Effektives Visualisieren von Daten

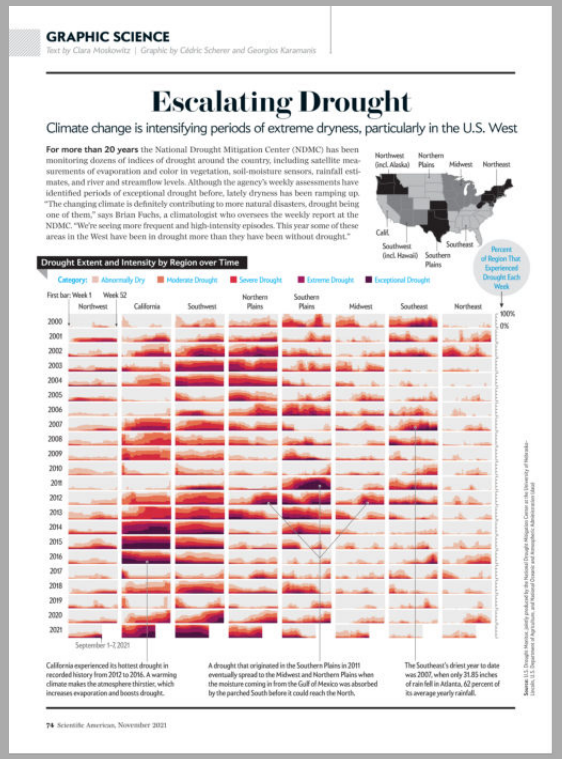
Dr. Cédric Scherer

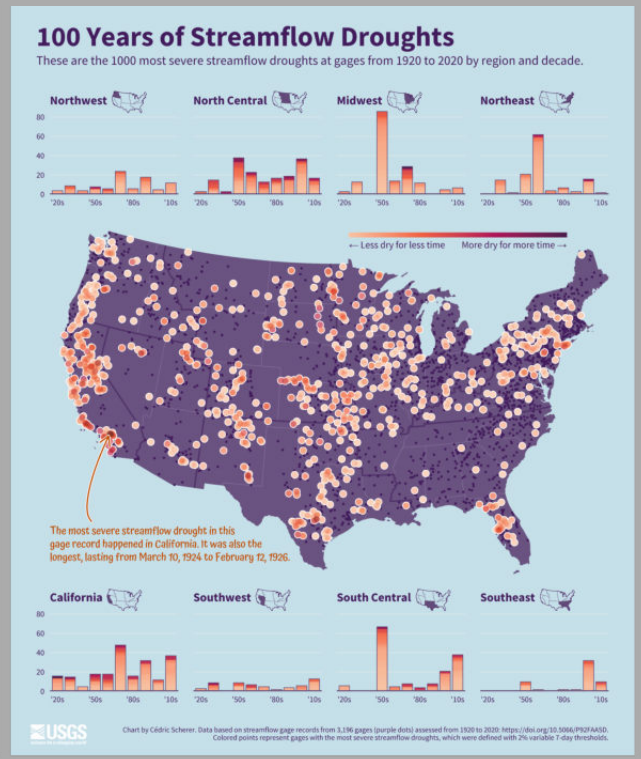
Roland Müller Autorenakademie der DGIM // 23. November 2023

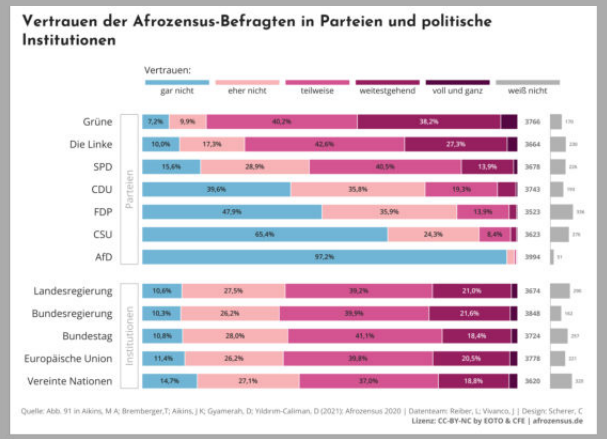
CÉDRIC SCHERER

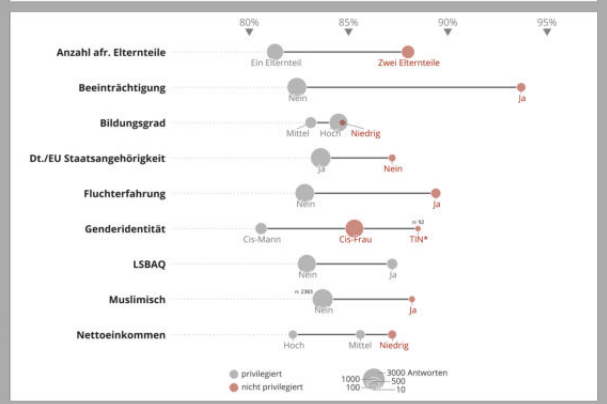
Data Visualization & Information Design

Consulting **Coaching** **Coding**


GRAPHIC SCIENCE
Text by Clara Moskowitz | Graphic by Cédric Scherer and Georgios Karamanis
Escalating Drought
Climate change is intensifying periods of extreme dryness, particularly in the U.S. West
For more than 20 years the National Drought Mitigation Center (NDMC) has been monitoring dozens of indices of drought around the country, including satellite measurements of evaporation and color in vegetation, soil-moisture sensors, rainfall estimates, and river and streamflow levels. Although the agency's weekly assessments have identified periods of exceptional drought before, lately dryness has been ramping up. "The changing climate is definitely contributing to more natural disasters, drought being one of them," says Brian Fuchs, a climatologist who oversees the weekly report at the NDMC. "We're seeing more frequent and high-intensity episodes. This year some of these areas in the West have been in drought more than they have been without drought."
Drought Extent and Intensity by Region over Time
Category: Abnormally Dry Moderate Drought Severe Drought Extreme Drought Exceptional Drought
First bar: Week 1 Week 52
Northwest California Southwest Northern Plains Southern Plains Midwest Southeast Northeast
Percent of Region That Experienced Drought Each Week
100%
0%
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.
74 Scientific American, November 2021

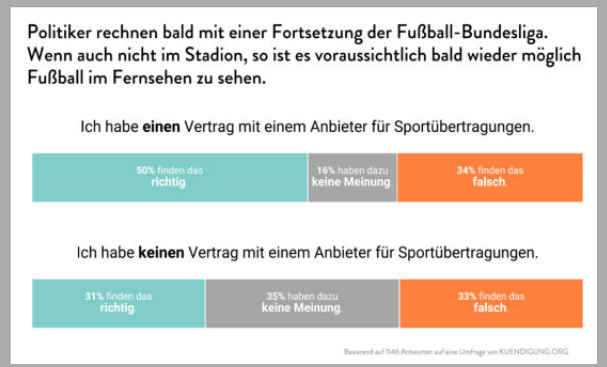

100 Years of Streamflow Droughts
These are the 1000 most severe streamflow droughts at gages from 1920 to 2020 by region and decade.
Northwest
North Central
Midwest
Northeast
'20s '50s '80s '10s
← Less dry for less time More dry for more time →
The most severe streamflow drought in this gage record happened in California. It was also the longest, lasting from March 10, 1924 to February 12, 1926.
California
Southwest
South Central
Southeast
USGS
Chart by Cédric Scherer. Data based on streamflow gage records from 3,196 gages (purple dots) assessed from 1920 to 2020: https://doi.org/10.5066/P92FA4SD.
Colored points represent gages with the most severe streamflow droughts, which were defined with 2% variable 7-day thresholds.

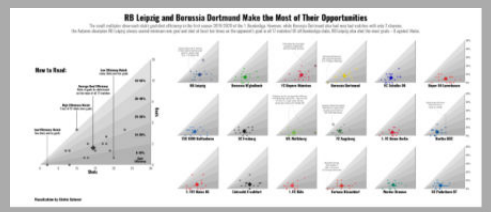

Vertrauen der Afrozensus-Befragten in Parteien und politische Institutionen
Vertrauen:
gar nicht eher nicht teilweise weitestgehend voll und ganz weiß nicht
Parteien
Grüne 7,2% 9,9% 40,2% 38,2% 3766
Die Linke 10,0% 17,3% 42,6% 27,3% 3664
SPD 15,6% 28,9% 40,5% 13,9% 3678
CDU 39,6% 35,8% 19,3% 3743
FDP 47,9% 35,9% 13,9% 3523
CSU 65,4% 24,3% 8,4% 3623
AfD 97,2% 3994
Institutionen
Landesregierung 10,6% 27,5% 39,2% 21,0% 3674
Bundesregierung 10,3% 26,2% 39,9% 21,6% 3848
Bundestag 10,8% 28,0% 41,1% 18,4% 3724
Europäische Union 11,4% 26,2% 39,8% 20,5% 3778
Vereinte Nationen 14,7% 27,1% 37,0% 18,8% 3620
Quelle: Abb. 91 in Aikins, M A; Bremberger,T; Aikins, J K; Gyamerah, D; Yildirim-Caliman, D (2021): Afrozensus 2020 | Datenteam: Reiber, L; Vivanco, J | Design: Scherer, C
Lizenz: CC-BY-NC by EOTO & CFE | afrozensus.de

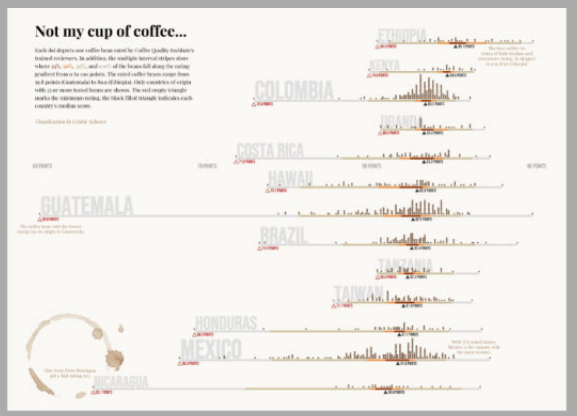

80% 85% 90% 95%
Anzahl afr. Elternteile Ein Elternteil Zwei Elternteile
Beeinträchtigung Nein Ja
Bildungsgrad Mittel Hoch Niedrig
Dt./EU Staatsangehörigkeit Ja Nein
Fluchterfahrung Nein Ja
Genderidentität Cis-Mann Cis-Frau TIN* n: 92
LSBAQ Nein Ja
Muslimisch Nein Ja n: 2383
Nettoeinkommen Hoch Mittel Niedrig
privilegiert
nicht privilegiert
1000 100 3000 Antworten 500 10

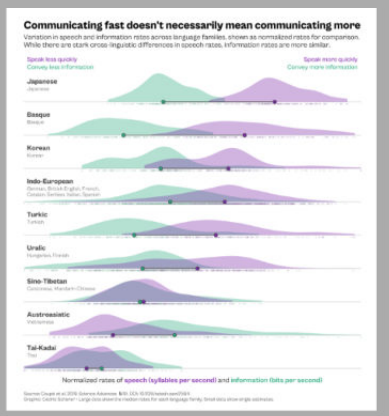

Demografischen Wandel neu entdecken
Berufliche Stellung

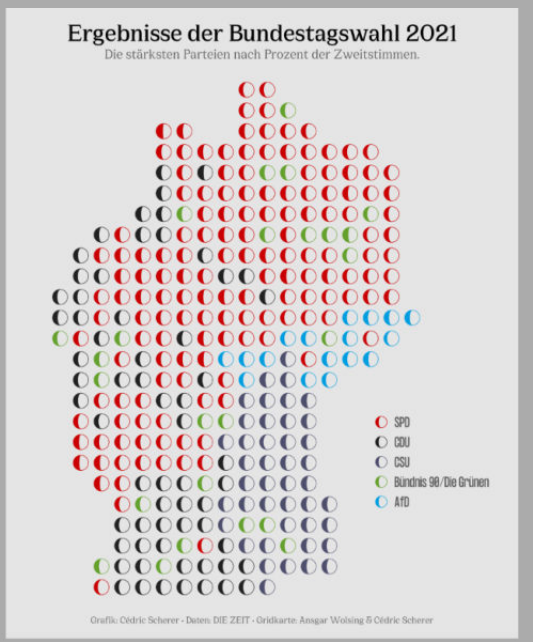

CeMAS
Q VADIS?
Zur Verbreitung von QAnon im deutschsprachigen Raum

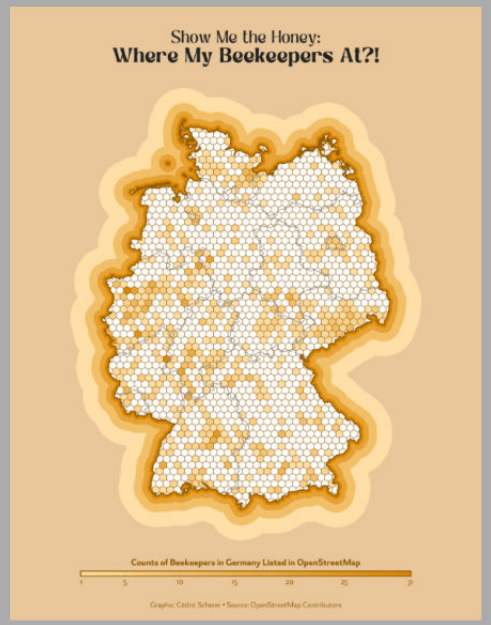

Politiker rechnen bald mit einer Fortsetzung der Fußball-Bundesliga. Wenn auch nicht im Stadion, so ist es voraussichtlich bald wieder möglich Fußball im Fernsehen zu sehen.
Ich habe einen Vertrag mit einem Anbieter für Sportübertragungen.
50% finden das richtig.
16% haben dazu keine Meinung.
34% finden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

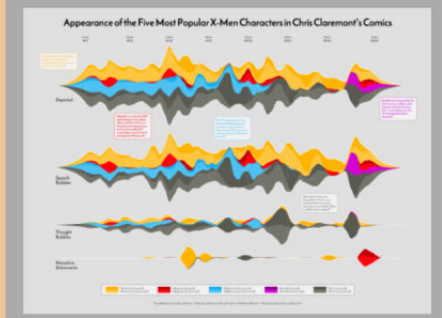

RB Leipzig and Borussia Dortmund Make the Most of Their Opportunities
How to Read:

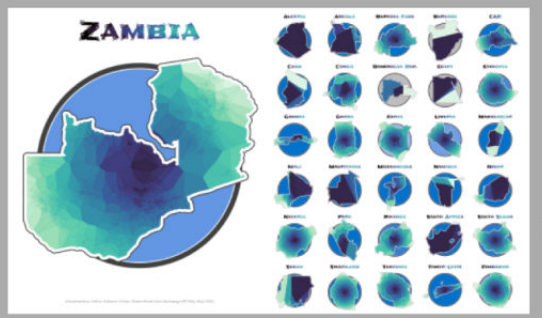

Not my cup of coffee...
ETHIOPIA
KENYA
COLOMBIA
UGANDA
COSTA RICA
HAWAII
GUATEMALA
BRAZIL
TANZANIA
TAIWAN
HONDURAS
MEXICO
SAUDI ARABIA

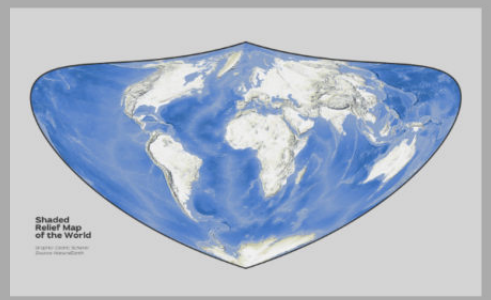

Communicating fast doesn't necessarily mean communicating more
Japanese
Basque
Korean
Indo-European
Turkic
Uralic
Sino-Tibetan
Austroasiatic
Tai-Kadai
Normalized rates of speech (syllables per second) and information (bits per second)

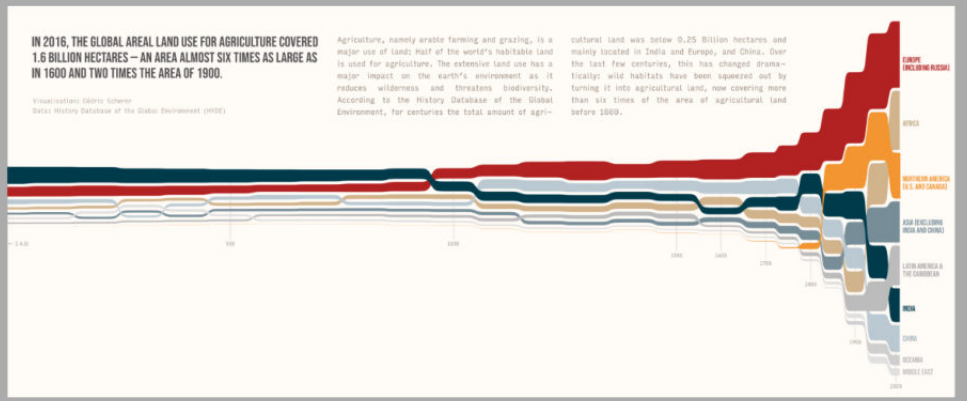

Ergebnisse der Bundestagswahl 2021
Die stärksten Parteien nach Prozent der Zweitstimmen.
SPD
CDU
CSU
Bündnis 90/Die Grünen
AfD
Grafik: Cédric Scherer · Daten: DIE ZEIT · Gridkarte: Ansgar Wolsing & Cédric Scherer

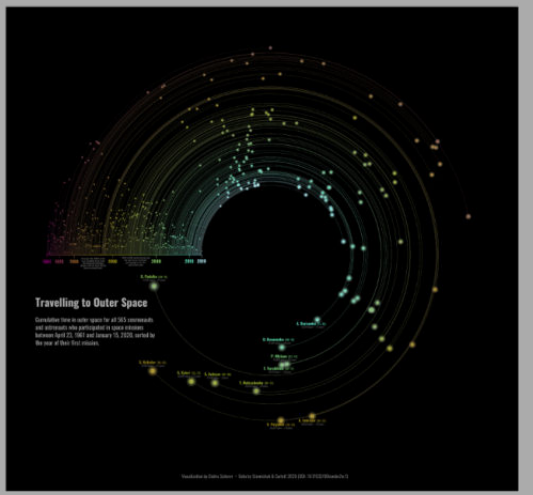

Show Me the Honey:
Where My Beekeepers At?!
Counts of Beekeepers in Germany Listed in OpenStreetMap
Graphic: Cédric Scherer • Source: OpenStreetMap Contributors


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

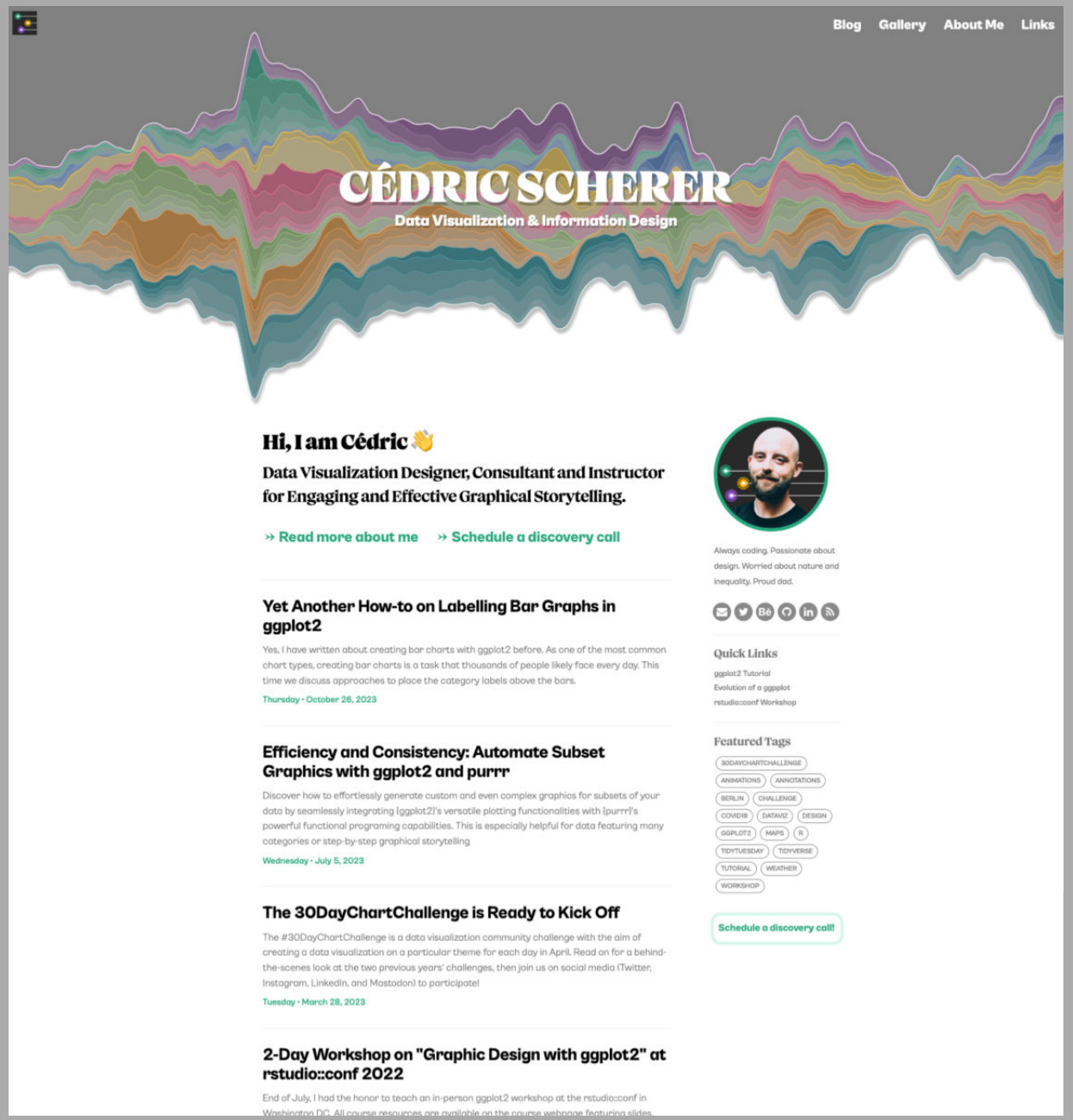

ZAMBIA


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 1000.
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

www.cedricscherer.com



Datenvisualisierung

ist die grafische Darstellung von Informationen und Daten.

Datenvisualisierung

wandelt Datenwerte in visuelle, quantifizierbare Formen um.

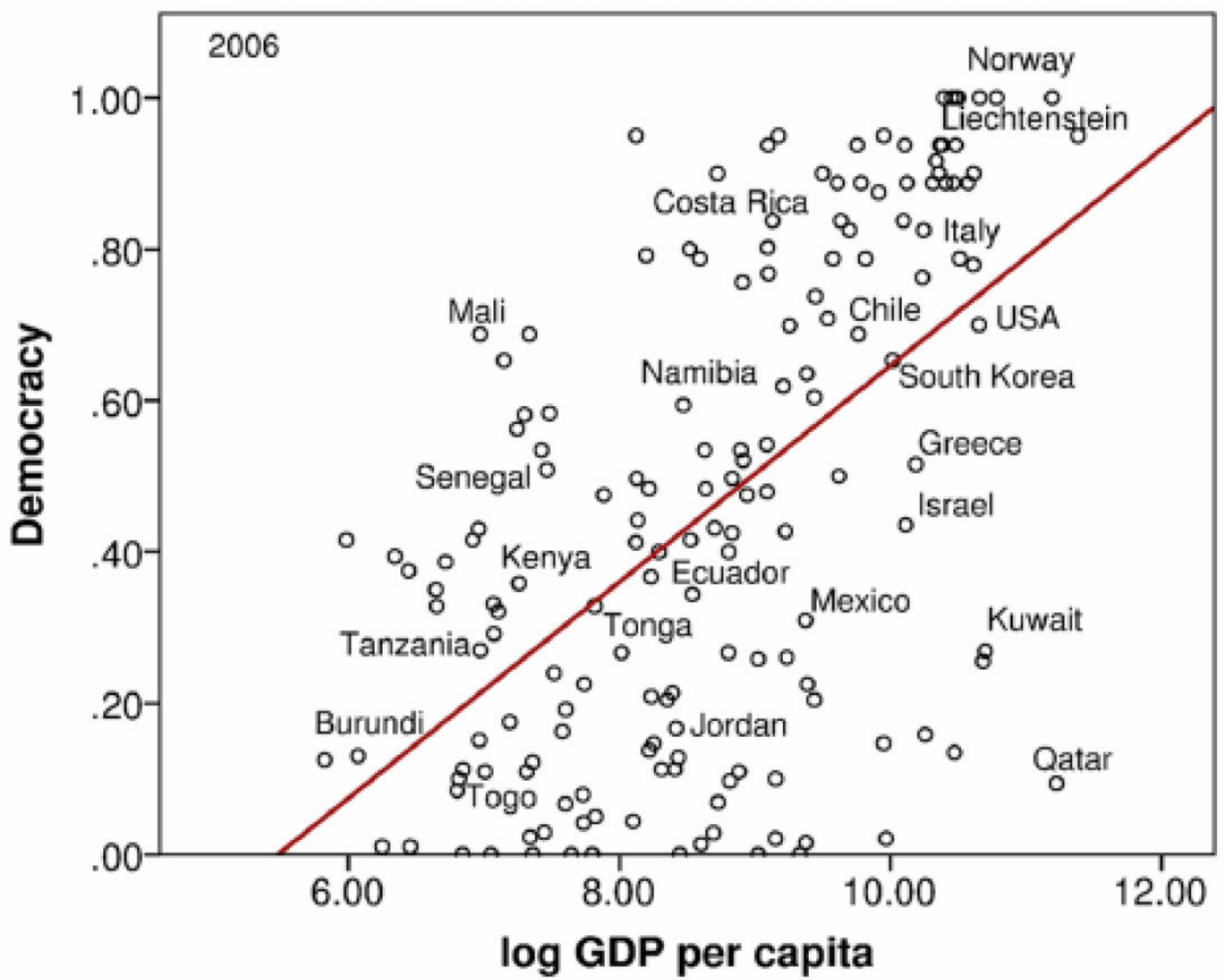
Datenvisualisierung

hilft zu erkennen, entdecken,
erklären und entscheiden.

