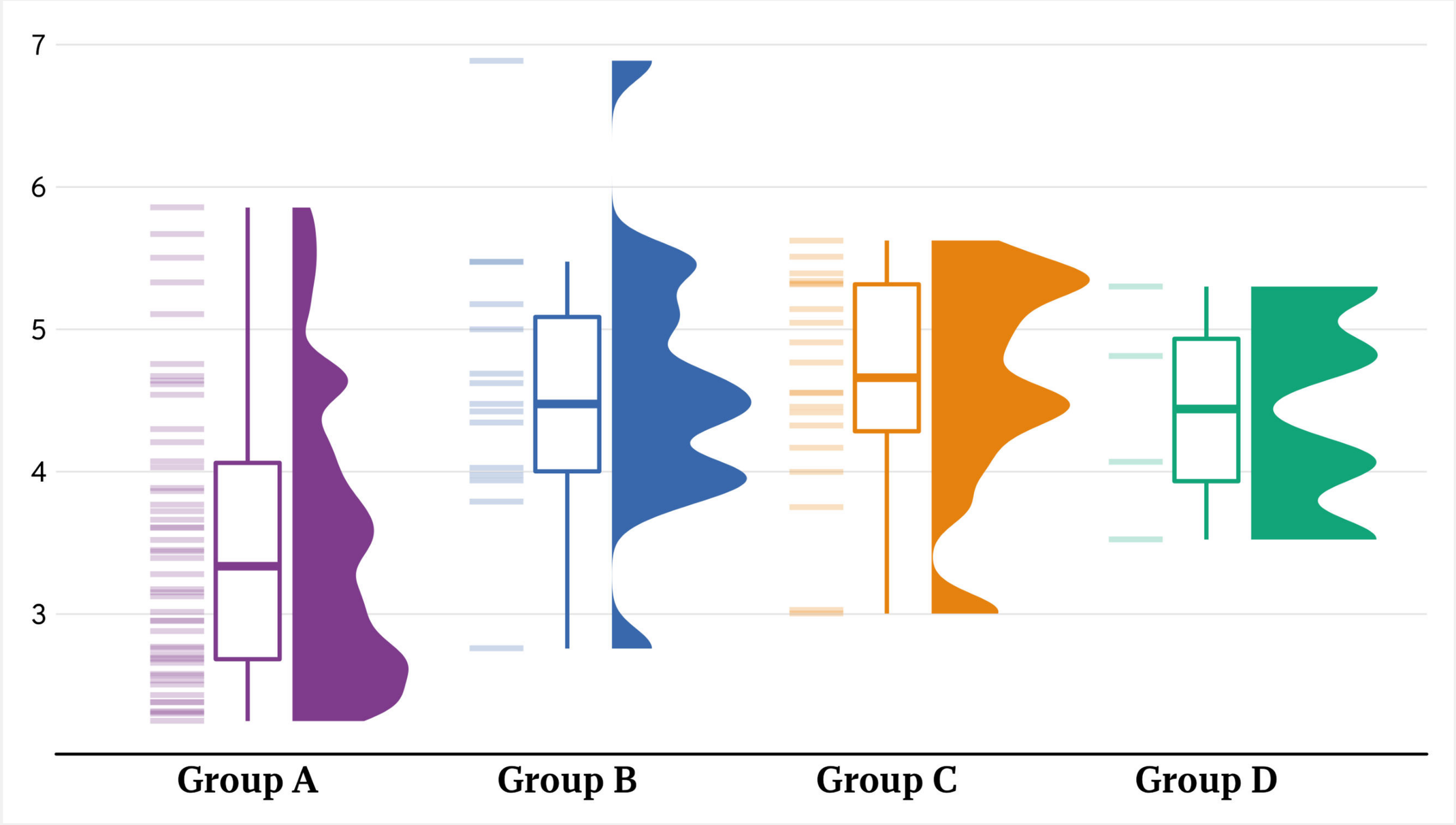

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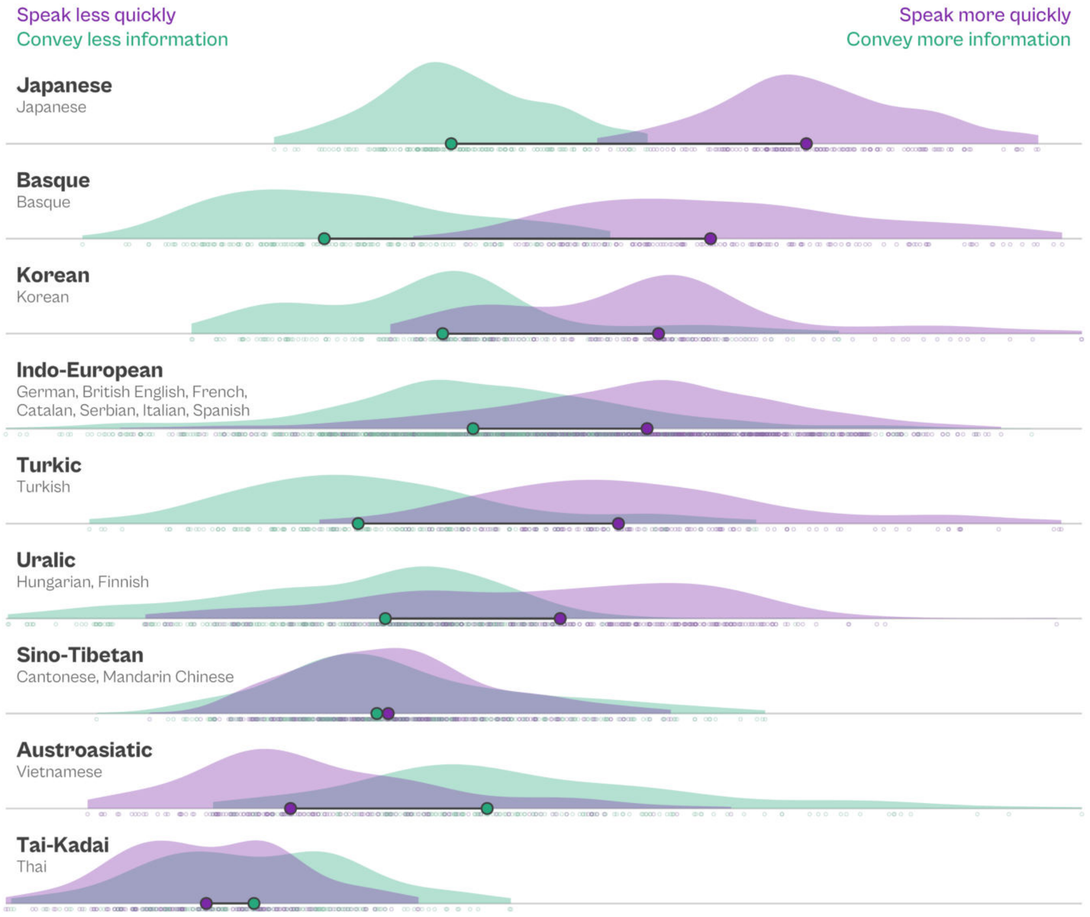
Communicating fast doesn't necessarily mean communicating more

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.



Normalized rates of **speech (syllables per second)** and **information (bits per second)**

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

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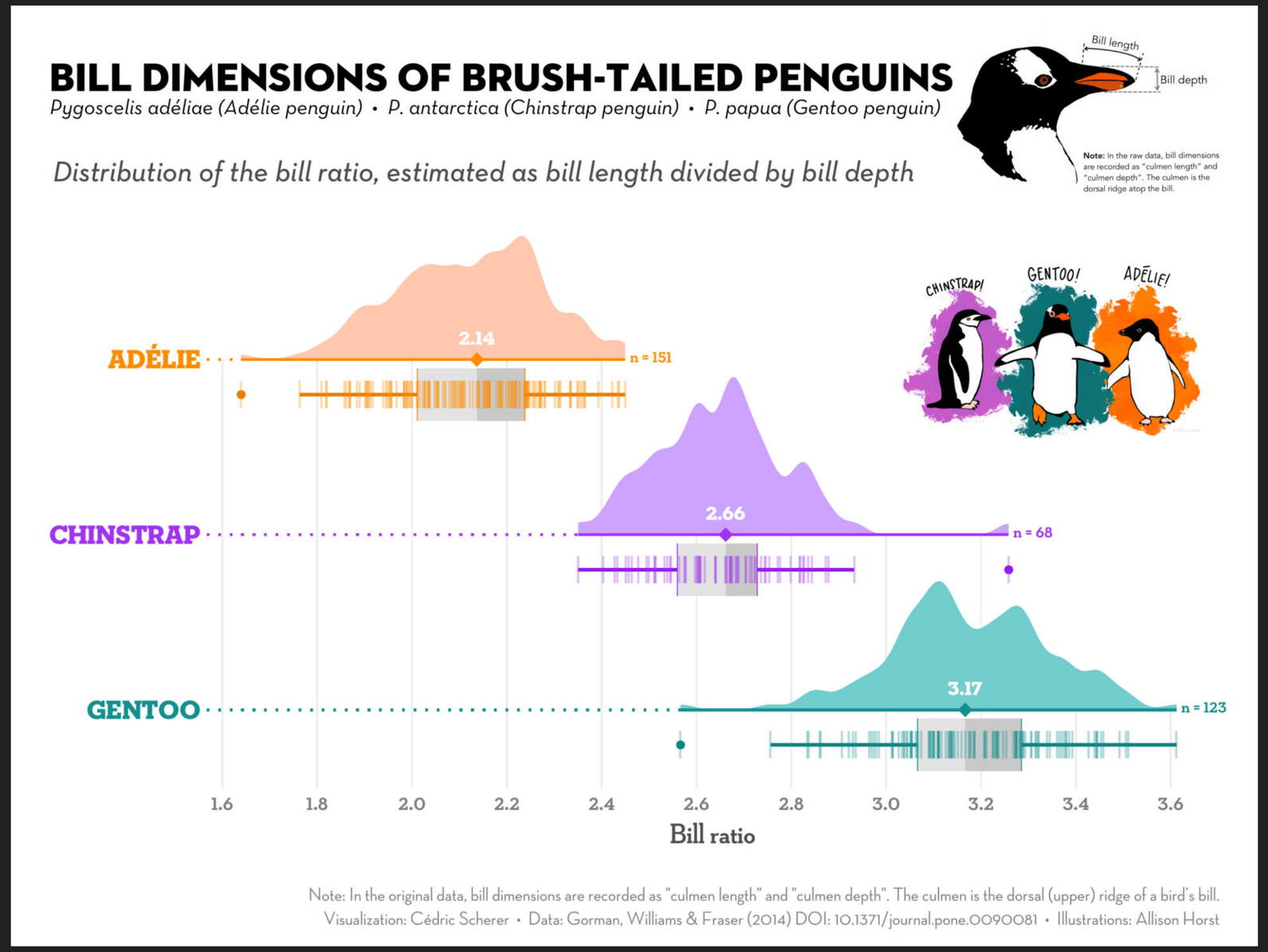
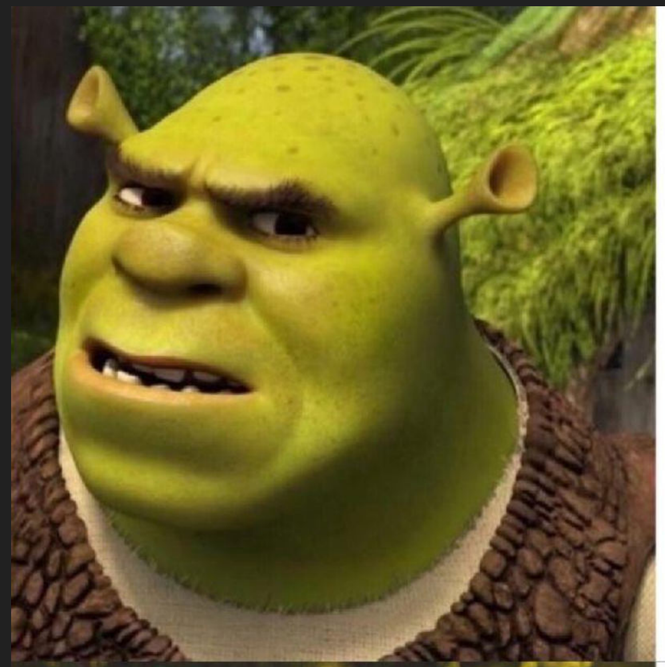
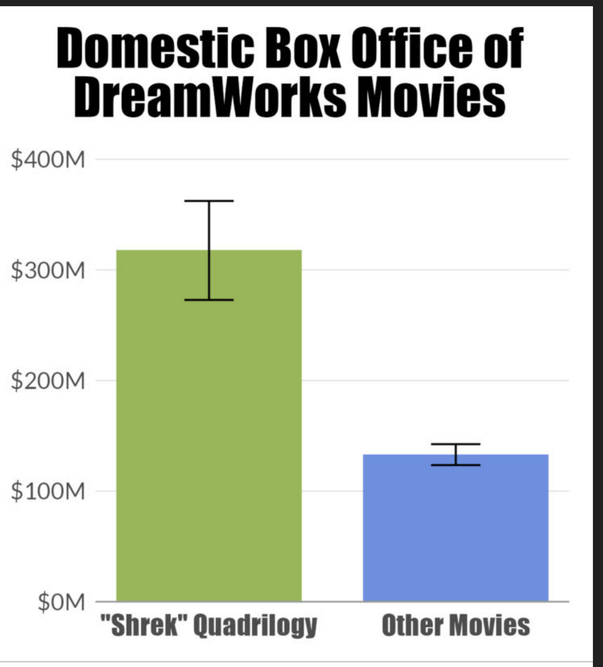
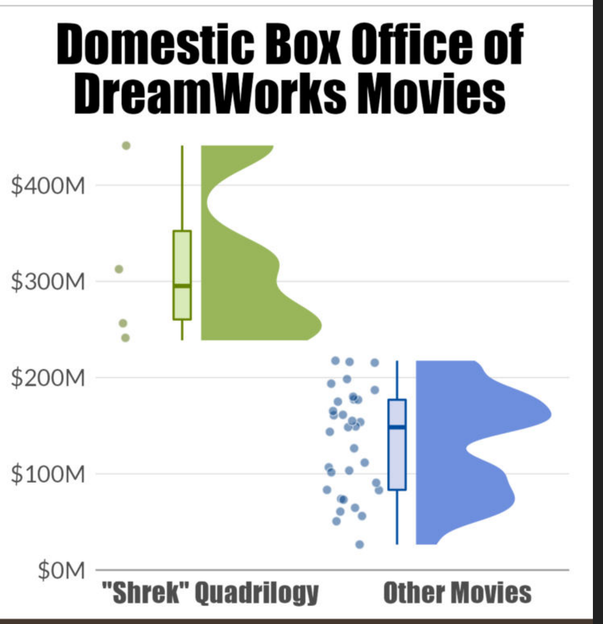


From my blog post "Visualizing Distributions with Raincloud Plots (and How to Create Them with ggplot2)"





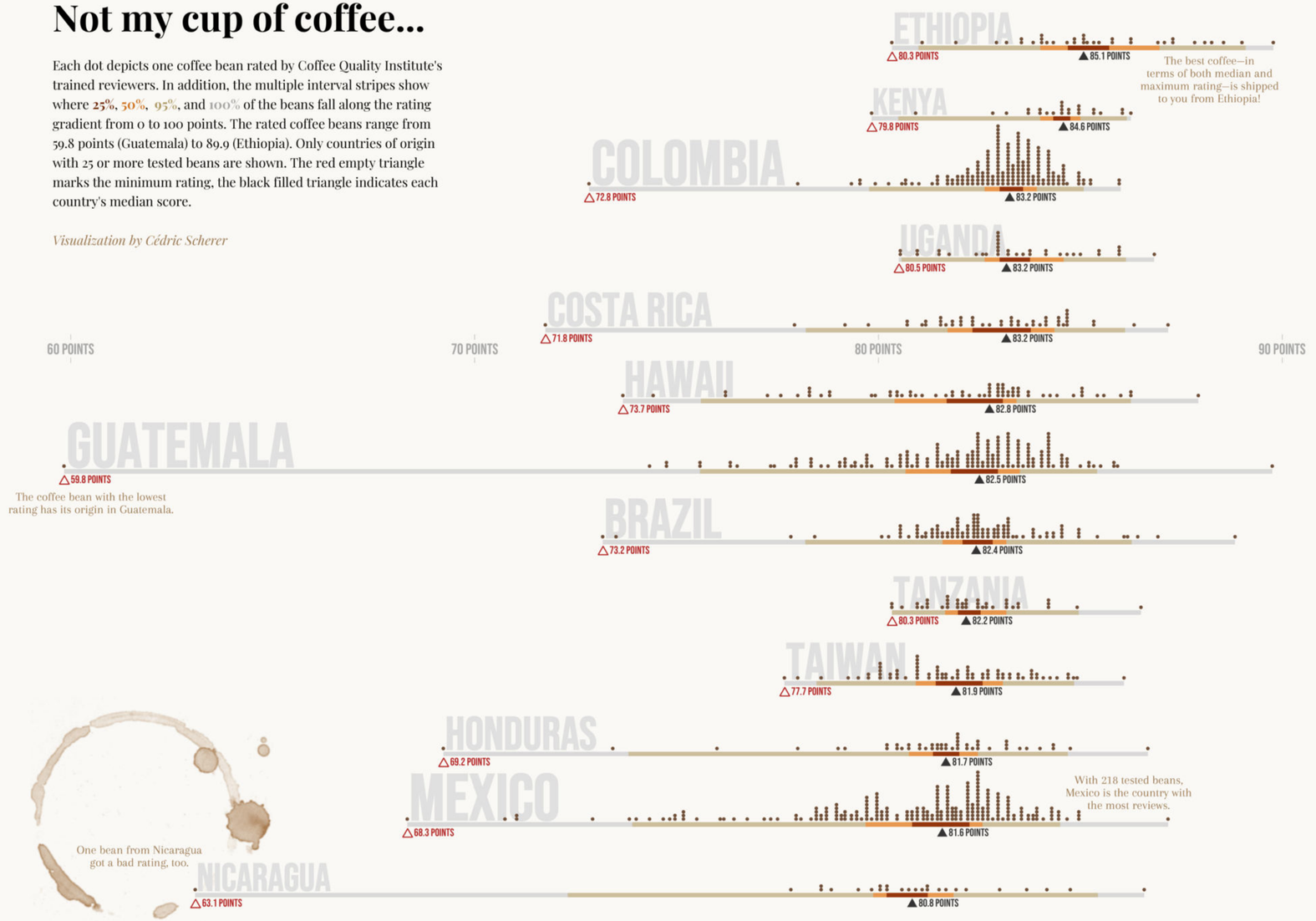


Why Dynamite Plots Are Terrible—and Why You Should Use Something Else | Cédric Scherer | #30DayChartChallenge 2021 | Day 27: Educational

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



"Not my cup of coffee", #TidyTuesday Contribution

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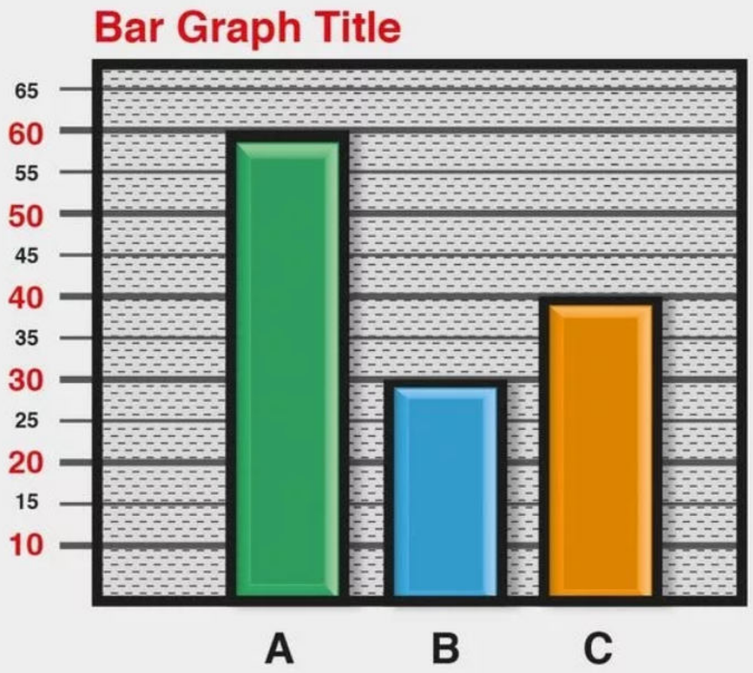
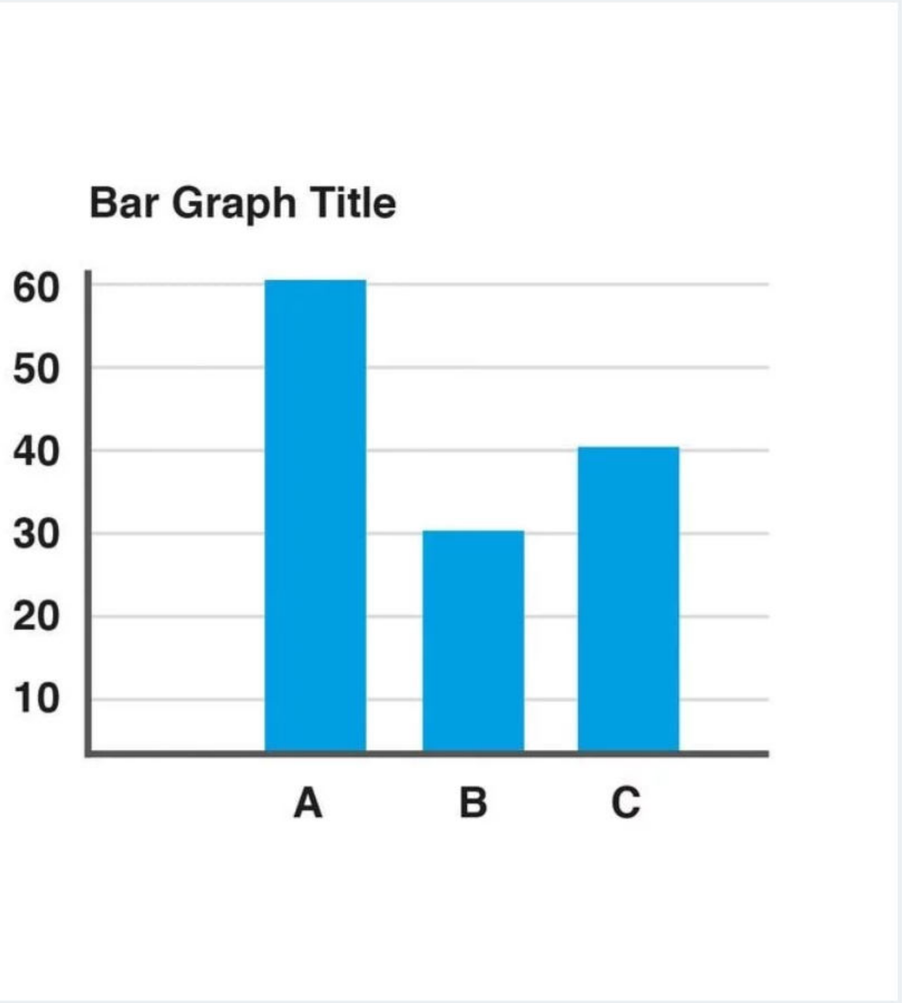
ONE
WAY
ONE
WAY
Guide the
View (er)

Decluttering

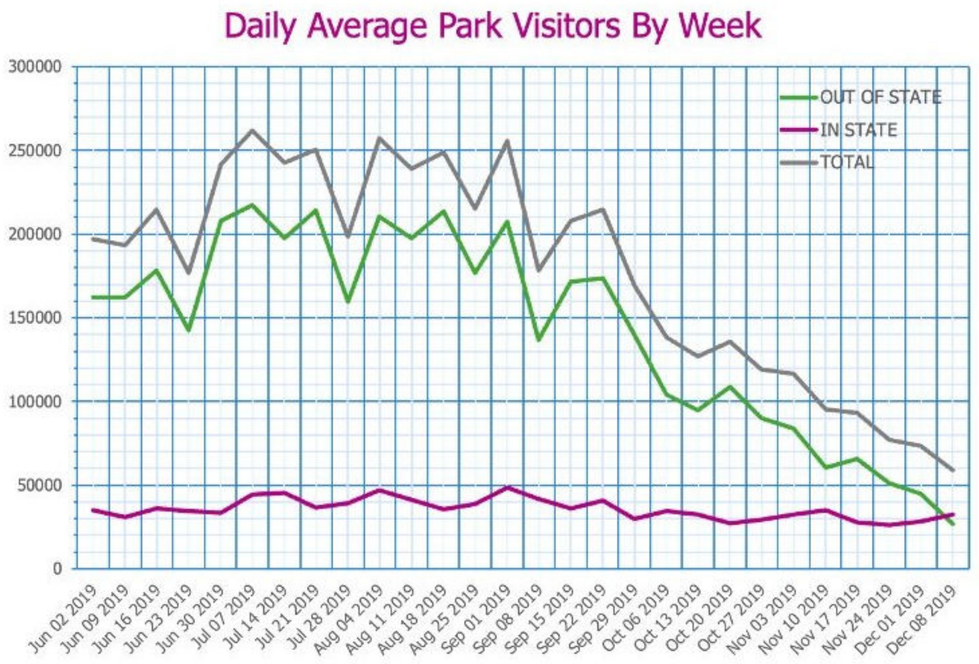




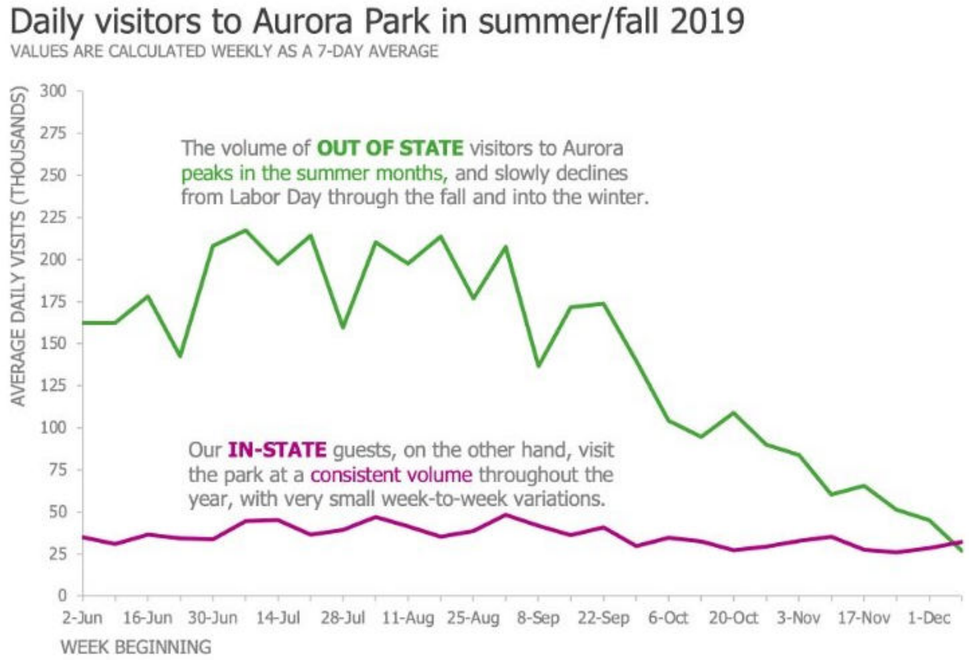
Source: canva.com

Decluttering

BEFORE: SPOOKY SKELETON



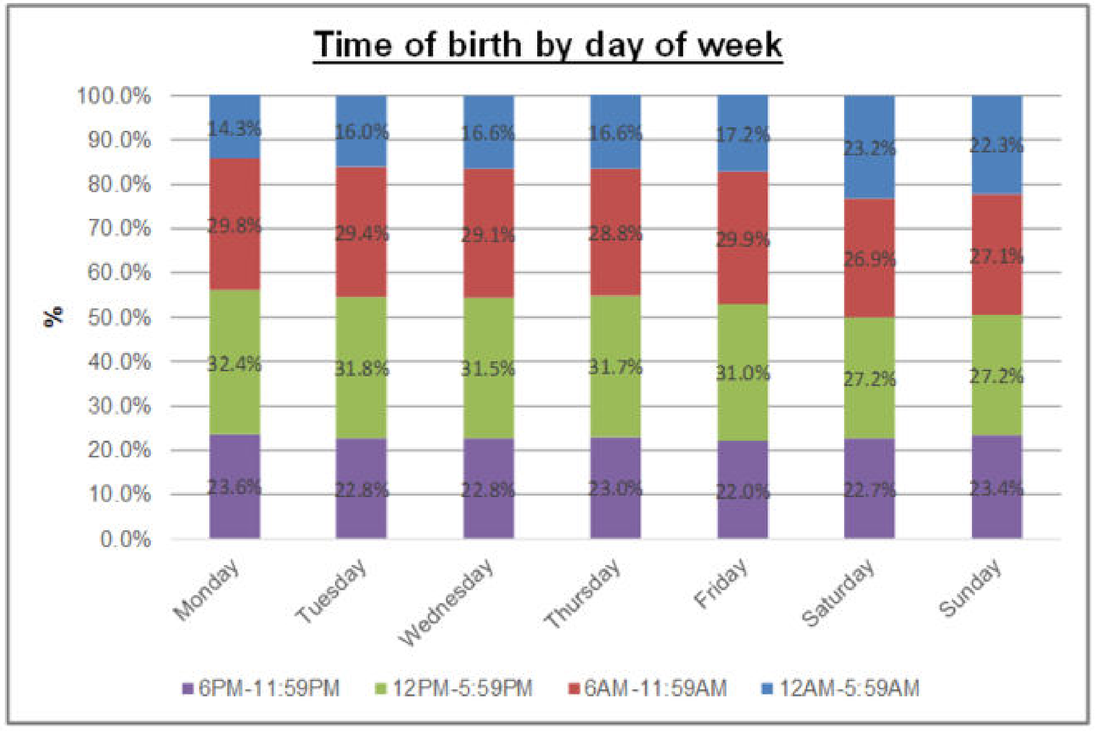
AFTER: GOOD BONES



"Your graph Skeleton Shouldn't Be Scary" by Mike Cisneros (Storytelling With Data)