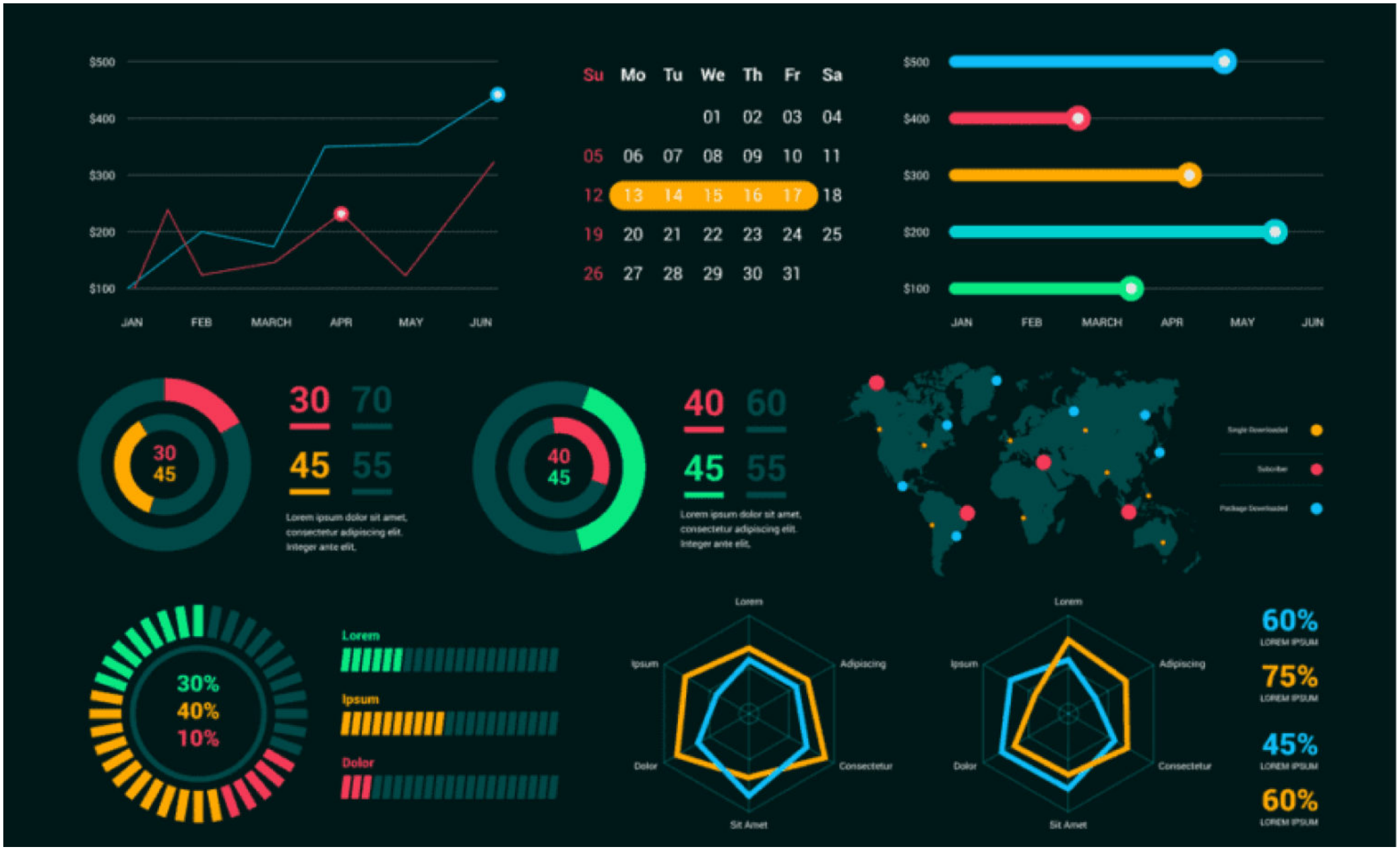
Datenvisualisierung

ist einerseits eine Kunst und
andererseits Wissenschaft.

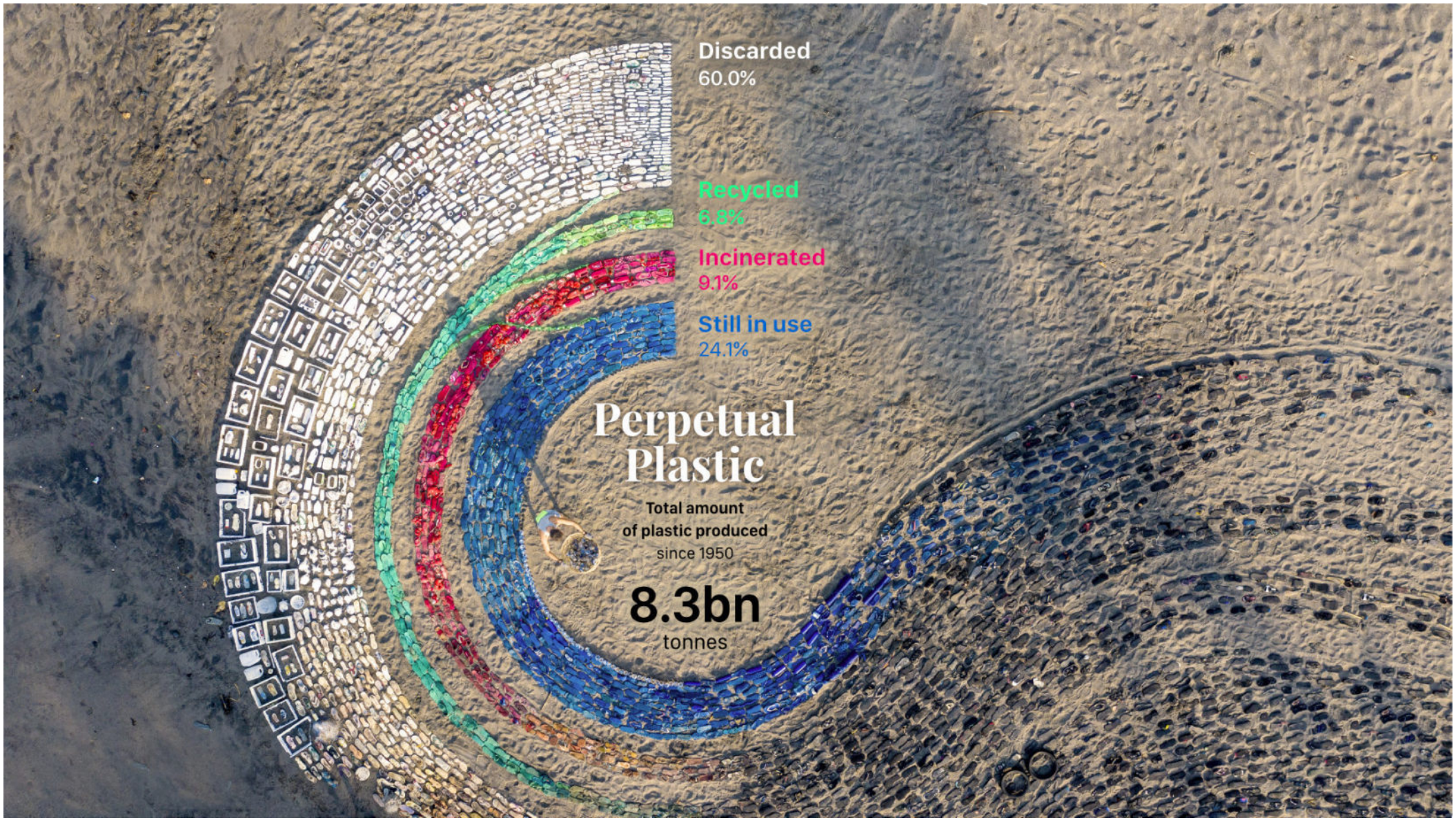
Quelle: eazybi



Quelle: Ranganathan et al. 2014

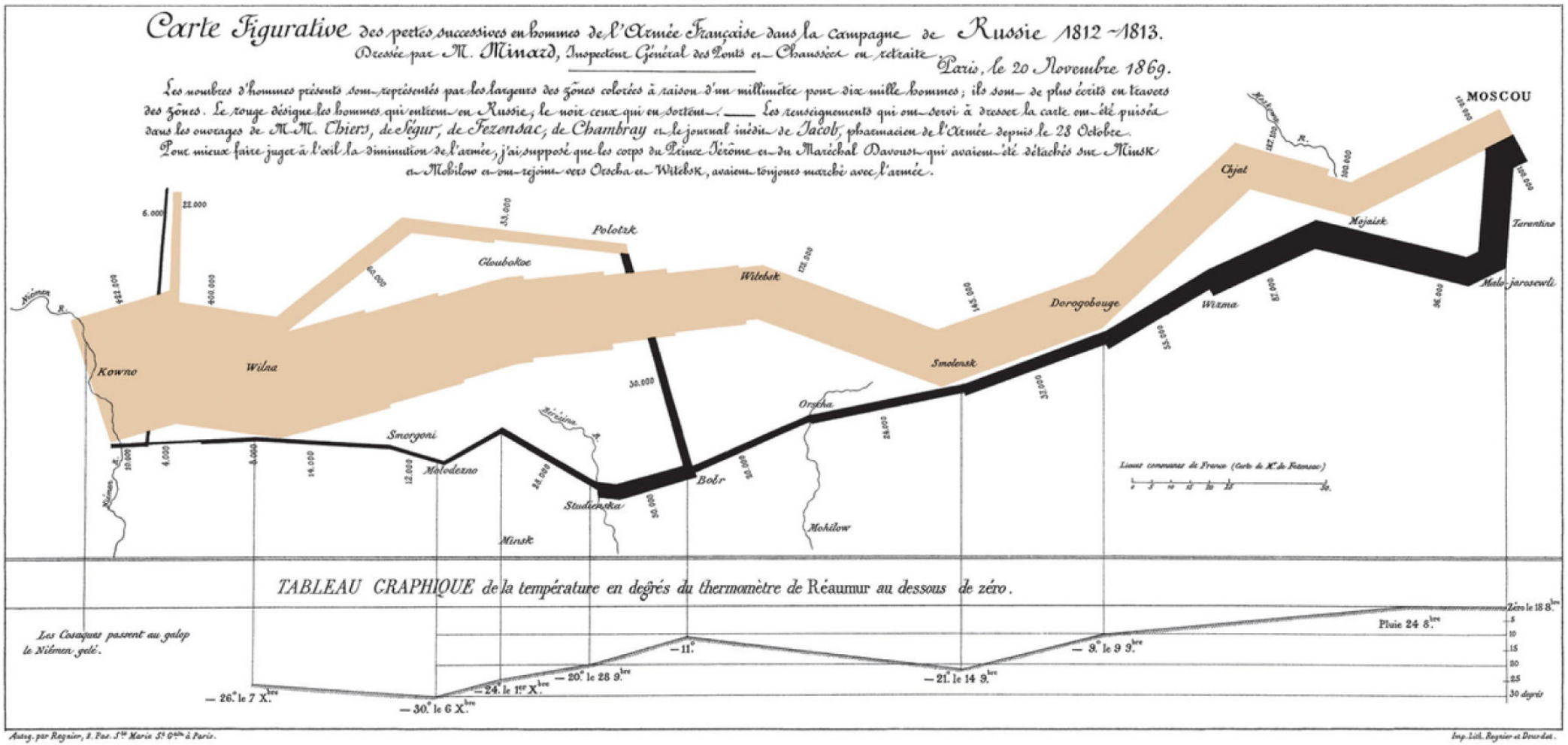


Quelle: datameer.com

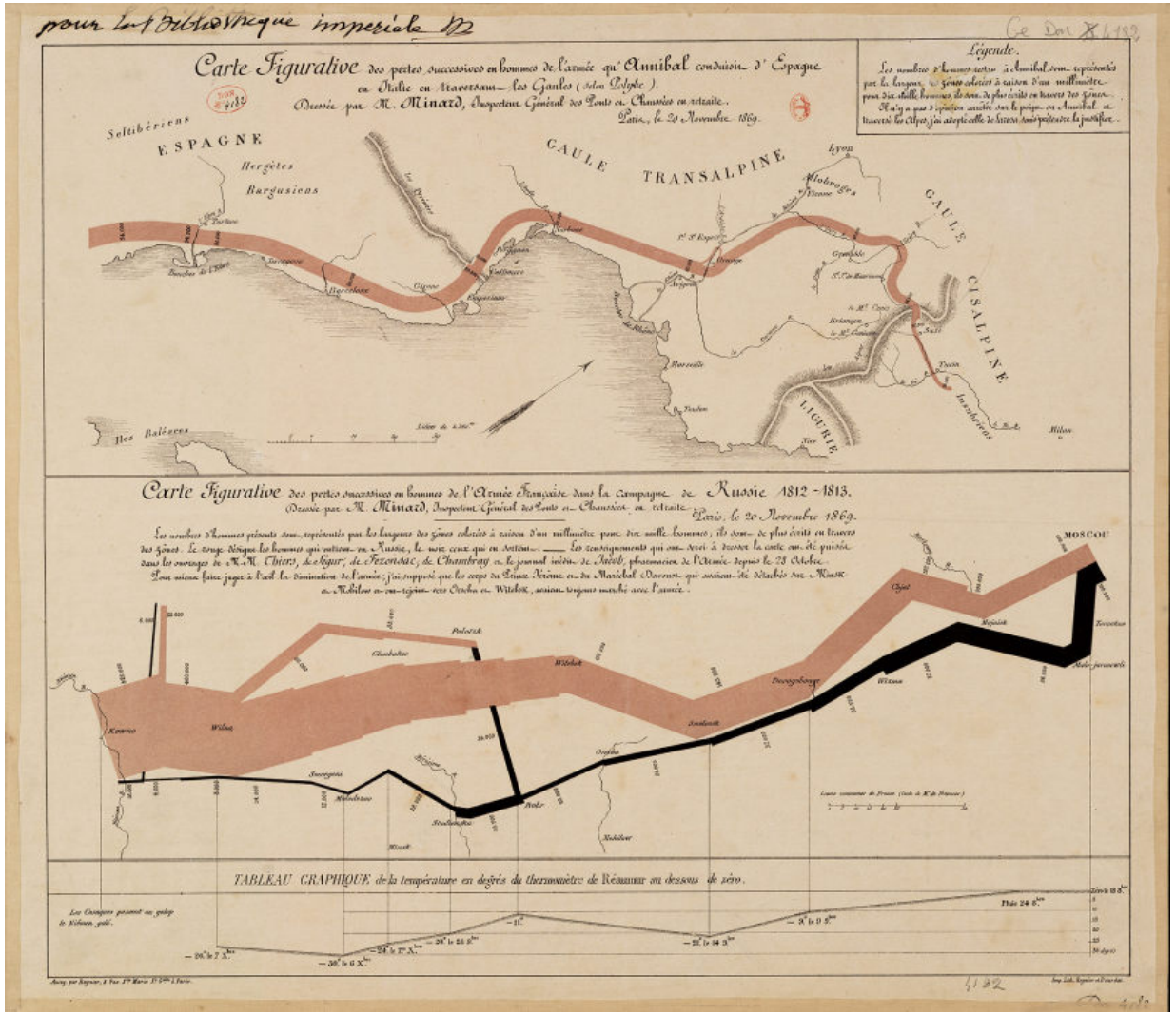


Quelle: "Perpetual Plastic" von Liina Klauss, Skye Morét & Moritz Stefaner

Quelle: "Patchwork Kingdoms" von Nadieh Bremer

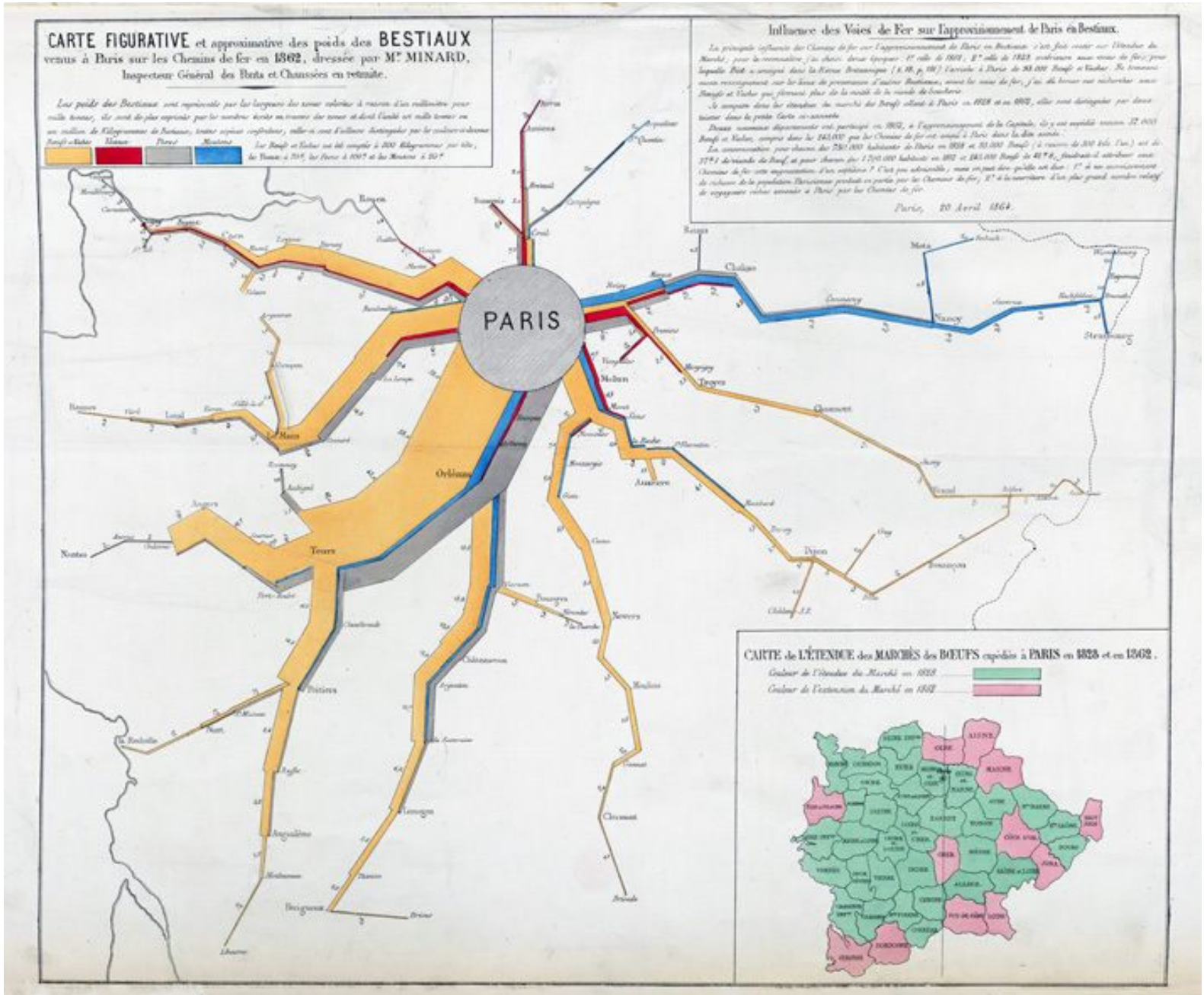


"Carte figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812–1813" von Charles Joseph Minard (1869)

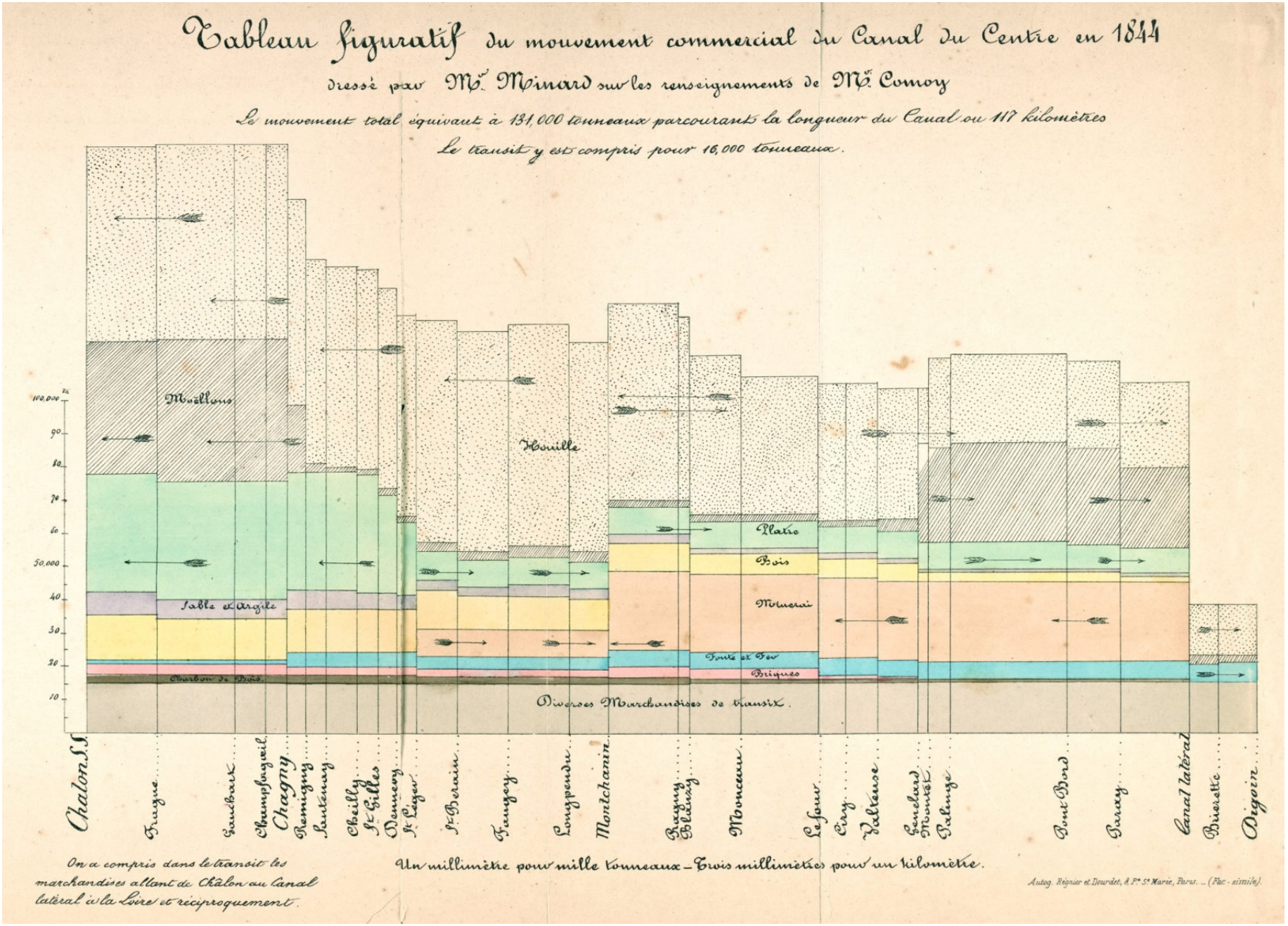


"Carte figurative des pertes successives en hommes de l'Armée qu'Annibal conduisit d'Espagne en Italie en traversant les Gaules (selon Polybe)" (oben) and "Carte figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812–1813" (unten) von Charles Joseph Minard (1869)

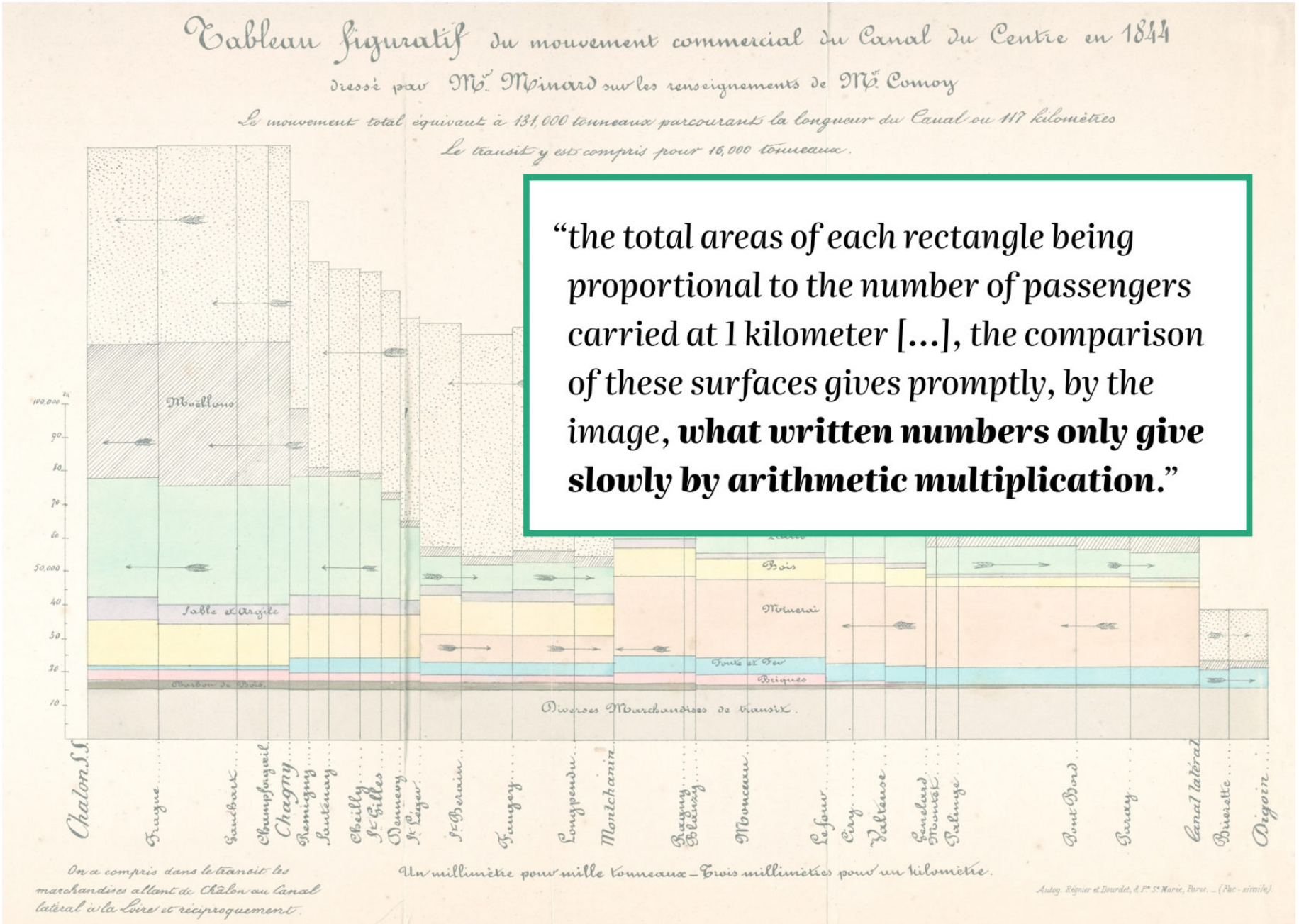
- zeigt die Truppenstärke der Armeen von Hannibal (218 v. Chr.) und Napoleon (1812–1813)
- wird als eine der besten statistischen Visualisierung überhaupt betitelt



"Carte figurative et approximative des poids des bestiaux venus á Paris sur les chemins de fer en 1862" von Charles Joseph Minard (1864)



"Tableau figuratif du mouvement commercial du Canal du Centre en 1844" von Charles Joseph Minard (1845)

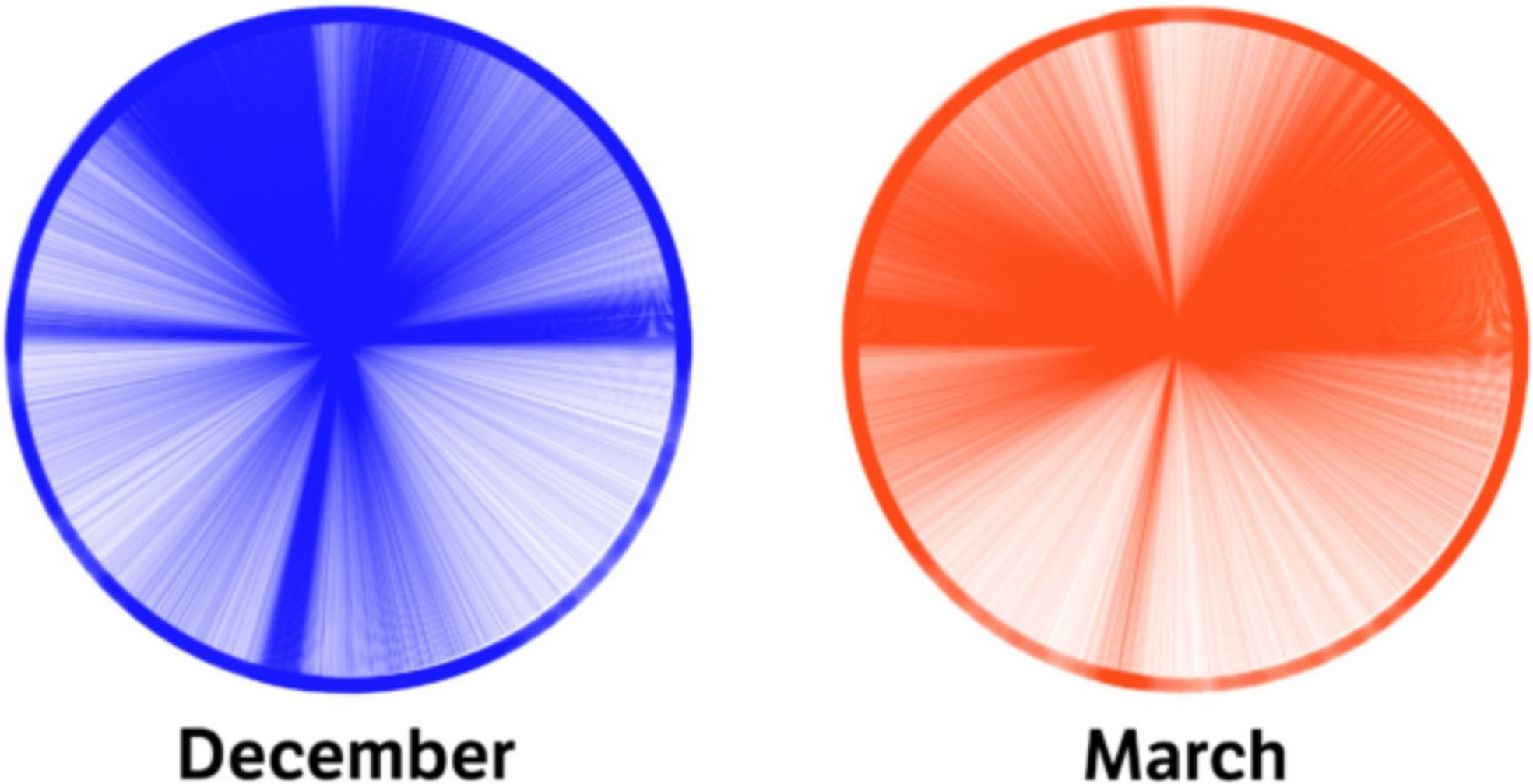


> "the total areas of each rectangle being proportional to the number of passengers carried at 1 kilometer [...], the comparison of these surfaces gives promptly, by the image, **what written numbers only give slowly by arithmetic multiplication.**"

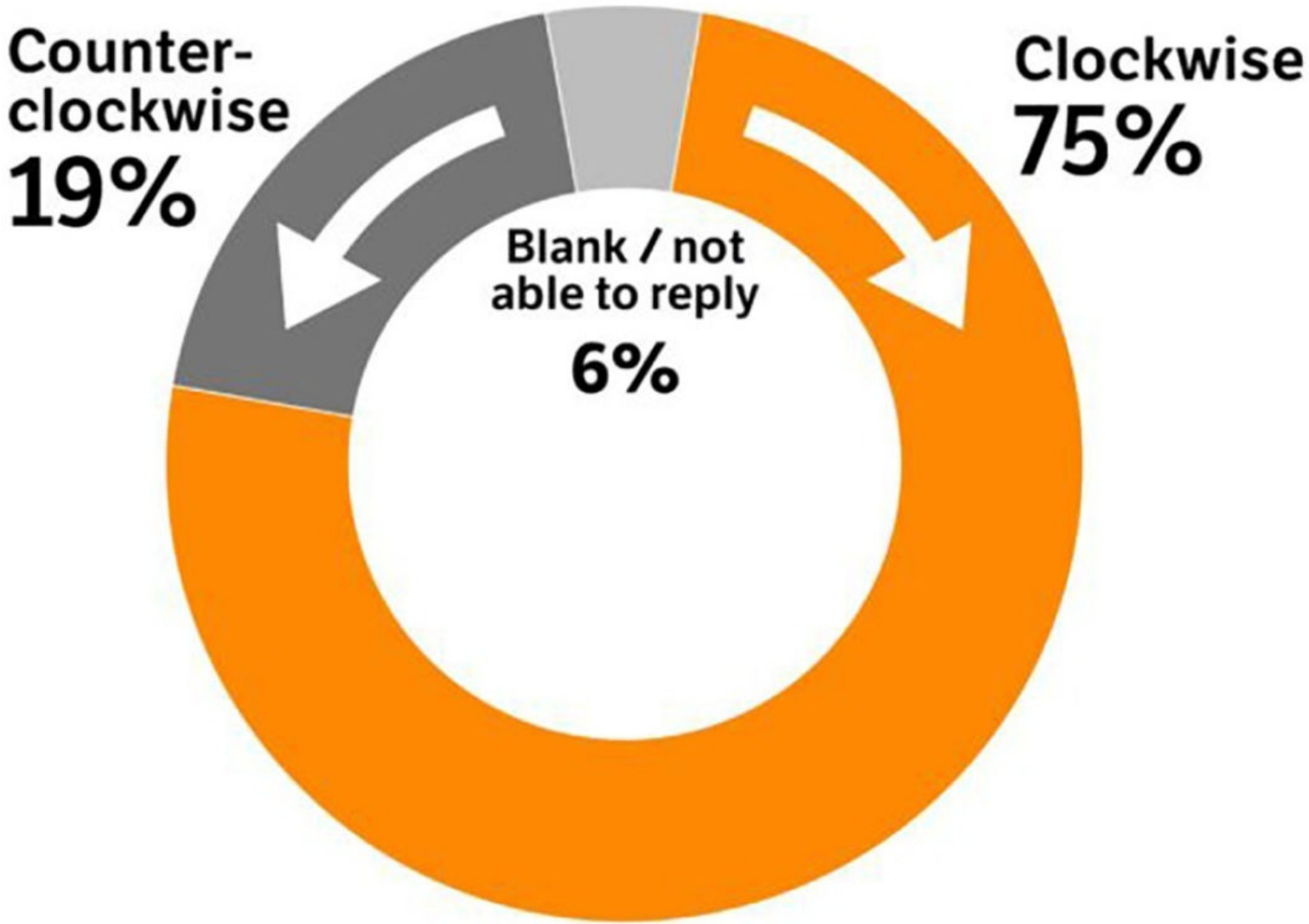
"Tableau figuratif du mouvement commercial du Canal du Centre en 1844" von Charles Joseph Minard (1845)

Experiment

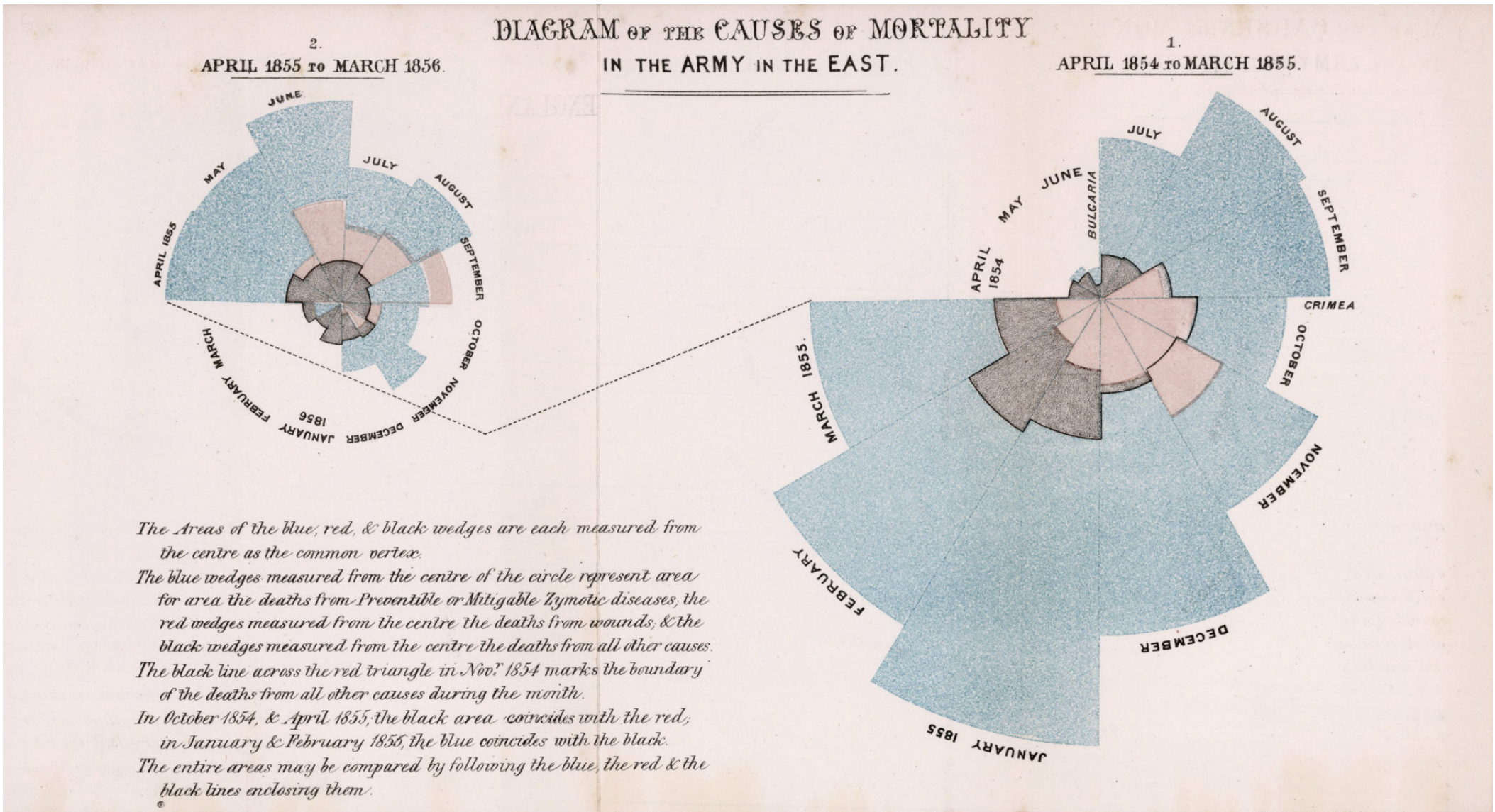
Wenn das Jahr ein Kreis ist – wo befinden sich März und Dezember?



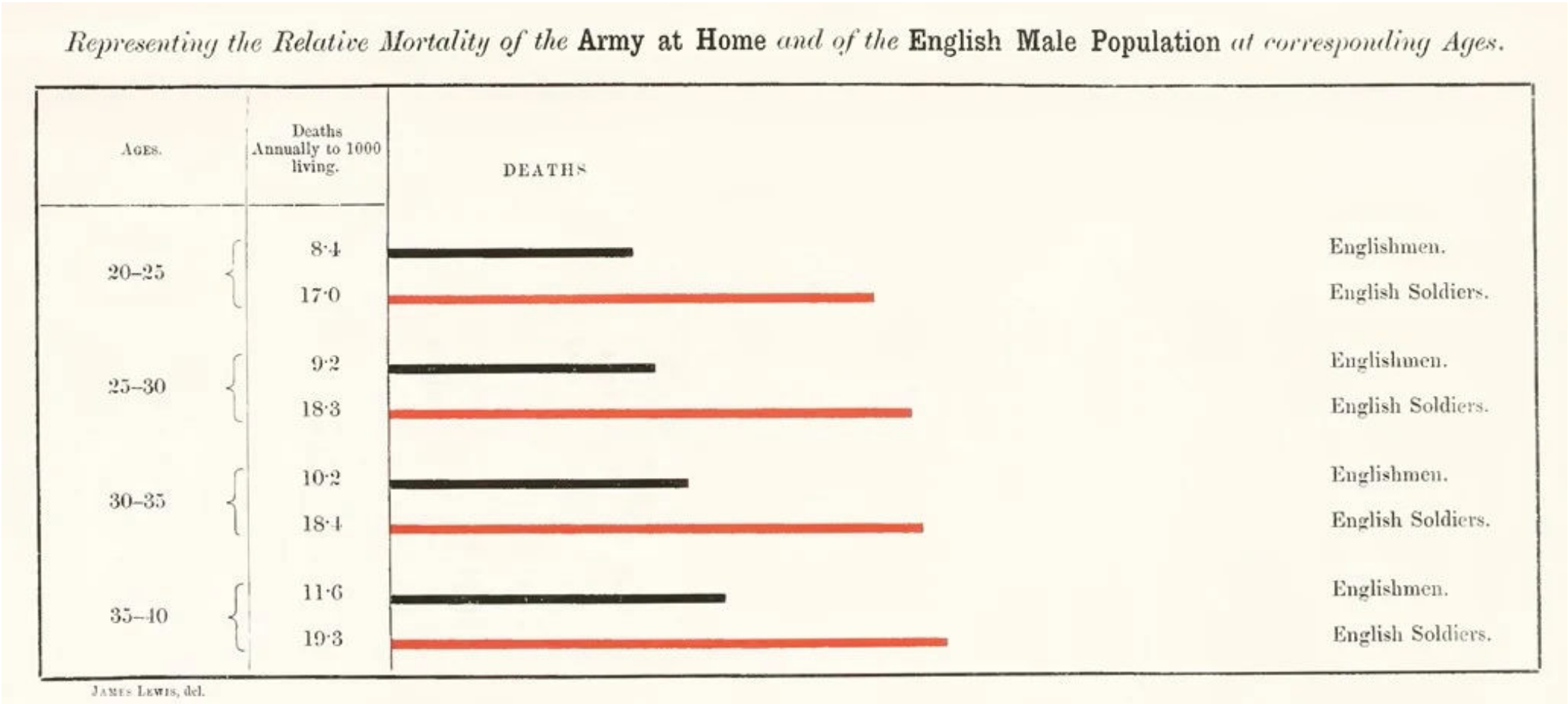
76,922 Platzierungen der Monate Dezember und März entlang eines Kreises.
Visualisierung: Henrik Lied, NRKbeta Laeng & Hofseth, Front Psychol. 2019



Anteil der Befragten gruppiert nach Richtung der Zeit auf dem Jahresrad.
Visualisierung: Vidar Kvien, NRK Laeng & Hofseth, Front Psychol. 2019



"Diagram of the causes and mortality in the army in the East" (coxcomb diagram) von Florence Nightingale (1858)



"Relative mortality of the army at home and of the English male population at corresponding ages" von Florence Nightingale (1858)

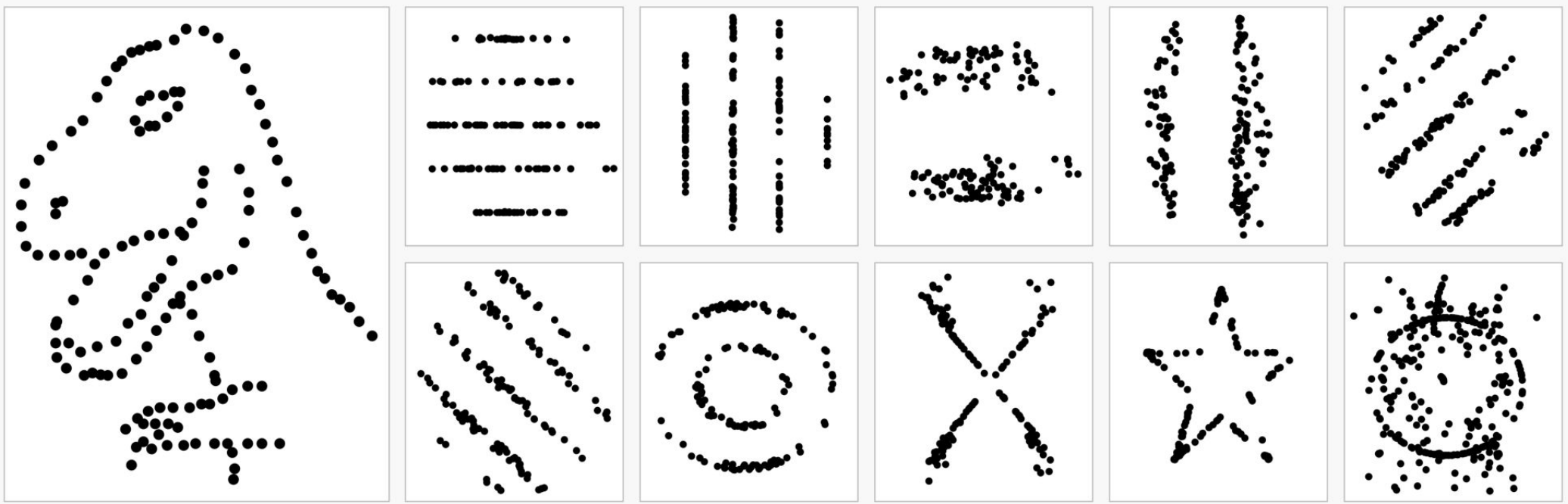
Visualisiere deine Daten!

… make both ***calculations and graphs****.*
Both sorts of output should be studied;
each will ***contribute to understanding****.*

F. J. Anscombe (1973)

The Datasaurus (*Anscombosaurus spec.*) Dozen

is a set of 13 different datasets with nigh-identical summary statistics, which could lead one to believe the datasets are quite similar. After visualizing the data, it becomes clear that the datasets are markedly different.