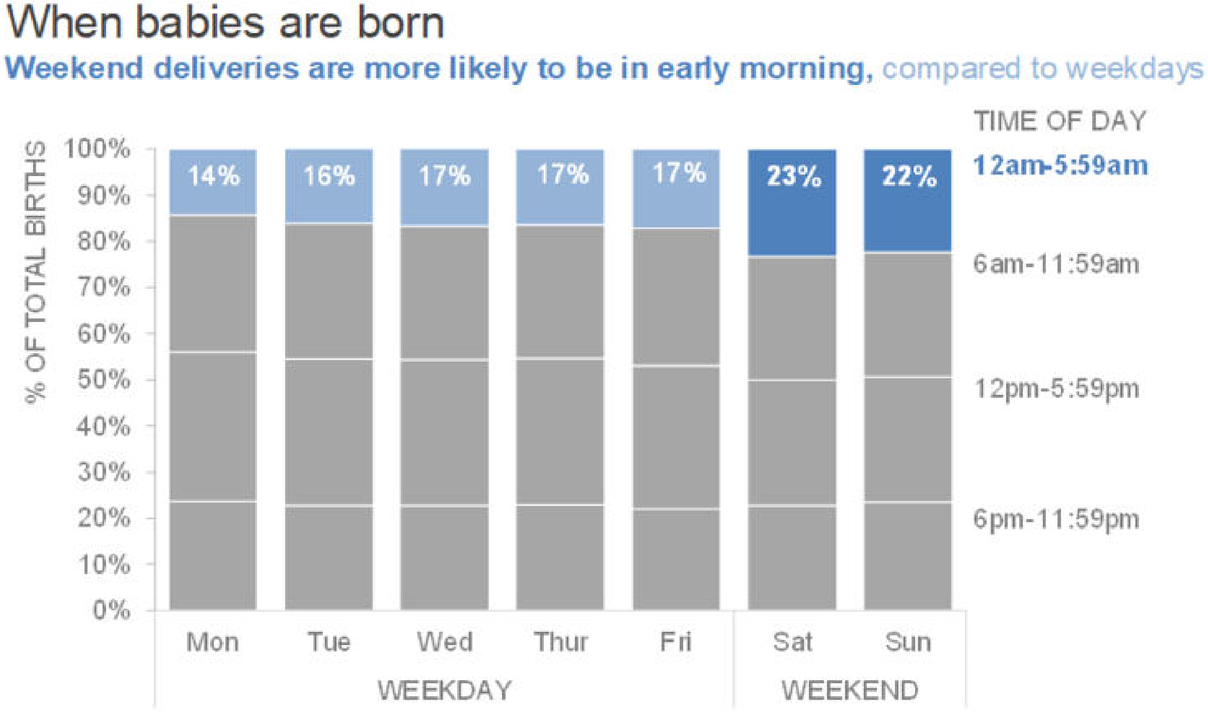
Decluttering

BEFORE



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

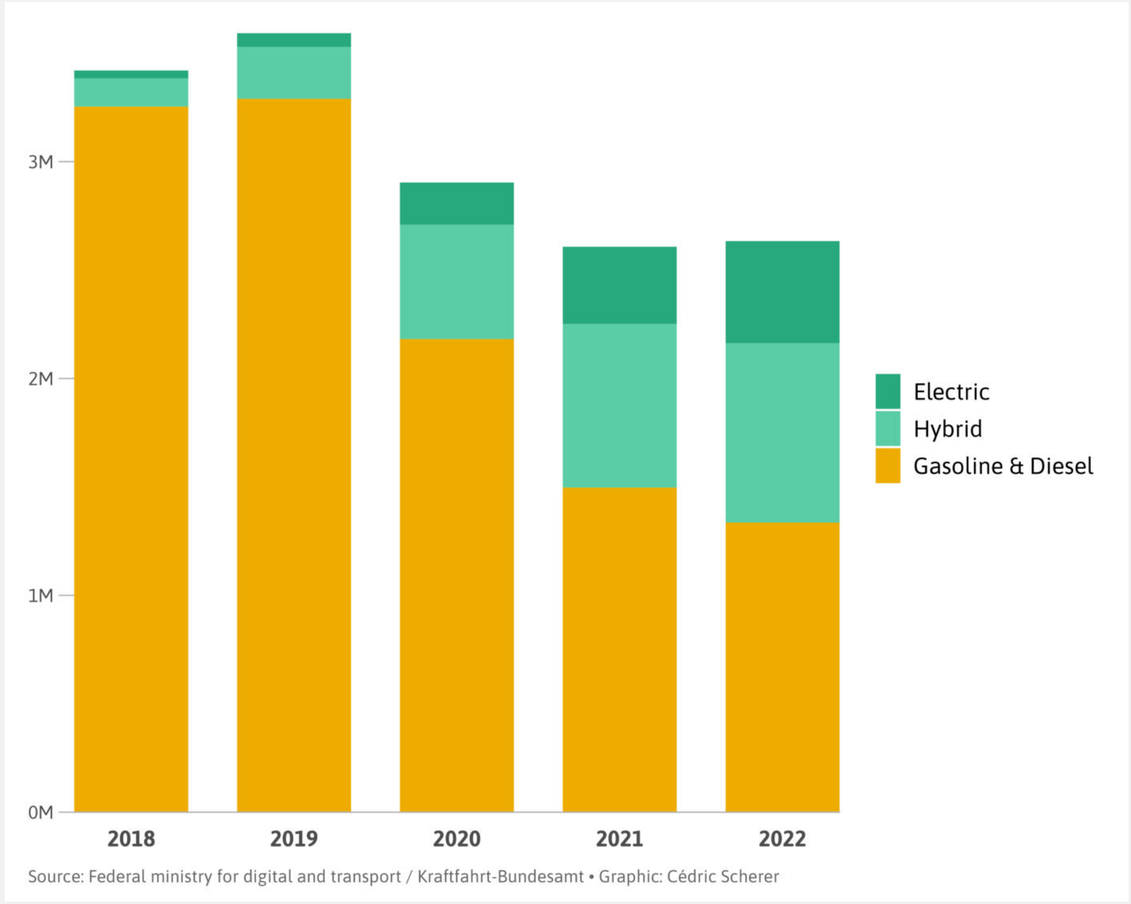
AFTER

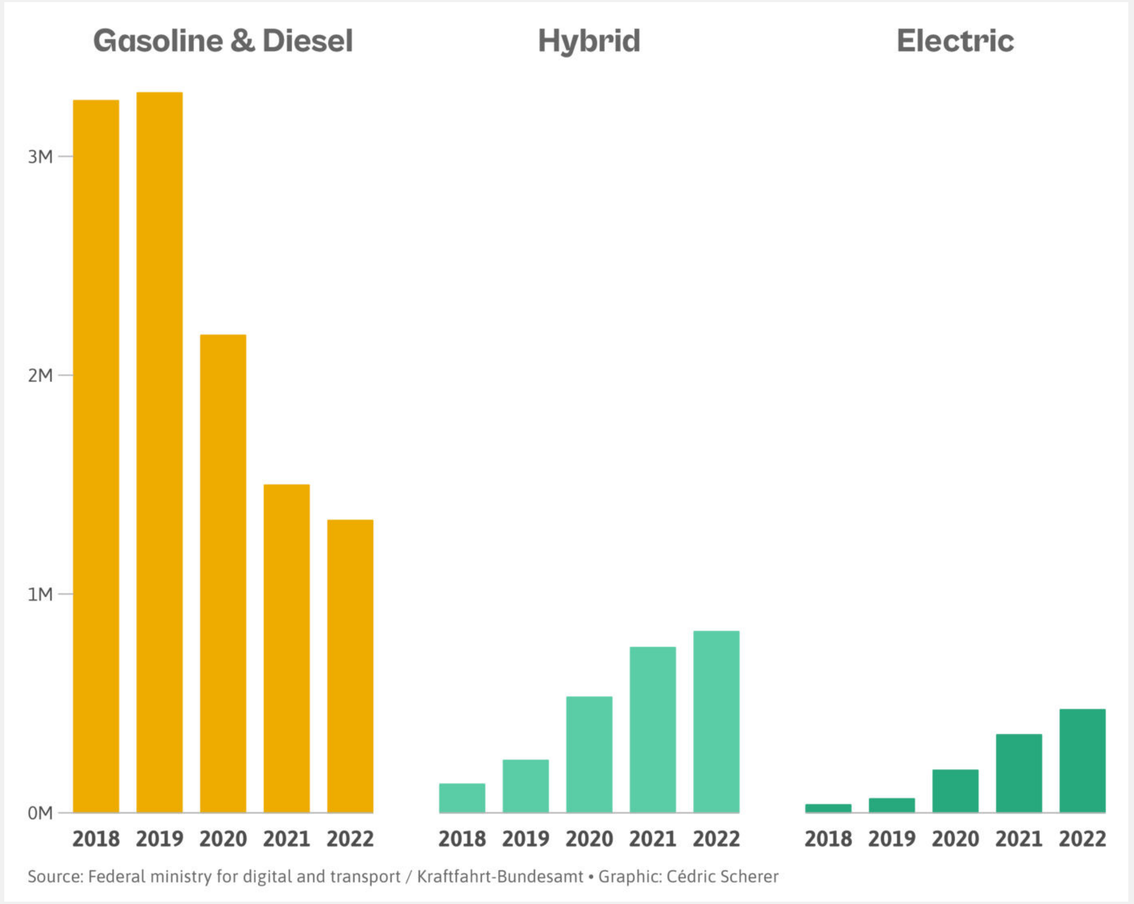


Data source: CDC (National Vital Statistics Reports, Vol. 67, No. 1, January 31, 2018)

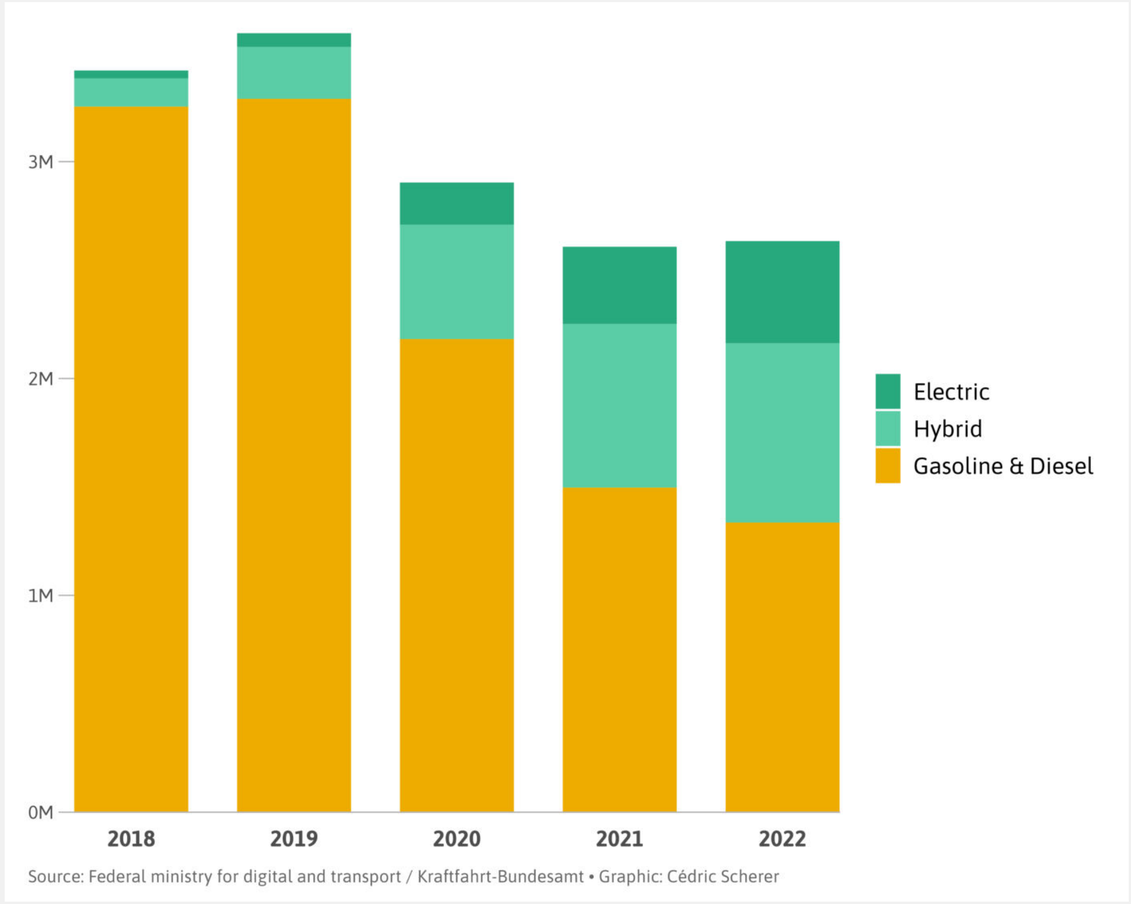
"Declutter! (and Question Default Settings)" by Elizabeth Ricks (Storytelling With Data)

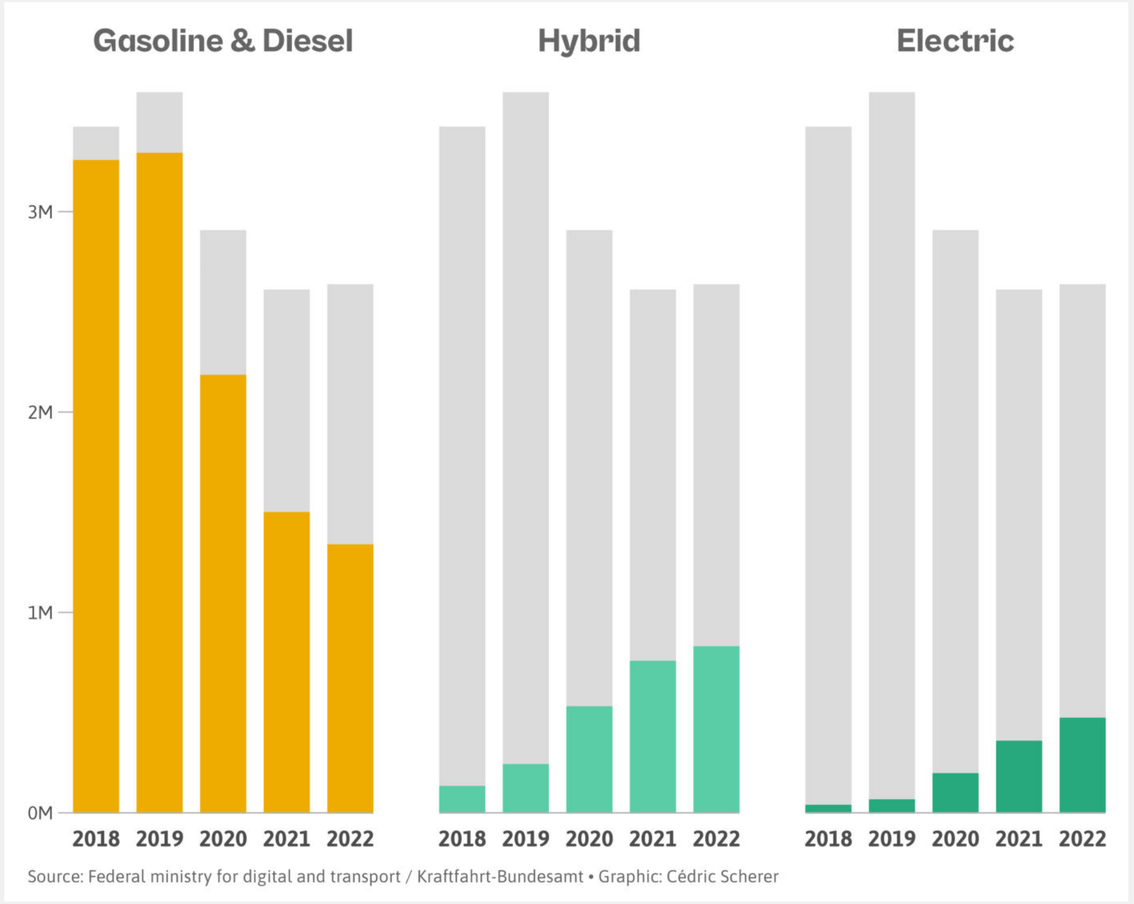
The Power of Small Multiples



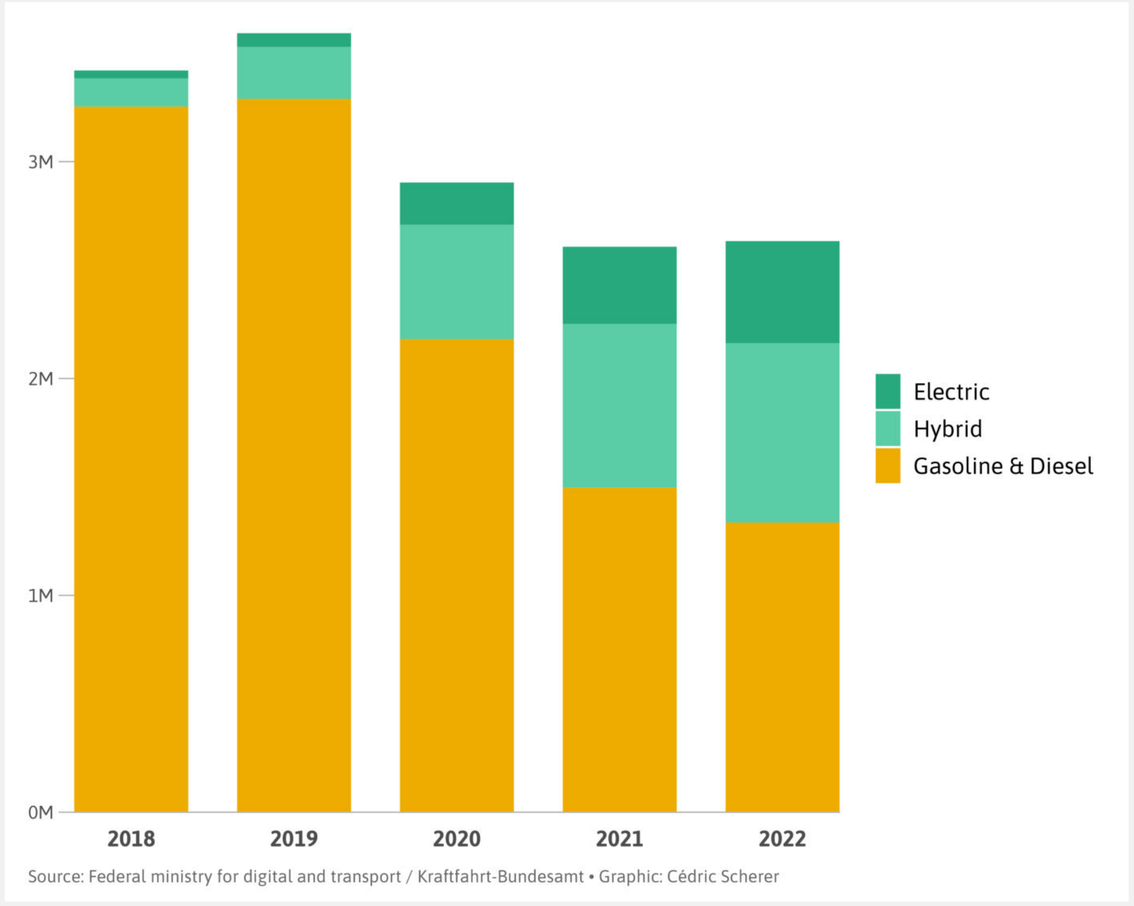


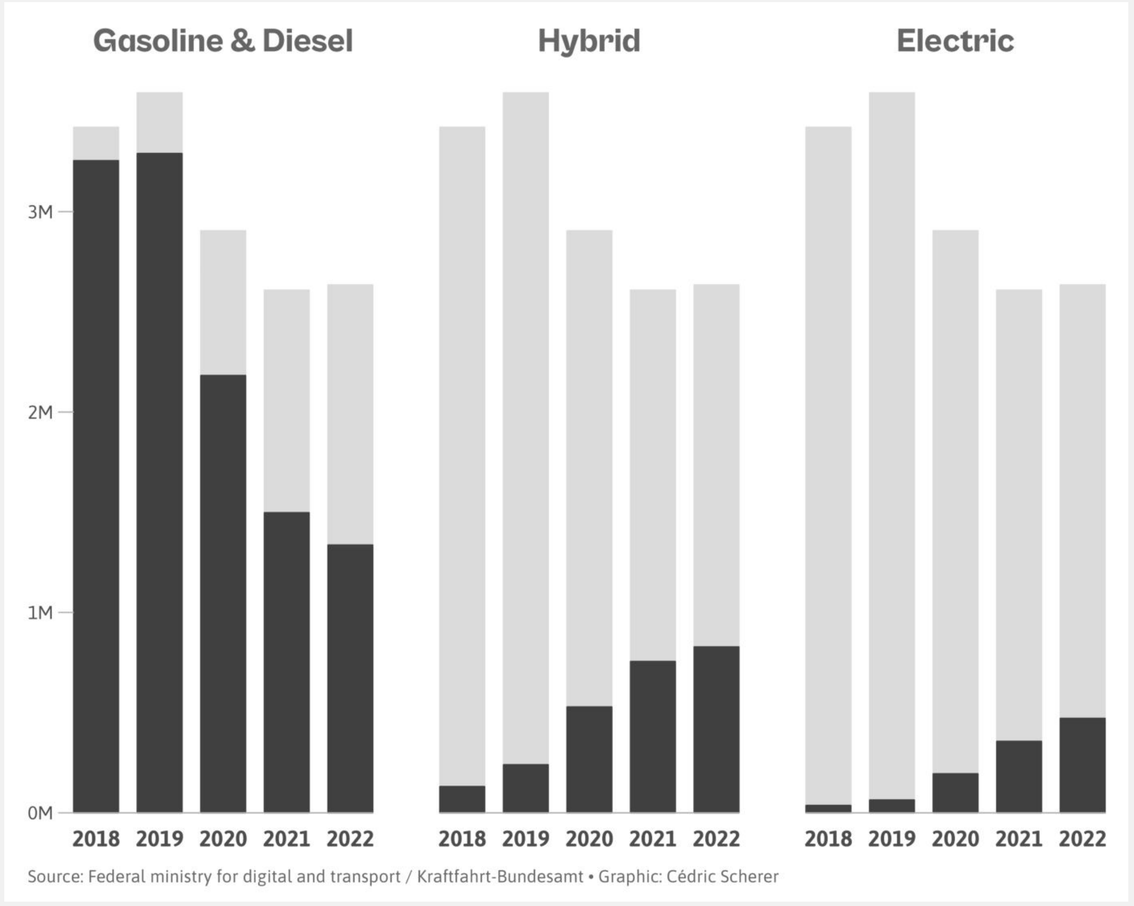
The Power of Small Multiples



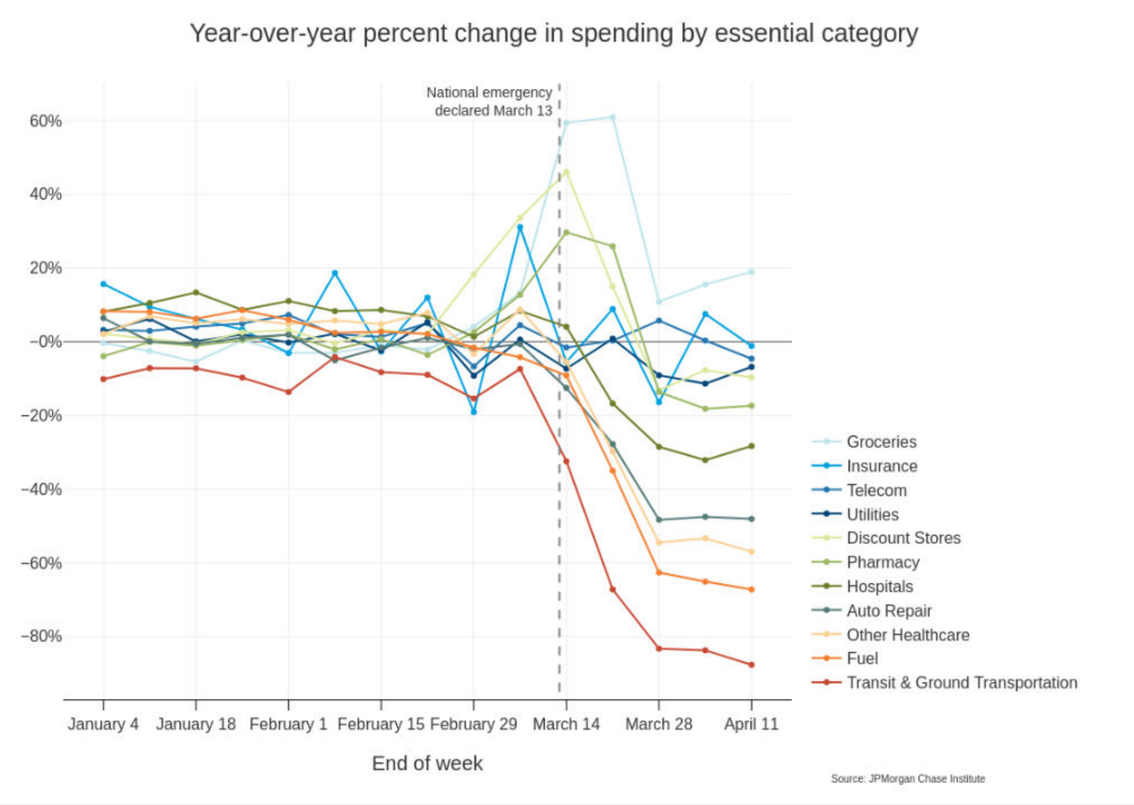


The Power of Small Multiples

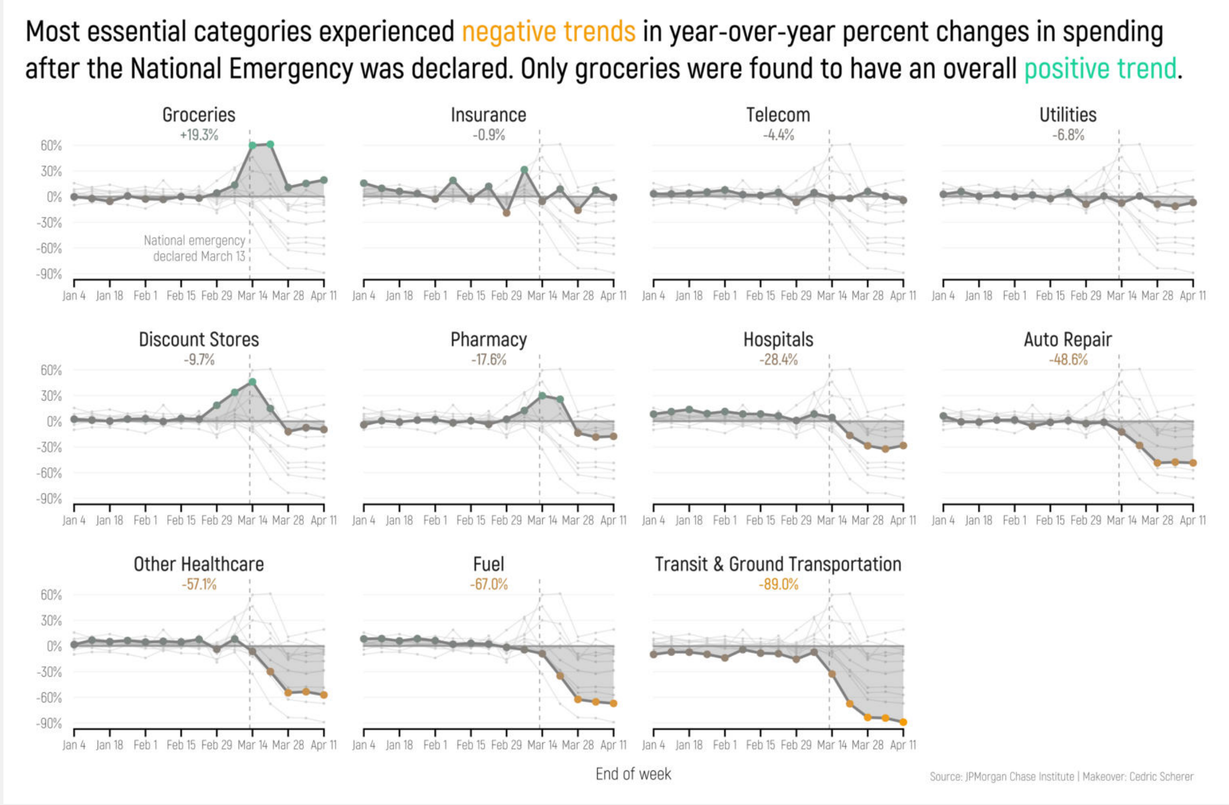




The Power of Small Multiples

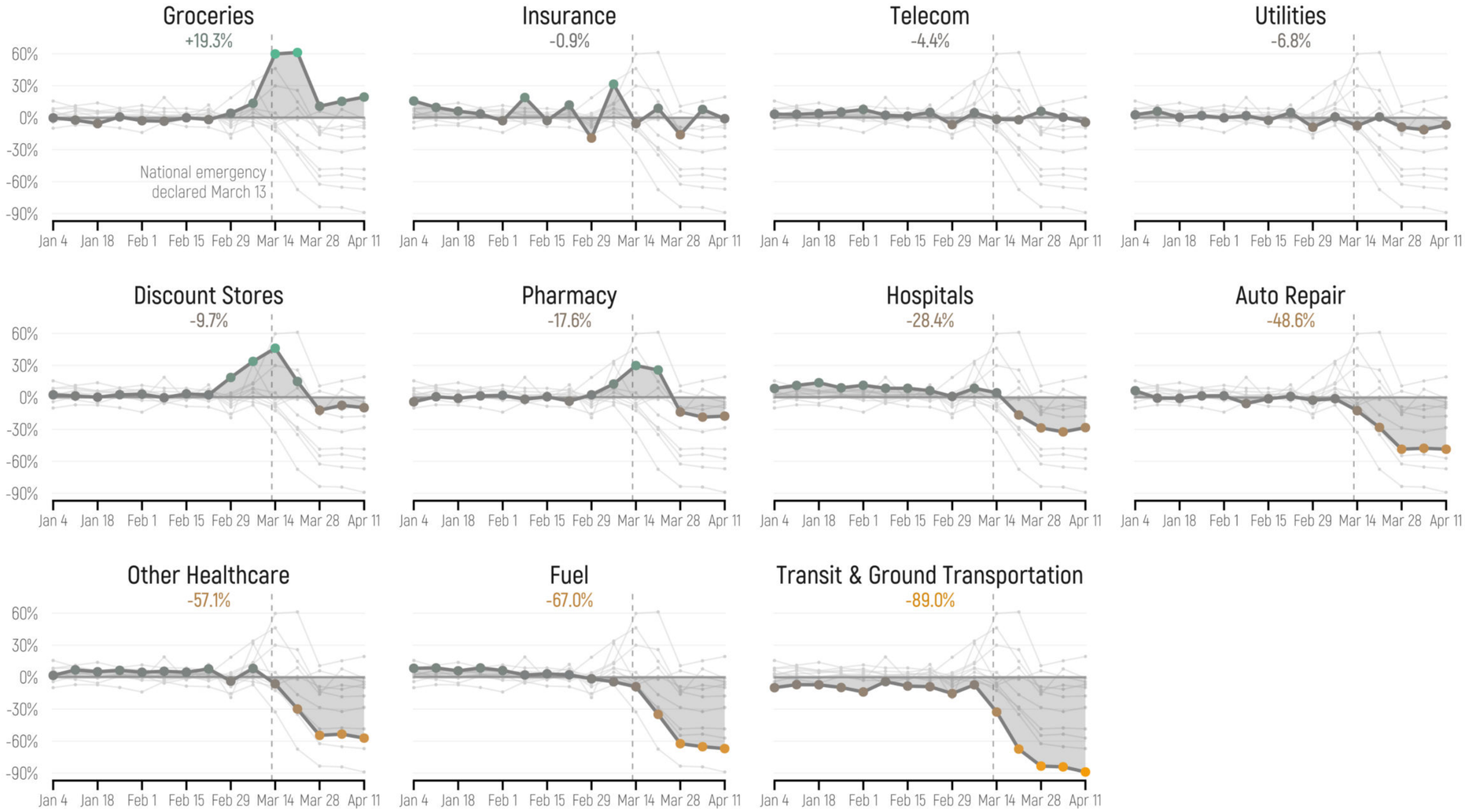


Originalgrafik vom JPMorgan Chase Institut

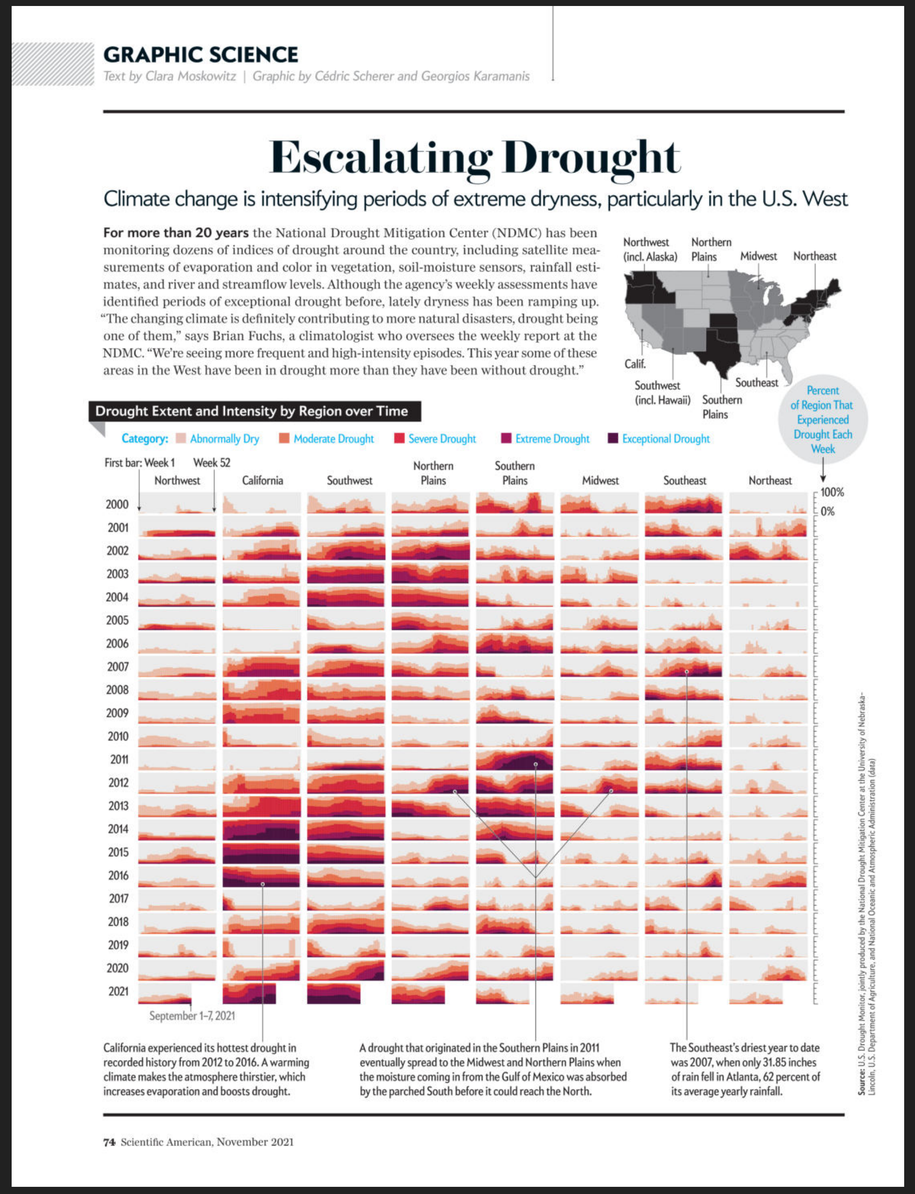


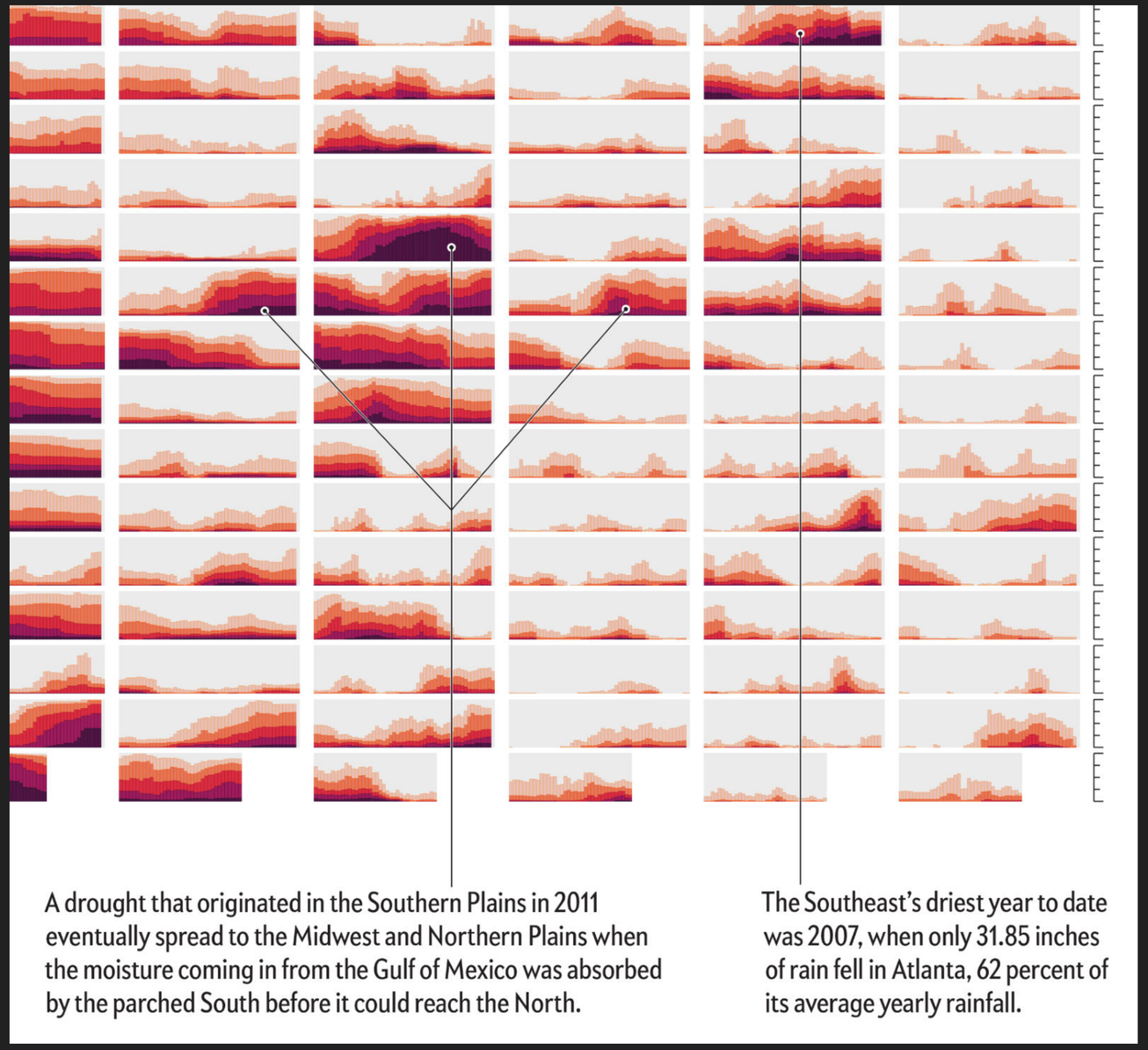
Umgestaltung mit “Small Multiples”

Most essential categories experienced negative trends in year-over-year percent changes in spending after the National Emergency was declared. Only groceries were found to have an overall positive trend.

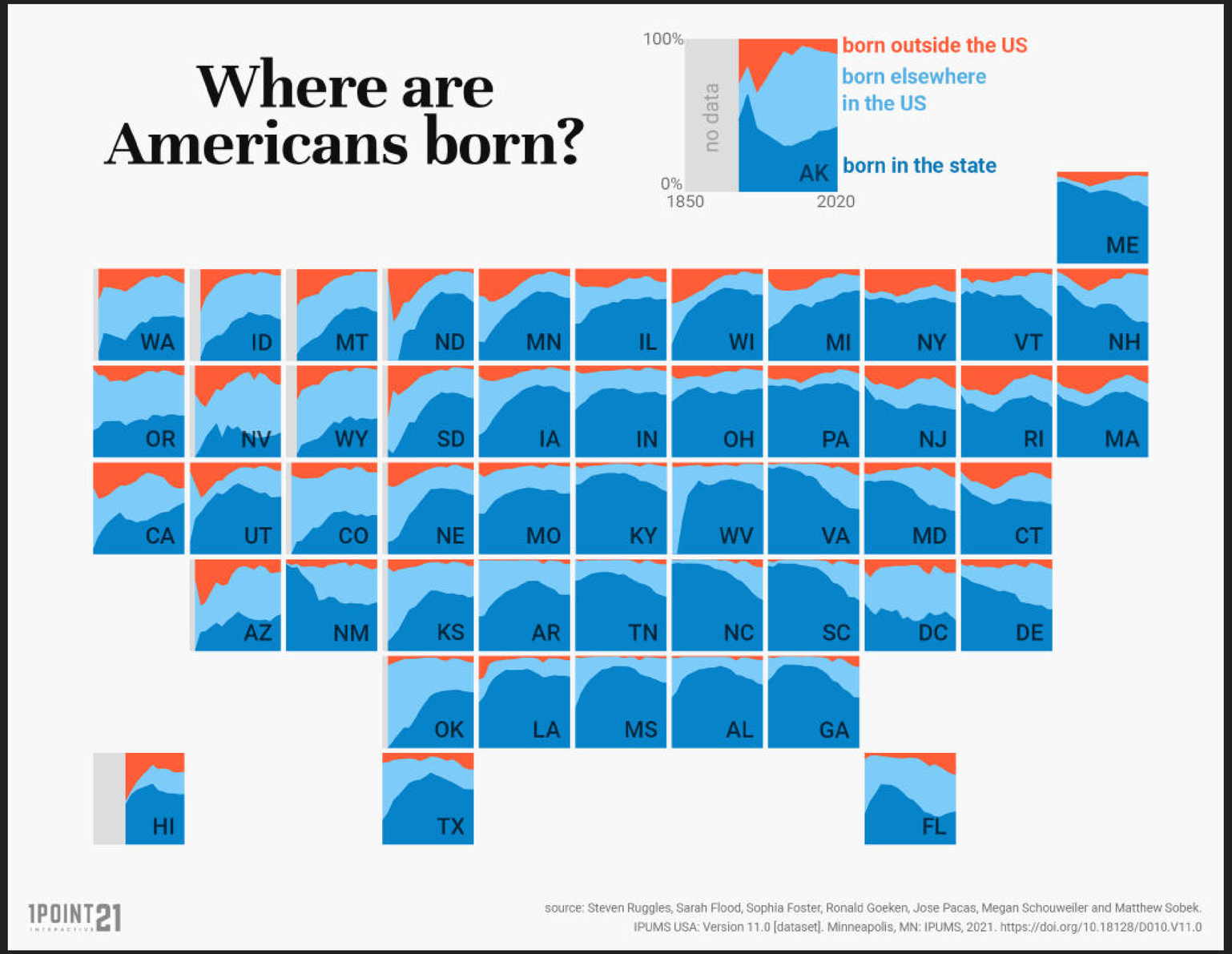


Source: JPMorgan Chase Institute | Makeover: Cedric Scherer





"Escalating Drought", zusammen mit Georgios Karamanis für den Scientific American, Ausgabe Nov 2021



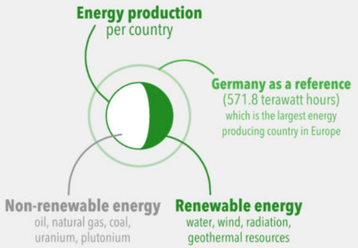
"Where are Americans born?" von @ErinDataViz

How European countries generated electricity in 2018

Germany is the largest energy producing country in Europe. It generates the most renewable and conventional thermal energy, representing 31% and 56% of its overall production respectively. **France** is the second largest energy European producer and by far the largest nuclear energy provider: 71% of its production is based on nuclear fission to generate heat.

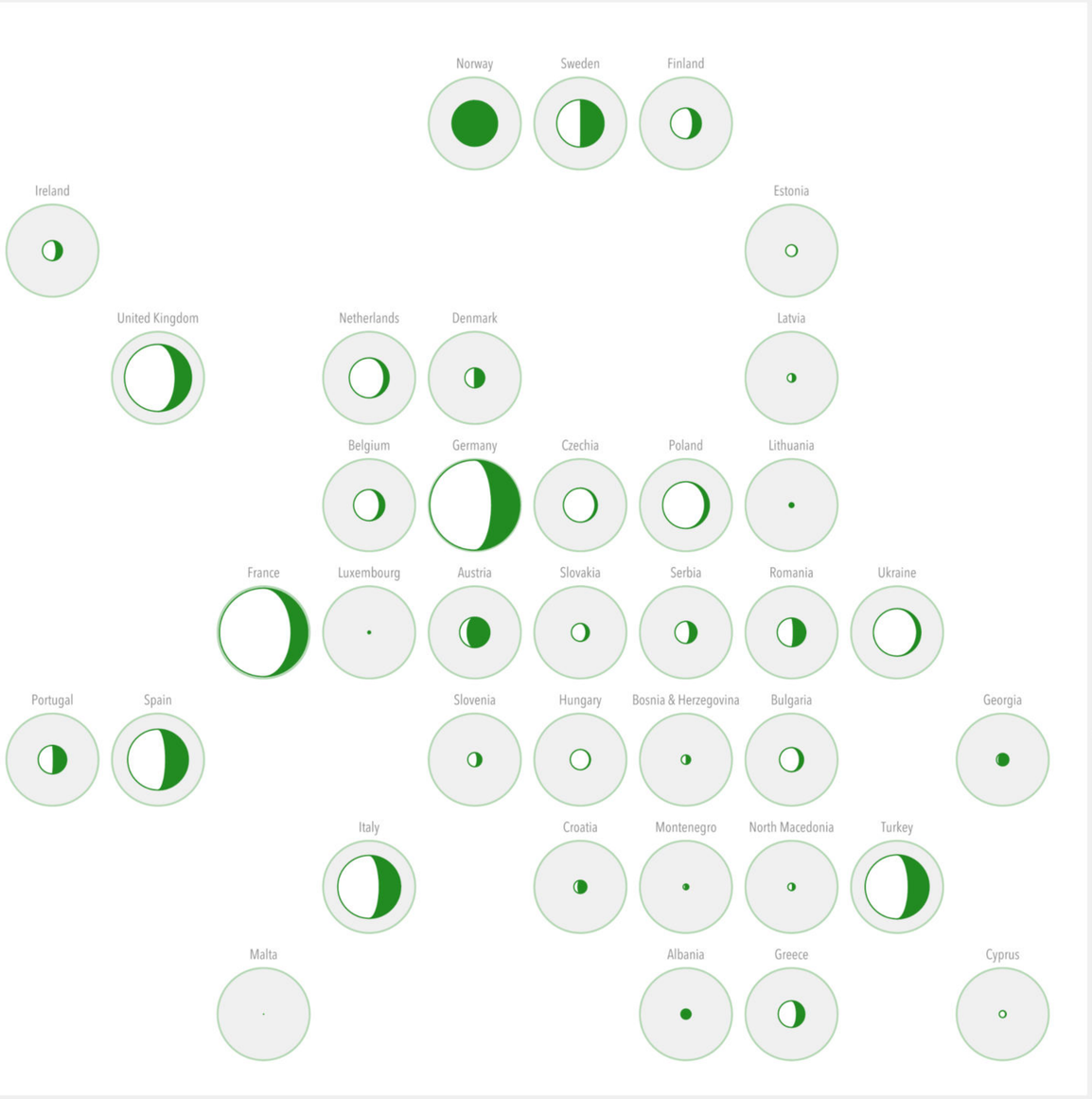
Renewable:	Nuclear:	Conventional thermal:
Germany	**France**	**Germany**
179.1 TWh	393.2 TWh	320.4 TWh
(31% of its production)	(71% of its production)	(56% of its production)

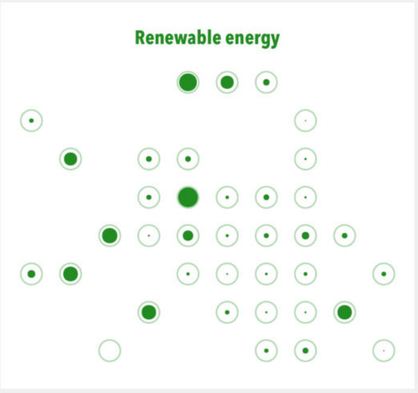
Renewable energy is energy that comes from resources that are naturally replenished such as sunlight, wind, water, and geothermal heat. Unlike fossil fuels, such as oil, natural gas and coal, or nuclear power sources such as uranium and plutonium, renewable energy regenerates naturally in a short period of time.

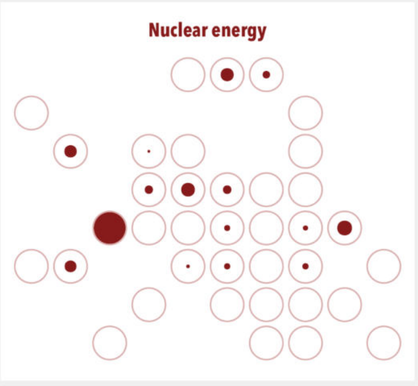


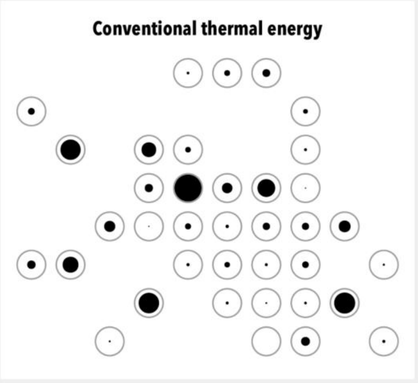
Norway had an electricity production almost entirely made up of renewable energy (98%). This makes Norway the second largest producer of this energy type in Europe. Interestingly, most of the renewable energy is produced by hydro power that take up 95% and only 3% by wind. In contrast, twelve European countries were reported to produce less than 20% of their energy with renewable resources: **Malta** (0%), **Hungary** (5%), **Estonia** (6%), **Czechia** (7%), **Cyprus** (9%), **Ukraine** (9%), **Poland** (10%), **Netherlands** (13%), **Bulgaria** (17%), **Belgium** (18%), **Slovakia** (19%), and **France** (19%).

Note: Energy production is mapped to the area of the circles.
Visualization by Cédric Scherer • Data by Eurostat



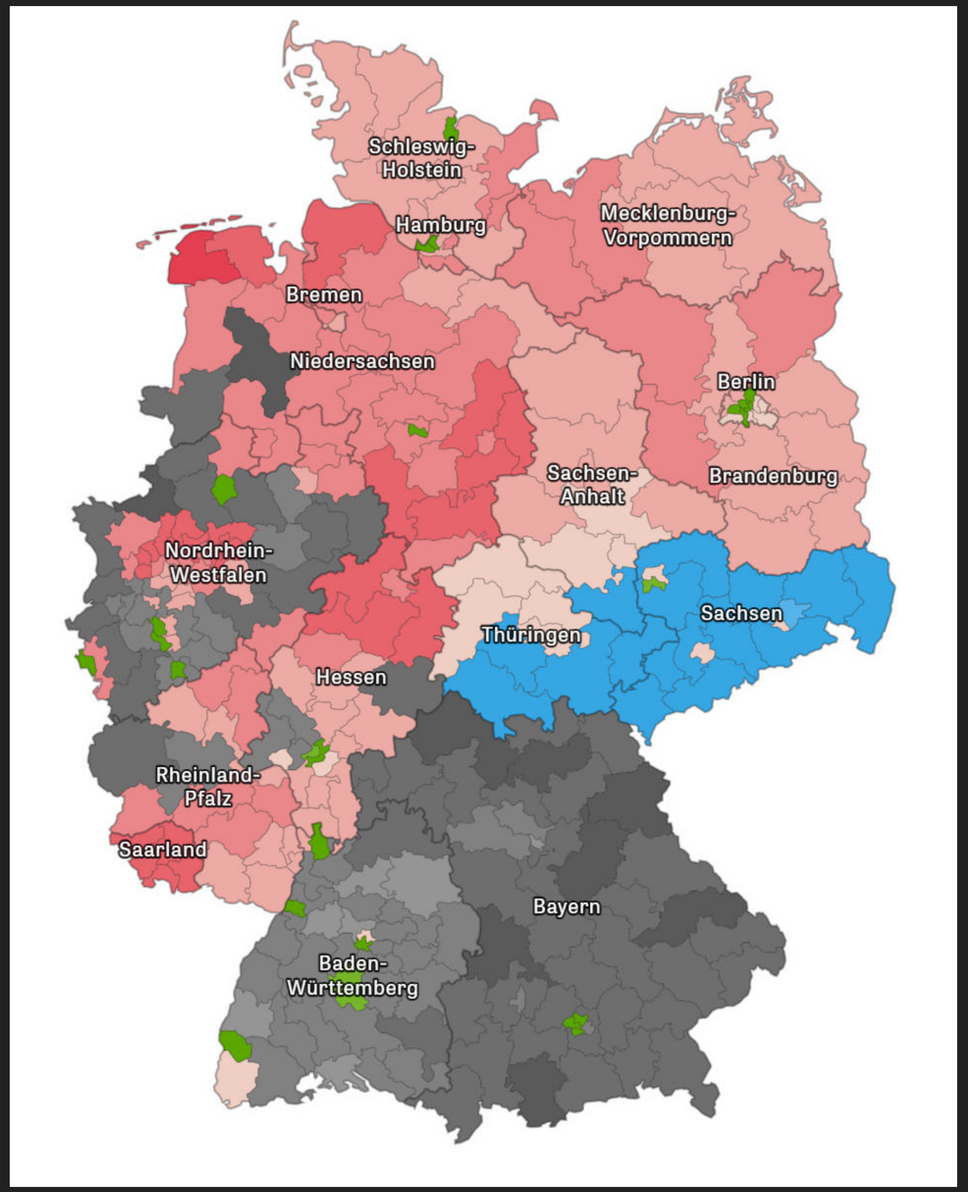


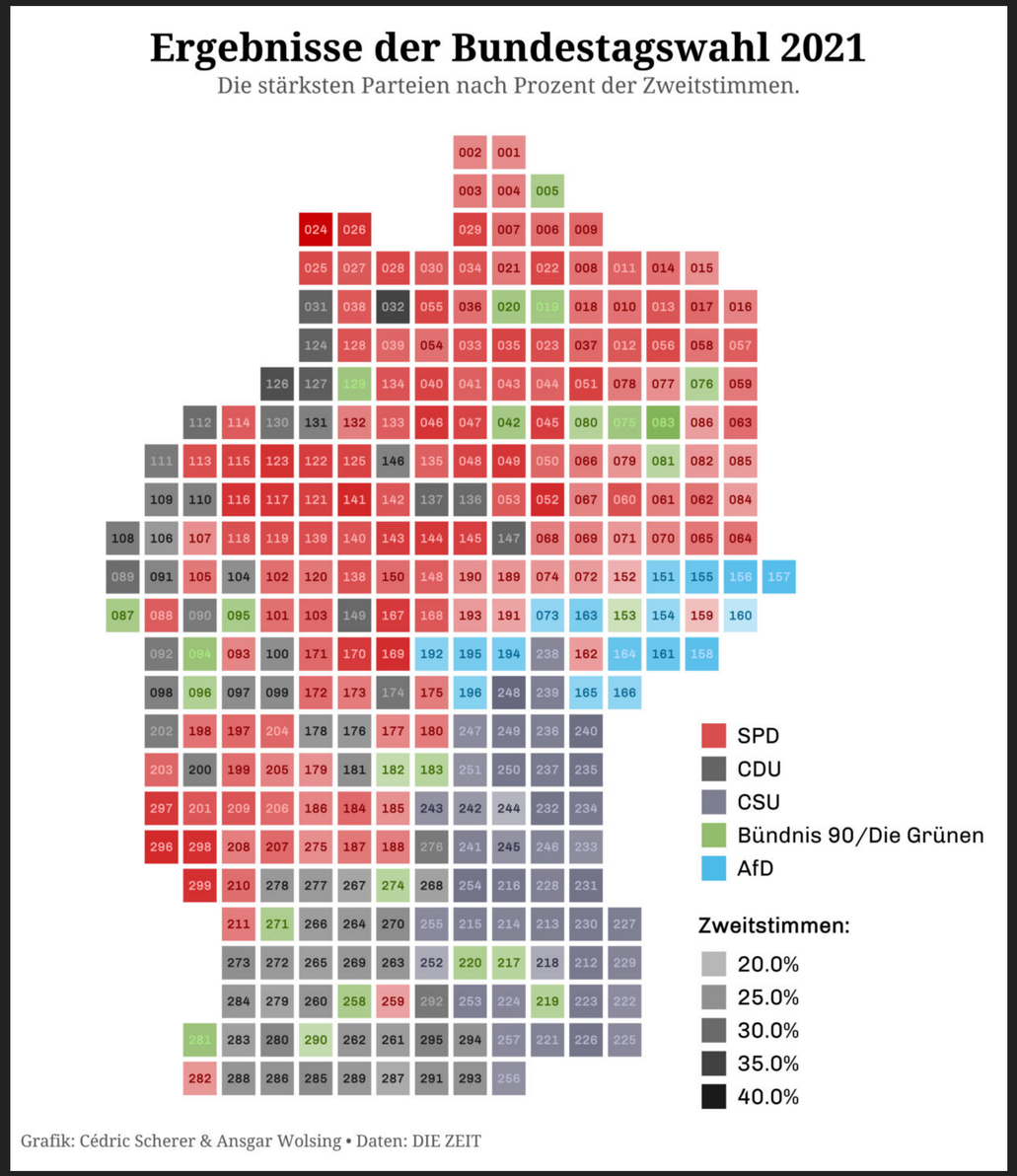




"How European countries generated electricity in 2018", #TidyTuesday Contribution

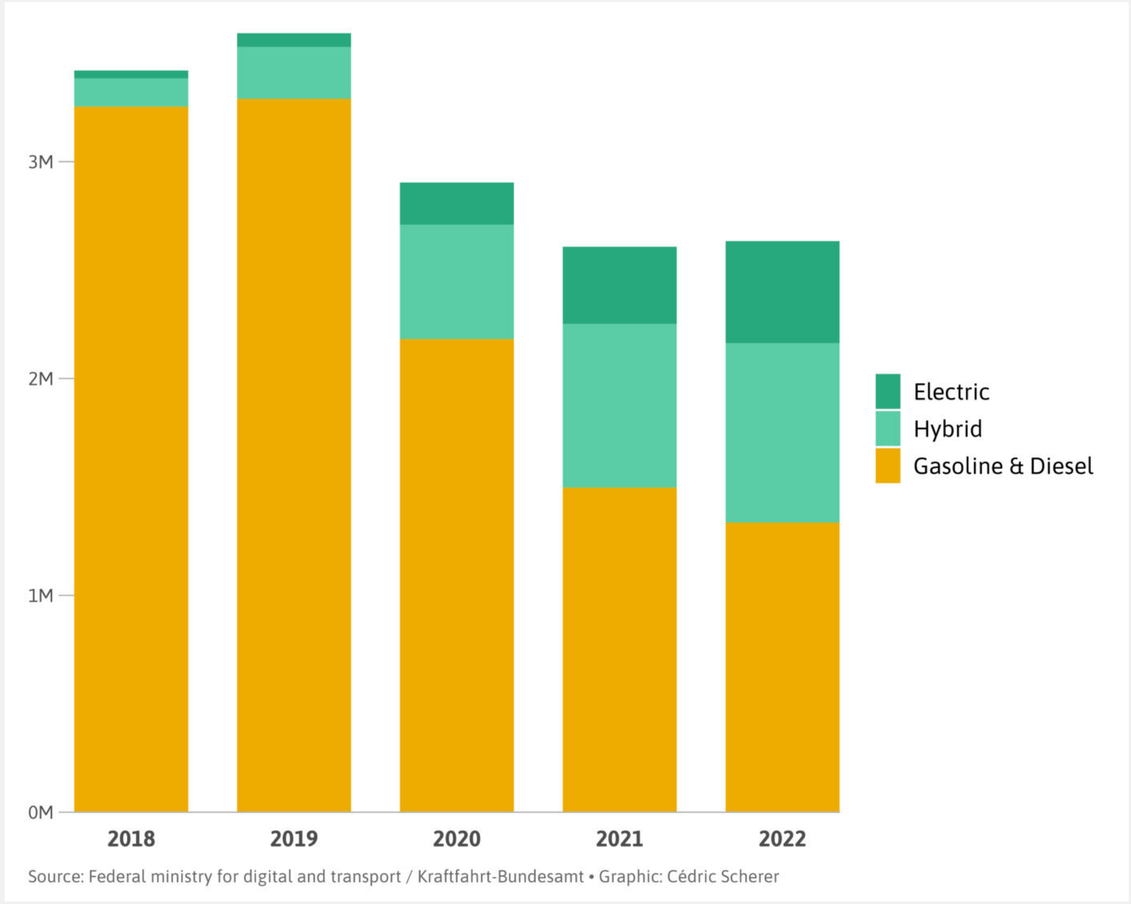
cedricscherer.com @CedScherer z3tt

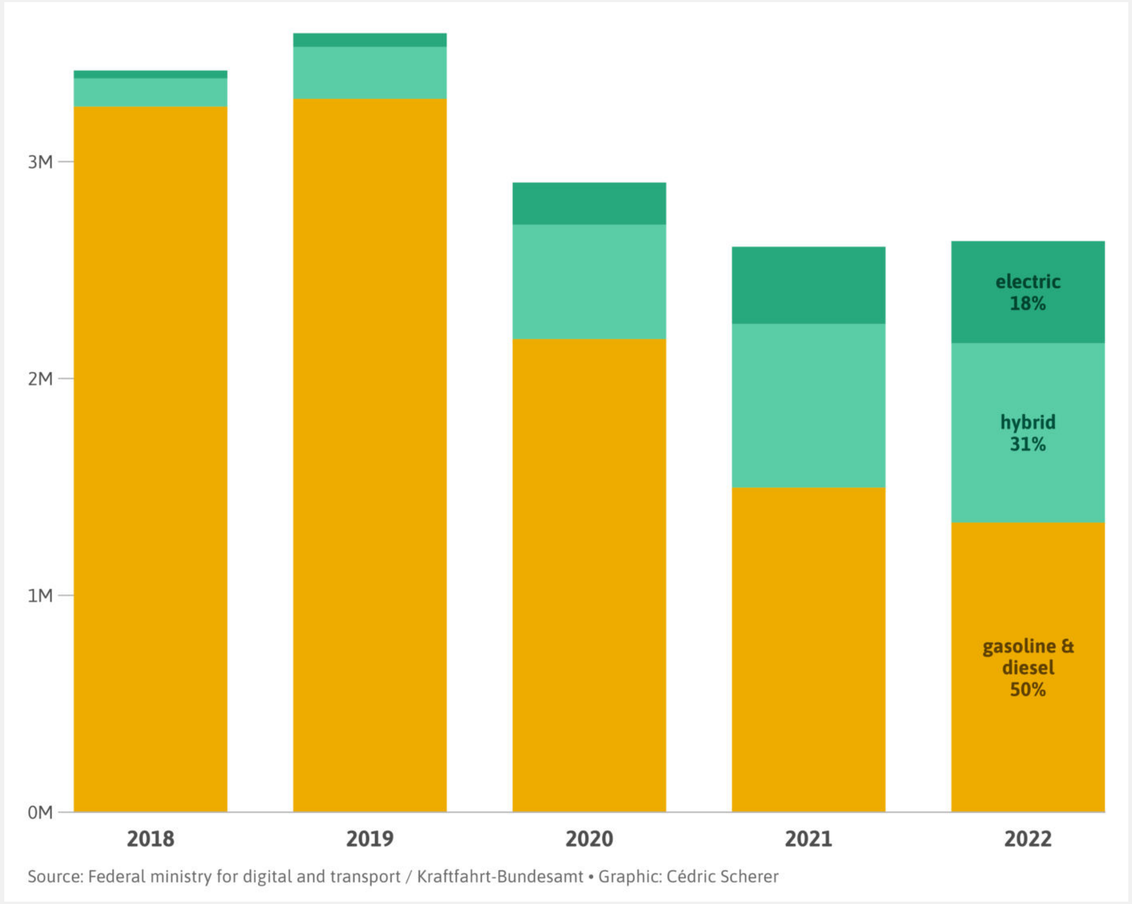




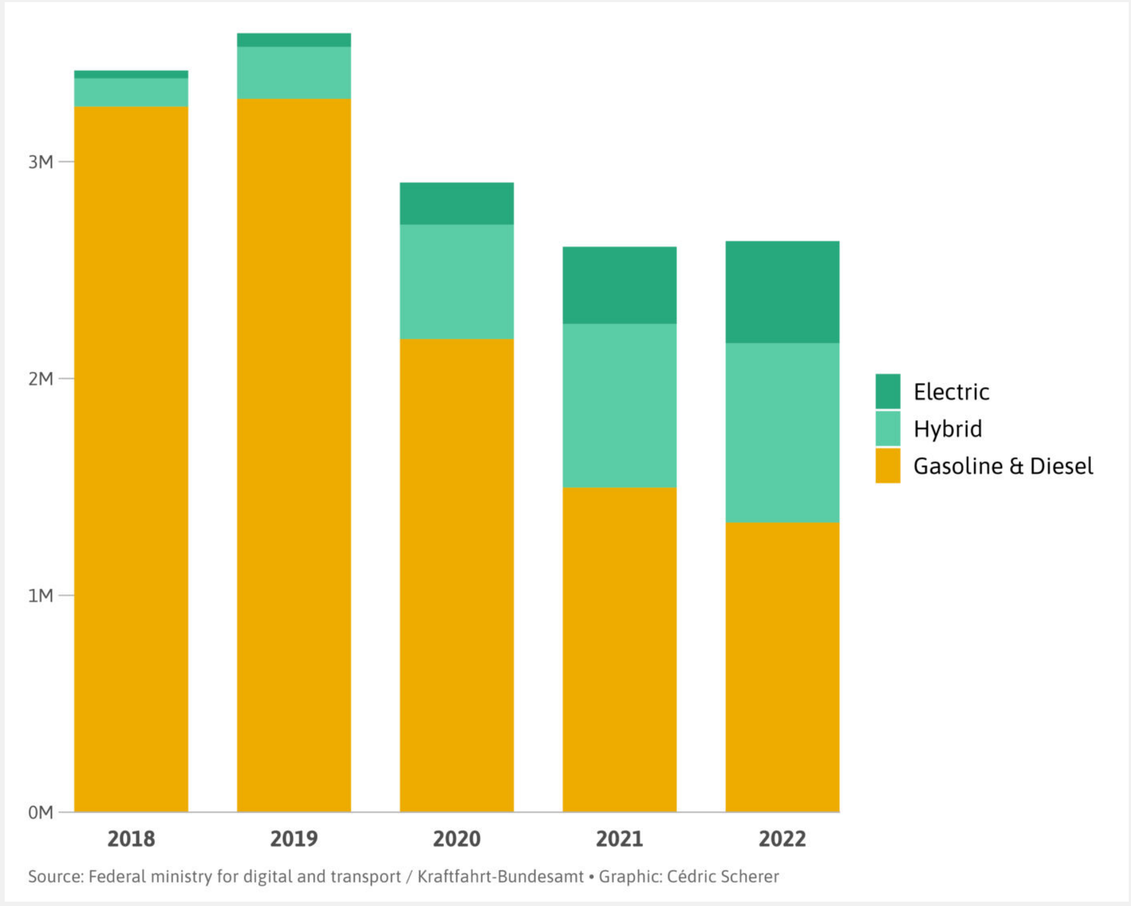
Links: Choropleth-Karte von Die Zeit | Rechts: Kachel-Karte ("Tile Grid Map") von Cédric Scherer & Ansgar Wolsing