Quelle: “Same Stats, Different Graphs: Generating Datasets with Varied Appearance and Identical Statistics through Simulated Annealing”, Justin Matejka & George Fitzmaurice (2017) • Grafik: Cédric Scherer

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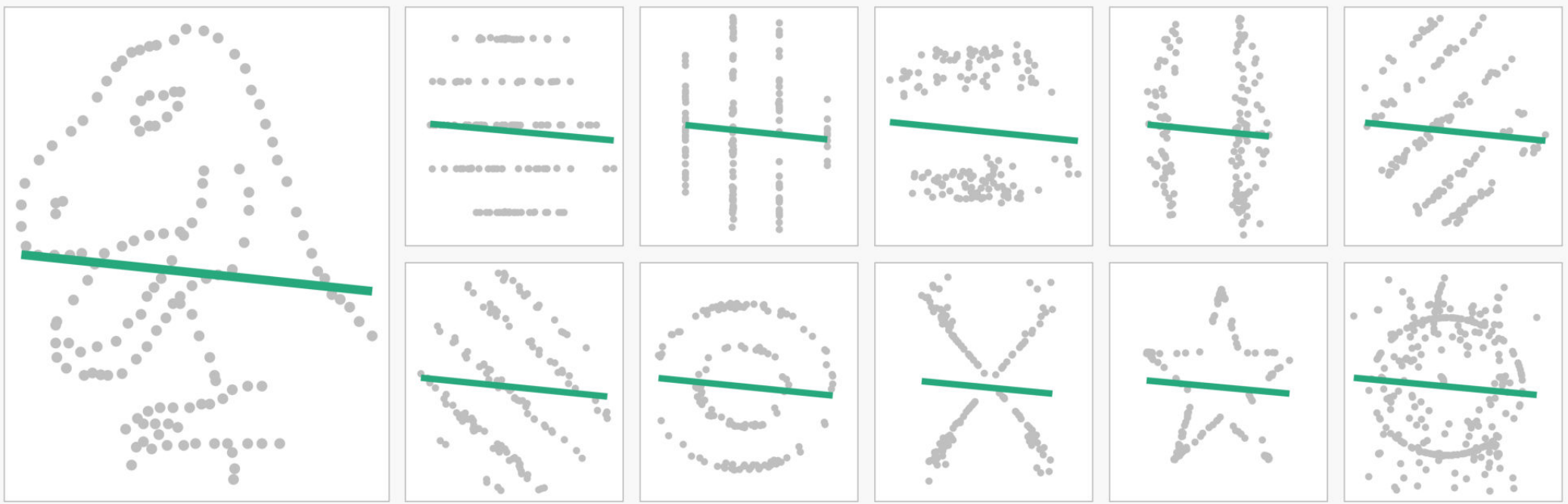
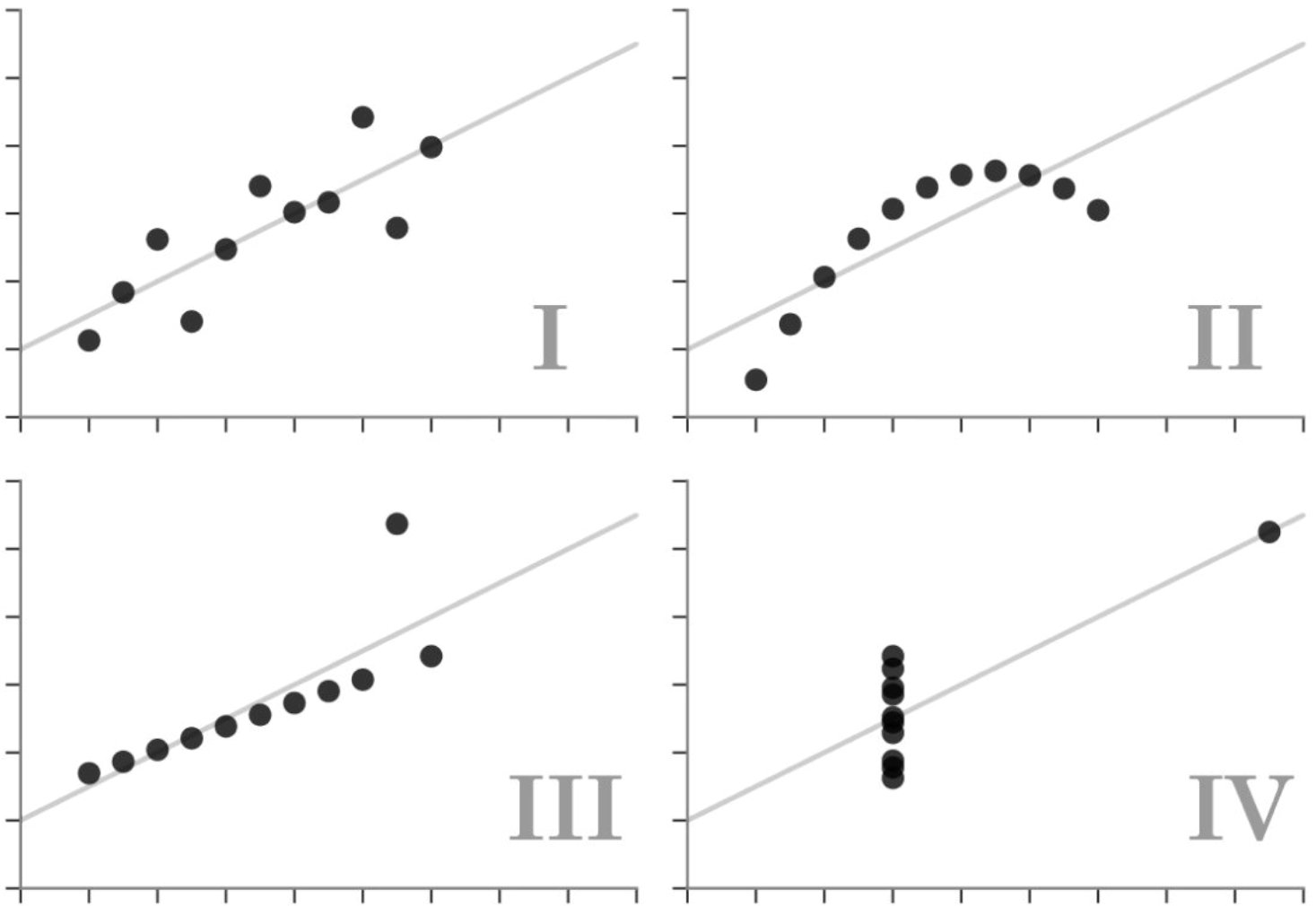


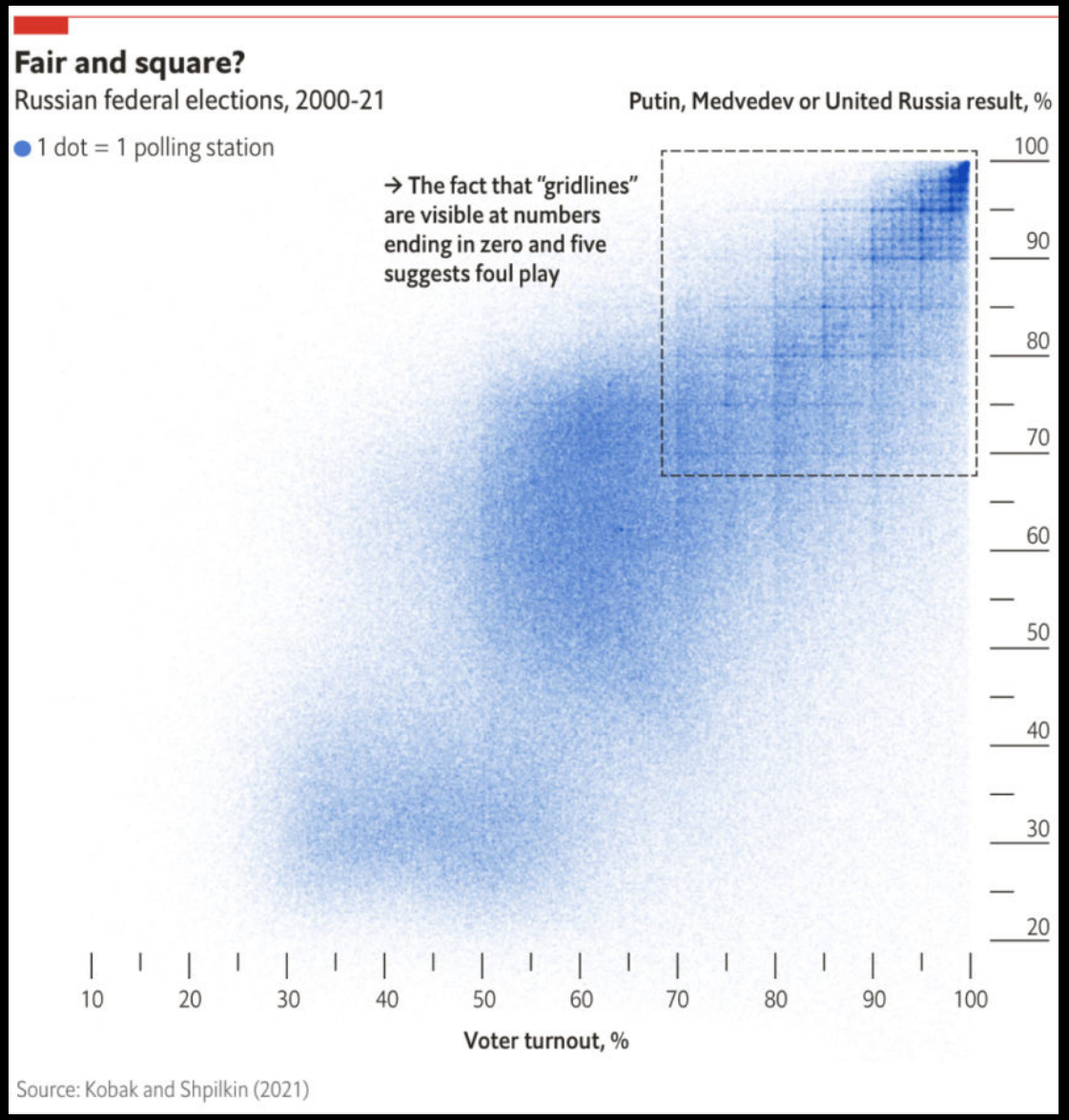
Quelle: "Same Stats, Different Graphs: Generating Datasets with Varied Appearance and Identical Statistics through Simulated Annealing", Justin Matejka & George Fitzmaurice (2017) • Grafik: Cédric Scherer

Anscombe's Quartet



Quelle: Matejka & Fitzmaurice (2017)

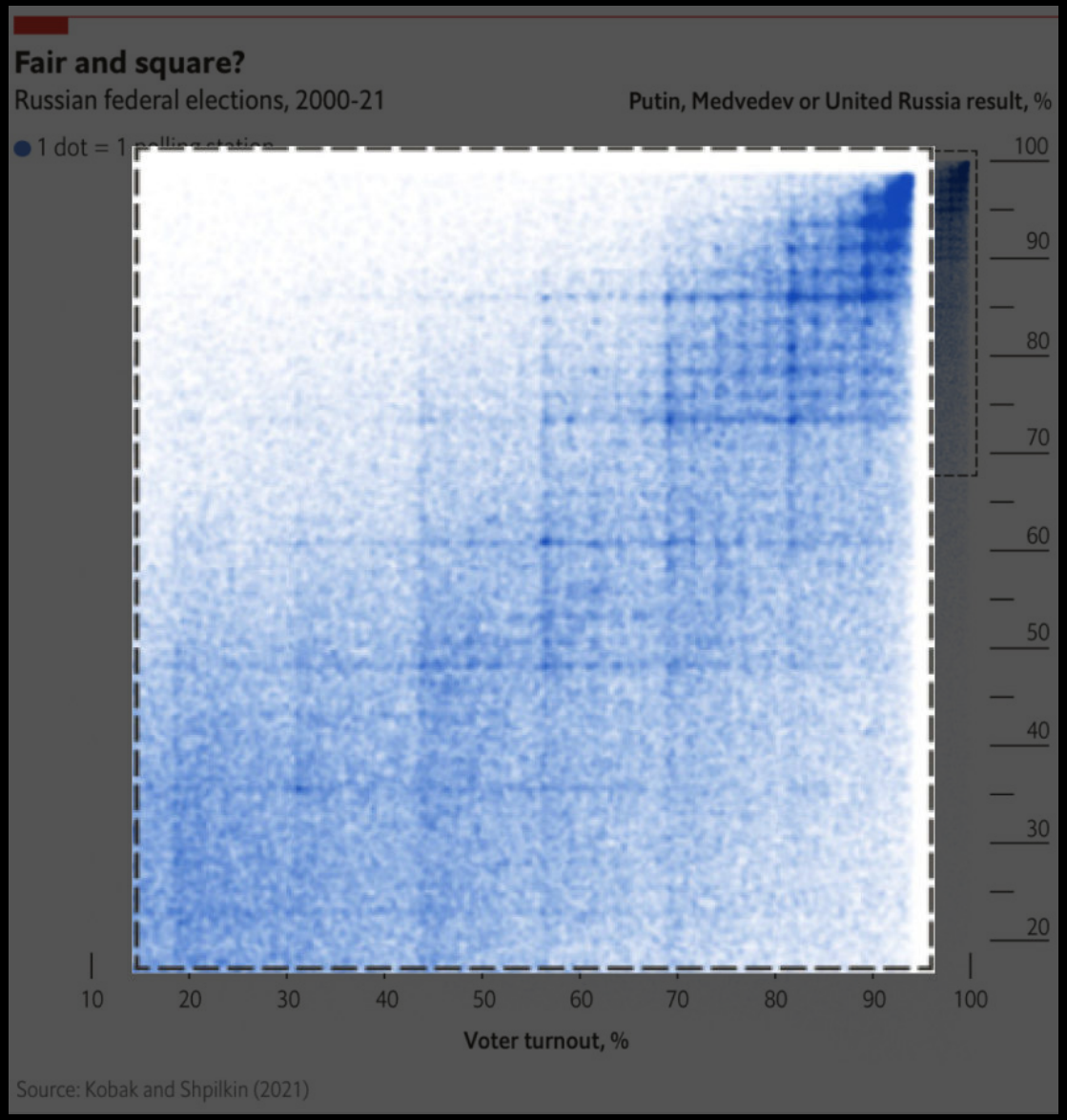
Muster erkennen



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**.

"Russian elections once again had a suspiciously neat result" (The Economist)

Muster erkennen



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"Russian elections once again had a suspiciously neat result" (The Economist)

*Eine effektive Datenvisualisierung kann den Unterschied zwischen **Erfolg** und **Scheitern** bedeuten.*

- Kommunikation bedeutender Ergebnisse und Erkenntnisse
- Einwerben von Geldmitteln für eine Organisation oder ein Projekt
- Präsentation vor einem Gremium oder auf einer Konferenz
- Unterstützung bei fundierten Entscheidungen
- Grundlagen und Orientierung für Verbesserungen bieten
- …
- **Deine Botschaft vermitteln!**


Good vs Bad

Was macht eine gute Visualisierung aus?

→ **Information** (Integrität)

→ **Erzählung** (Bedeutsamkeit)

→ **Ziel** (Zweckmäßigkeit)

→ **Visuelle Form** (Eleganz)

Integrität der Daten

und mögliche Probleme

Integrität der Daten

— **Datenqualität:**

→ Schätzung, Präzision und Fehler

→ Fehler und Irrtümer bei der Berechnung

→ Unvollständige Daten und fehlende Werte

→ Zusammengefasste und relative Daten

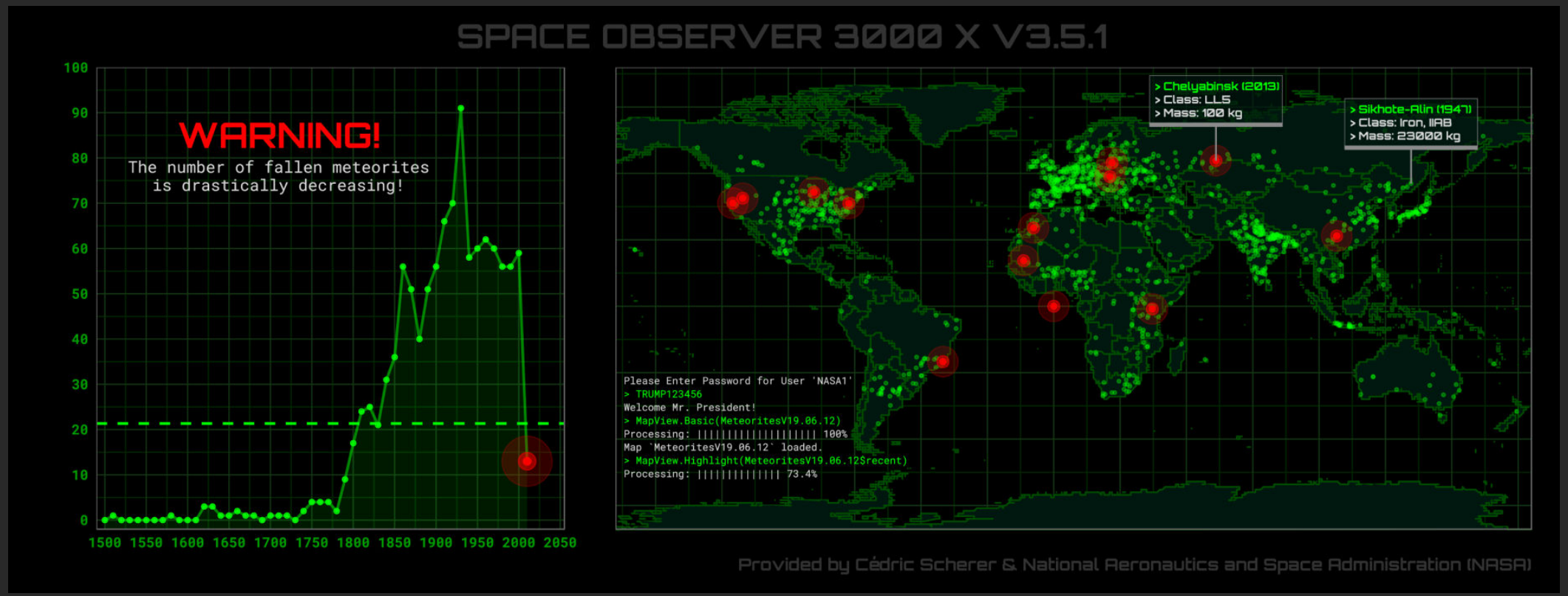
— **Nur ein Teilabbild:**

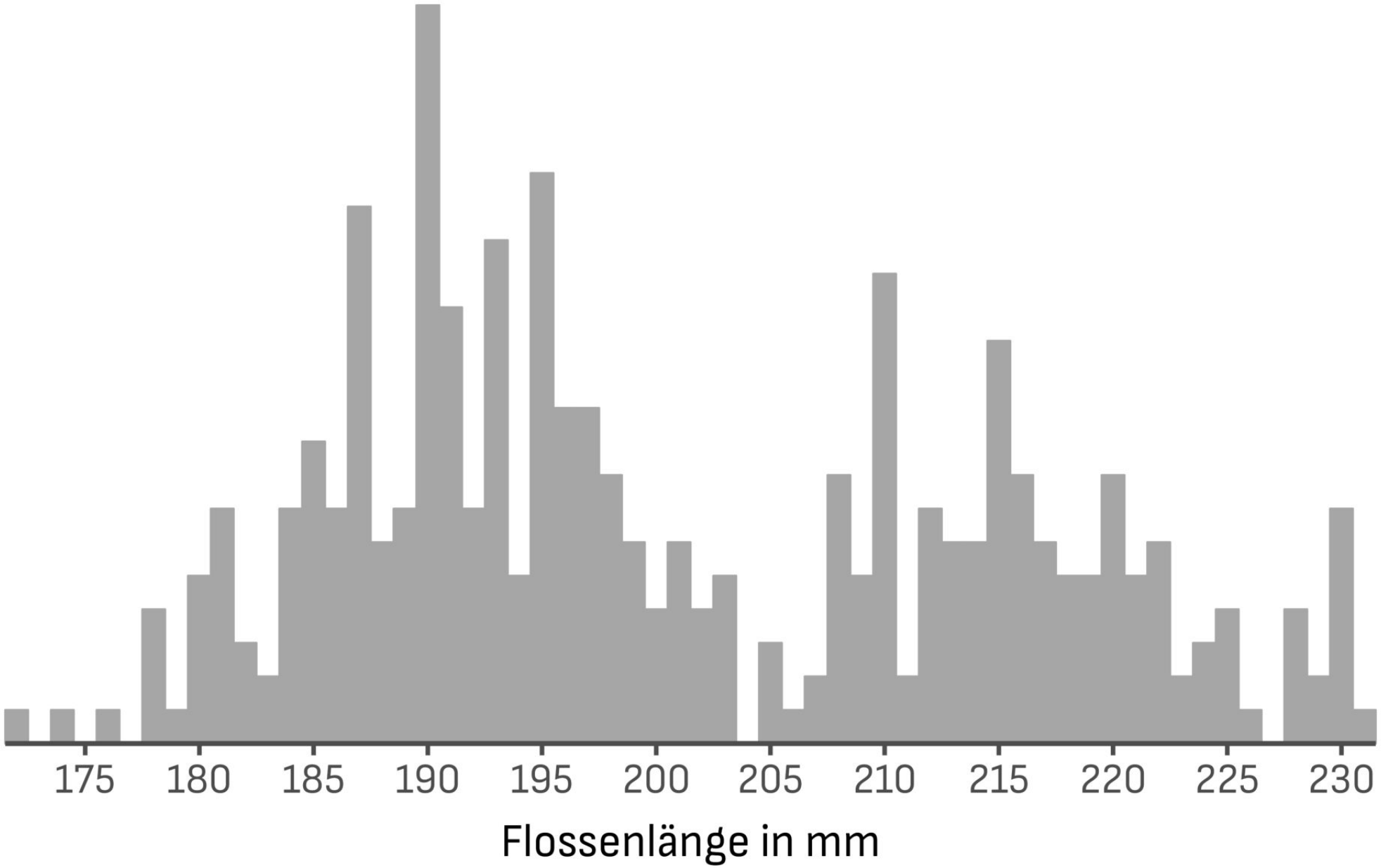
→ nicht Straftaten, sondern gemeldete Straftaten*

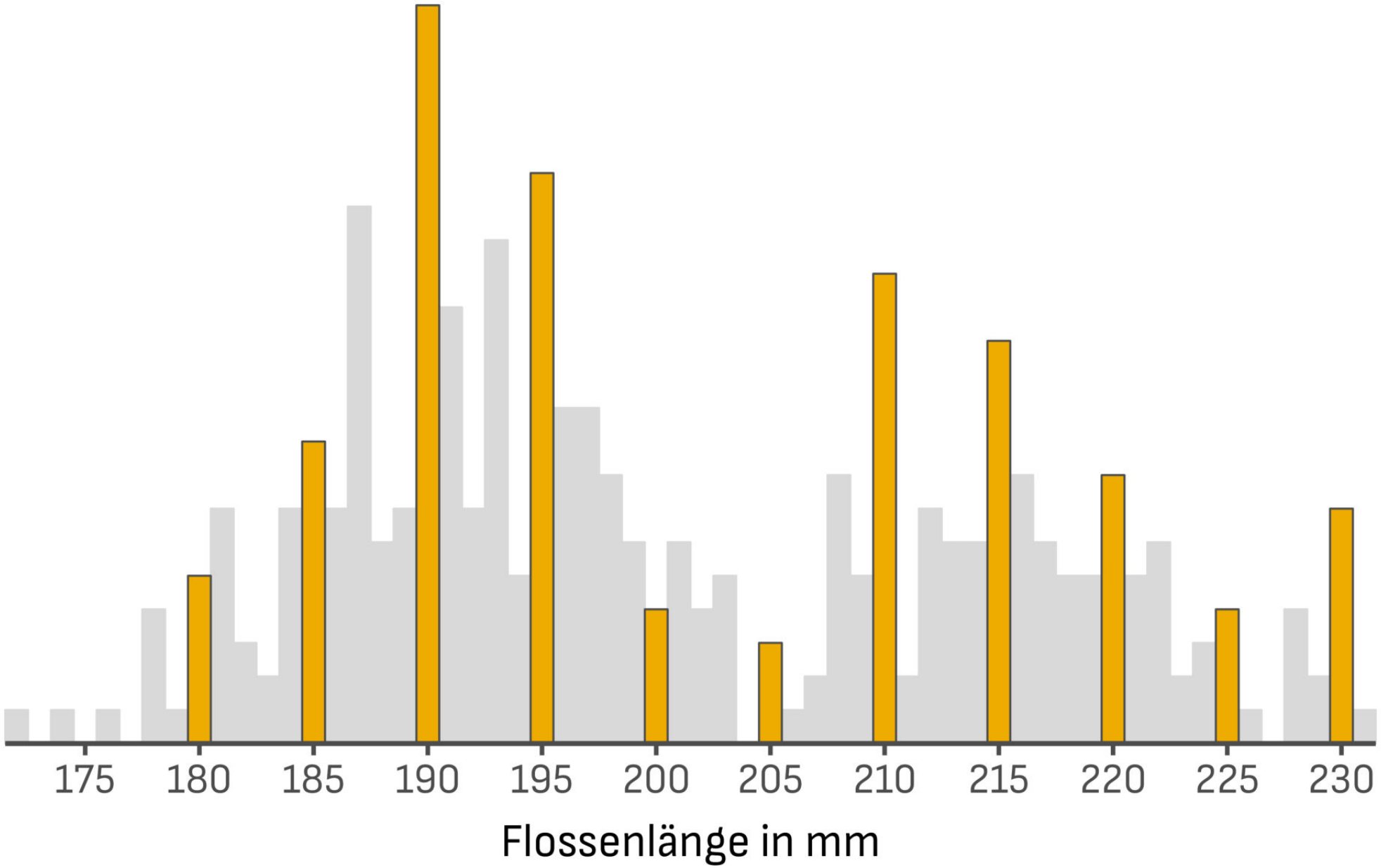
→ historischer oder gegenwärtiger Zustand