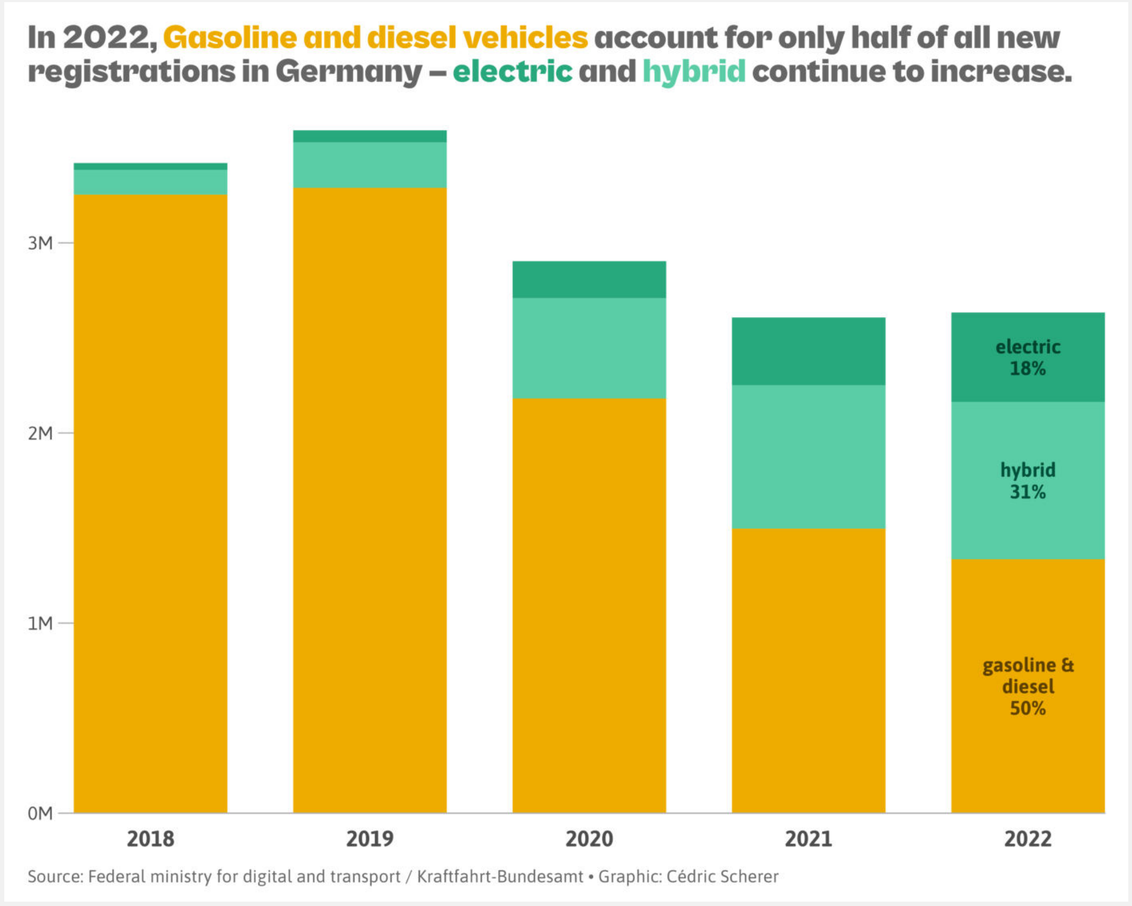
The Power of Annotations



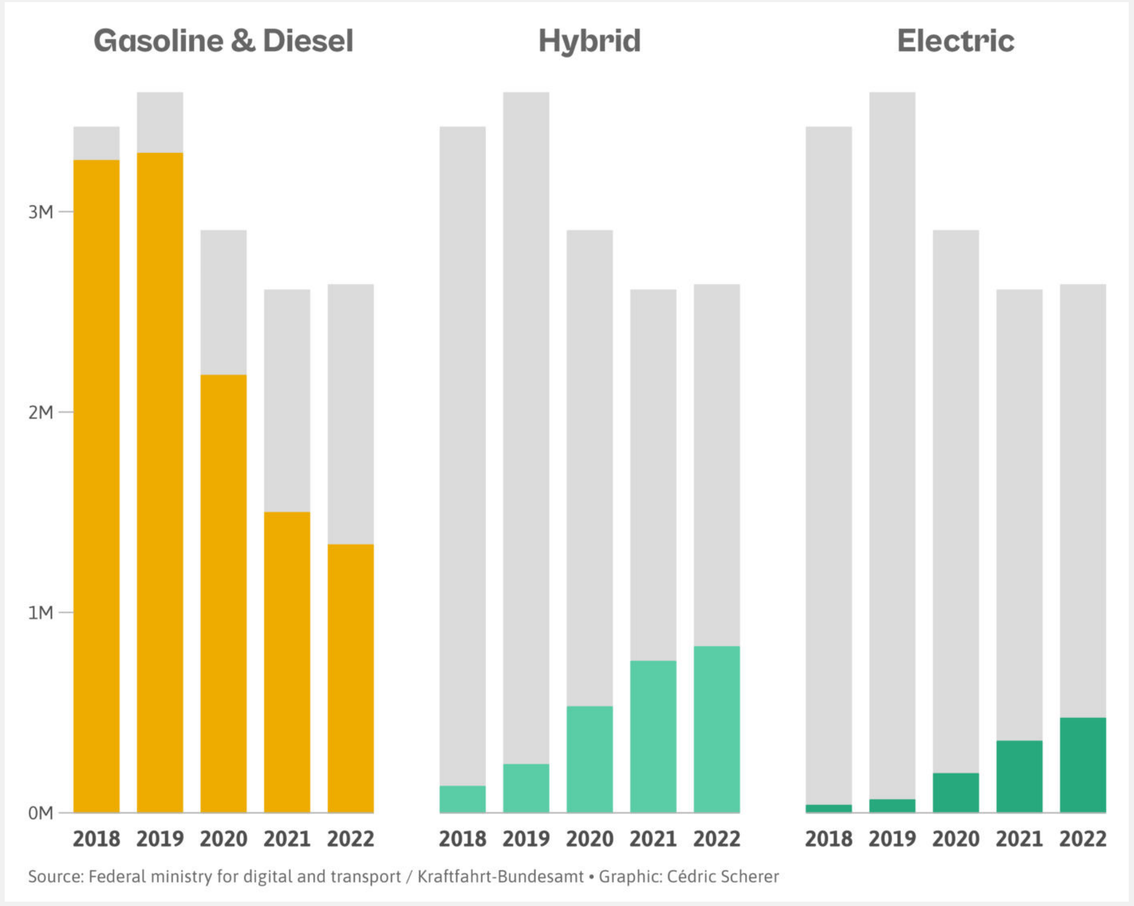


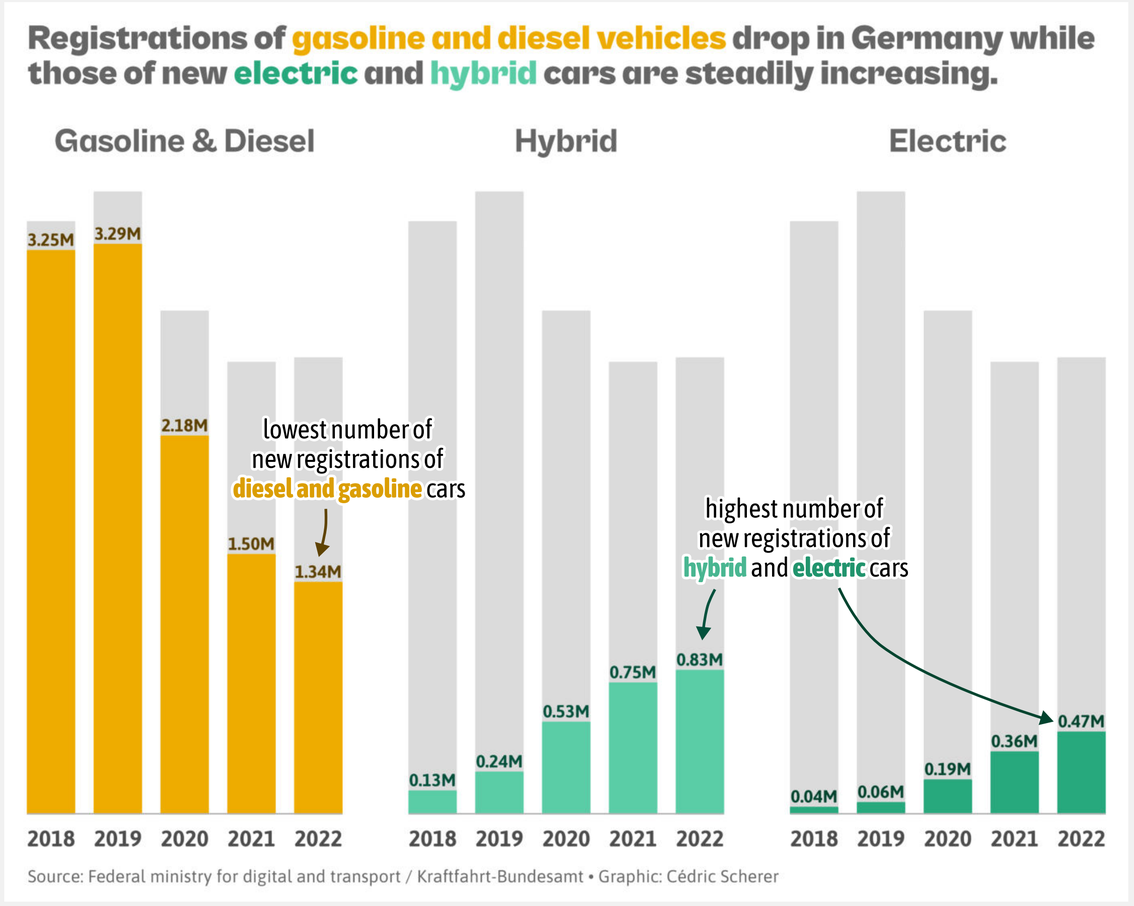
The Power of Annotations



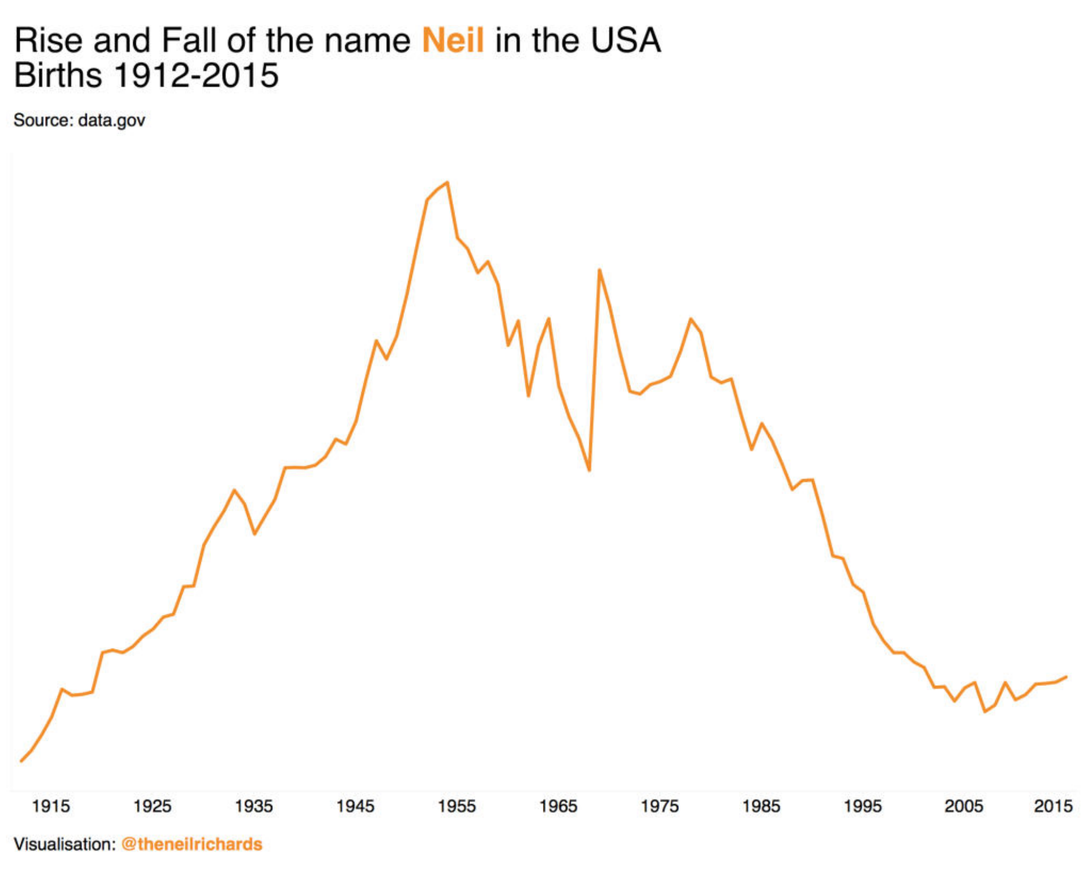


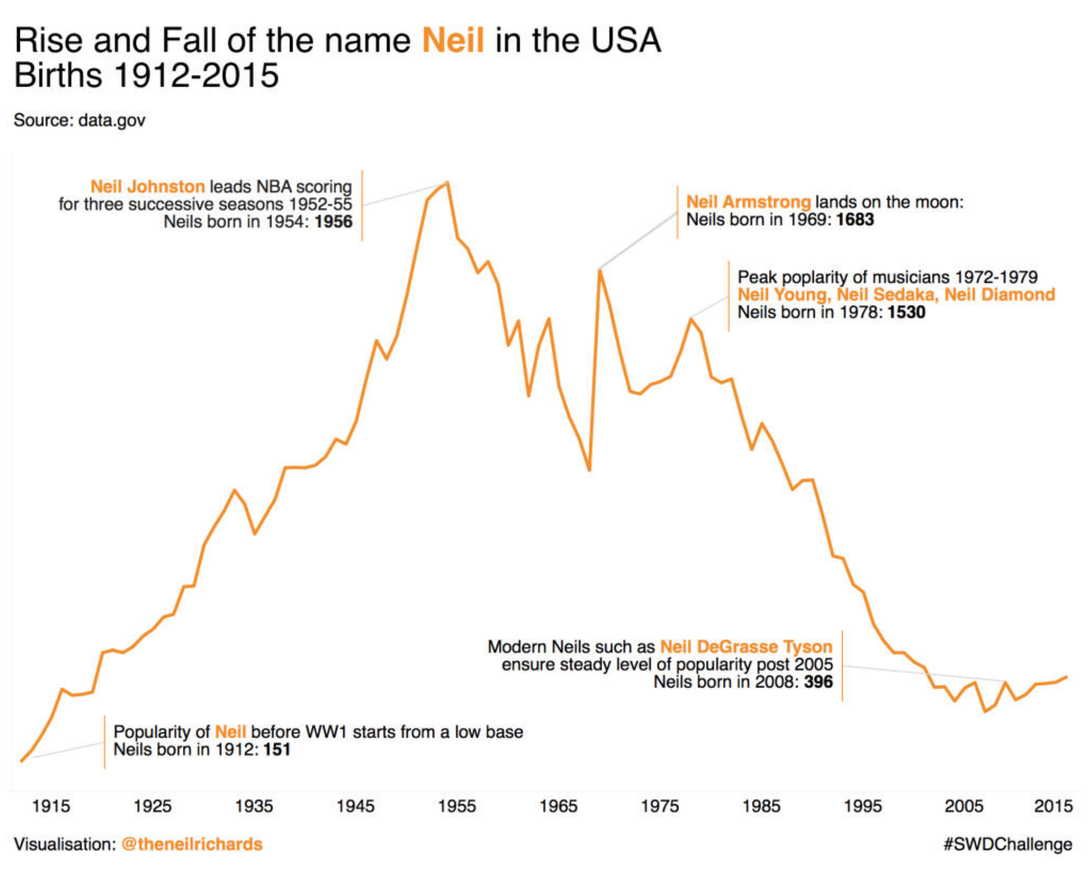
The Power of Annotations



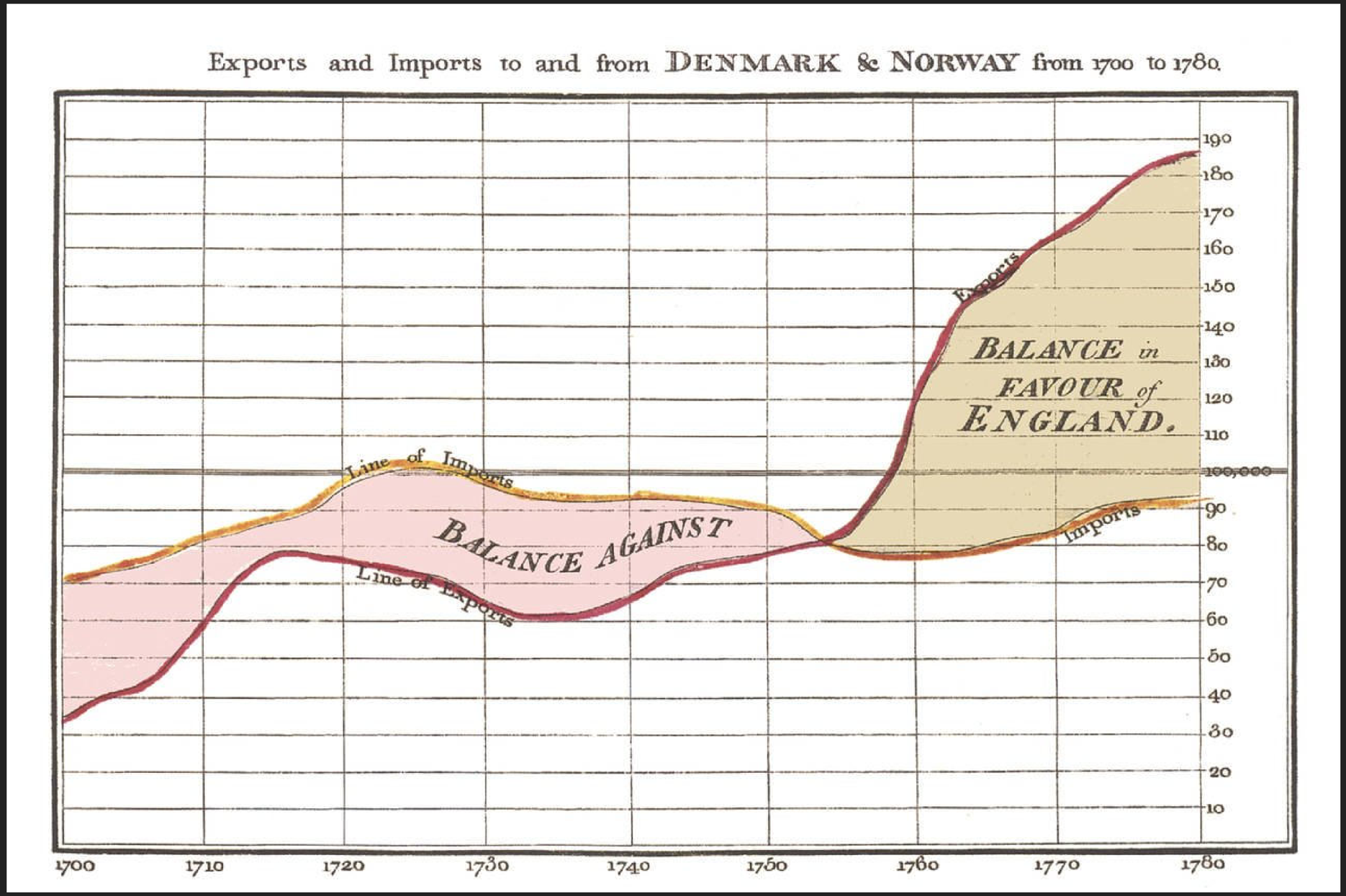


The Power of Annotations





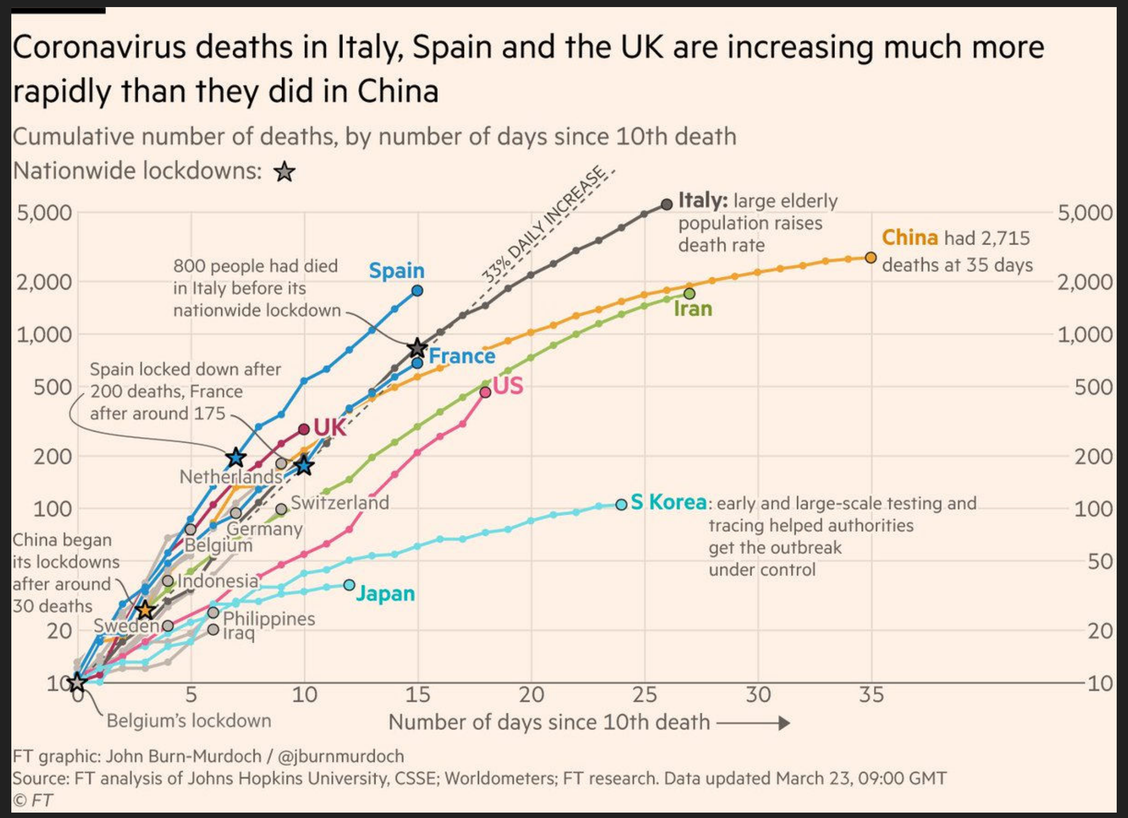
"Is white space always your friend?" by Neil Richards

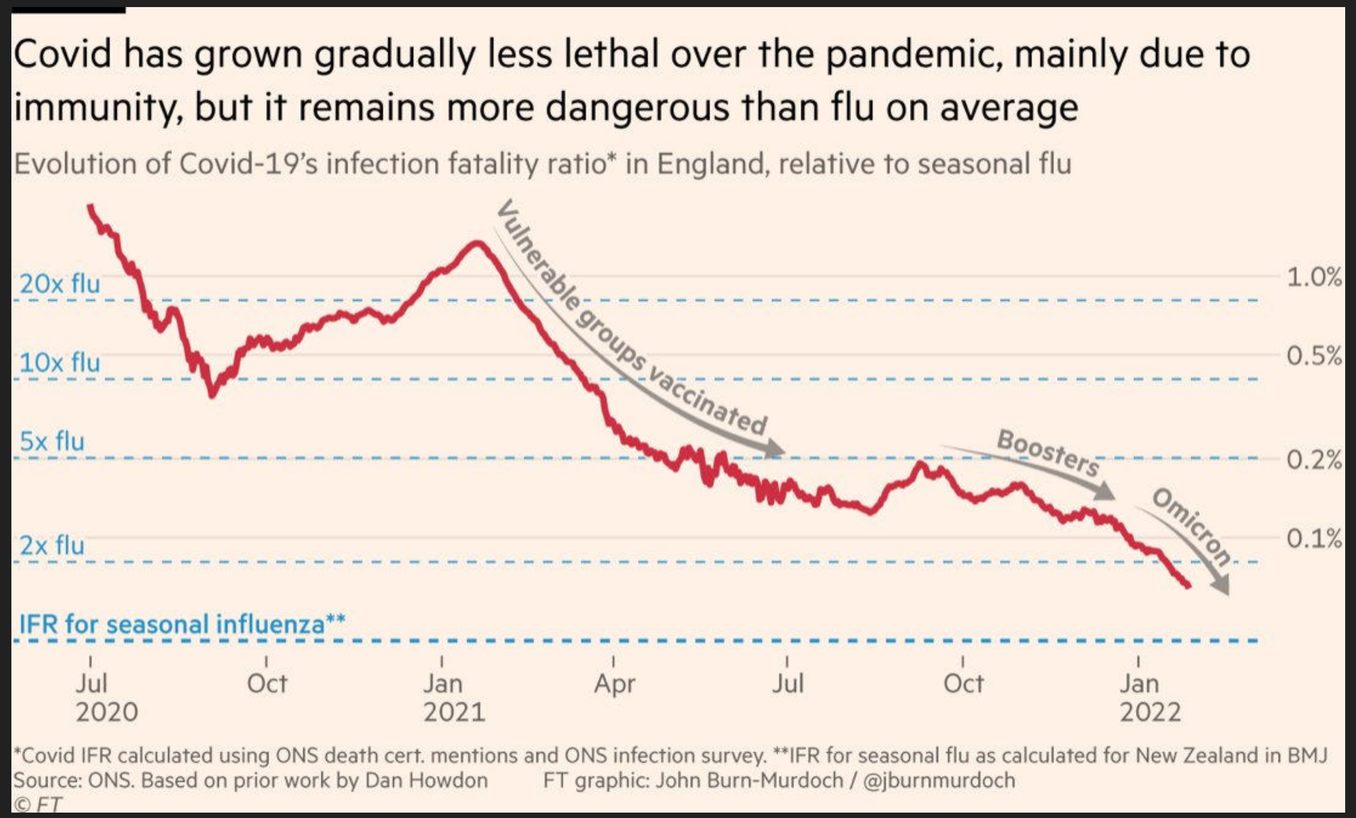


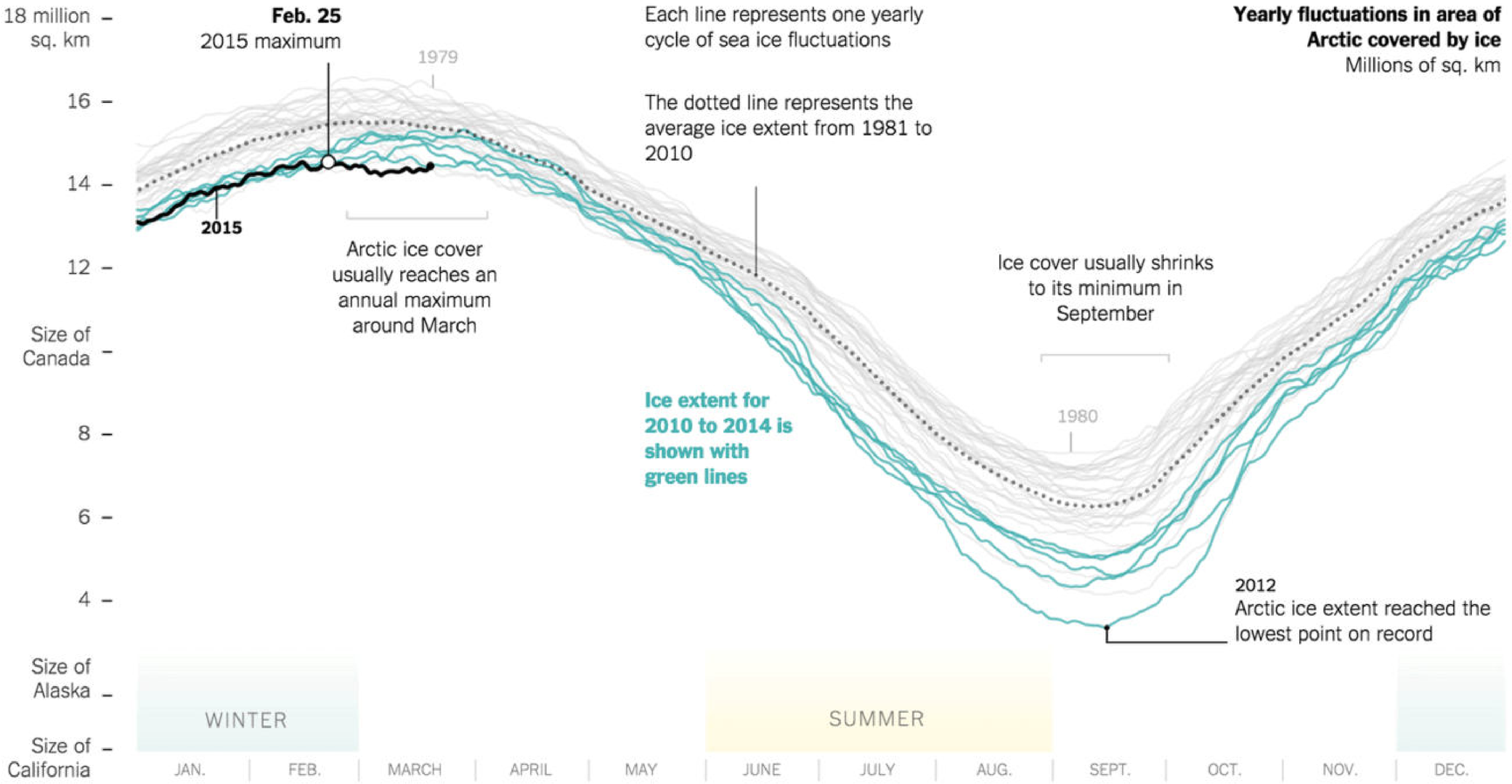
Zeitreihe mit Beschriftungen von William Playfair from “The Commercial and Political Atlas and Statistical Breviary” (1786)

“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 enourmous value for non-chart people**.”