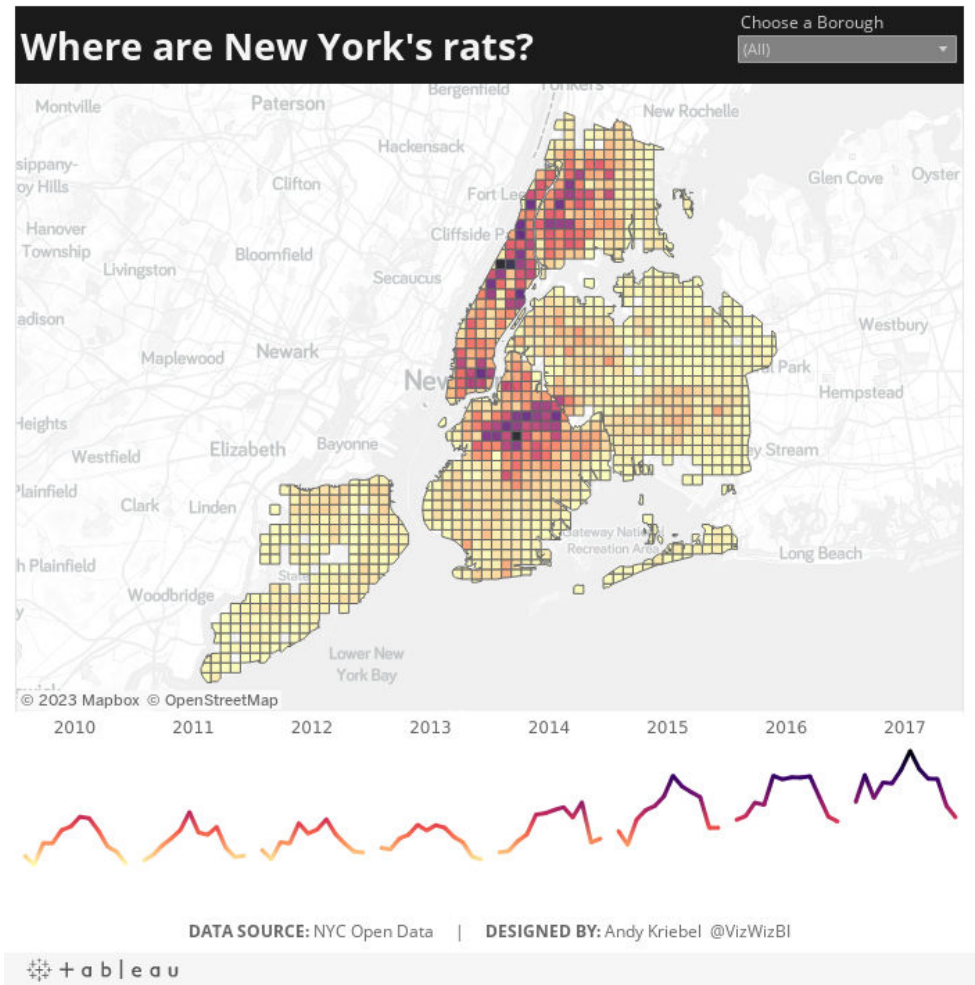
* oder Ratten, UFO-Sichtungen, …

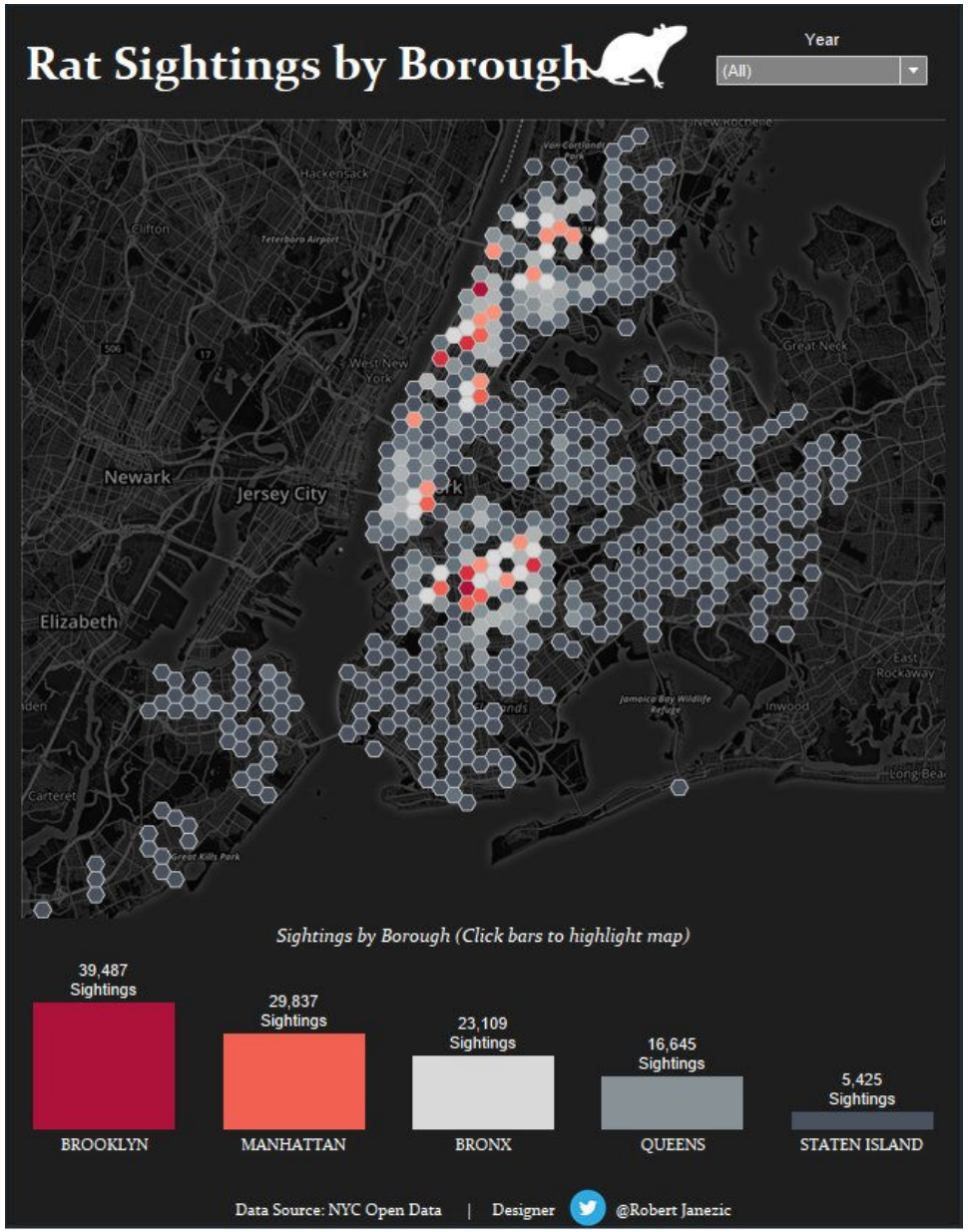
Unsere Daten sind **niemals** eine perfekte Abbildung der realen Welt.


SPACE OBSERVER 3000 X V3.5.1
WARNING!
The number of fallen meteorites
is drastically decreasing!
100
90
80
70
60
50
40
30
20
10
0
1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000 2050
> Chelyabinsk (2013)
> Class: LL5
> Mass: 100 kg
> Sikhote-Alin (1947)
> Class: Iron, IIAB
> Mass: 23000 kg
Please Enter Password for User 'NASA1'
> TRUMP123456
Welcome Mr. President!
> MapView.Basic(MeteoritesV19.06.12)
Processing: |||||||||||||||||||| 100%
Map `MeteoritesV19.06.12` loaded.
> MapView.Highlight(MeteoritesV19.06.12$recent)
Processing: ||||||||||||| 73.4%
Provided by Cédric Scherer & National Aeronautics and Space Administration (NASA)


175
180
185
190
195
200
205
210
215
220
225
230
Flossenlänge in mm


175
180
185
190
195
200
205
210
215
220
225
230
Flossenlänge in mm


Where are New York's rats?
Choose a Borough
(All)
Montville
Paterson
Bergenfield
New Rochelle
Hackensack
Clifton
Glen Cove
Oyster
Hanover Township
Livingston
Bloomfield
Secaucus
Cliffside Park
Fort Lee
Westbury
Maplewood
Newark
Hempstead
Elizabeth
Bayonne
Westfield
Clark
Linden
Long Beach
Woodbridge
Lower New York Bay
© 2023 Mapbox © OpenStreetMap
2010
2011
2012
2013
2014
2015
2016
2017
DATA SOURCE: NYC Open Data | DESIGNED BY: Andy Kriebel @VizWizBI
+ableau


Rat Sightings by Borough
Year
(All)
Hackensack
Clifton
Great Neck
Newark
Jersey City
Elizabeth
Carteret
Sightings by Borough (Click bars to highlight map)
39,487 Sightings
BROOKLYN
29,837 Sightings
MANHATTAN
23,109 Sightings
BRONX
16,645 Sightings
QUEENS
5,425 Sightings
STATEN ISLAND
Data Source: NYC Open Data | Designer @Robert Janezic

Kontext

Typologie von Informationsgrafiken

Ist die Information konzeptionell oder messbar?

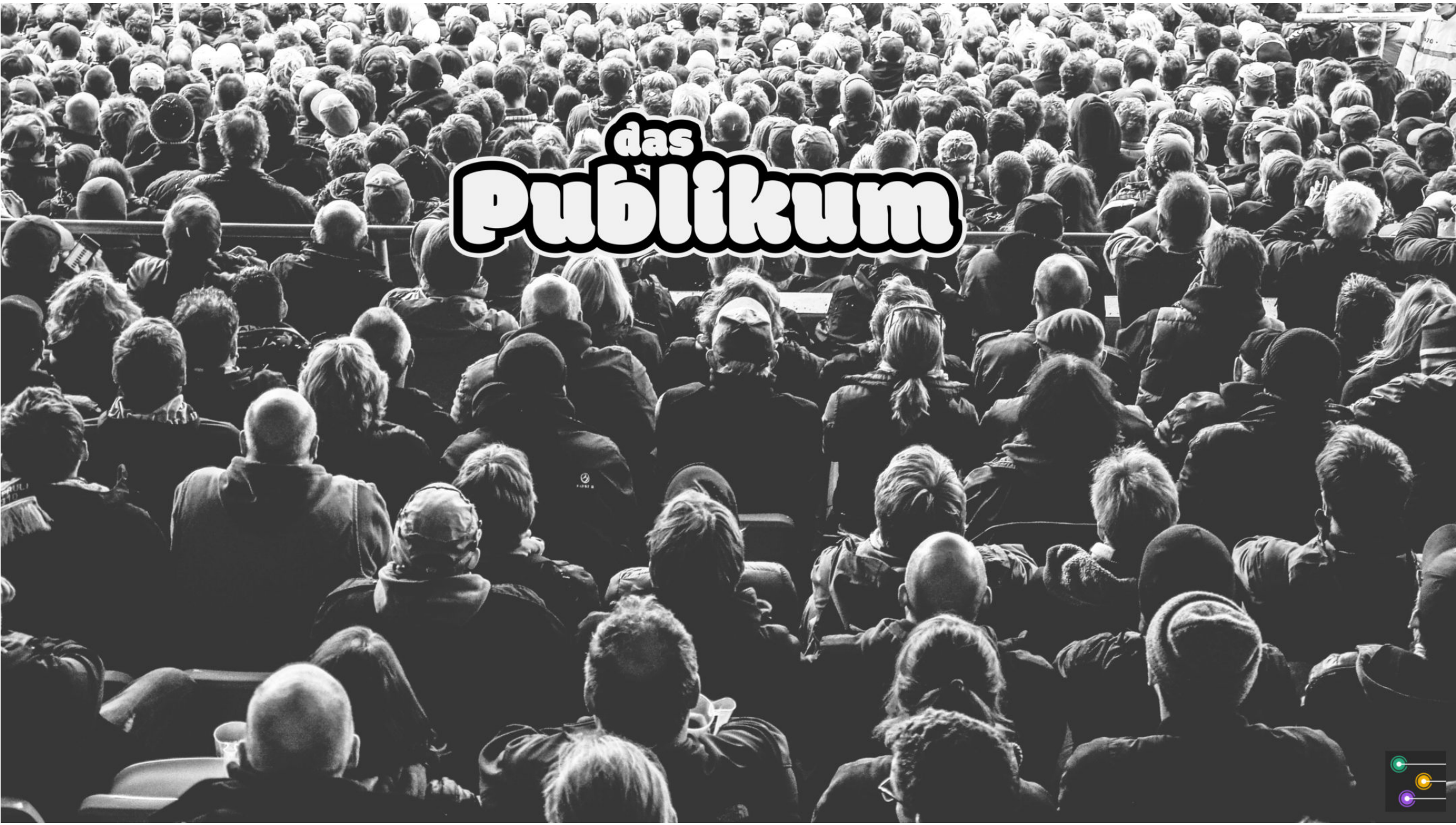
→ **Art der Information:** Schematische Darstellung <> Umwandlung von Datenwerten

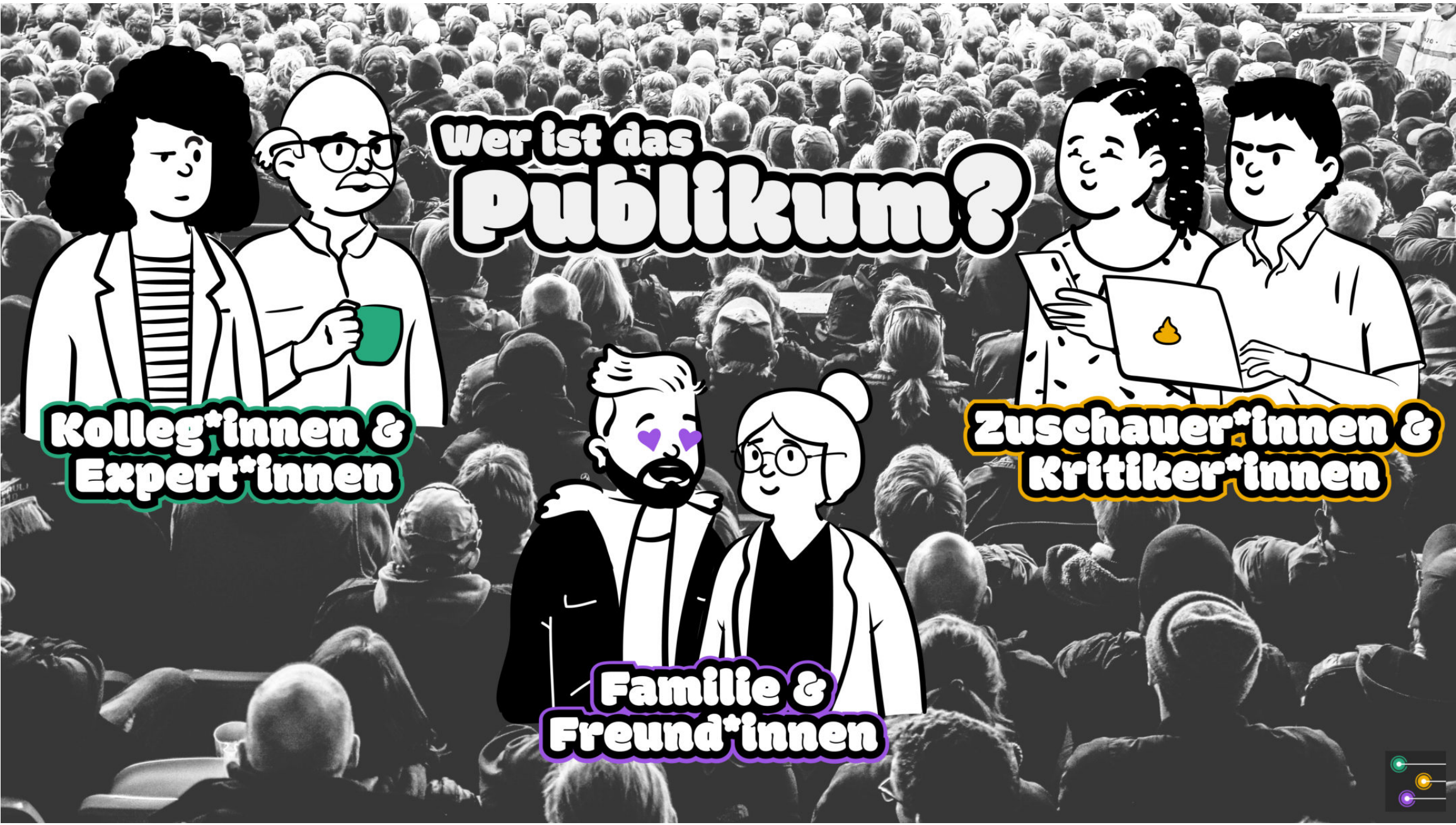
Ist das Ziel, die Information zu erkunden oder zu erklären?

→ **Zweck der Grafik:** Entdeckung erleichtern <> Informationen vermitteln

Publikum (wer)

- An wen richtet sich die Kommunikation?
- Was weiß das Publikum bereits?
- Was ist die eigene Position und Beziehung?


das
Publikum


Wer ist das Publikum?
Kolleg*innen & Expert*innen
Familie & Freund*innen
Zuschauer*innen & Kritiker*innen

Publikum (wer)

- An wen richtet sich die Kommunikation?
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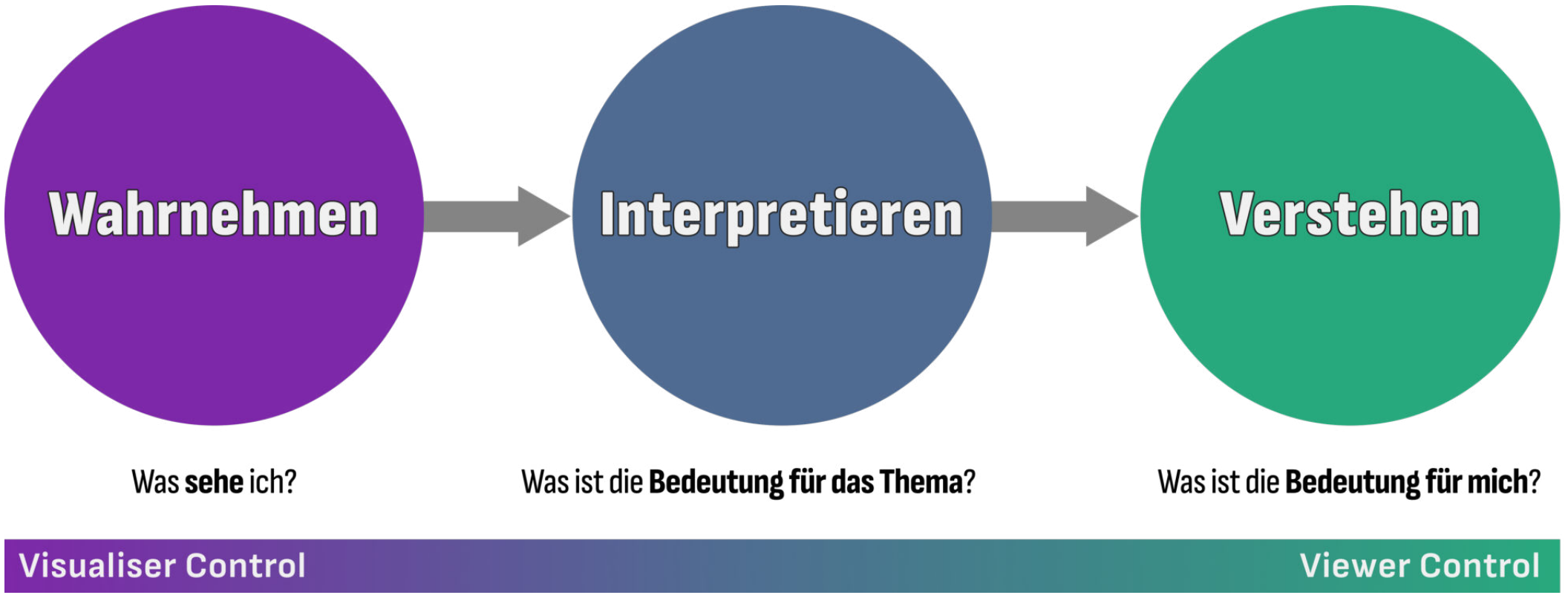
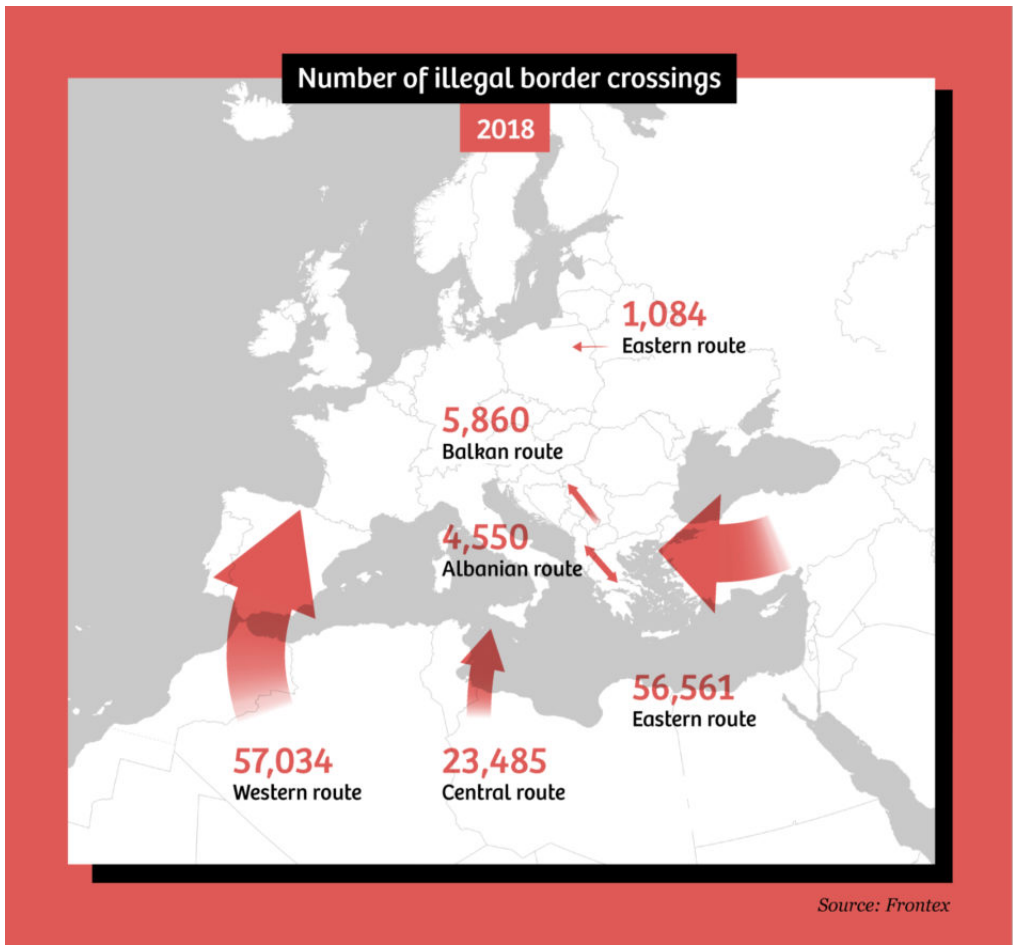
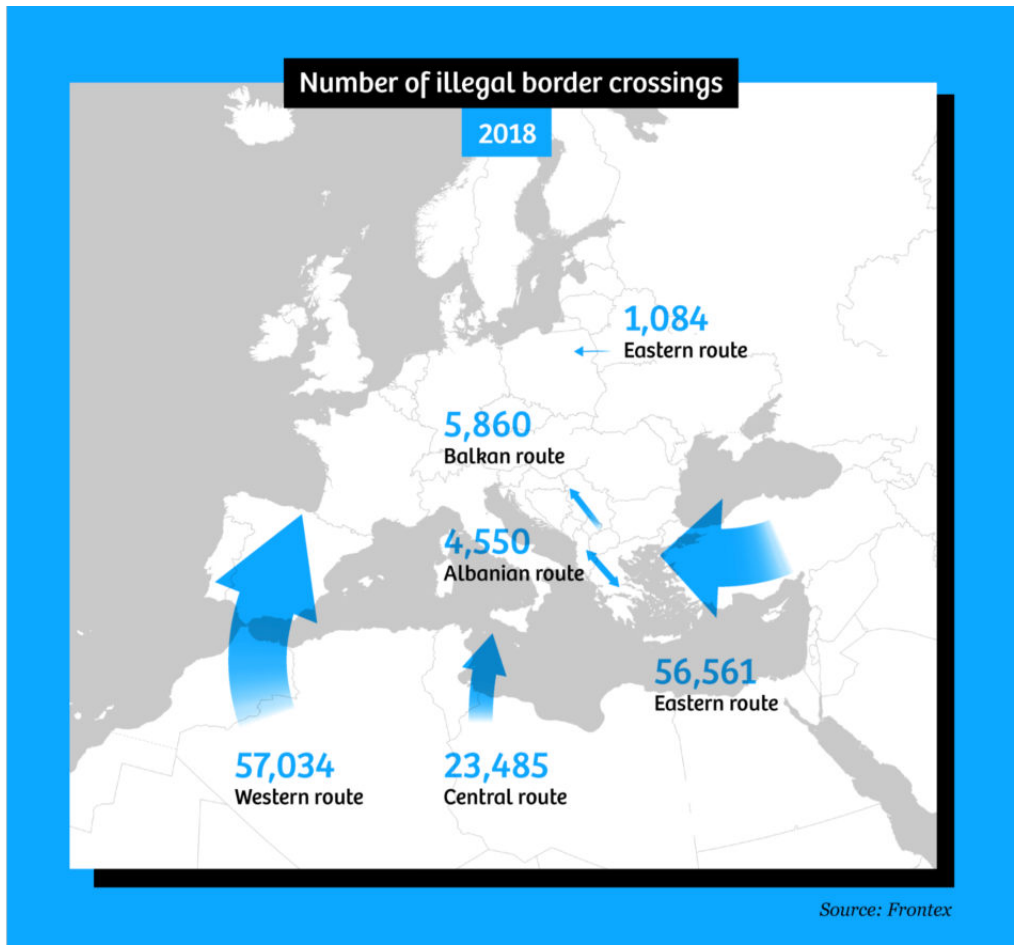
Inhalt (was)

- Welche Erkenntnisse oder Aufgaben sollen die Zuhörenden mitnehmen?
- Auf welchem Weg findet die Kommunikation statt?
- Welchen Ton soll die Datenvisualisierung transportieren?