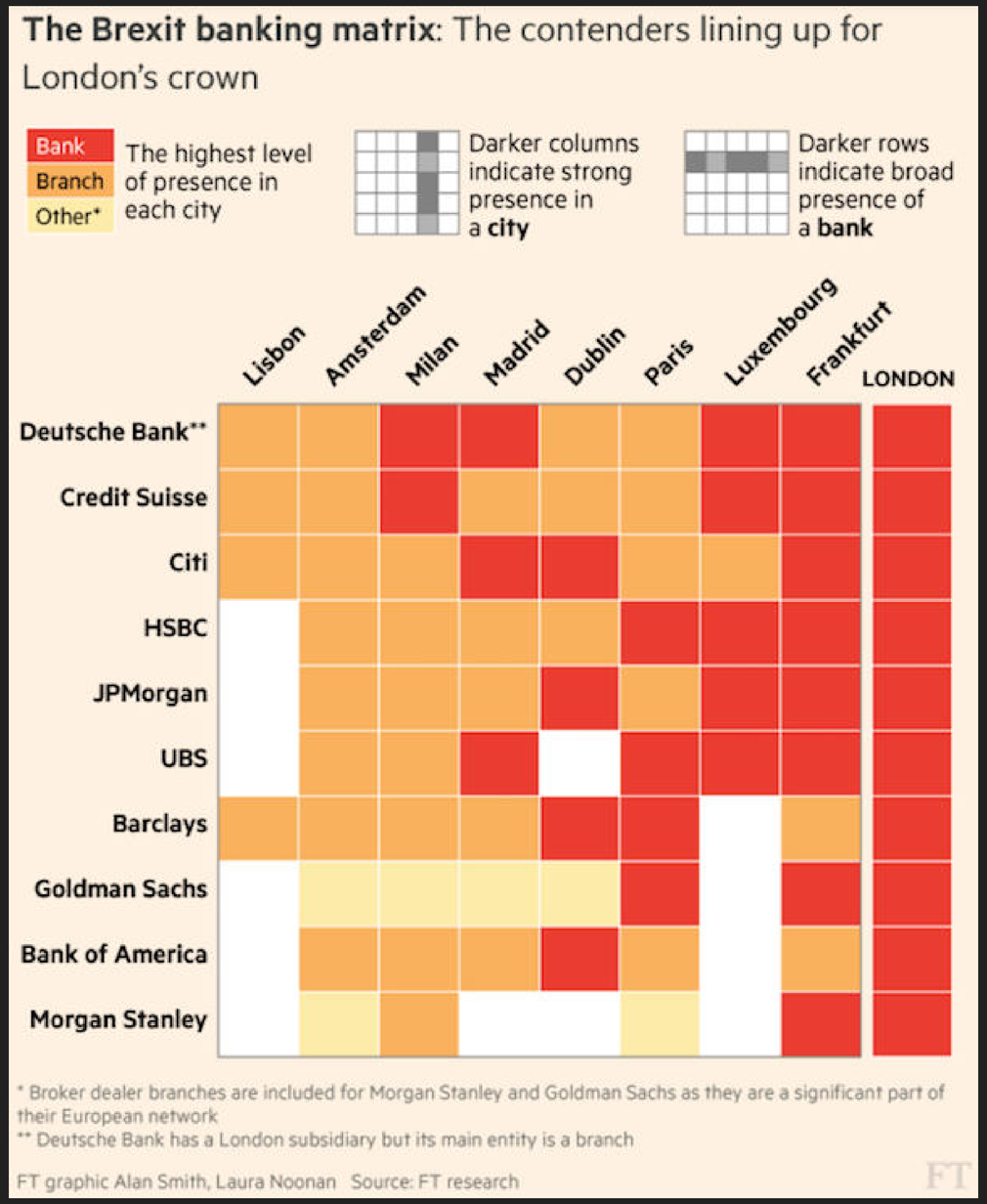
~ John Burn-Murdoch, Financial Times







"Yearly Fluctuations in Area of Arctic Covered by Ice" by Derek Watkins (New York Times)



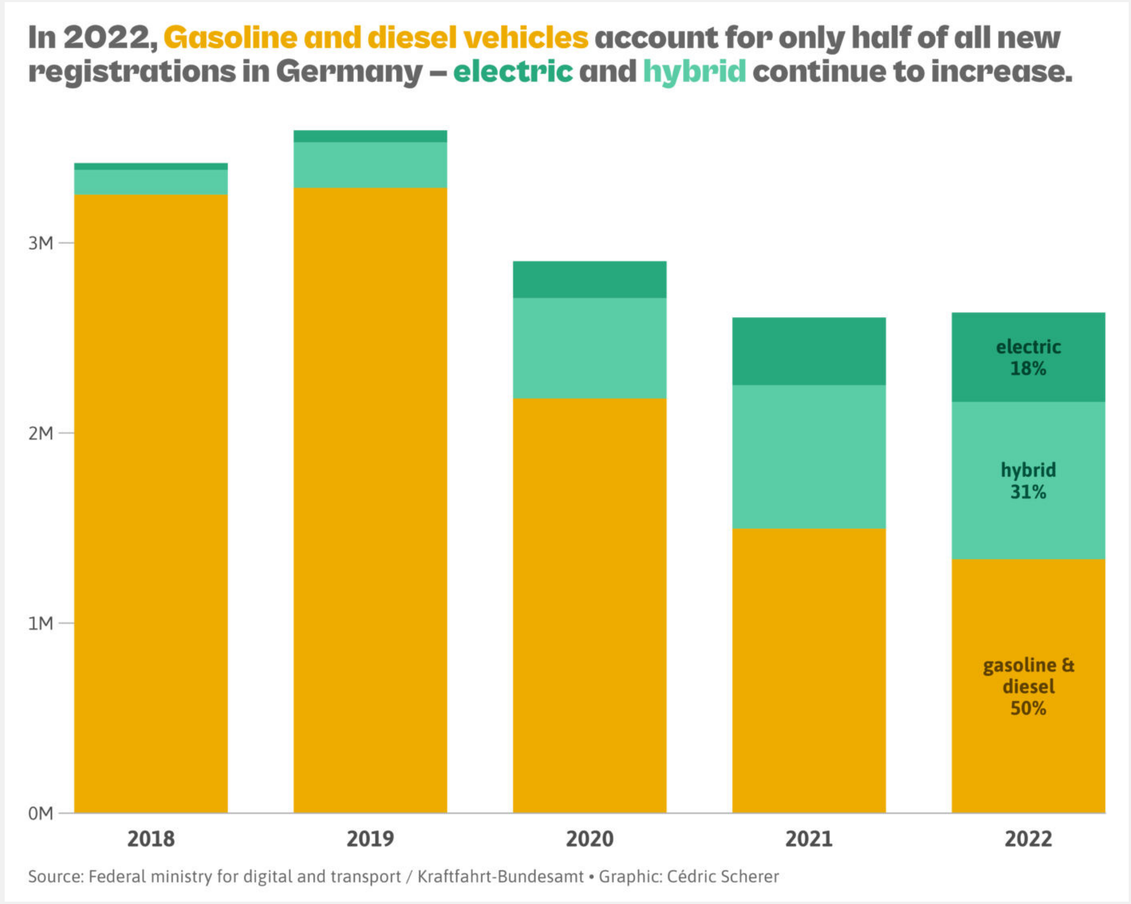
"Frankfurt vies for UK banking jobs post-Brexit" by Alan Smith und Laura Noonan (Financial Times)

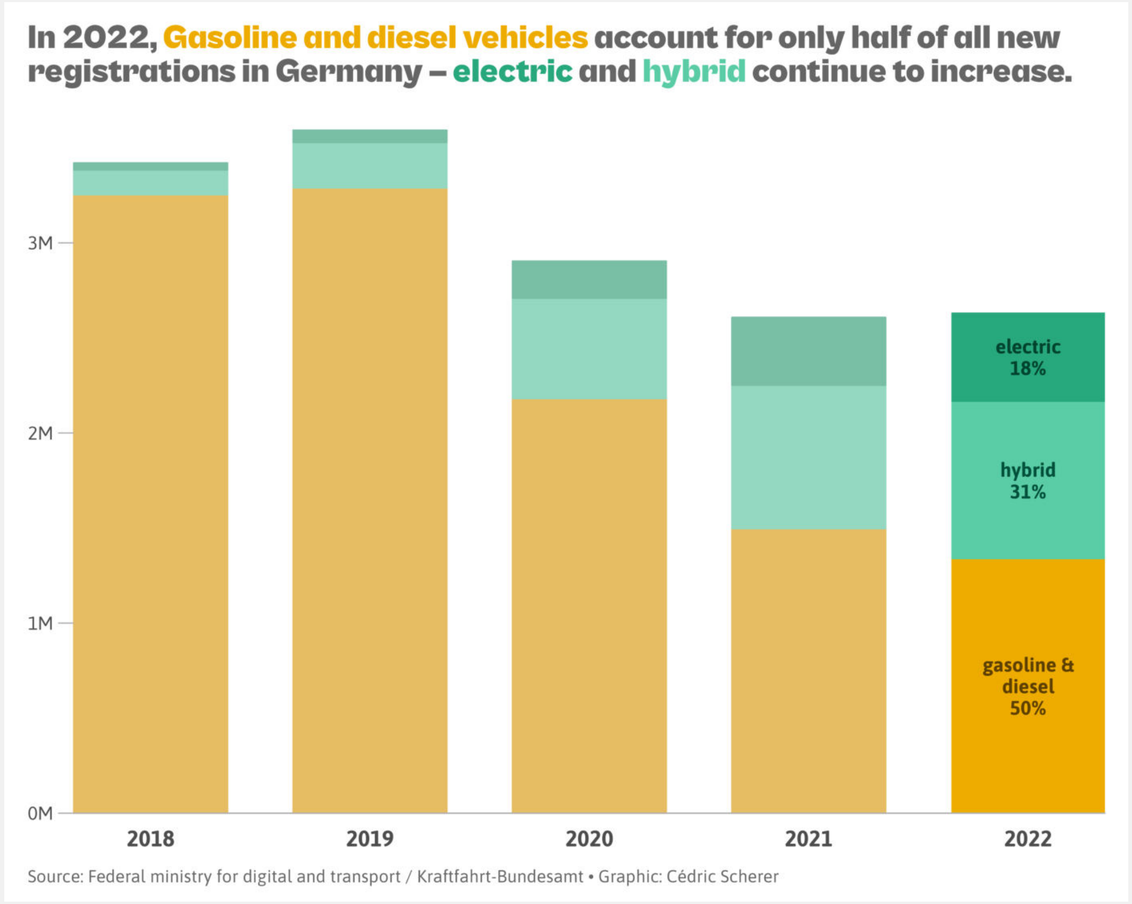
Supplementary supermarket shopping

	Aldi	Asda	Iceland	Lidl	Marks & Spencer	Morrisons	Sainsbury's	Tesco	The Co-operative	Waitrose
Aldi		36	26	34	17	33	23	28	22	16
Asda	38		34	32	19	29	20	27	20	11
Iceland	18	22		20	12	19	14	17	12	7
Lidl	25	24	26		13	24	20	24	21	17
Marks & Spencer	9	12	9	9		17	28	17	17	37
Morrisons	27	26	21	25	22		20	22	20	13
Sainsbury's	26	25	20	33	47	29		32	31	39
Tesco	45	39	42	44	43	37	42		42	40
The Co-operative	15	15	11	17	18	17	20	19		20
Waitrose	5	5	6	9	30	7	21	11	14	

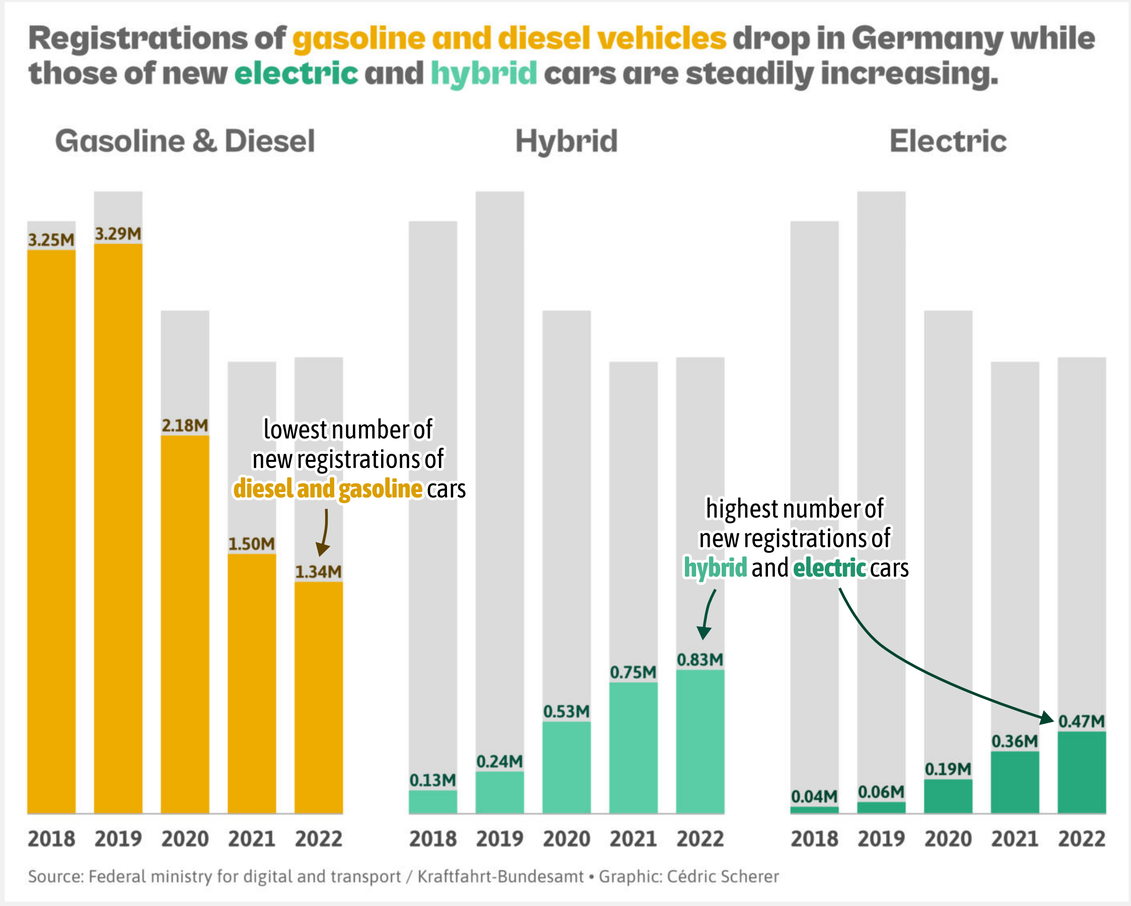
"Tesco is the nation's primary AND secondary supermarket" by Matthew Smith (YouGov)

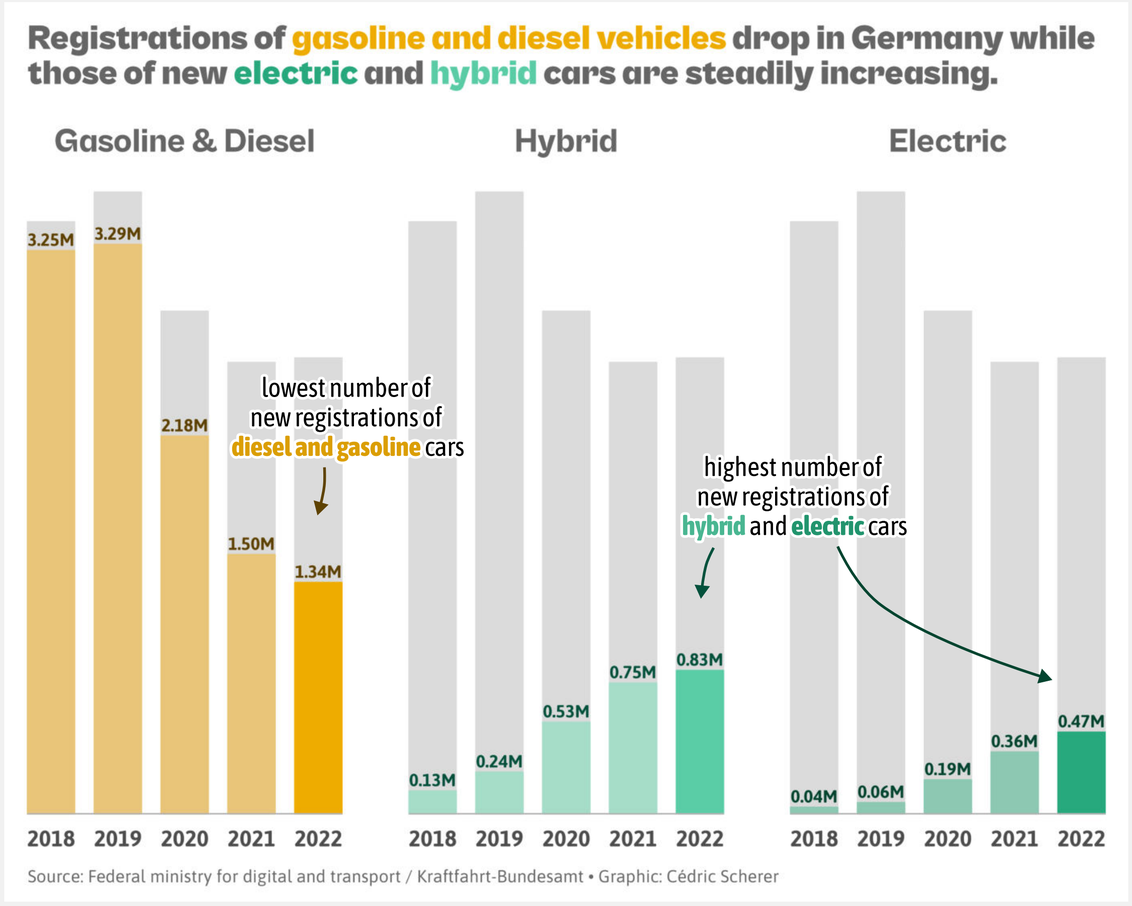
The Power of Colors



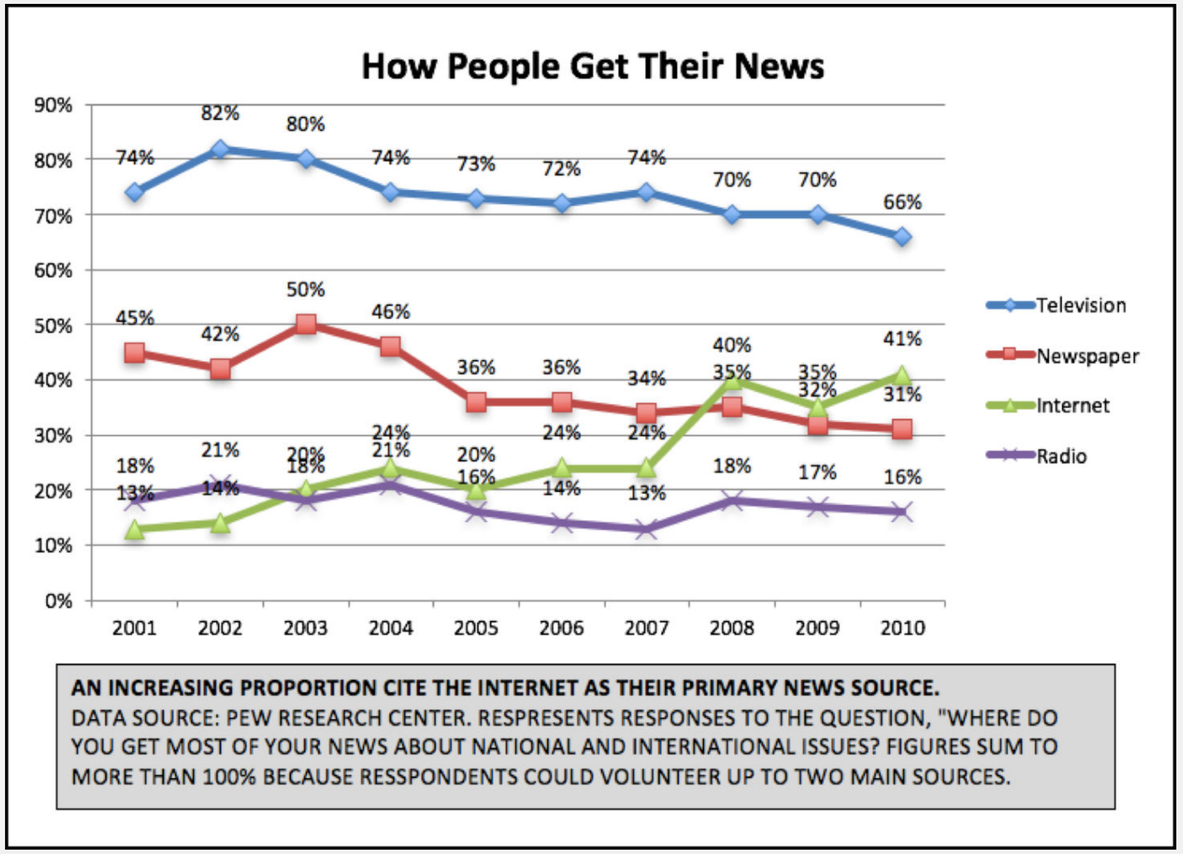


The Power of Colors





Group Exercise



Declutter this graphic

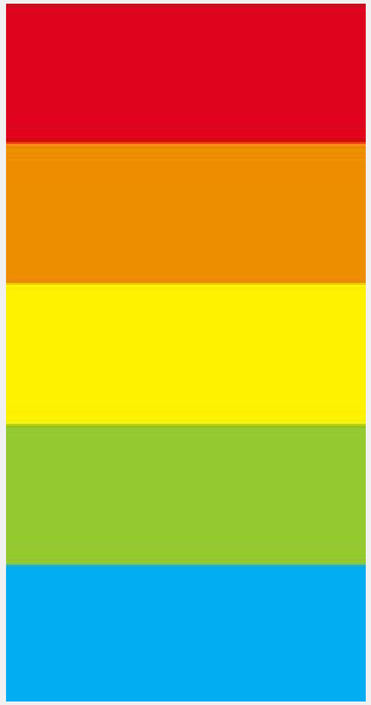
- ☛ What is the main message?
- ☛ Is all the data relevant?
- ☛ What would you change?
- ☛ How can you highlight the **increase**?

- ☛ **Draw a decluttered version!**

Source: StorytellingWithData

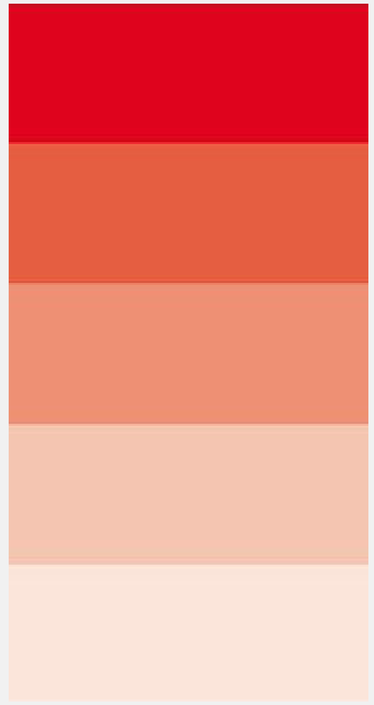

COLORS
and Pitfalls

Hue
color family



Chroma
colorfulness

Luminance
lightness / brightness



Non Uniform Distances

Med Phys. 2015 Jun; 42(6): 2942–2954. Published online 2015 May 20. doi: 10.1118/1.4921125

PMCID: PMC5148121 | PMID: 26127048

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[a)]

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

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

Authors

David Borland, University of North Carolina at Chapel Hill

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Education and communication

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

Michael Stoelzle[1] and Lina Stein[2]

[1]Faculty of Environment and Natural Resources, University of Freiburg, Freiburg, Germany

[2]Department of Civil Engineering, University of Bristol, Bristol, UK

Med Phys. 2015 Jun; 42(6): 2942–2954. Published online 2015 May 20. doi: 10.1118/1.4921125

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

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Rainbow Color Map (Still) Considered Harmful

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

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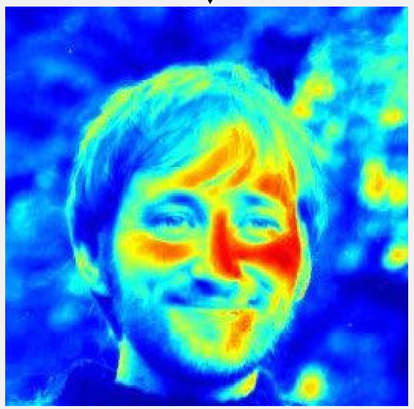
Authors

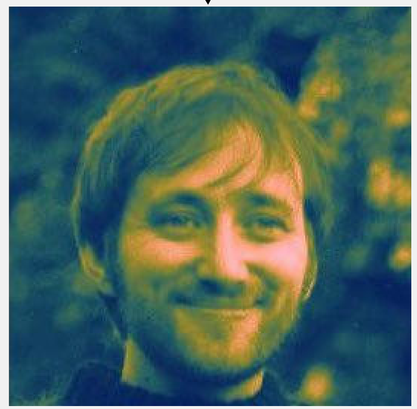
"The ad hoc manner in which color is handled and the lack of standard approaches have been associated with suboptimal and **inconsistent diagnostic decisions with a negative impact on patient treatment and prognosis**."

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

true-color Phil



rainbow Phil



batlow Phil

Source: Fabio Crameri (modified)

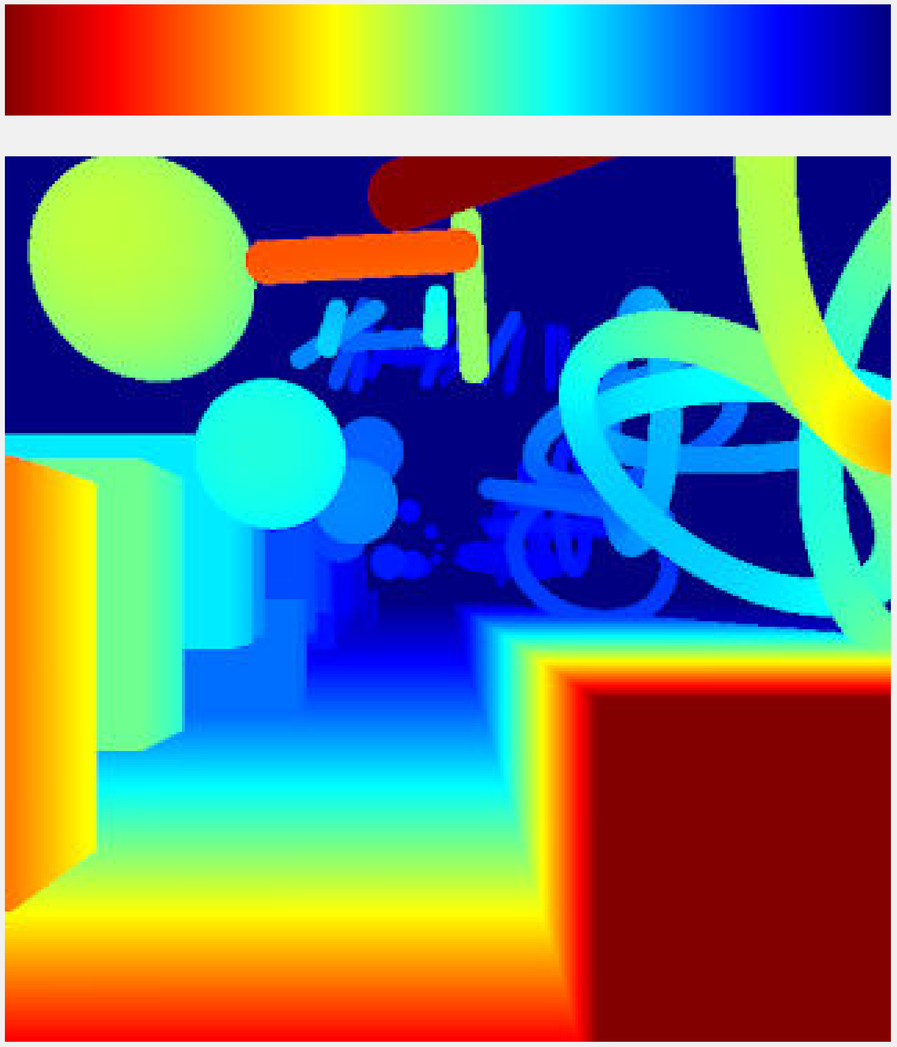
Turbo

Rainbow

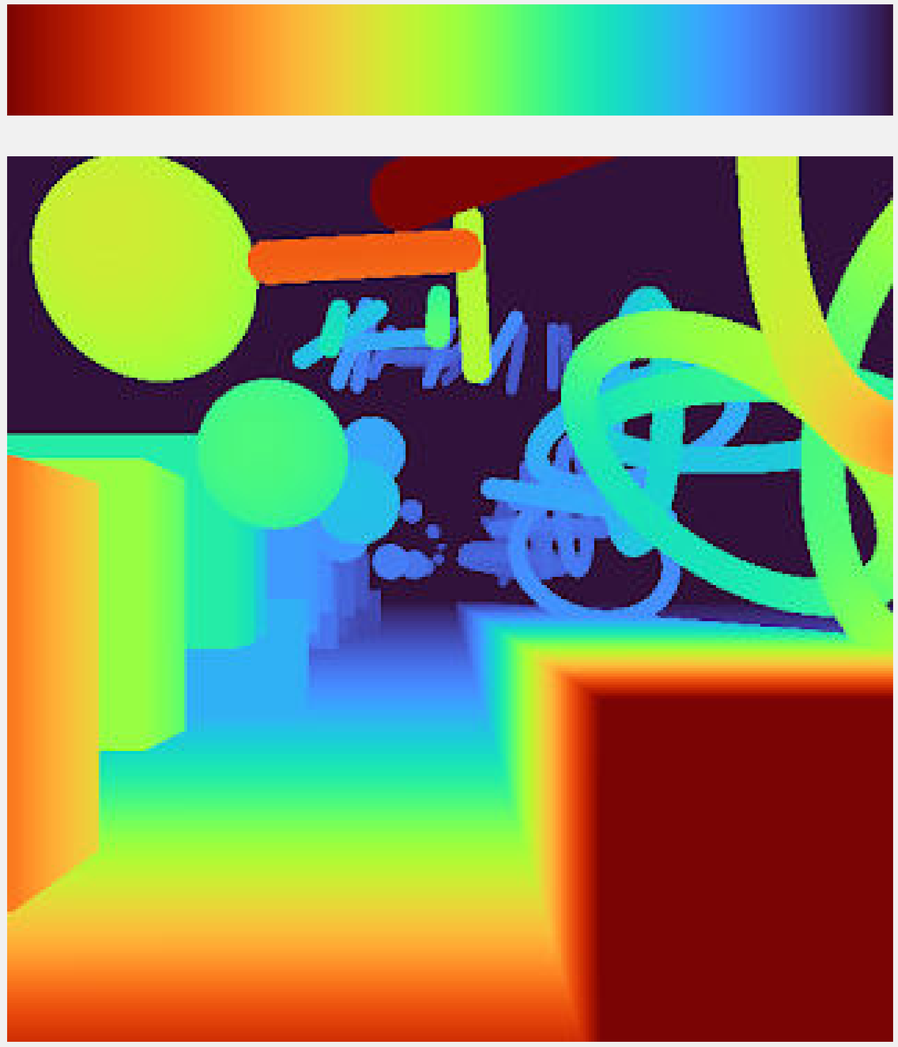
Turbo

Jet

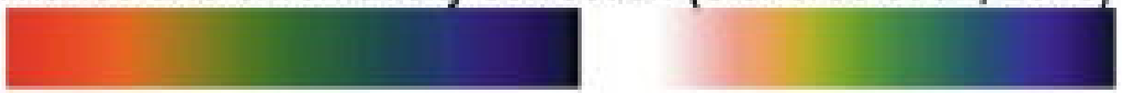
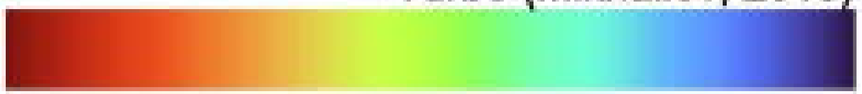
Jet



Turbo



"Turbo, An Improved Rainbow Colormap for Visualization" by Anton Mikhailov (Google Research)

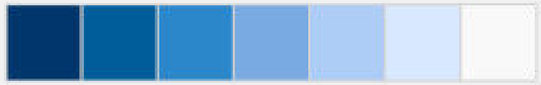
modification with examples	luminance variation	false boundaries	color vision deficiency sensitive
isoluminant rainbow (e.g. Brewer, 1997; Kindlmann et al., 2002; Rogowitz & Kalvin, 2001; Szafir et al., 2016a) 	addressed		
luminance and chromaticity correction (Sisneros et al., 2016) 	addressed	addressed	
adjusting color distribution to fit it to data (Wang et al., 2021)		addressed	
			
Turbo (Mikhailov, 2019) 		addressed	addressed

Gołębiowska & Çöltekin (2022) ISPRS Journal of Photogrammetry and Remote Sensing 194

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

Diverging

Palette

Desaturated

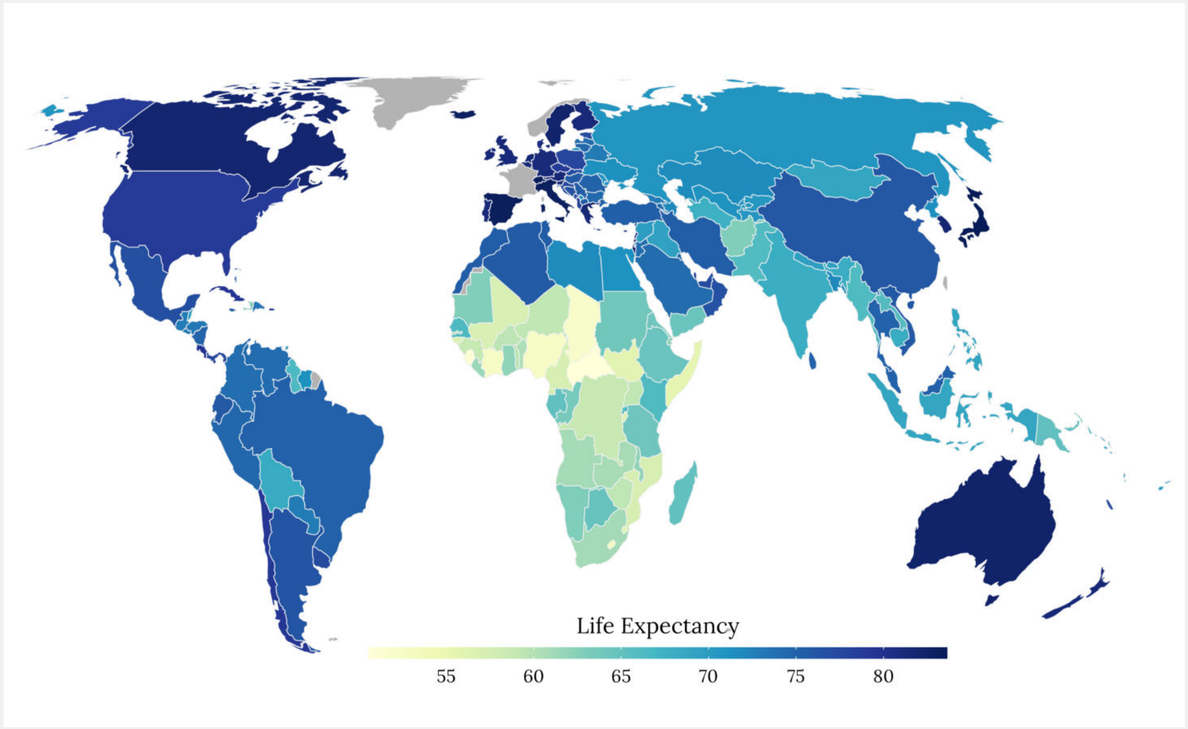
Use to encode
numerical information with critical midpoint