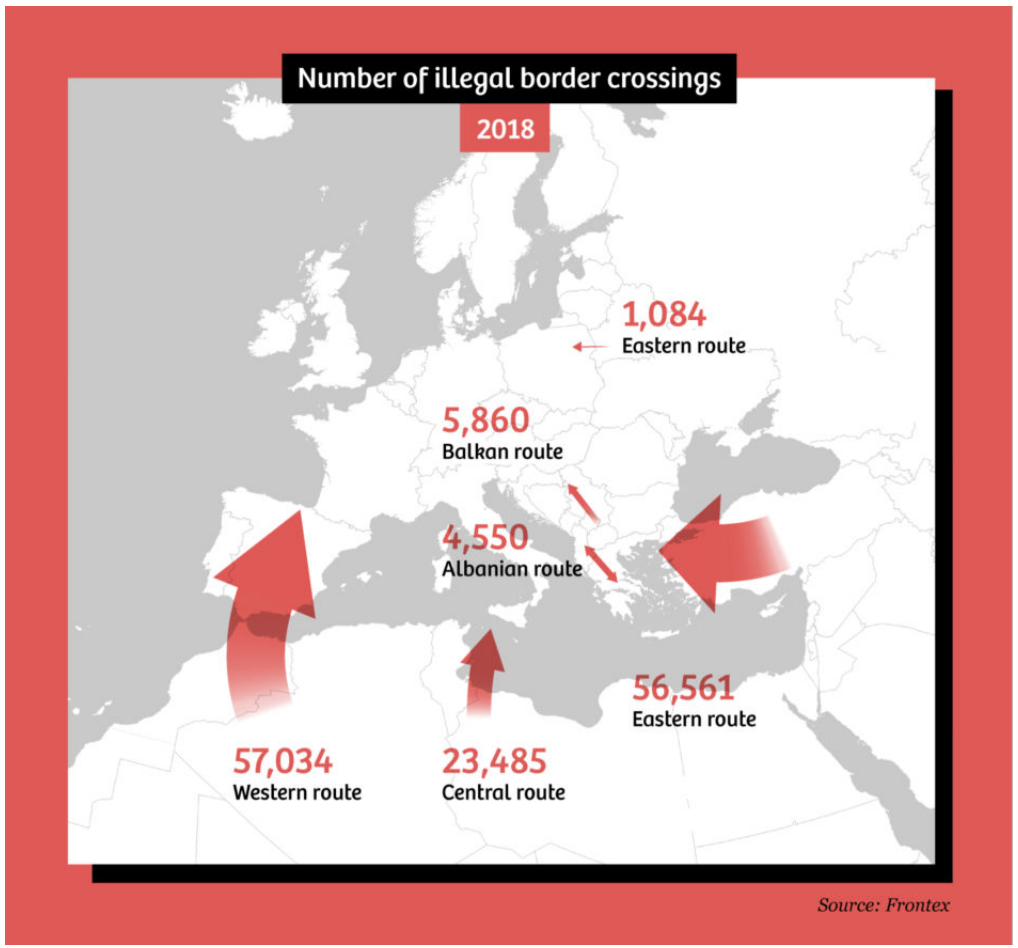


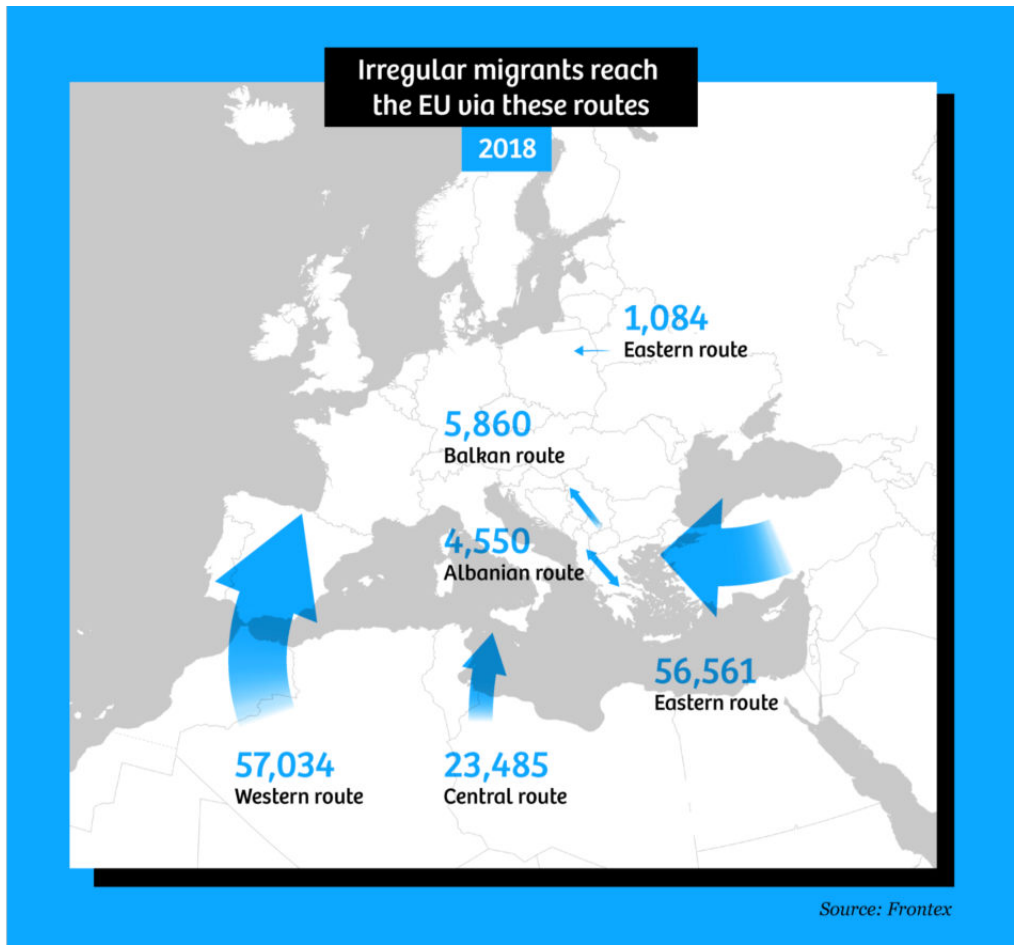
Schema von Andy Kirk (modifiziert)





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





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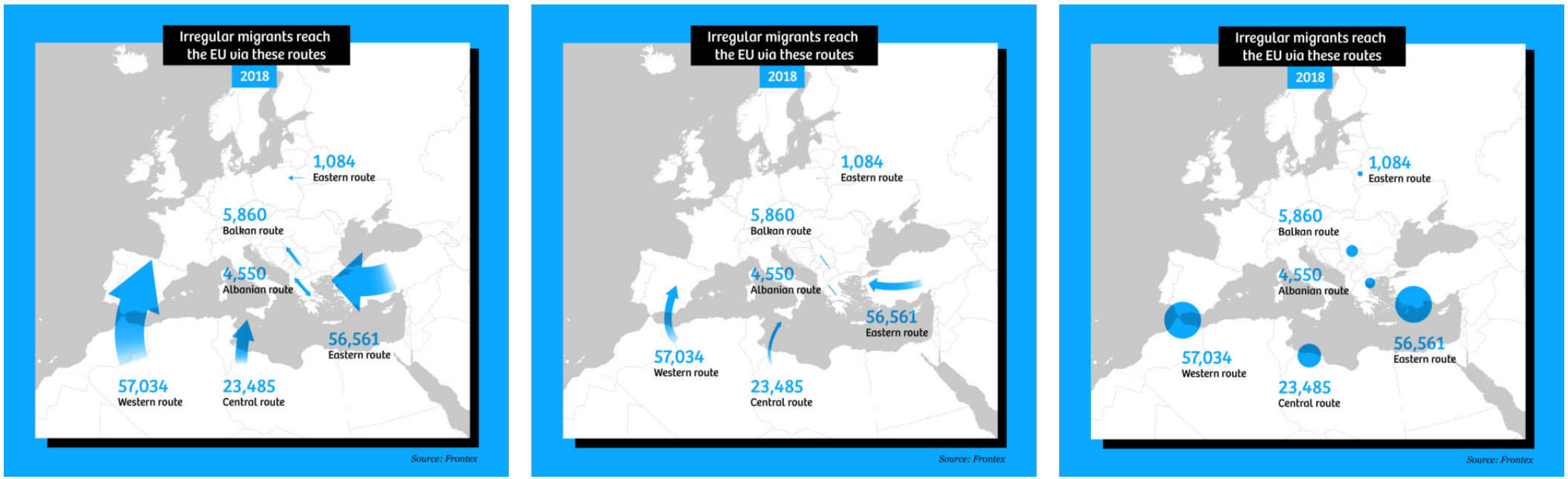

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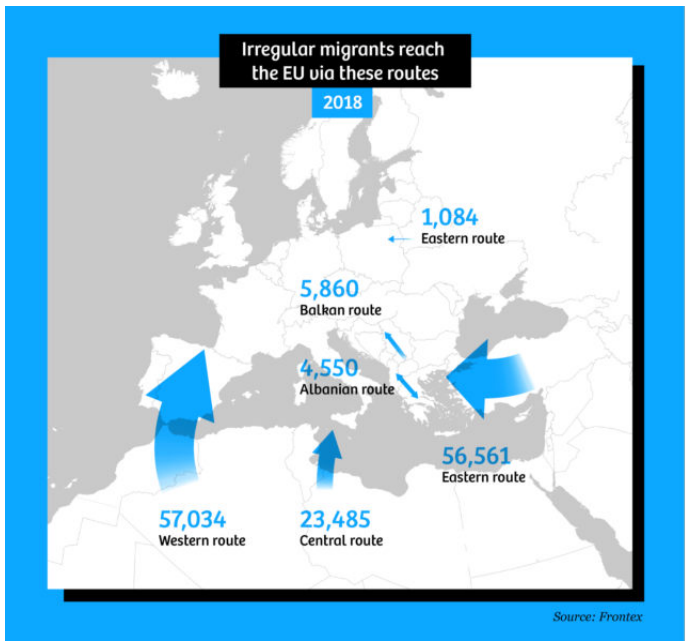

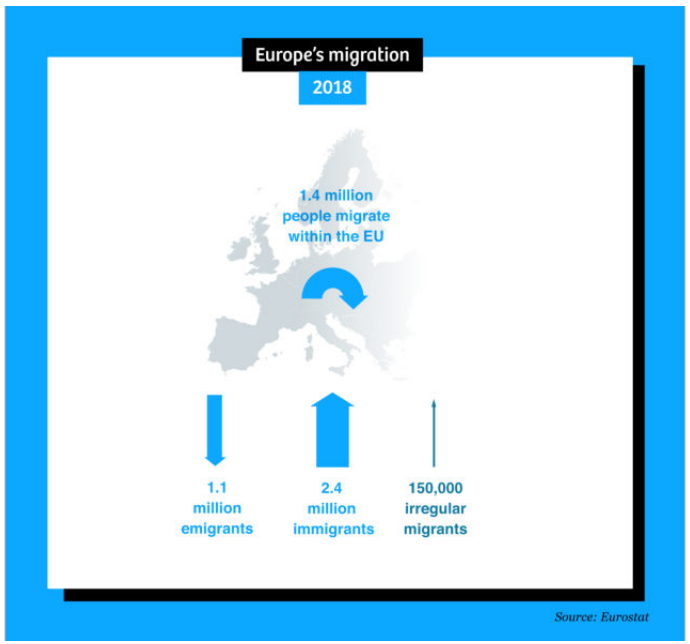

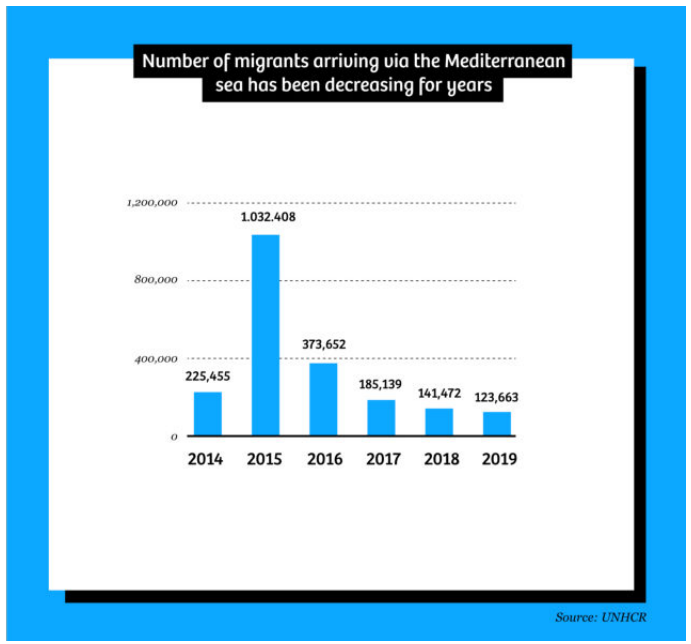

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Grundlage (wie)

- Welche Daten können meinen Standpunkt untermauern?

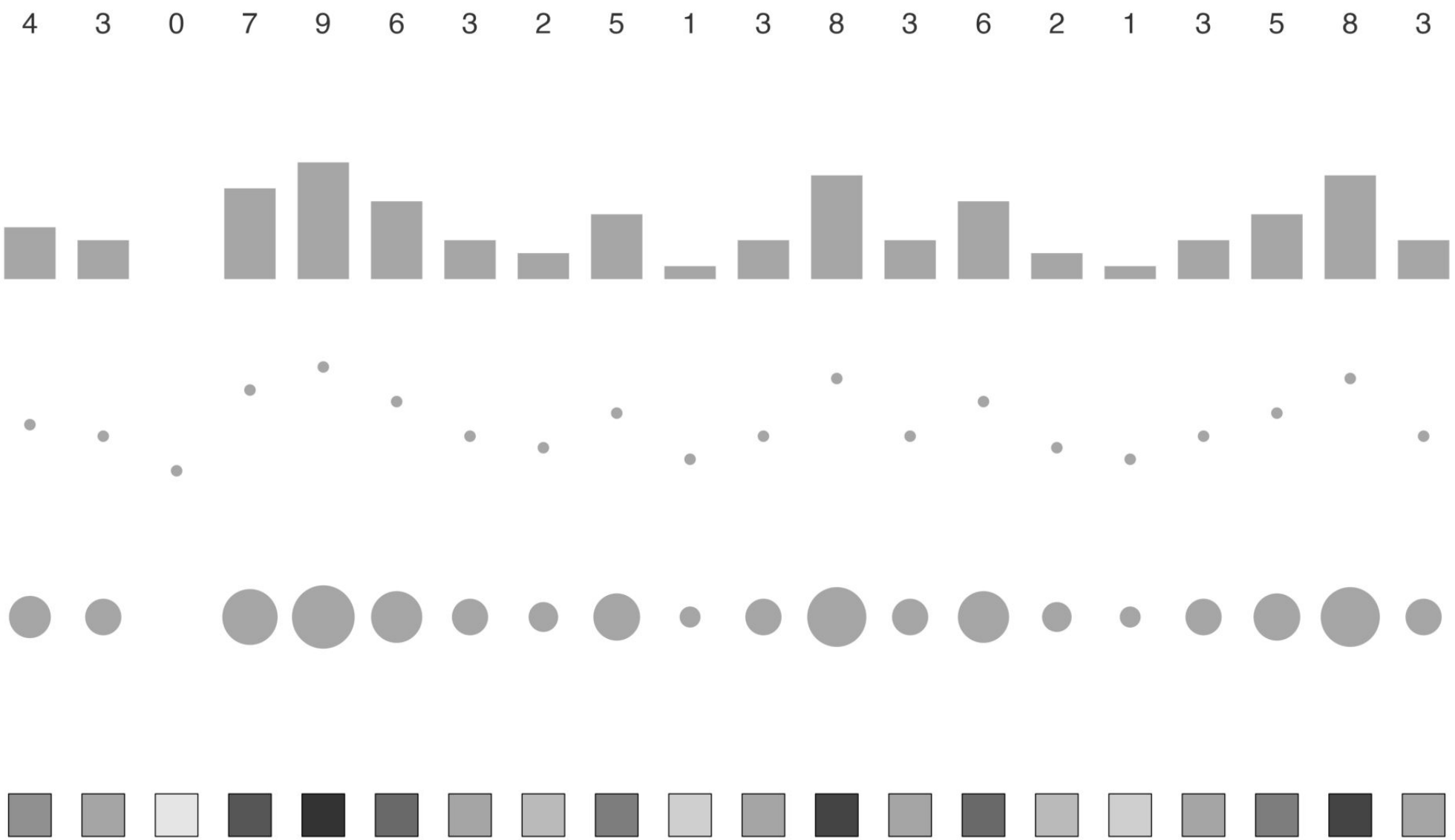
Kontext: Vorbereitet sein!

- Was ist die wichtigste Botschaft, die sie mitnehmen sollten?
- Welche (Hintergrund-)Informationen sind wesentlich? Was ist irrelevant?
- Welche potenziellen Voreingenommenheiten könnten bei (einigen) Teilnehmenden bestehen?
- Welche Faktoren könnten die eigene Position schwächen? Kann man ihnen proaktiv begegnen?

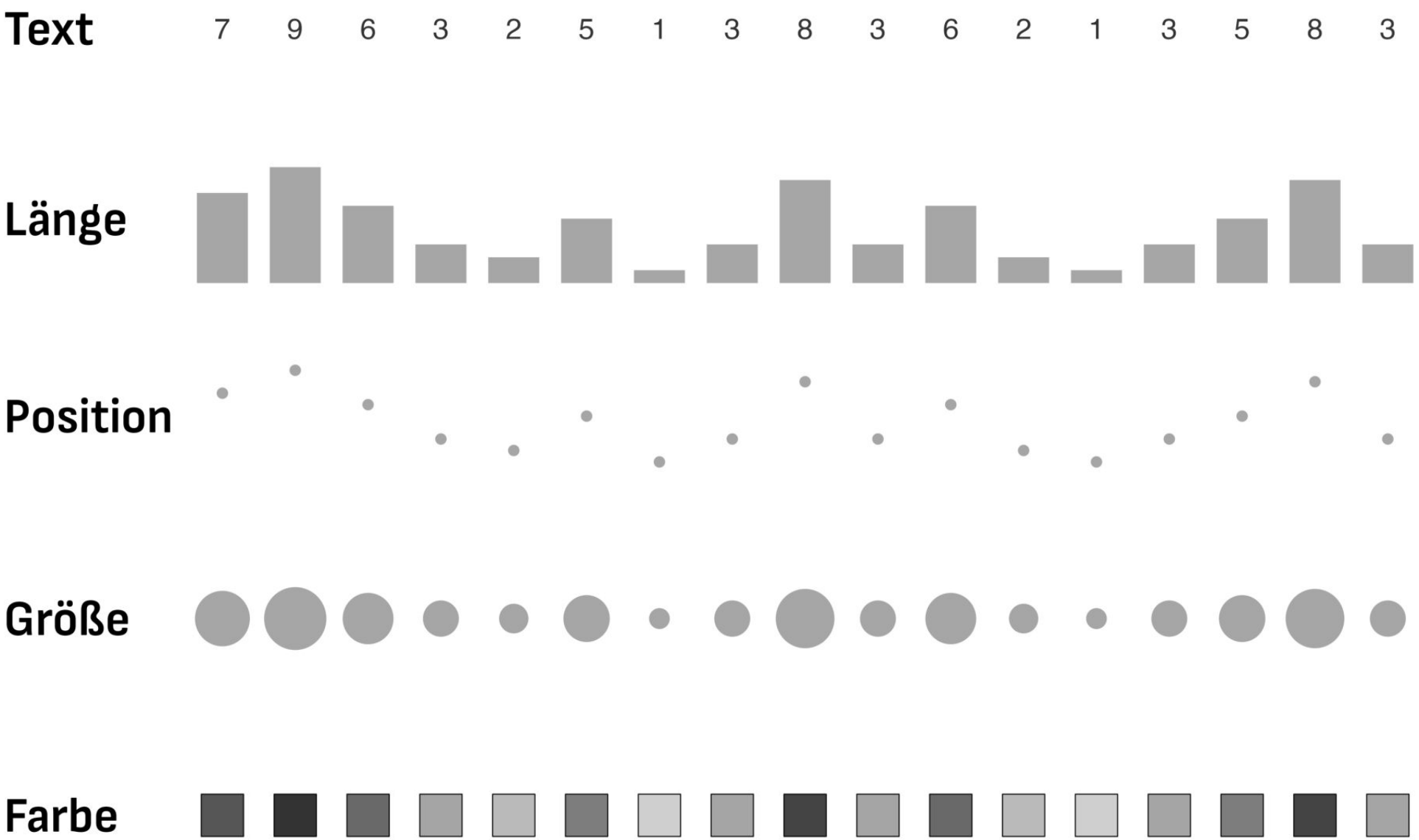
Kodierungen

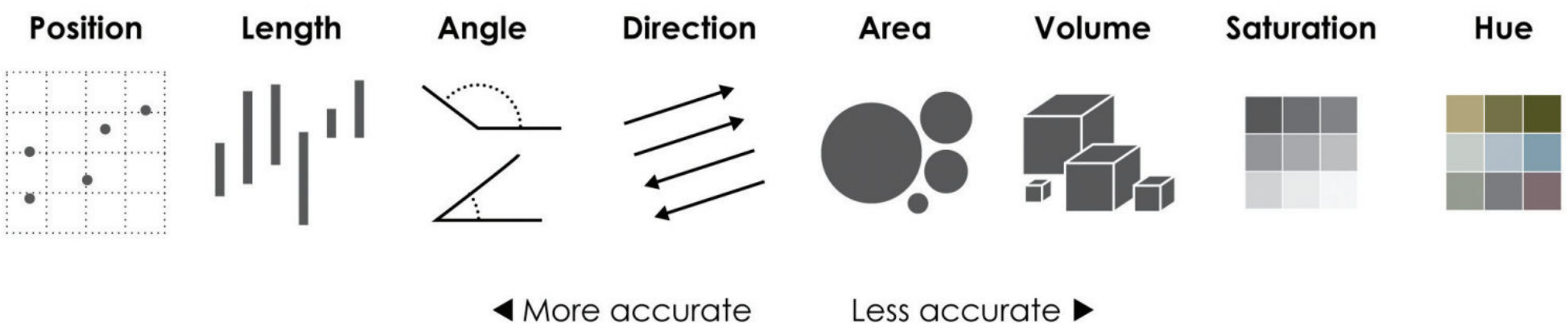
Zuordnung von Datenwerten zu visuellen Eigenschaften.