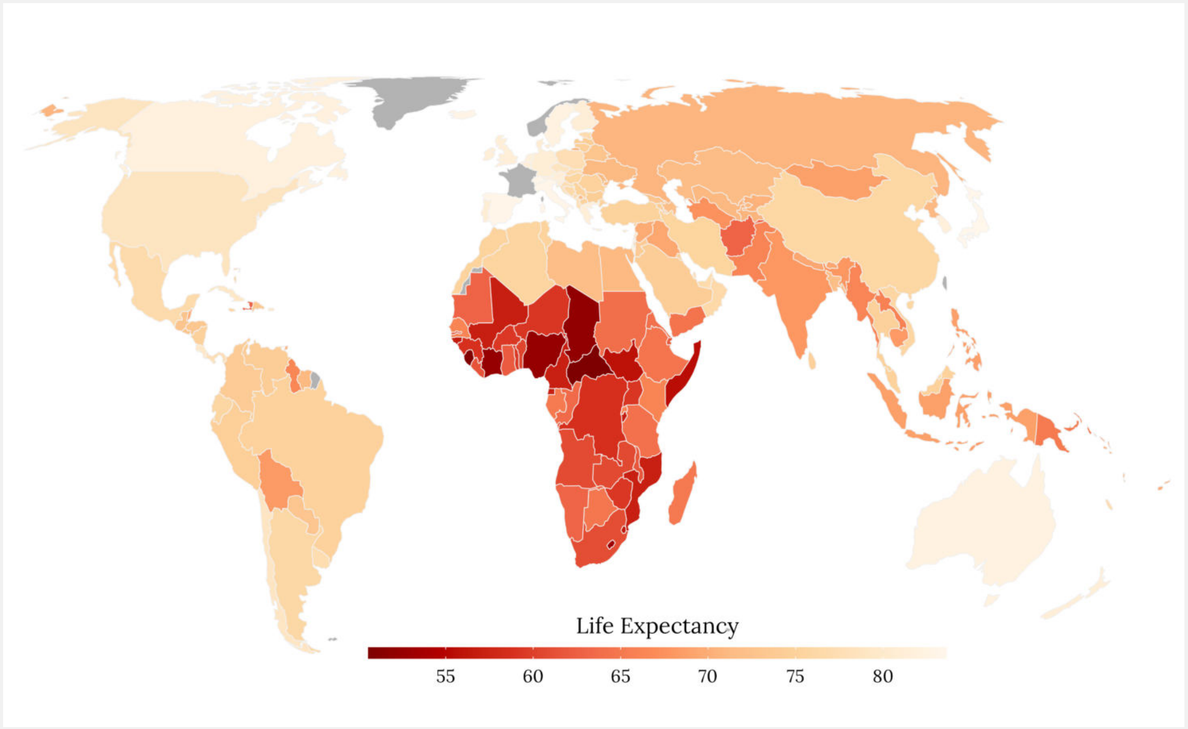
ensure a meaningful midpoint value and use balanced extremes

combination of two sequential palettes

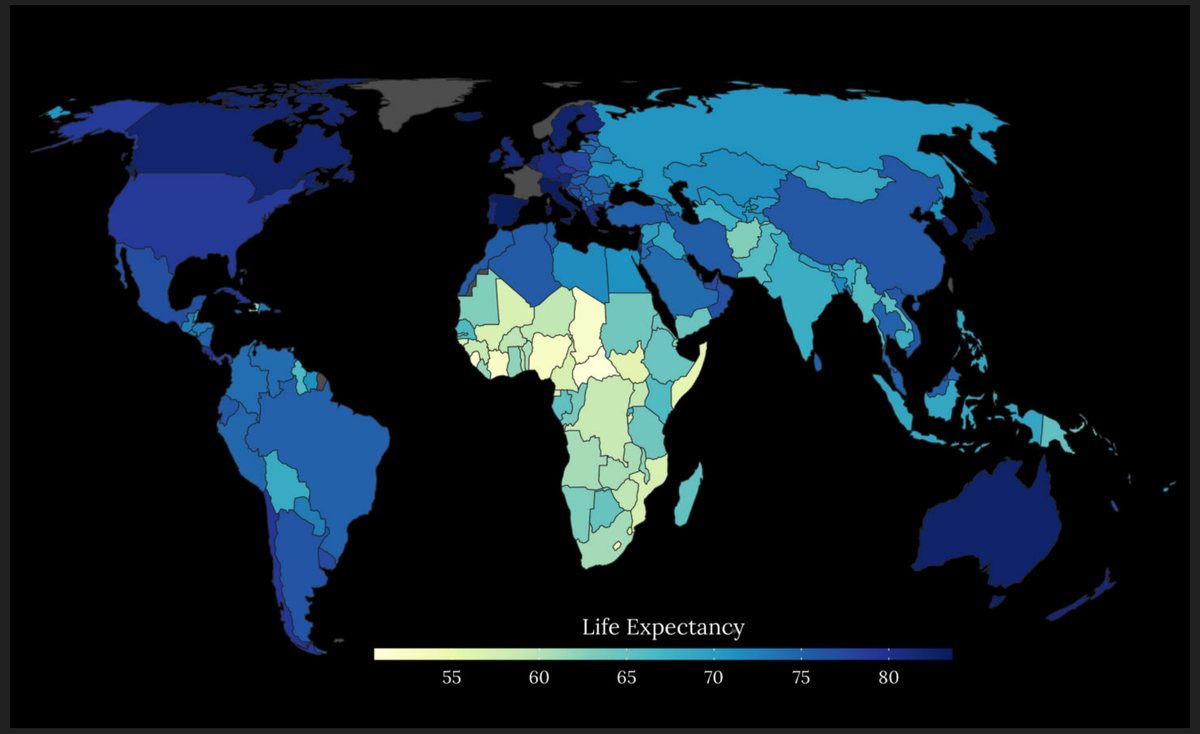
Modified from the {colorspace} R package vignette

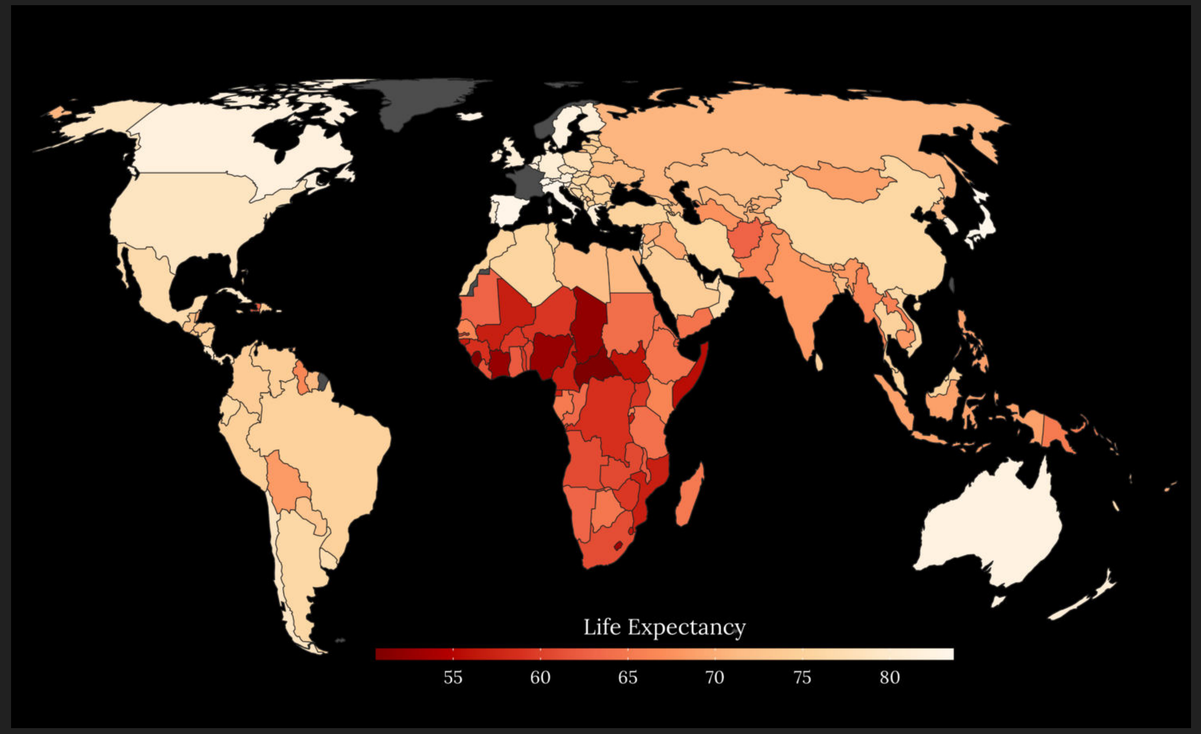
Dark Equals More?





Dar kEquals More?

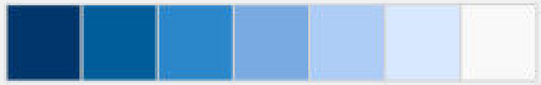




Color Palette Choice

Sequential

Palette



Desaturated

Use to encode
numerical information with order

use highest contrast for most important information

either single- or multi-hue

Diverging

Palette

Desaturated

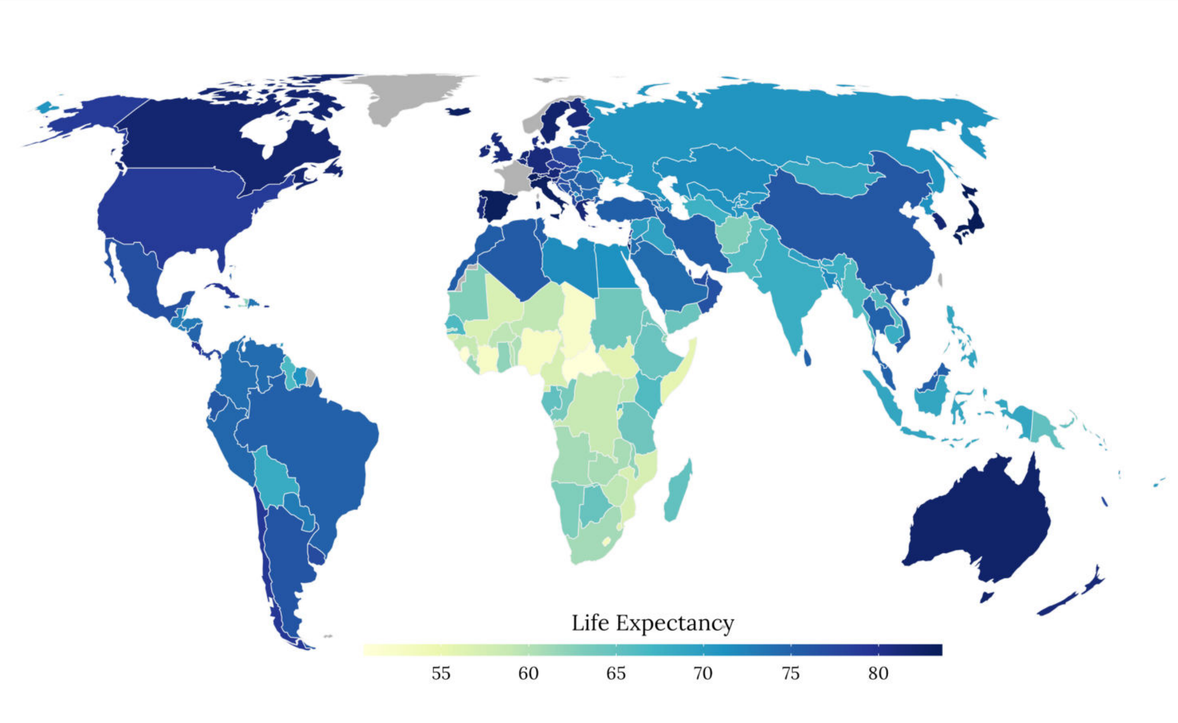
Use to encode
numerical information with critical midpoint

ensure a meaningful midpoint value and use balanced extremes

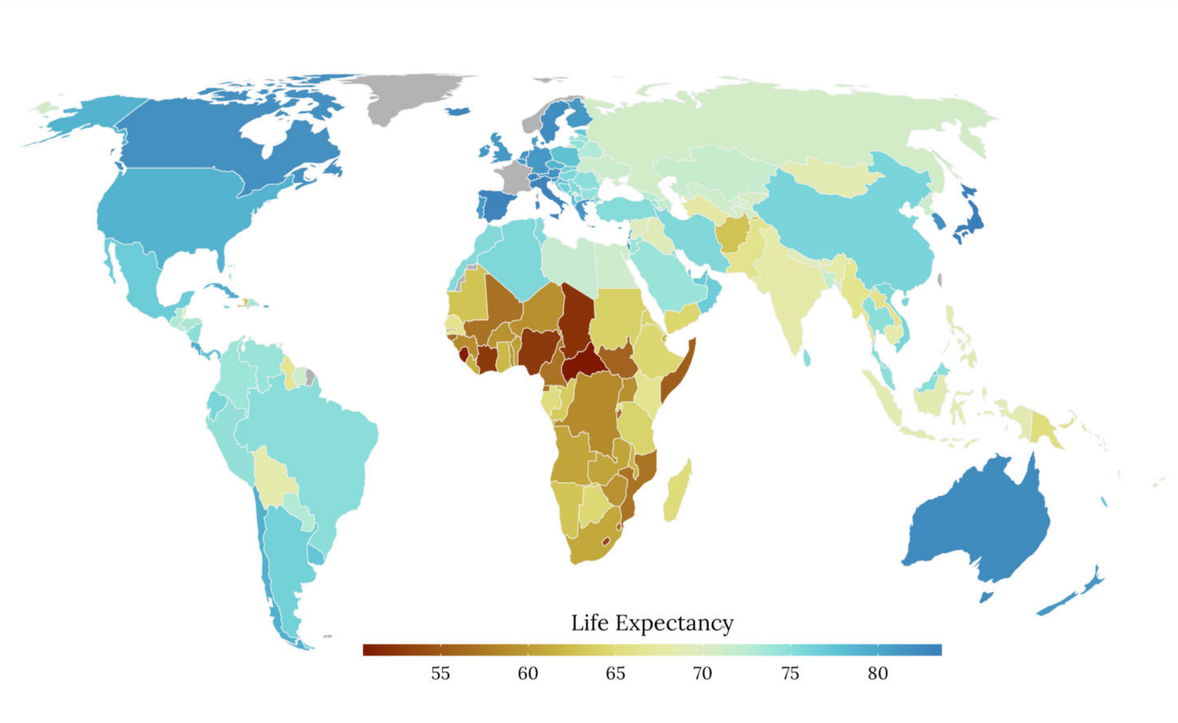
combination of two sequential palettes

Modified from the {colorspace} R package vignette

Sequential or Diverging?



multi-hue sequential

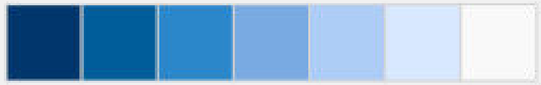


diverging

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

Diverging

Palette

Desaturated

Use to encode
numerical information with critical midpoint

ensure a meaningful midpoint value and use balanced extremes

combination of two sequential palettes

Qualitative

Palette

Desaturated

Use to encode
categorical information

pick distinct colors with the same perceptual weight

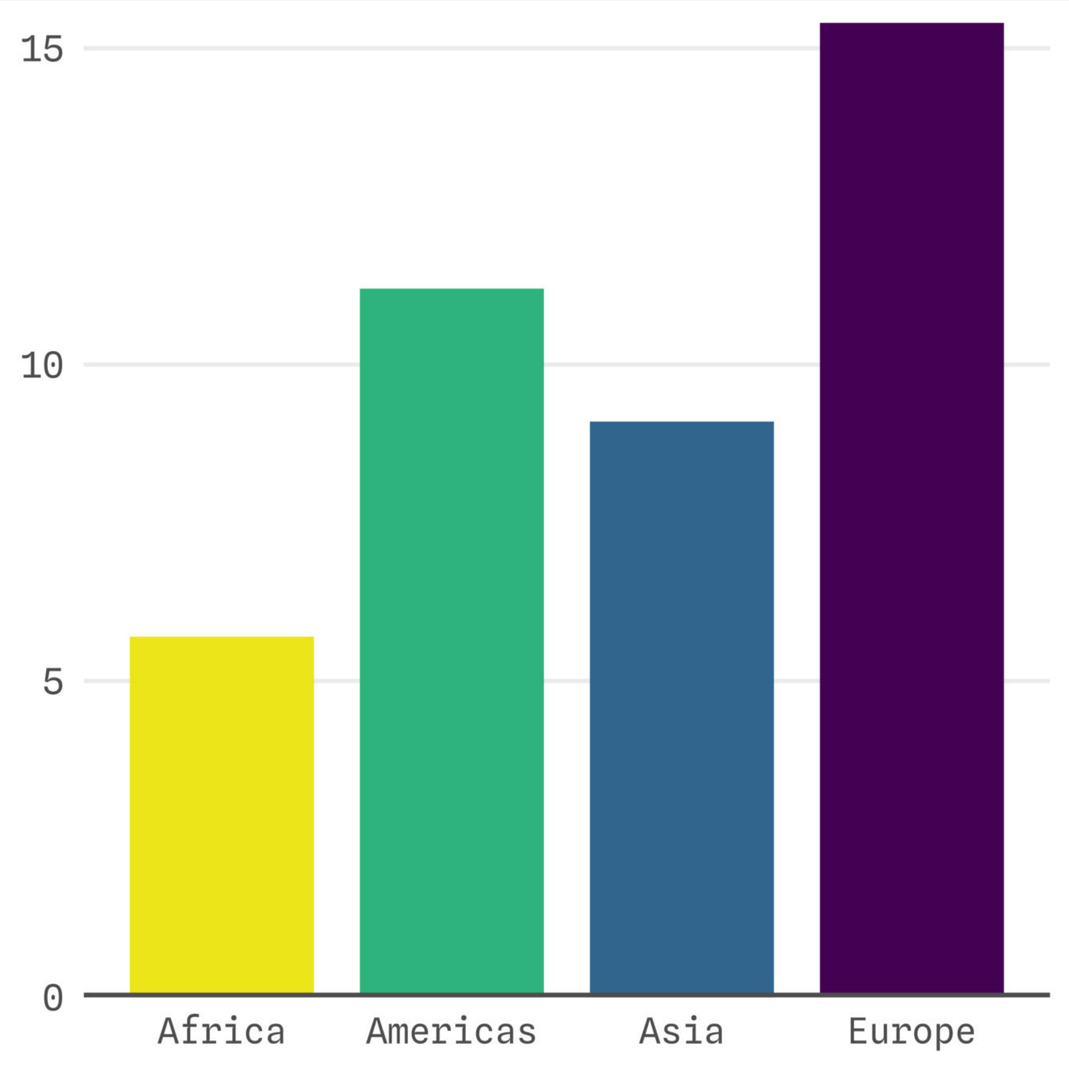
limit categories to 6–8

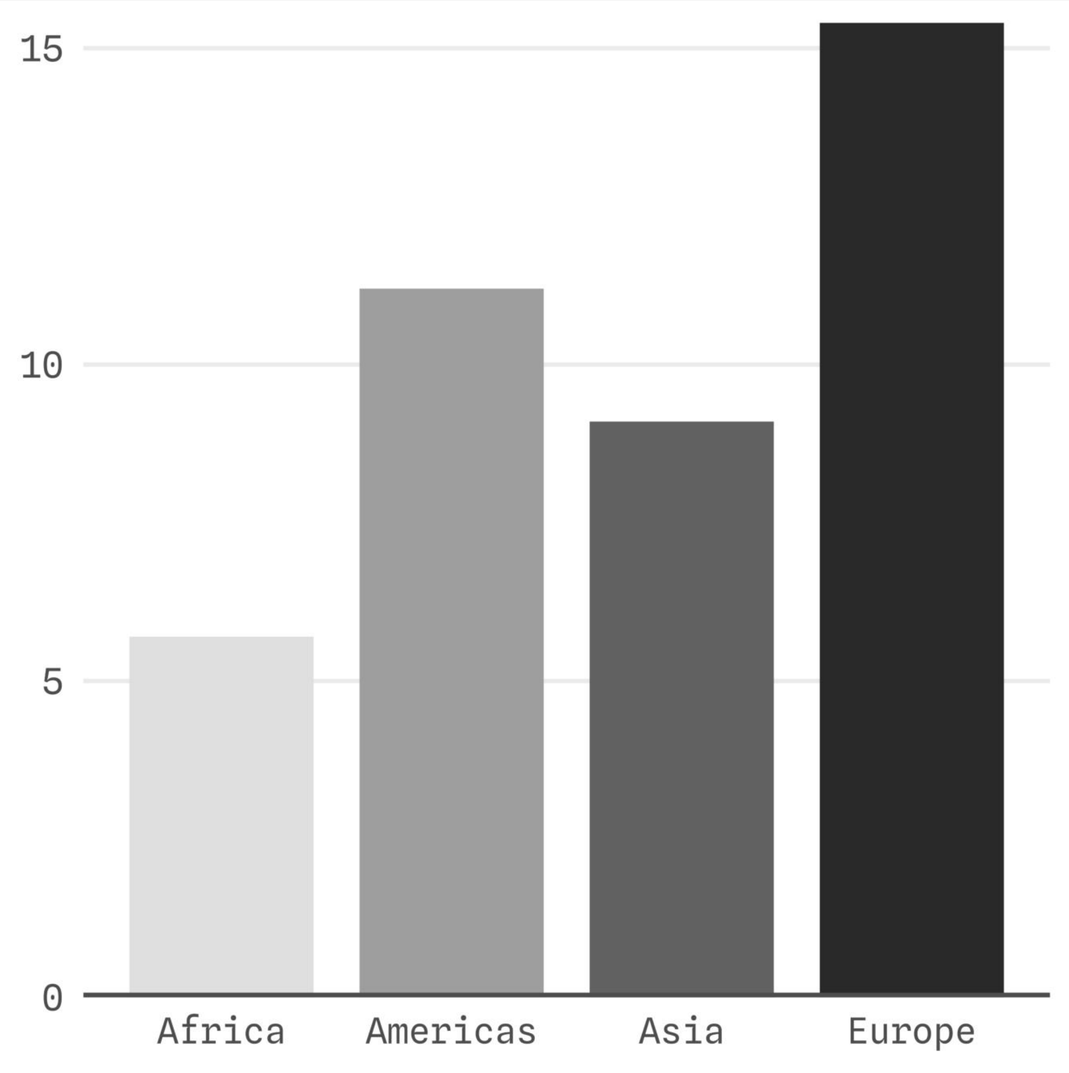
Modified from the {colorspace} R package vignette

Sequential or Qualitative?

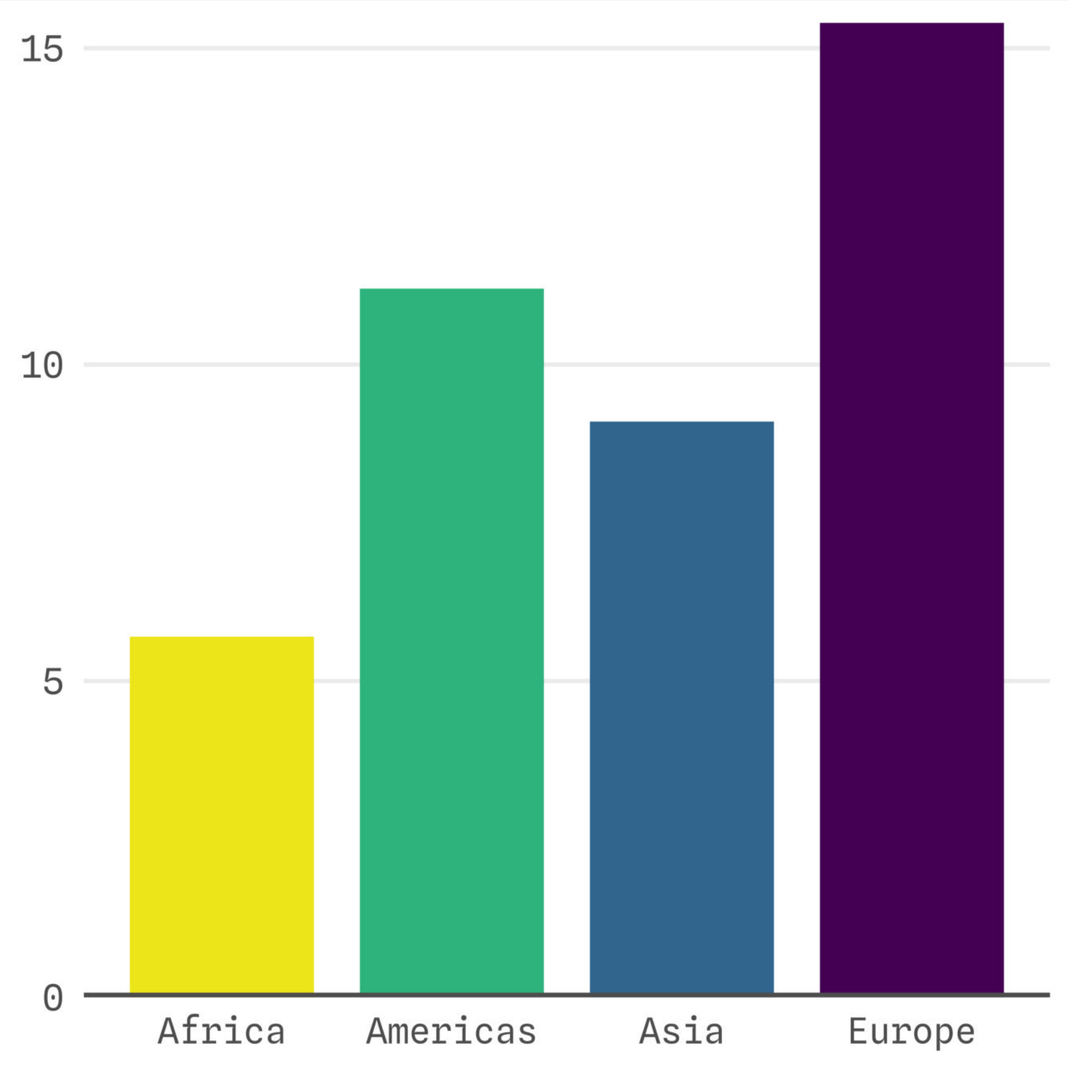
Source: "When to use sequential and when to use diverging color scales" by Lisa C. Muth / DataWrapper

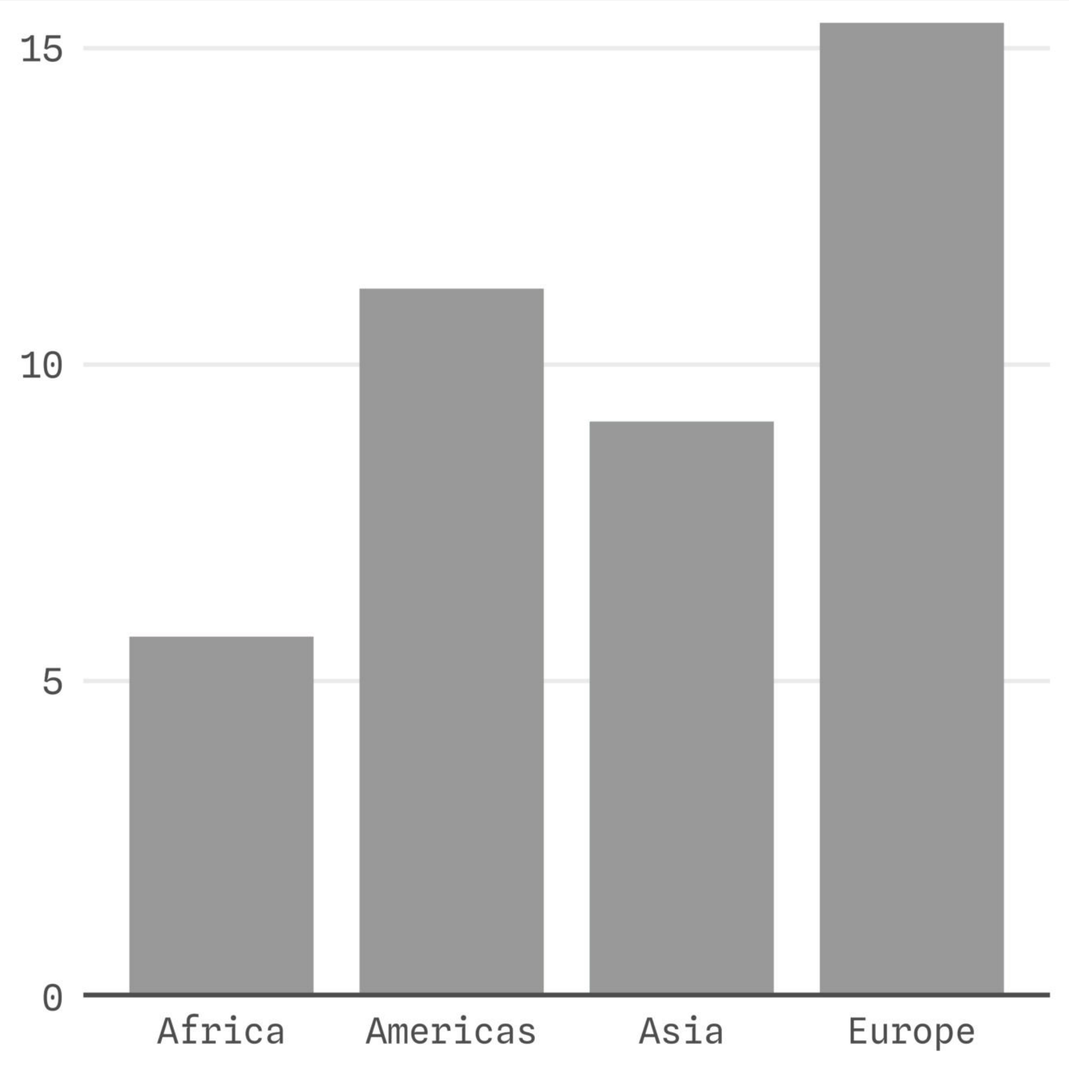
“Viridis is THE perfect color palette!”





“Viridis is THE perfect color palette!”





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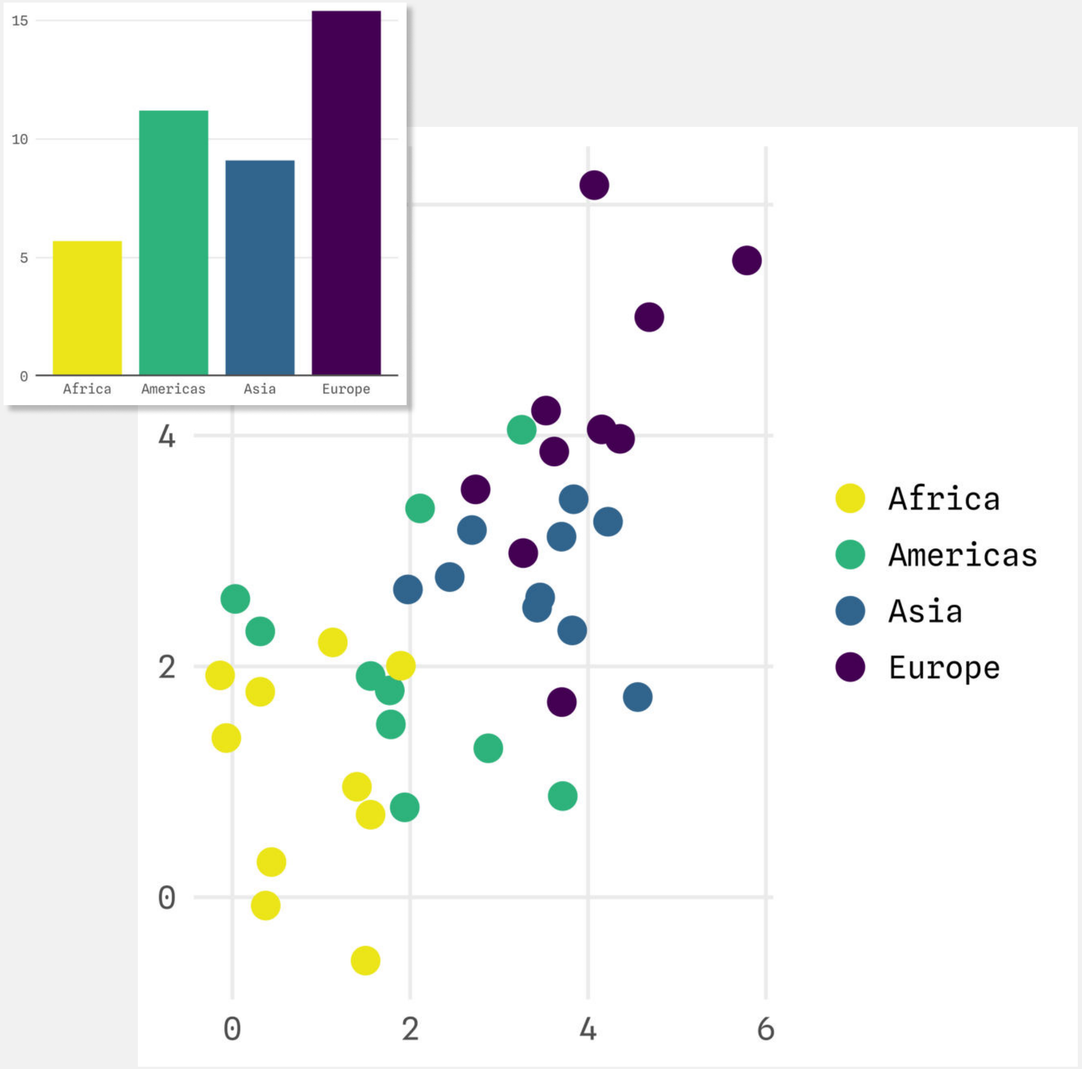

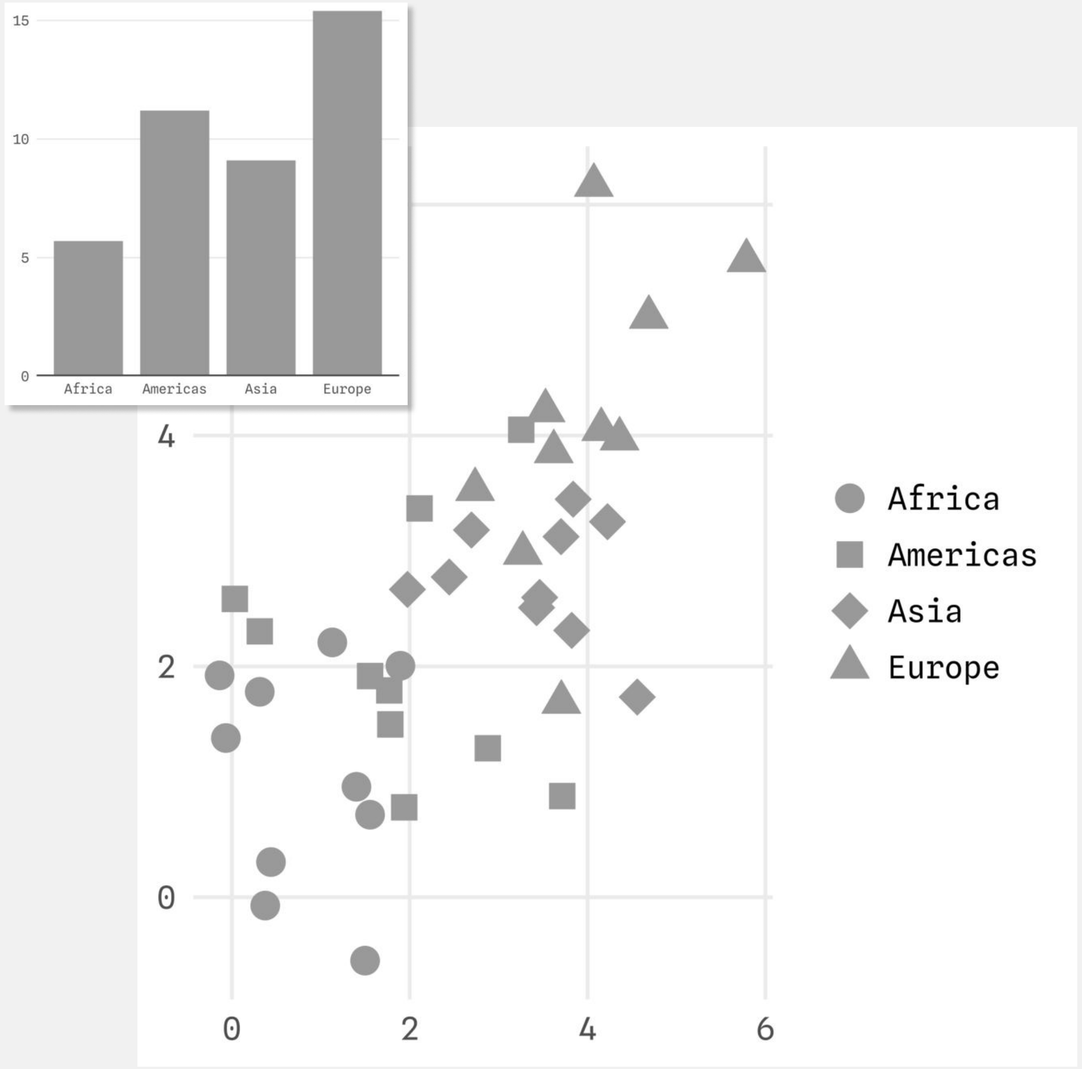

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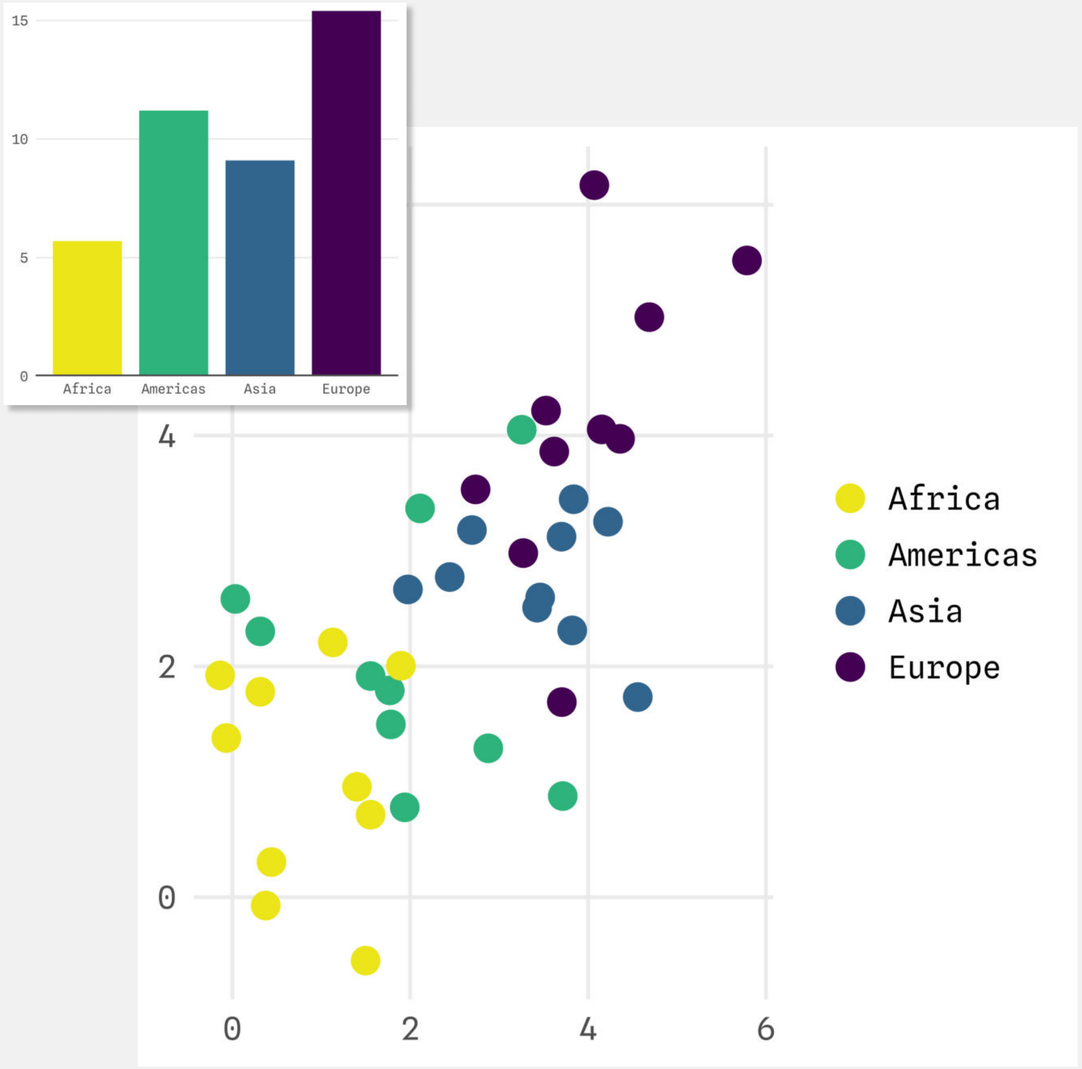
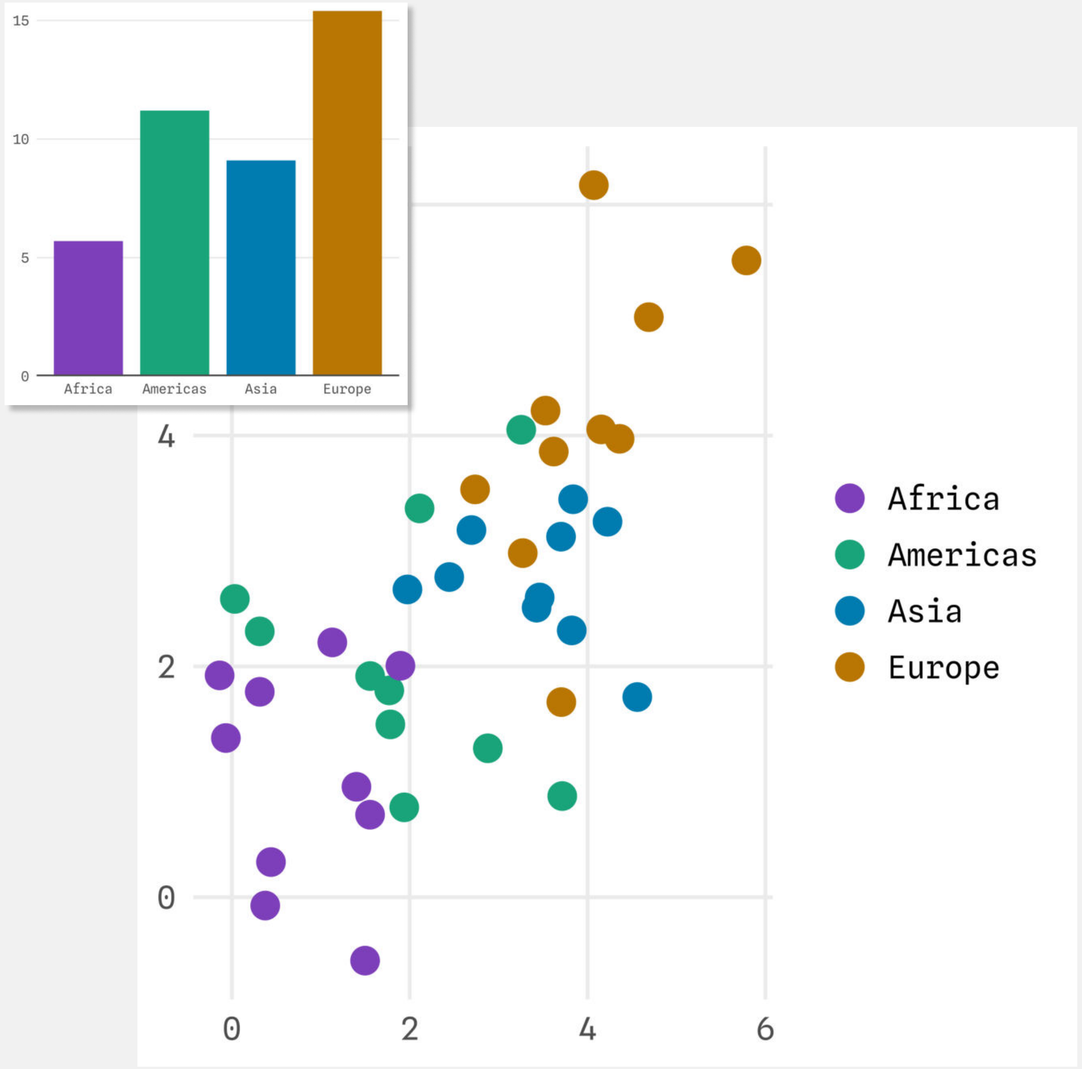




Use Colors Consistently

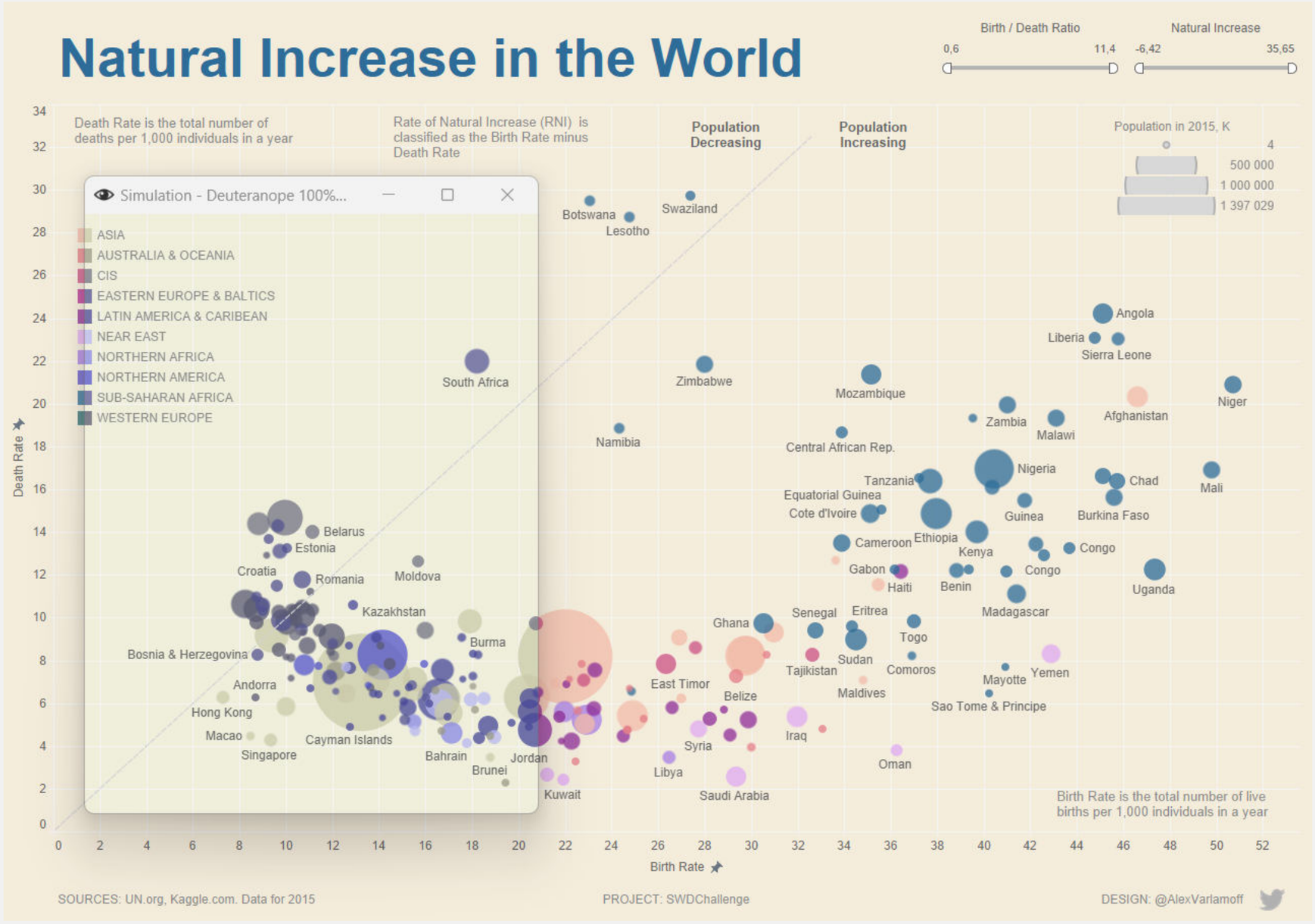
Source: "When to use sequential and when to use diverging color scales" by Lisa C. Muth / DataWrapper

Use Intuitive Colors (?)

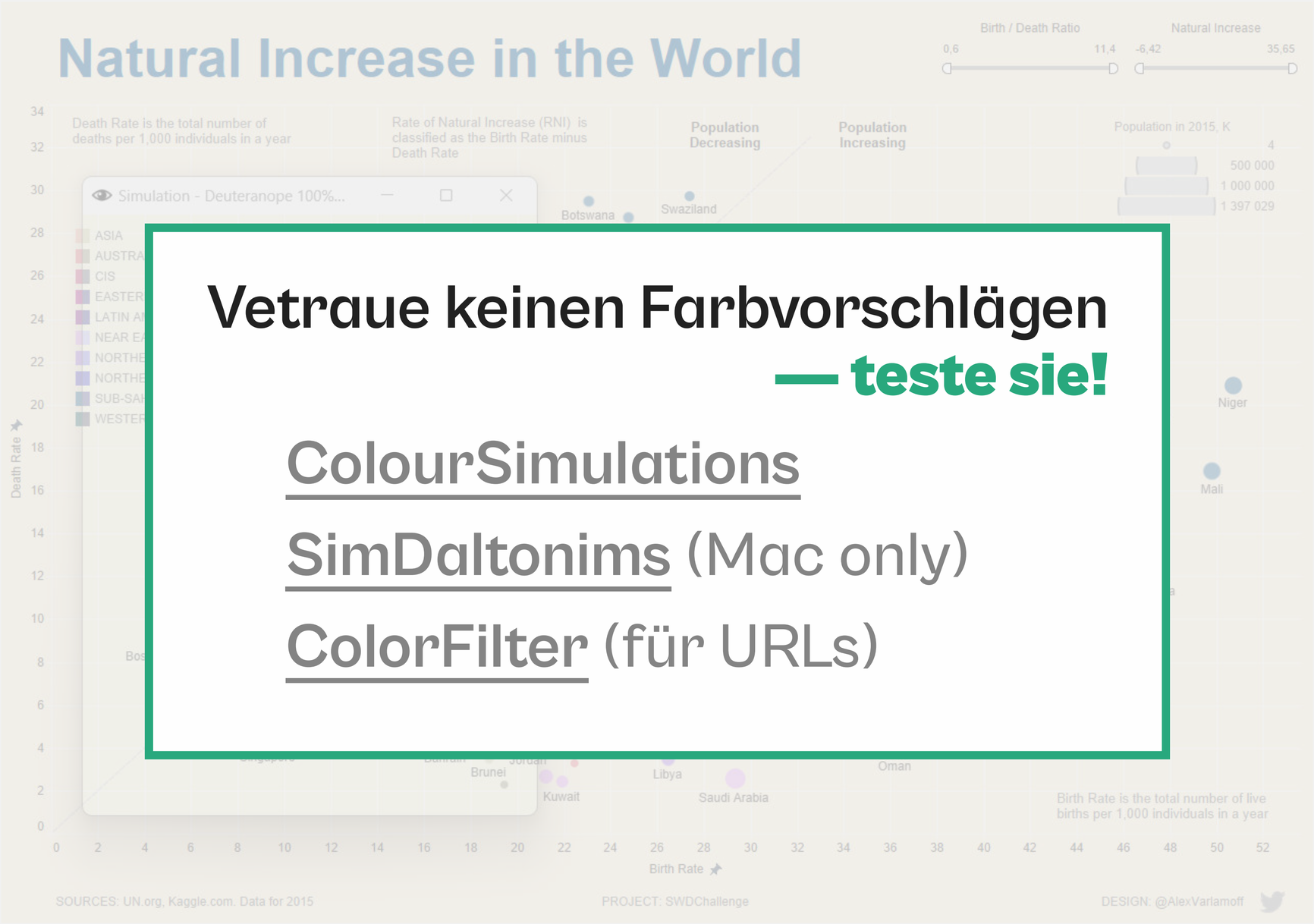
Source: "When to use sequential and when to use diverging color scales" by Lisa C. Muth / DataWrapper

Ensure Readibility for Color-Blind Persons

Source: "Fundamentals of Data Visualization" by Claus O. Wilke



Beitrag zur SWDchallenge von Alex Varlamoff — getested mit einem Farbblindheitssimulator



Vetraue keinen Farbvorschlägen — teste sie!

ColourSimulations

SimDaltonims (Mac only)

ColorFilter (für URLs)

Beitrag zur SWDchallenge von Alex Varlamoff — getested mit einem Farbblindheitssimulator

VIZ PALETTE

By: Elijah Meeks & Susie Lu

PICK

Use Chroma.js

Use Colorgorical

Use ColorBrewer

Add

Replace

EDIT

4 Colors

Add

#hex rgb hsl

1 #2a9571

2 #8fb9bf

3 #dfb468

4 #4b8cd8

GET

#hex rgb hsl

String quotes

Object with metadata

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

COLORS IN ACTION

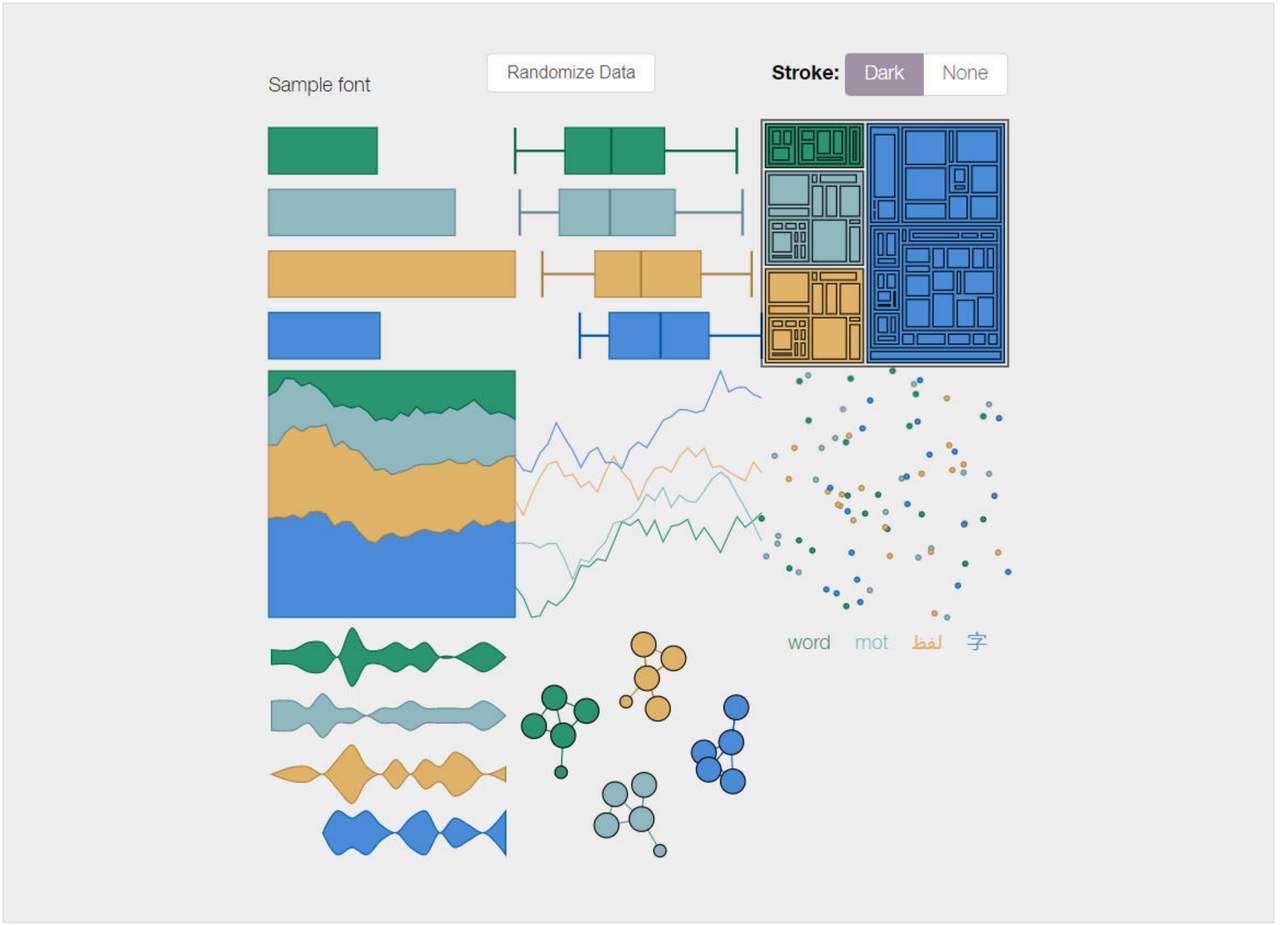
Background color: #eeeeee

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

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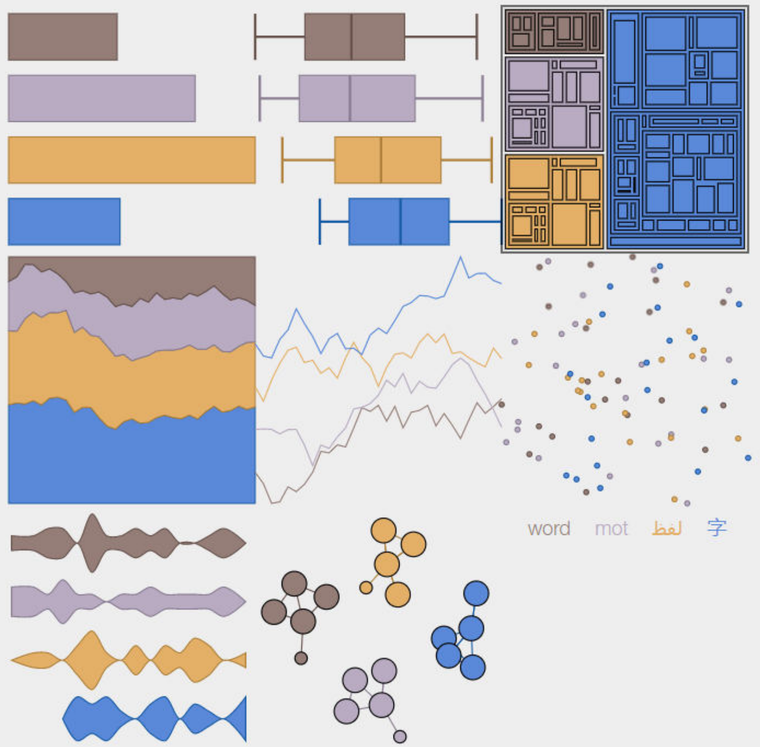
Sample font | Randomize Data | **Stroke:** Dark None



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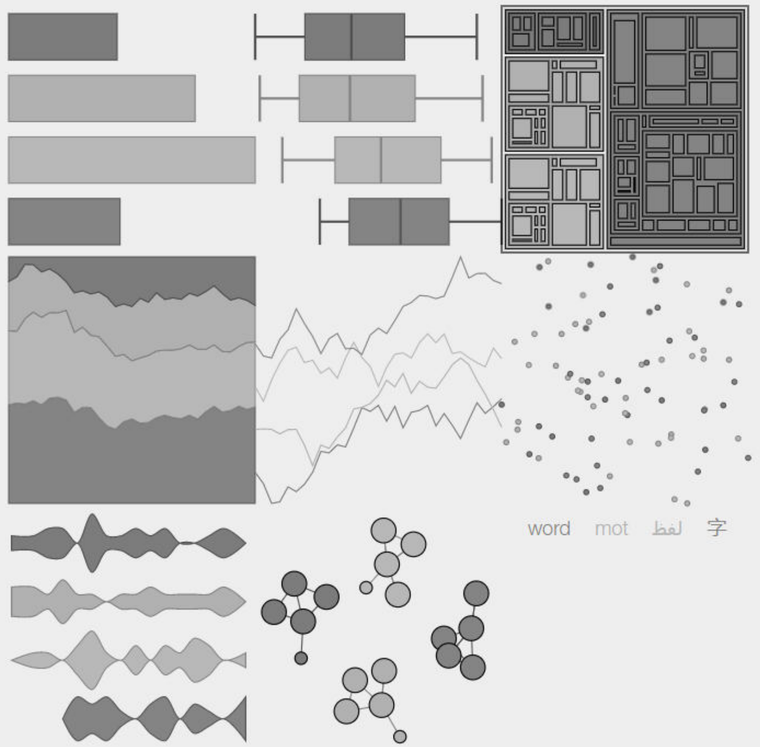

Viz Palette

VIZ PALETTE

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PICK

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Add | Replace

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1 #2a9571
2 #8fb9bf
3 #dfb468
4 #4b8cd8

GET

String quotes
Object with metadata

#hex rgb hsl

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

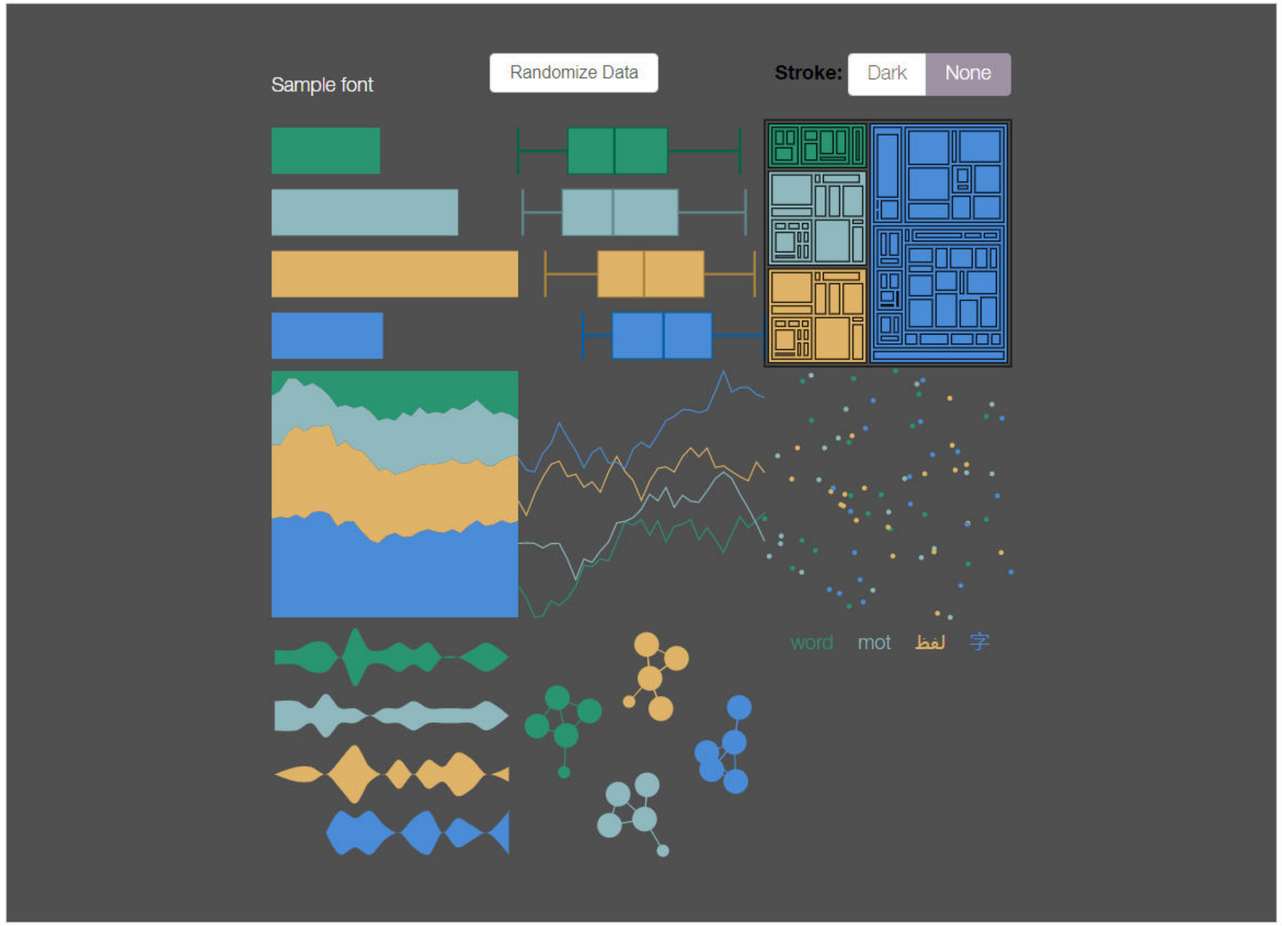
COLORS IN ACTION

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

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APCA Contrast Calculator

MYNDEX RESEARCH

TEXT / ICON COLOR

#212121 · rgb(33,33,33)