Gleiche Werte, andere Kodierung

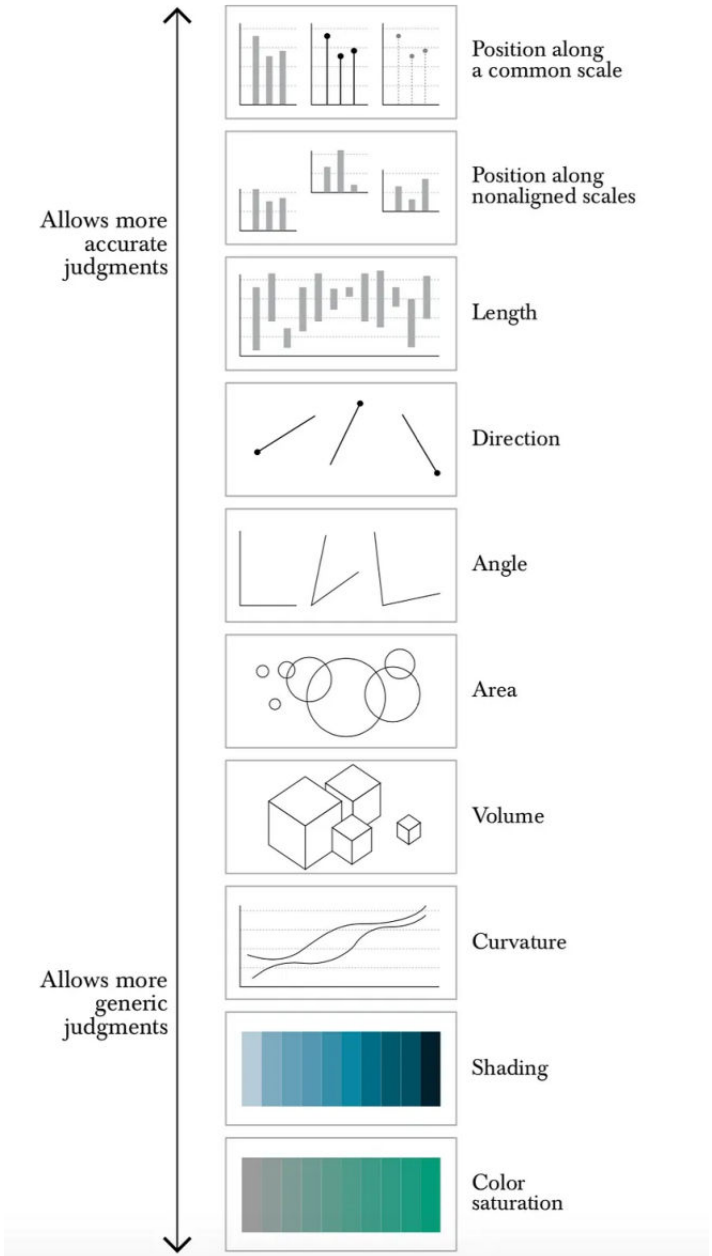


Gleiche Werte, andere Kodierung

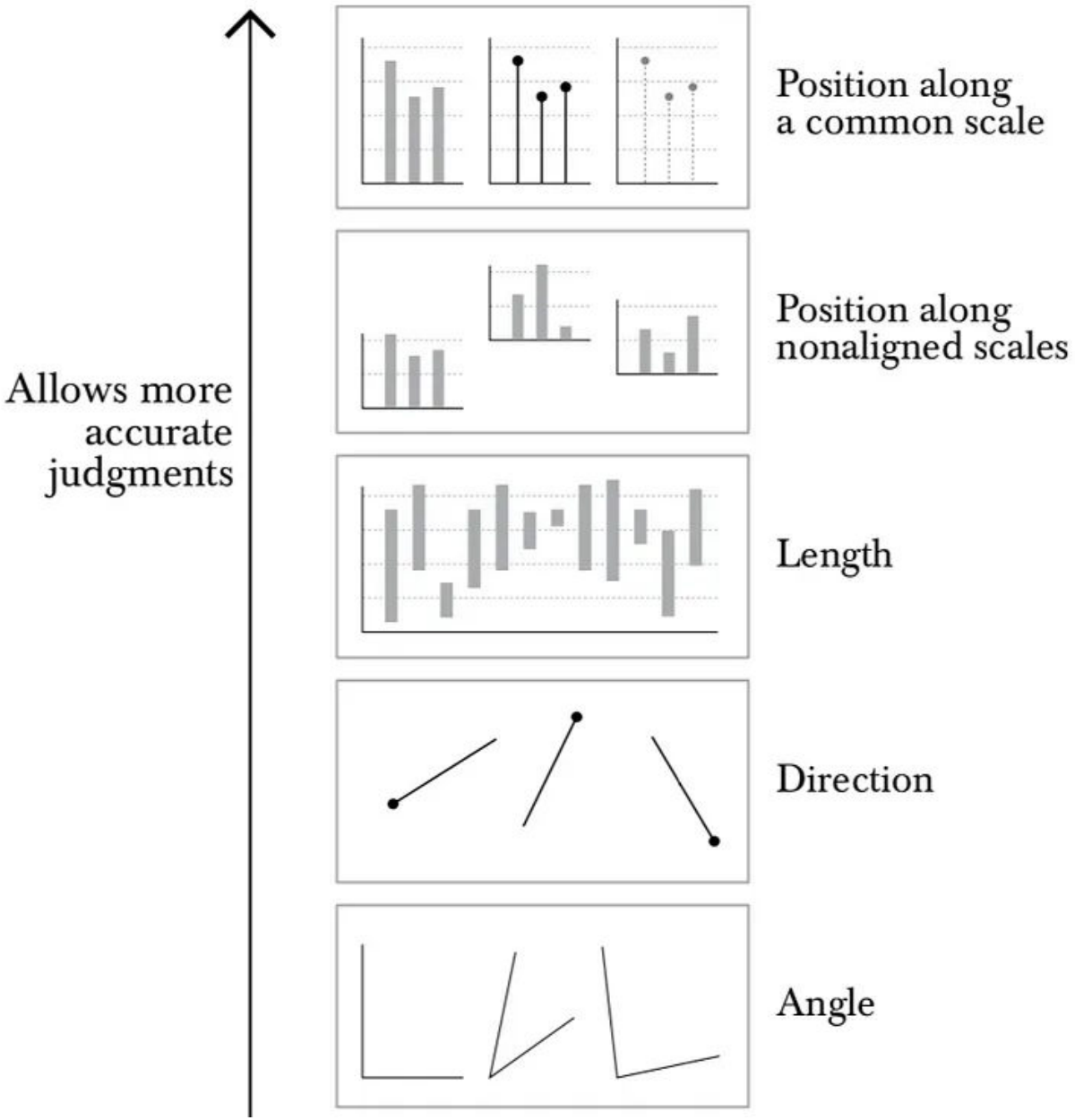




Quelle: "Data Points" von Nathan Yau (S. 104)

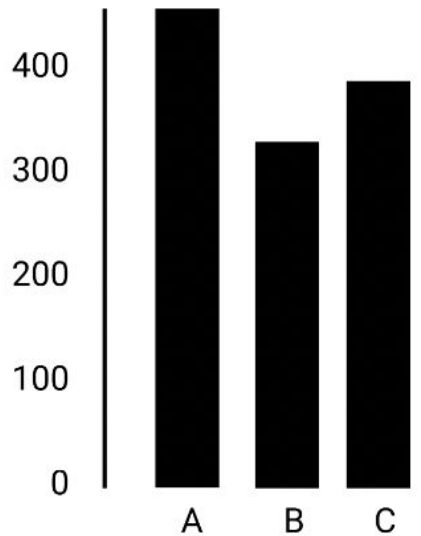


Cleveland's and McGill's Scale of Perpetual Elementary Tasks
Quelle: "The Functional Art" von Alberto Cairo (S. 120)

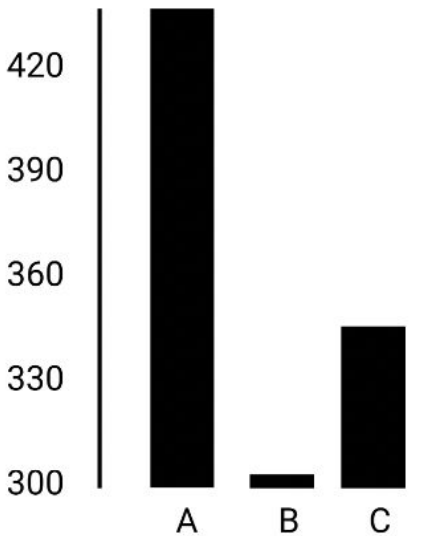


Cleveland's and McGill's Scale of Perpetual Elementary Tasks
Quelle: "The Functional Art" von Alberto Cairo (S. 120)

Immer bei Null beginnen?



Good. Y-axis starts at 0 and has natural increments

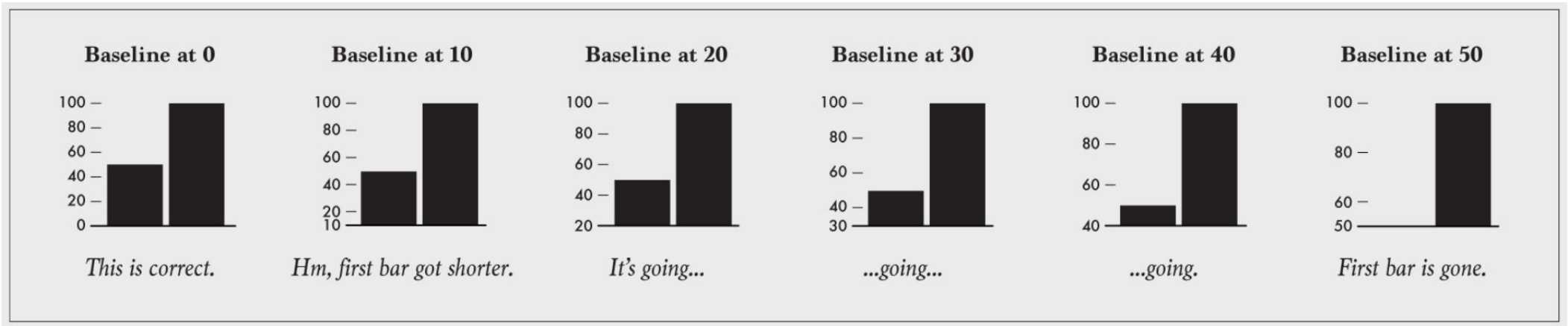


Bad. Y-axis starts at 300, exaggerating the difference among columns. Intervals are awkward

Quelle: "Hands-On Data Visualization" von Jack Dougherty & Ilya Ilyankou

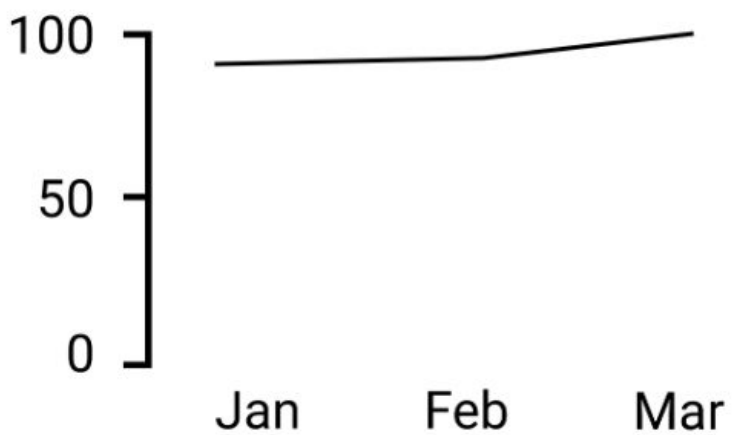
mehr dazu: z.B. Correl, Bertini & Francoeri (2020) und Witt (2019)

Immer bei Null beginnen?

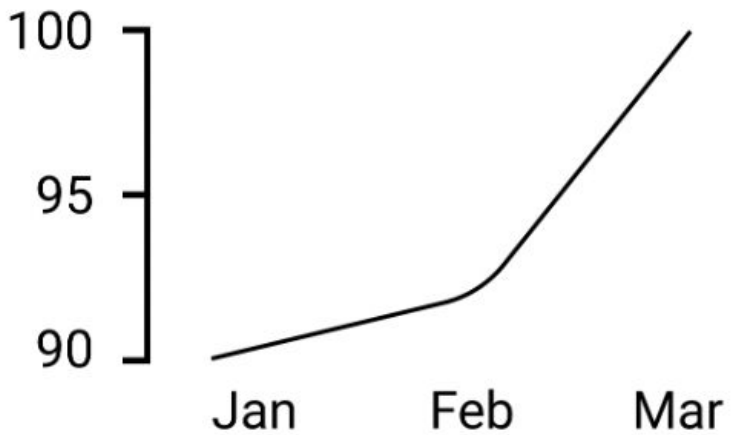


Quelle: Nathan Yau

Immer bei Null beginnen?

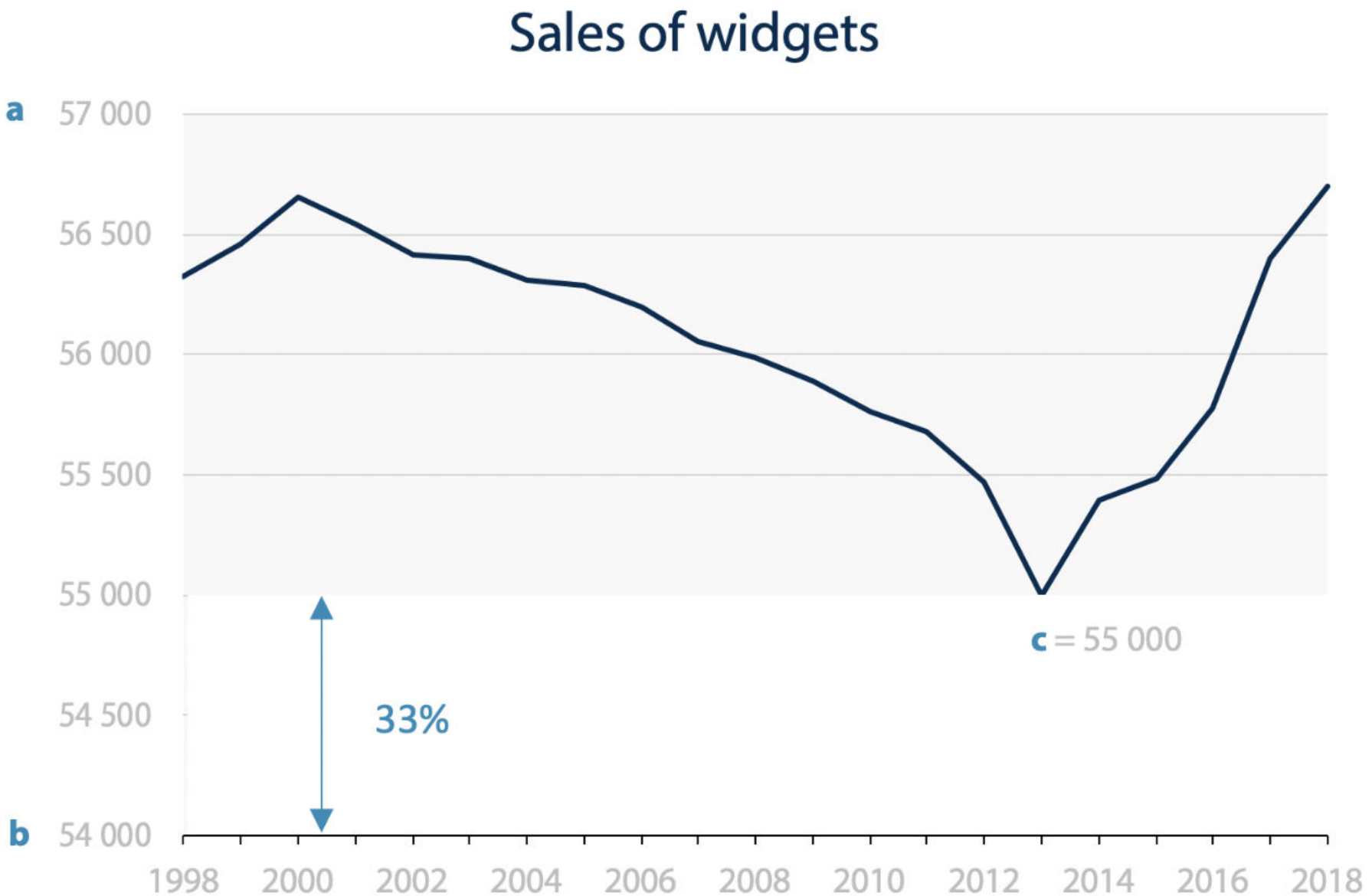


Acceptable, but starting the vertical axis at zero obscures changes in values

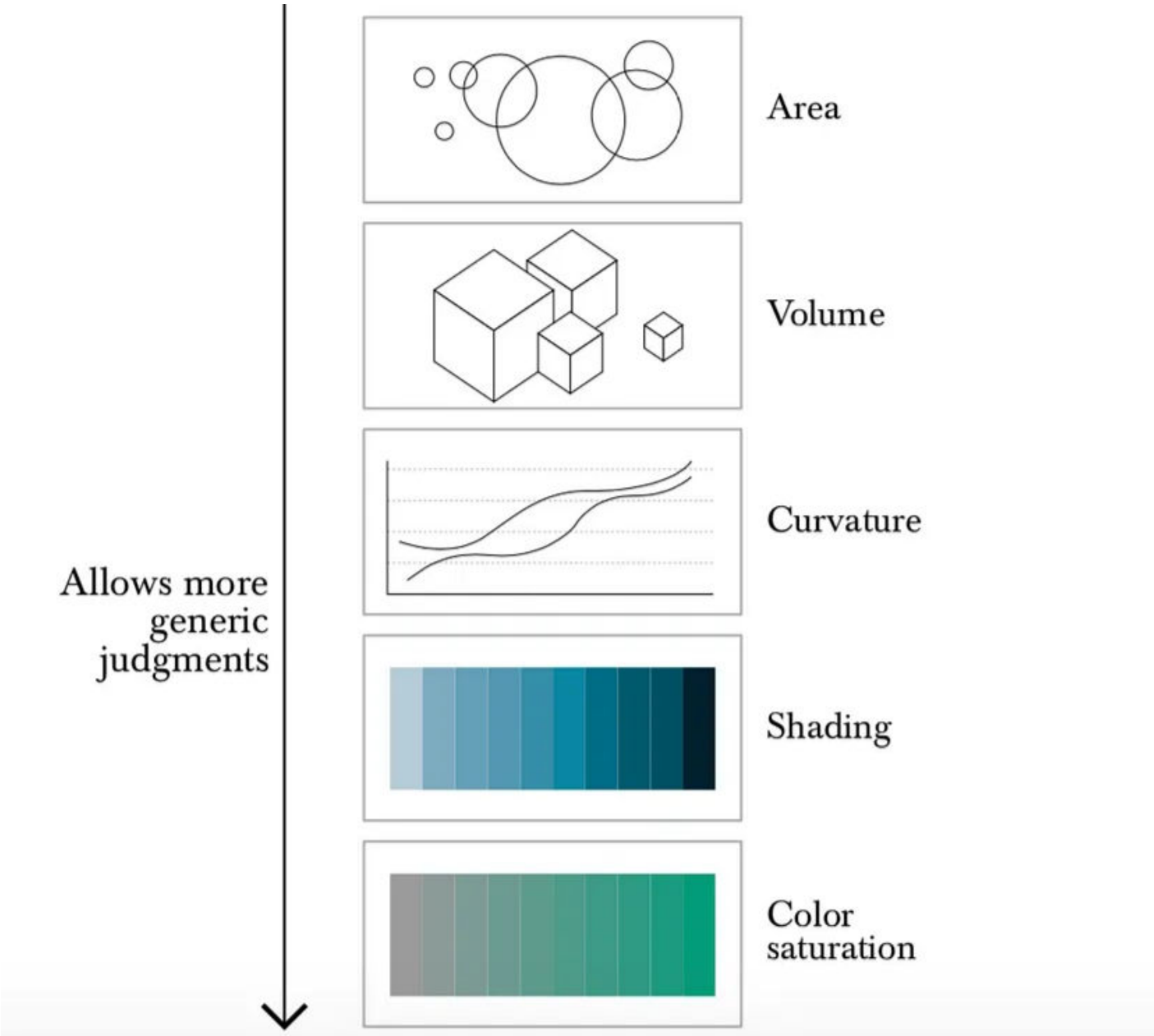


Better: By reducing the vertical axis to match the values, we see change more clearly

Quelle: "Hands-On Data Visualization" von Jack Dougherty & Ilya Ilyankou



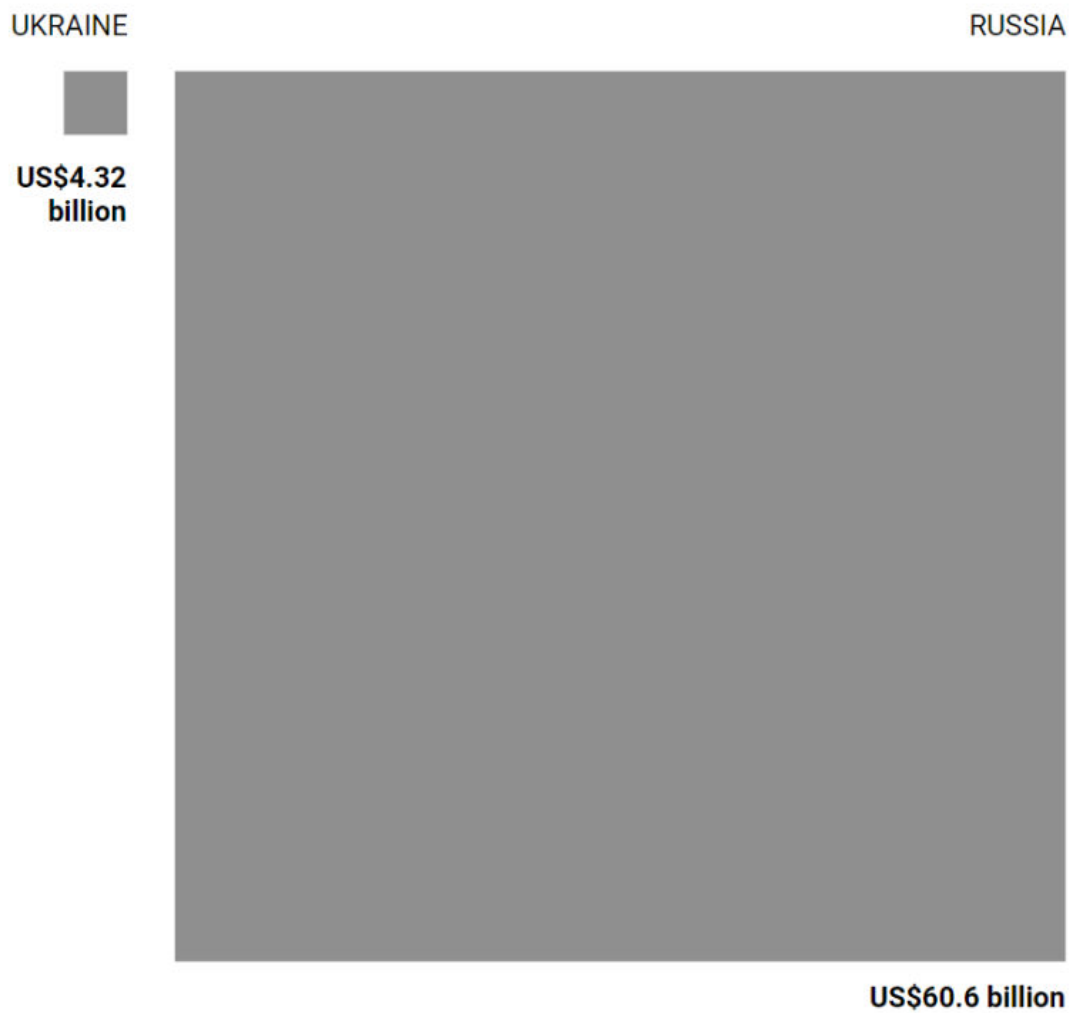
Quelle: Francis Gagnon



Cleveland's and McGill's Scale of Perpetual Elementary Tasks
Quelle: "The Functional Art" von Alberto Cairo (S. 120)