212121

SAMPLE

&

Click To Swap

BACKGROUND COLOR

#ffffff · rgb(255,255,255)

ffffff

CONTRAST

Lc 103.1

All font sizes are in CSS px • Reference font shown with colors at actual size & weight

USAGE	200	300 (Light)	400 (Normal)	500	600	700 (Bold)
SMALL BODY TEXT ONLY	26px The lazy afternoo frolicked	18.5px The lazy grey dog slept in afternoon sun, but the fr frolicked freely in the fie flowers without a care in	15px The lazy grey dog slept in the afternoon sun, but the frisky fo frolicked freely in the field of flowers without a care in the w The fox saw the slumbering do	14.5px The lazy grey d afternoon sun, frolicked freely flowers withou The fox saw the	13.5px The lazy grey do afternoon sun, b frolicked freely flowers without The fox saw the tried to wake hi	12.5px The lazy grey dog slept in the afternoon sun, but the frisky fox frolicked freely in the field of flowers without a care in the world. The fox saw the slumbering dog and tried to wake him, but the dog was

The Myndex APCA Contrast Calculator displays modern contrast ratios for various combinations of text size and font weight

APCA Contrast Calculator

MYNDEX RESEARCH

TEXT / ICON COLOR

#ffffff · rgb(255,255,255)

ffffff

SAMPLE

Click To Swap

BACKGROUND COLOR

#212121 · rgb(33,33,33)

212121

CONTRAST
Lc -105.6

All font sizes are in CSS px • Reference font shown with colors at actual size & weight

USAGE	200	300 (Light)	400 (Normal)	500	600	700 (Bold)
SMALL BODY TEXT ONLY	25px The lazy afternoo frolicked	18px The lazy grey dog slept in afternoon sun, but the fri frolicked freely in the fiel flowers without a care in The fox saw the slumberi	14.5px The lazy grey dog slept in the afternoon sun, but the frisky fo frolicked freely in the field of flowers without a care in the wo The fox saw the slumbering dog tried to wake him, but the dog w	14px The lazy grey do afternoon sun, frolicked freely flowers without The fox saw the tried to wake hi	13px The lazy grey do afternoon sun, b frolicked freely i flowers without The fox saw the tried to wake hin	12px The lazy grey dog slept in the afternoon sun, but the frisky fox frolicked freely in the field of flowers without a care in the world. The fox saw the slumbering dog and tried to wake him, but the dog was

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APCA Contrast Calculator

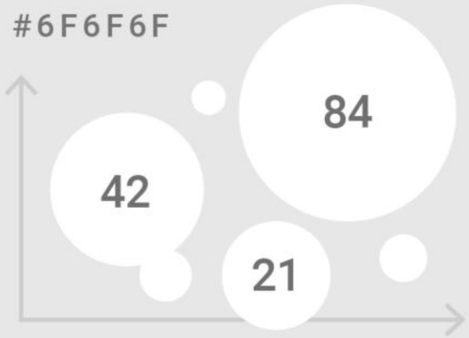
MYNDEX RESEARCH

All font sizes are in CSS px • Reference font shown with colors at actual size & weight

USAGE	200	300 (Light)	400 (Normal)	500	600	700 (Bold)
FLUENT TEXT OKAY	46px Sam	32px The lazy grey c afternoon sun,	22px The lazy grey dog sle afternoon sun, but th frolicked freely in the	19.5px The lazy gr afternoon s frolicked fr flowers wit	17.5px The lazy grey afternoon su frolicked fre flowers with	15.5px The lazy grey dog slept in the afternoon sun, but the frisky frolicked freely in the field of flowers without a care in the The fox saw the slumbering

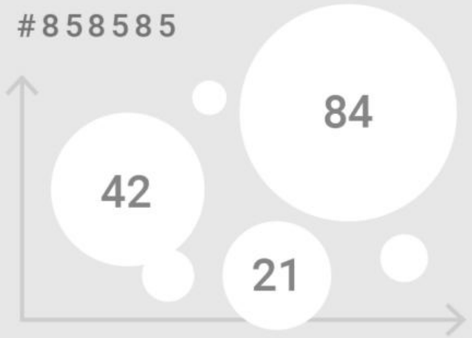
The Myndex APCA Contrast Calculator displays modern contrast ratios for various combinations of text size and font weight

#6F6F6F



WCAG 2.0: 5:1 AAA
APCA: 75% AAA

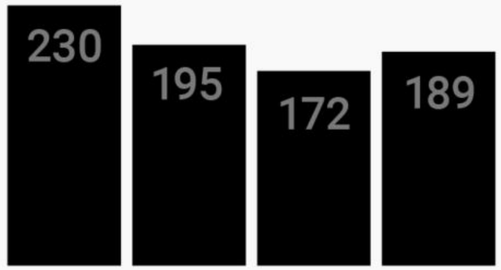
#858585



WCAG 2.0: 3.7:1 AA
APCA: 65% AAA

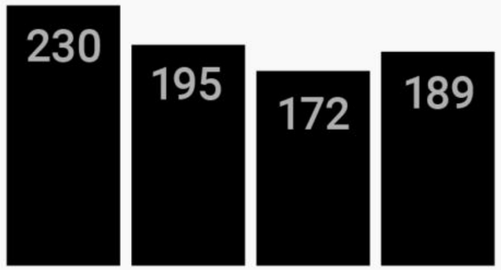
APCA allows for lighter gray on light backgrounds...

#7A7A7A



WCAG 2.0: 4.9:1 AAA
APCA: 32% ❌

#B1B1B1



WCAG 2.0: 9.8:1 AAA
APCA: 60% AAA

... but also requests lighter gray on dark backgrounds

"It's time for a more sophisticated color contrast check for data visualizations" by Lisa C. Muth / DataWrapper

APCA Contrast Calculator

MYNDEX RESEARCH

All font sizes are in CSS px • Reference font shown with colors at actual size & weight

USAGE	200	300 (Light)	400 (Normal)	500	600	700 (Bold)
LARGE & SUB-FLUENT TEXT	82	65px Sample	36px The lazy grey afternoon su	30px The laz afterno	26px The lazy afternoo	22.5px The lazy grey dog sl afternoon sun, but t frolicked freely in th

The Myndex APCA Contrast Calculator displays modern contrast ratios for various combinations of text size and font weight

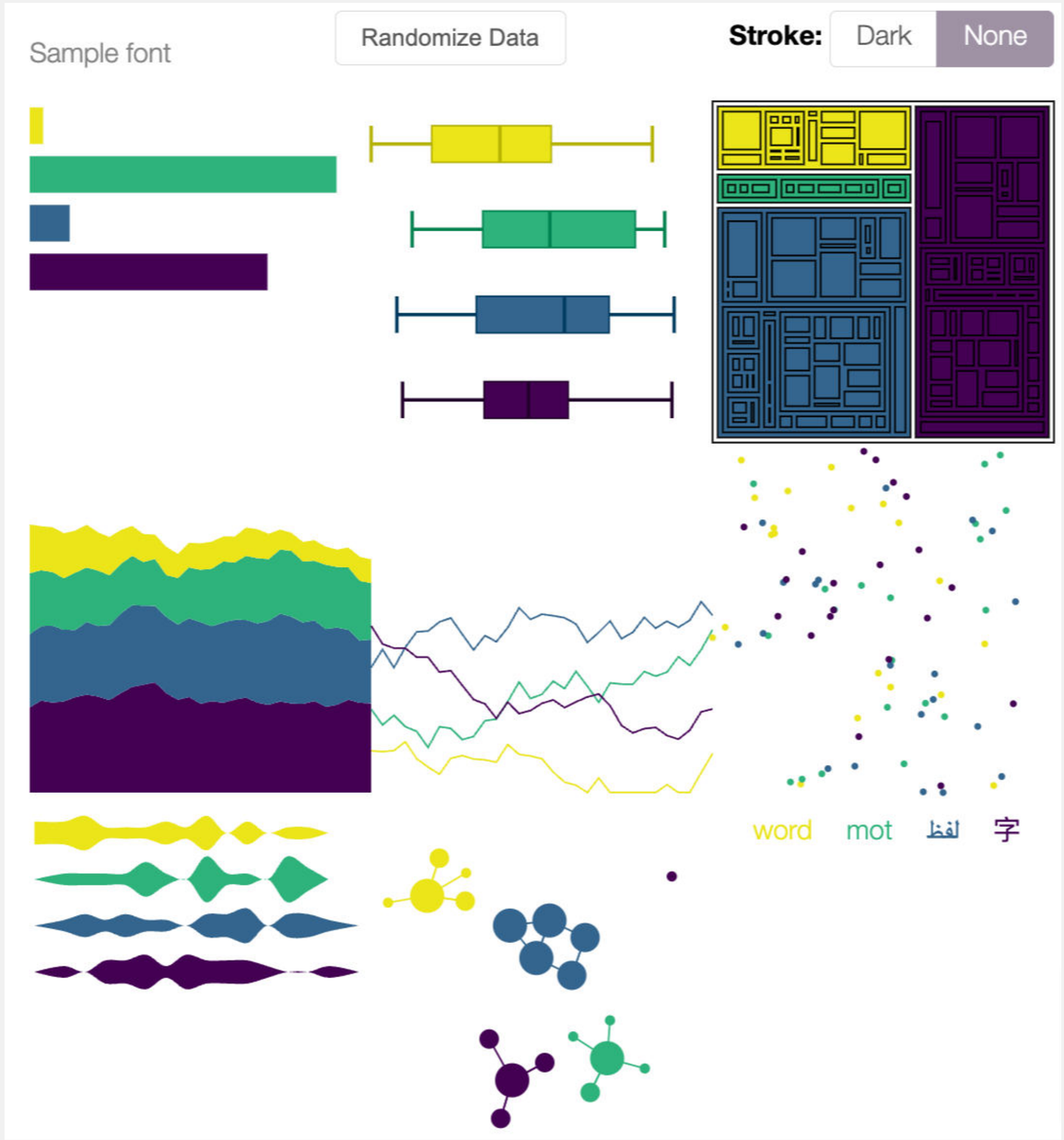
APCA Contrast Calculator

MYNDEX RESEARCH

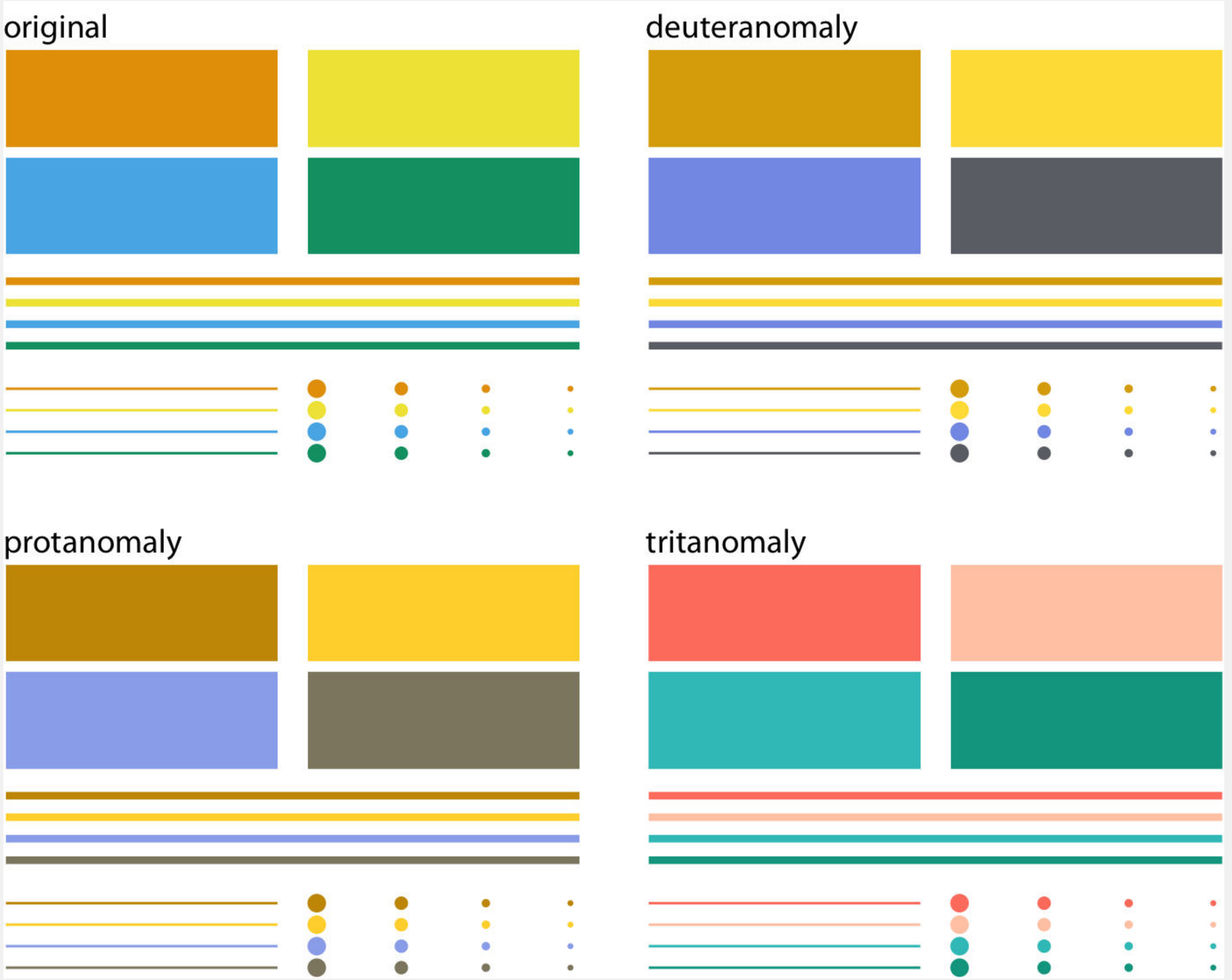
All font sizes are in CSS px • Reference font shown with colors at actual size & weight

USAGE	200	300 (Light)	400 (Normal)	500	600	700 (Bold)
NO TEXT USAGE	N	N	N	N	N	N

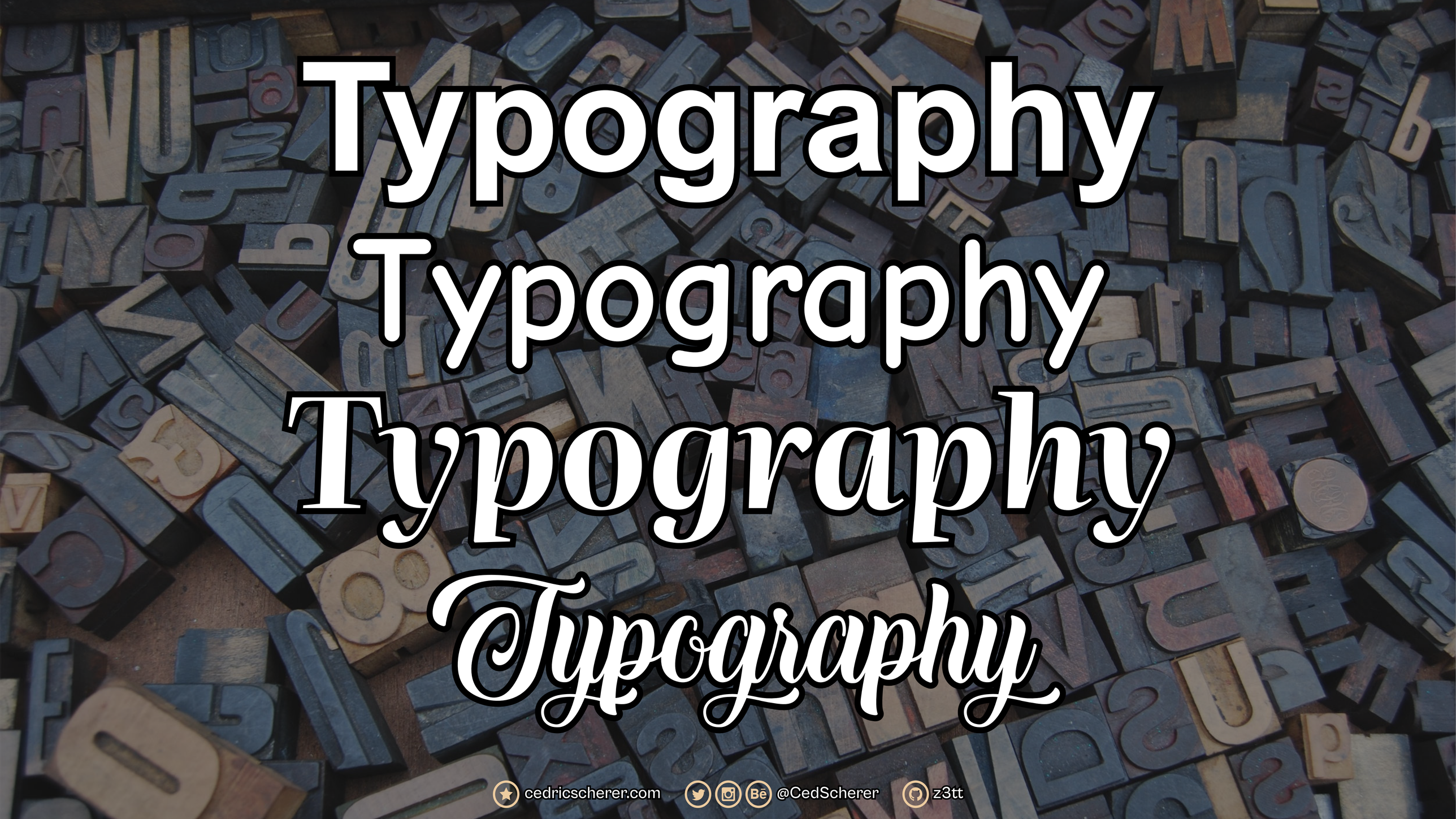
The Myndex APCA Contrast Calculator displays modern contrast ratios for various combinations of text size and font weight



Viz Palette



Source: *"Fundamentals of Data Visualization" by Claus O. Wilke*



cedricscherer.com @CedScherer z3tt

I'll be waiting for you!

I'LL BE WAITING FOR YOU!

I'LL BE WAITING FOR YOU!

I'll be waiting for you!

I'll be waiting for you!

I'll be waiting for you!

I'll be waiting for you!

I'll be waiting for you!

The Choice of the Typeface

- 👉 **Context matters**: font(s) should fit the topic and audience
- 👉 Use different sizes, weights and colors to **visualize hierarchy**
- 👉 Avoid using **ALL CAPS** and too many different styles
- 👉 Use **tabular typefaces** for numbers

The Choice of the Typeface

- **Context matters**: font(s) should fit the topic and audience
- Use different sizes, weights and colors to **visualize hierarchy**
- Avoid using **ALL CAPS** and too many different styles
- Use **tabular typefaces** for numbers
- **Consistency is key!**

The 1Il Test

1Il Calibri

1Il Cabin

1Il Open Sans

1Il Monda

1Il Roboto

1Il Chivo

1Il Lato

1Il Fira Sans

1Il Oswald

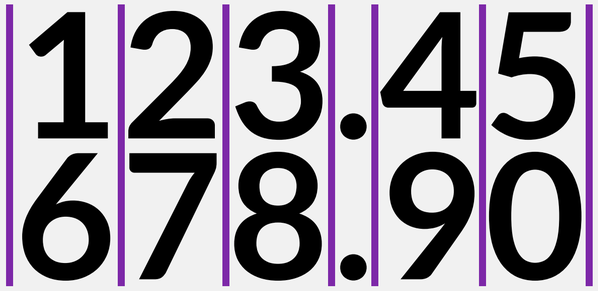
1Il Noto Sans

1Il Cabinet Grotesk

1Il Amulya

Proportional Numbers

Tabular Numbers



Using a lot of fonts
and different sizes
makes your design look
cluttered
overcomplicated
AND JUST NOT VERY NICE.

But if you just use
a small selection of
typefaces, styles and sizes
you can keep your design
cleaner, clearer
and just much easier to digest.

Visualize Text Hierarchy

I am important!

I am important, too.

Oh, hi there. Thanks for reading me…

Hey, also look at me!

Visualize Text Hierarchy

I am important!

I am important, too.

Oh, hi there. Thanks for reading me...

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Visualize Text Hierarchy

I am important!

I am important, too.

Oh, hi there. Thanks for reading me…

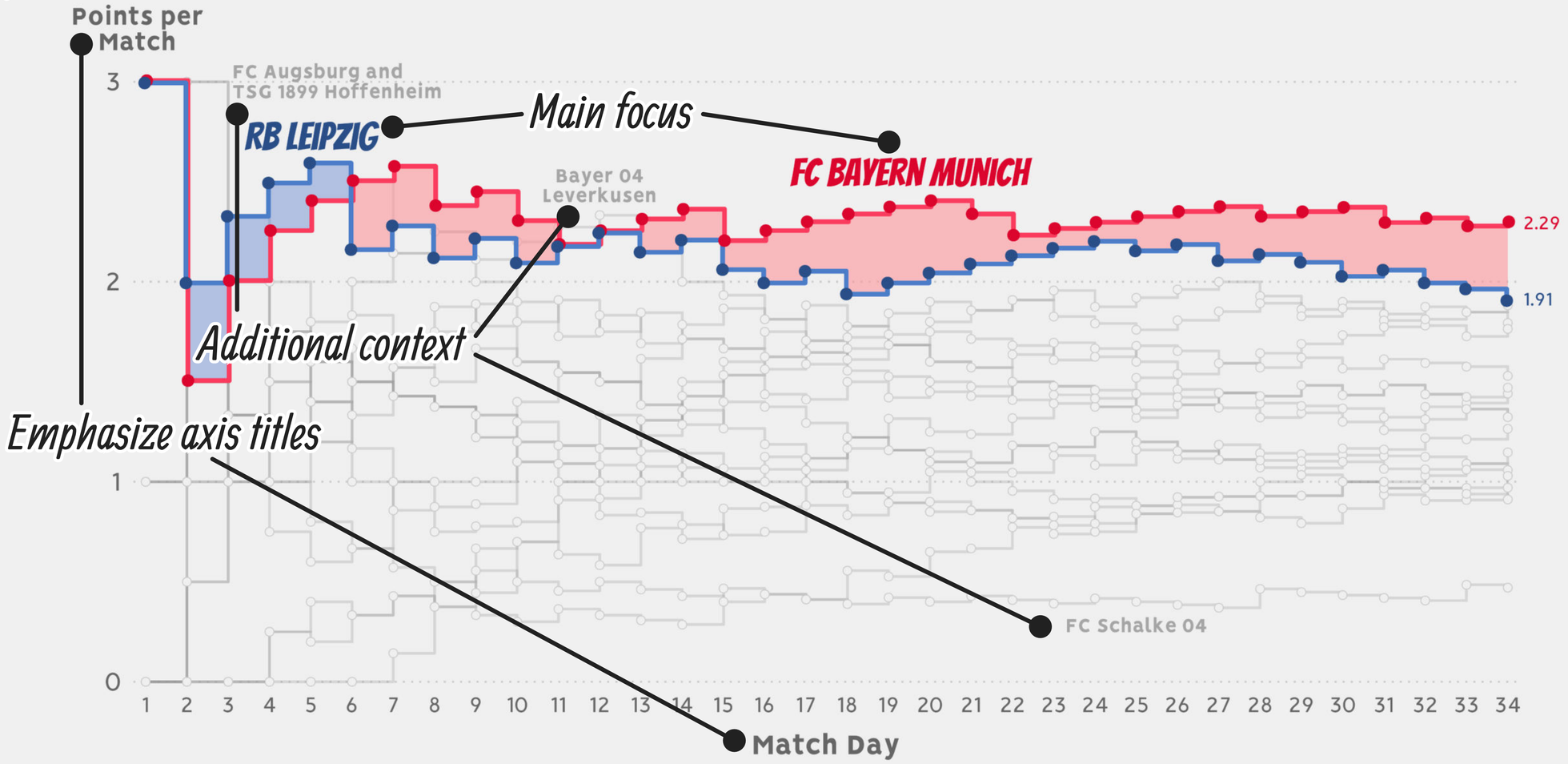
Hey, also look at me!

Bold primary summary

Bayern Munich's Road to the 31st Championship

Lighter secondary information *incl. color highlights*

FC Bayern Munich is the champion of the Bundesliga season 2020/21 with incredible 2.29 points per match, more than 0.3 points more than the best chasers. RB Leipzig (1.91 points per match) was getting close several times but has lost the trace again in the last matches.



Small, light credit

Visualization: Cédric Scherer

Wrap-Up

Information

Understand your data and be accurate.

Story

Be clear about the message of your visualization.

Goal

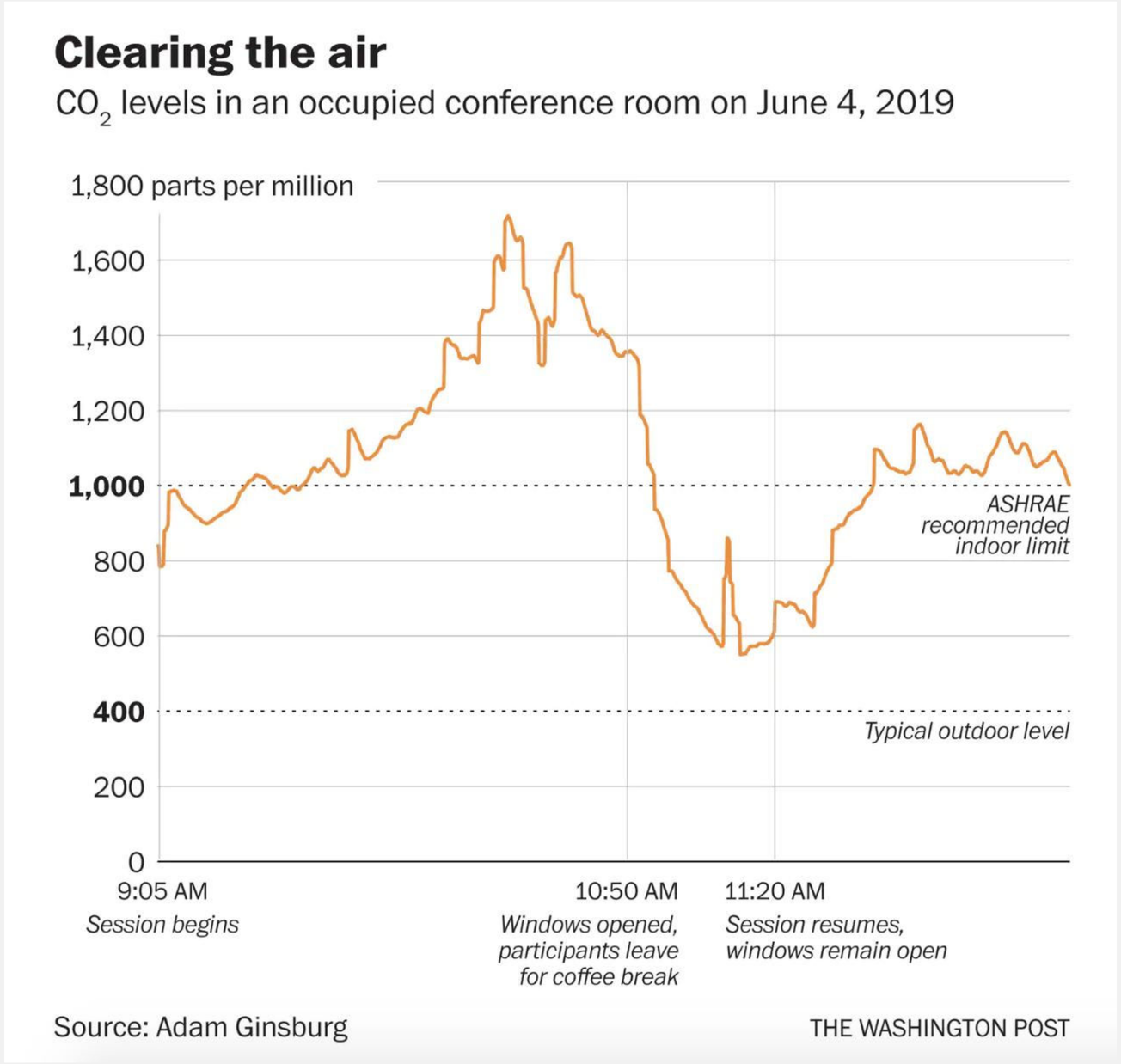
Select charts that successfully transport your story.

Visual Form

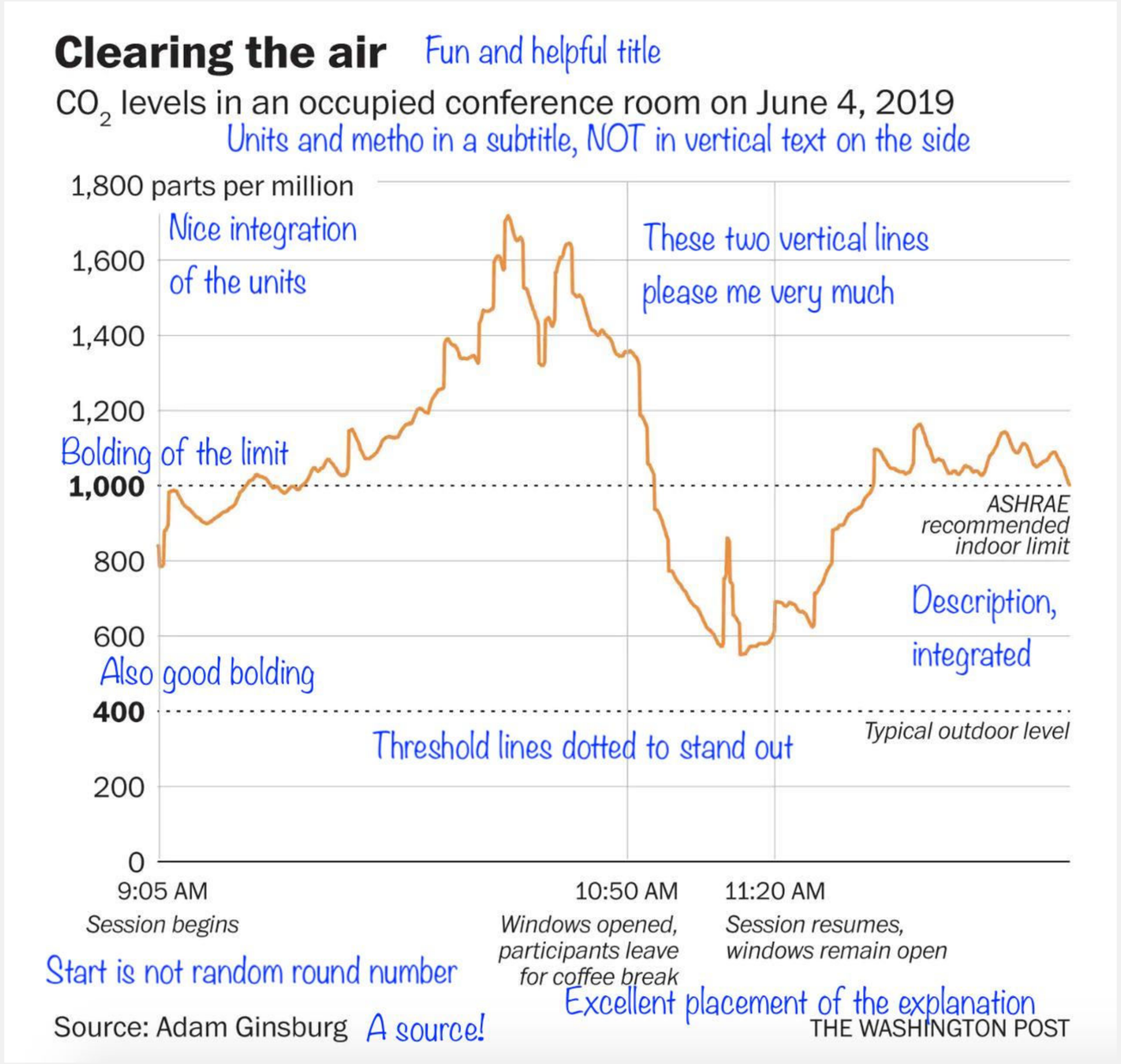
Present information in a logical, coherent way.

Guide the View(er)

- tell a story, do not “let the data speak for itself”
- use a suitable goal that transports the main finding
- use colors corretly and wisely
- add annotations, supporting text, and visual cues
- aim to work with direct labels, not legends



"Clearin the Air" by Adam Ginsburg (Washington Post)



...with notes by Francis Gagnon (Voilà)

Survey:

survey.mdc-berlin.de/129849

Thank you!

cedricscherer.com @CedScherer z3tt