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)

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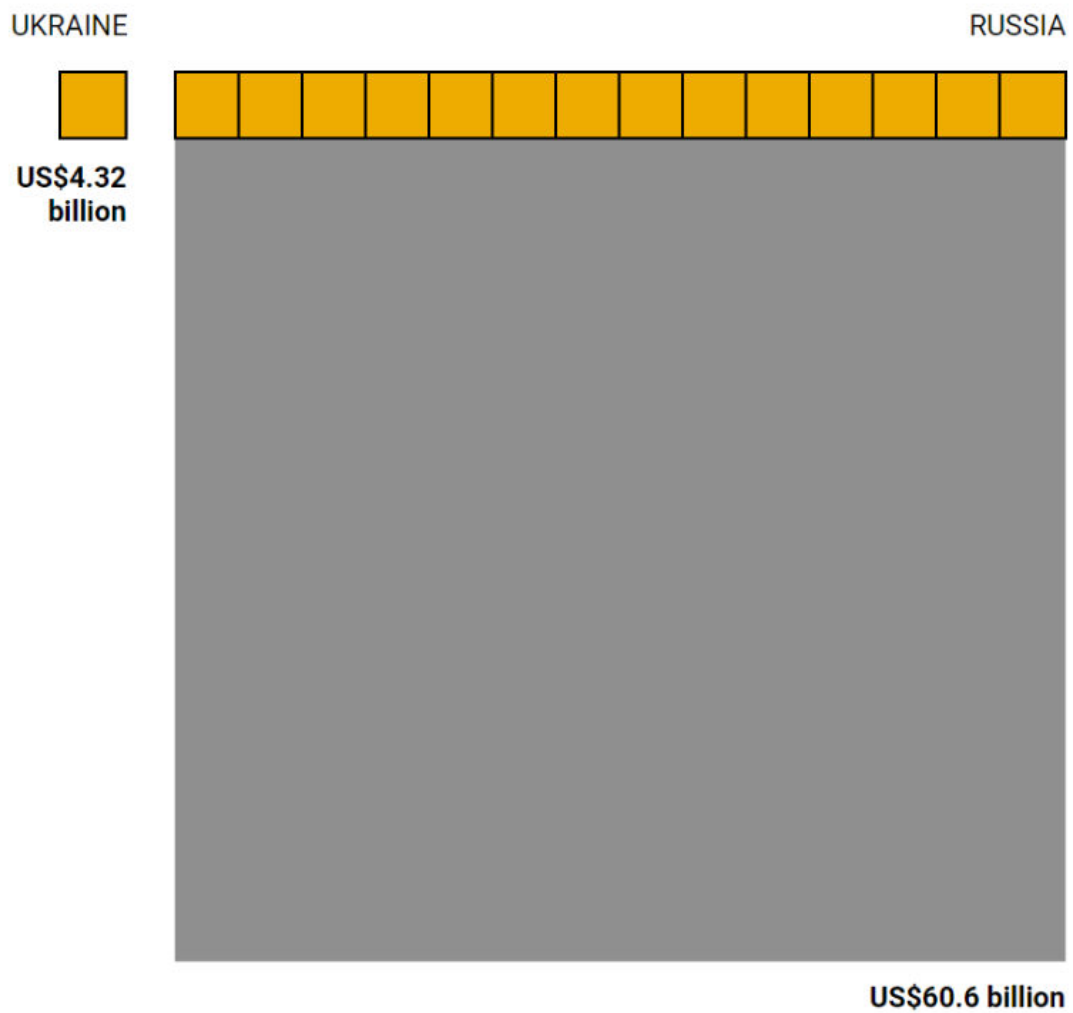
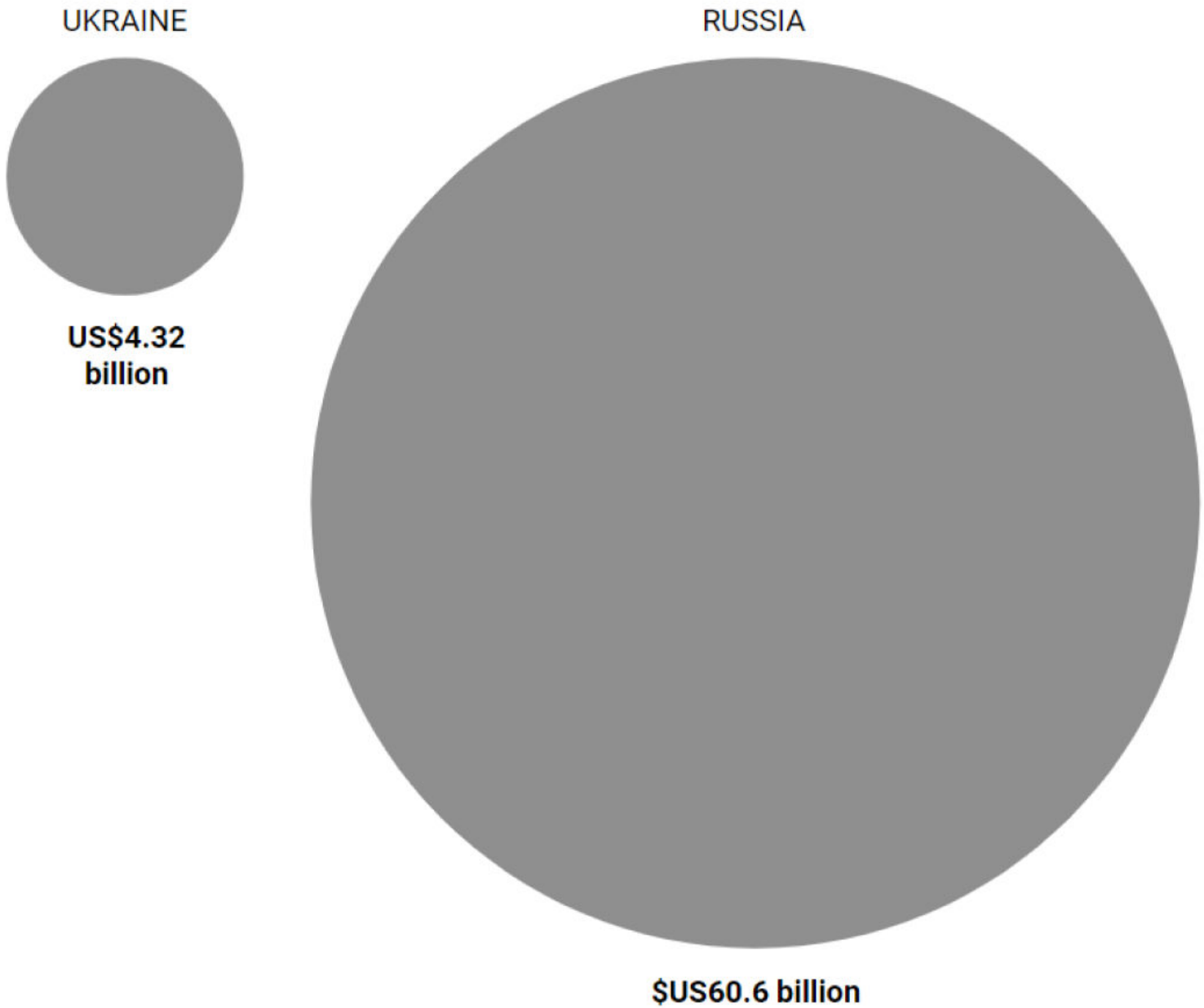


"Russia attacks Ukraine" von SCMP Graphic (South China Morning Post)



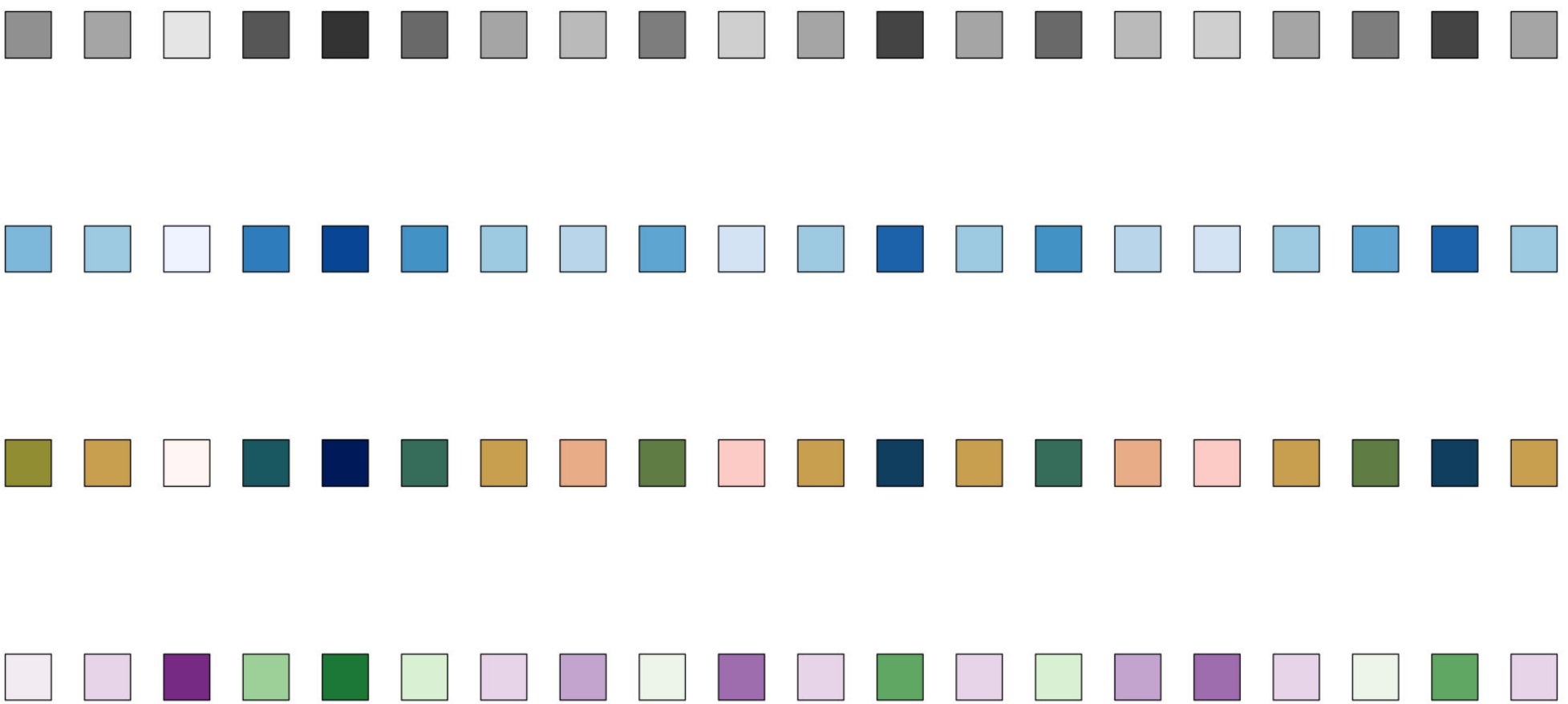
"Russia attacks Ukraine" von SCMP Graphic (South China Morning Post)

Ukraine's military spending was less than a 14th of Russia's in 2020

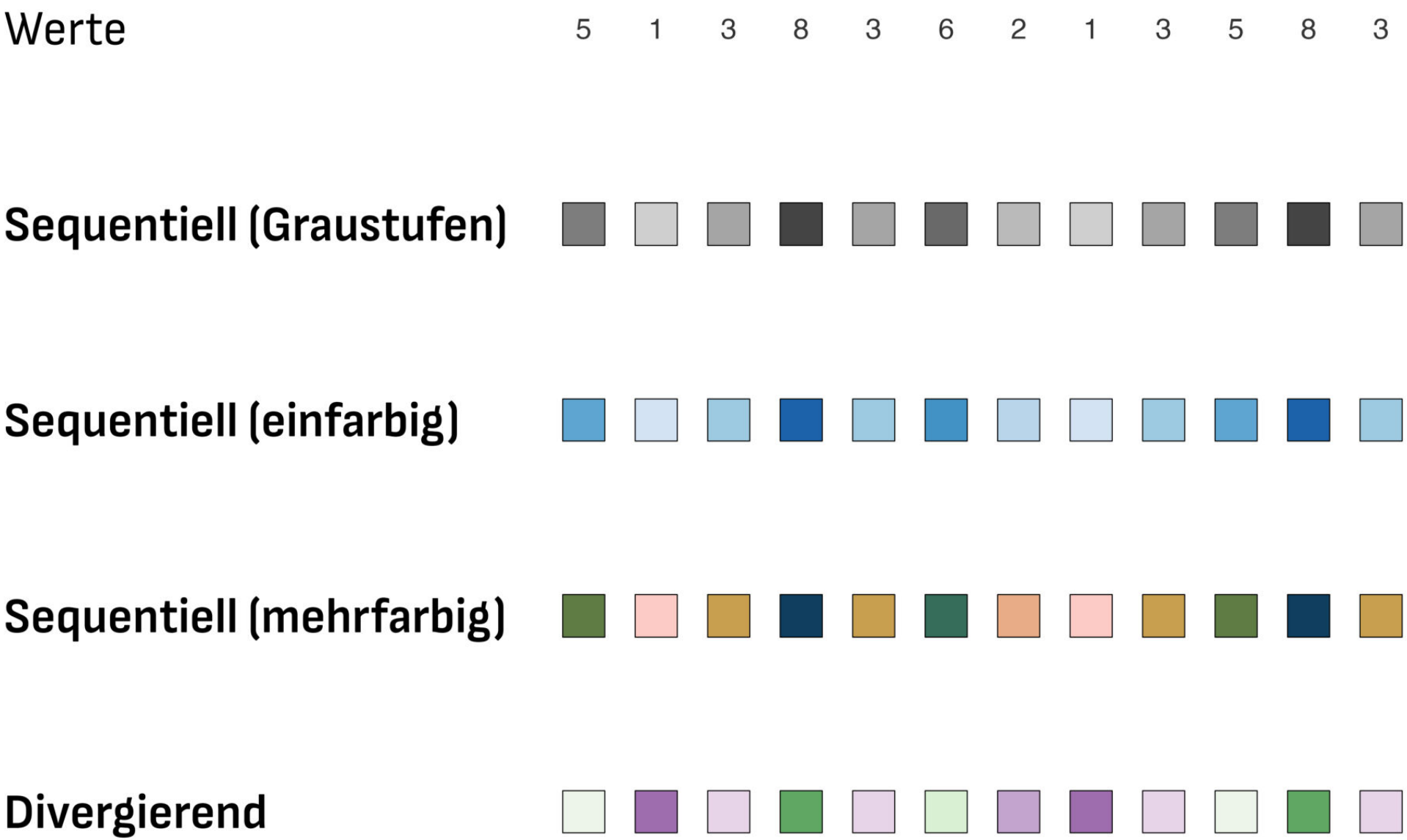
Ukraine's military spending was less than a 14th of Russia's in 2020.

Gleiche Werte, andere Farben

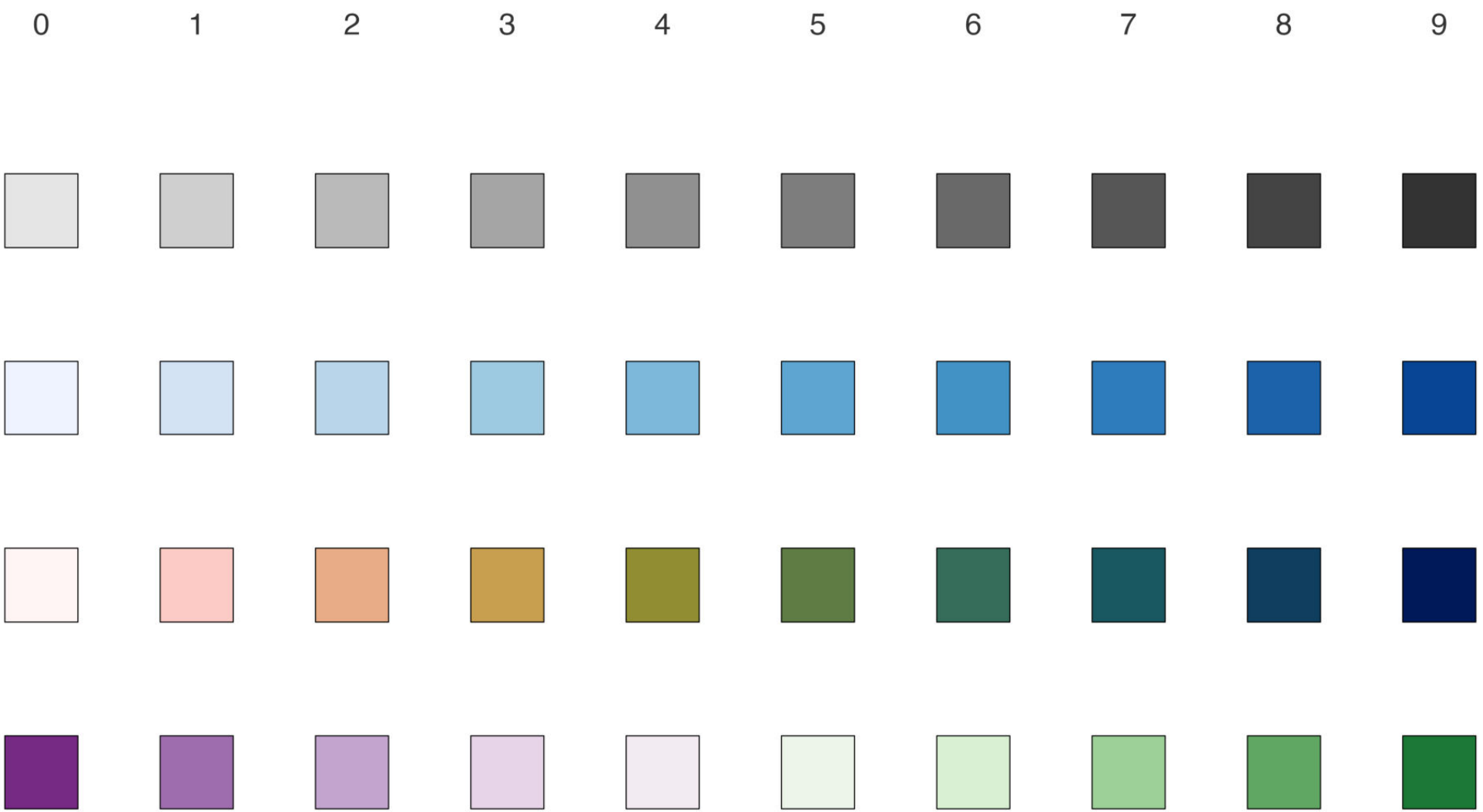
4 3 0 7 9 6 3 2 5 1 3 8 3 6 2 1 3 5 8 3



Gleiche Werte, andere Farben



Gleiche Werte, andere Farben



Arten von Farbpaletten

Sequentiell

Beispiel

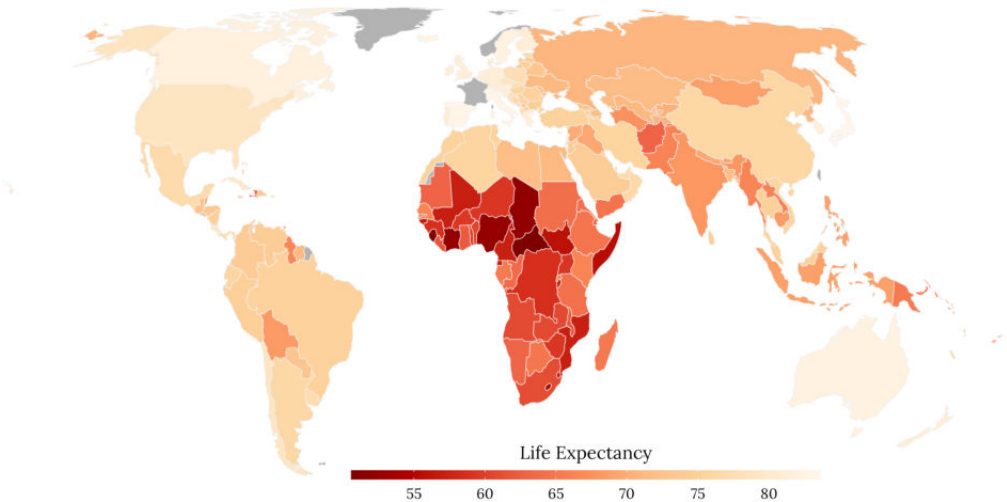
Graustufen

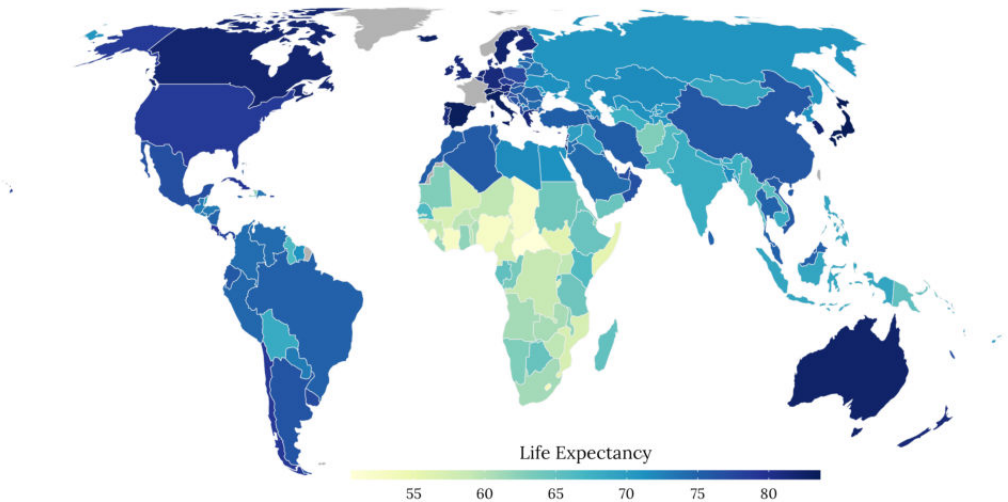
numerische Informationen mit steigender Reihenfolge

verwende den höchsten Kontrast für die wichtigsten Informationen

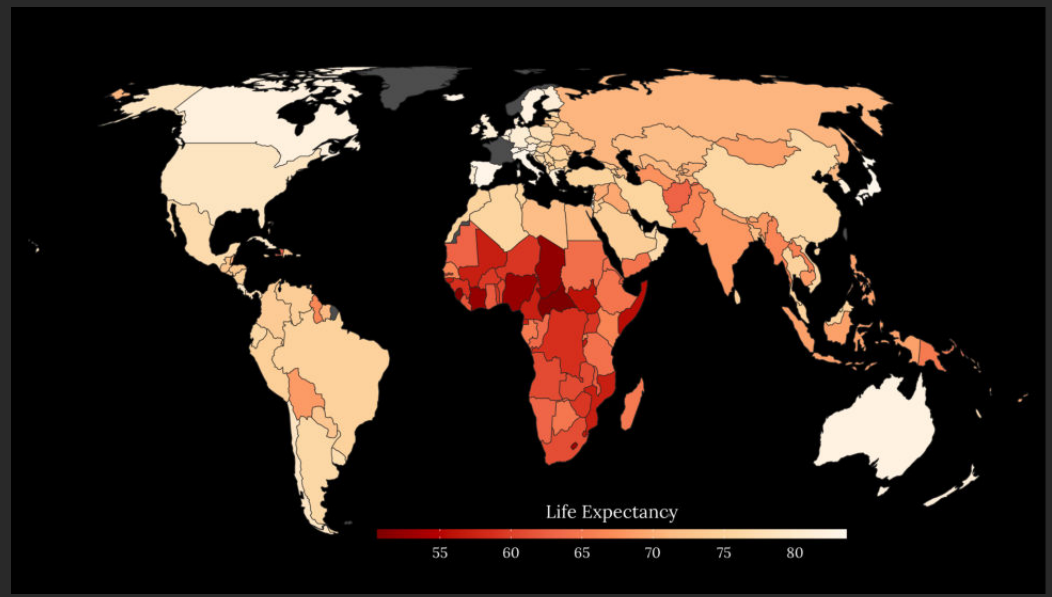
entweder einfarbige oder mehrfarbige Farbpaletten

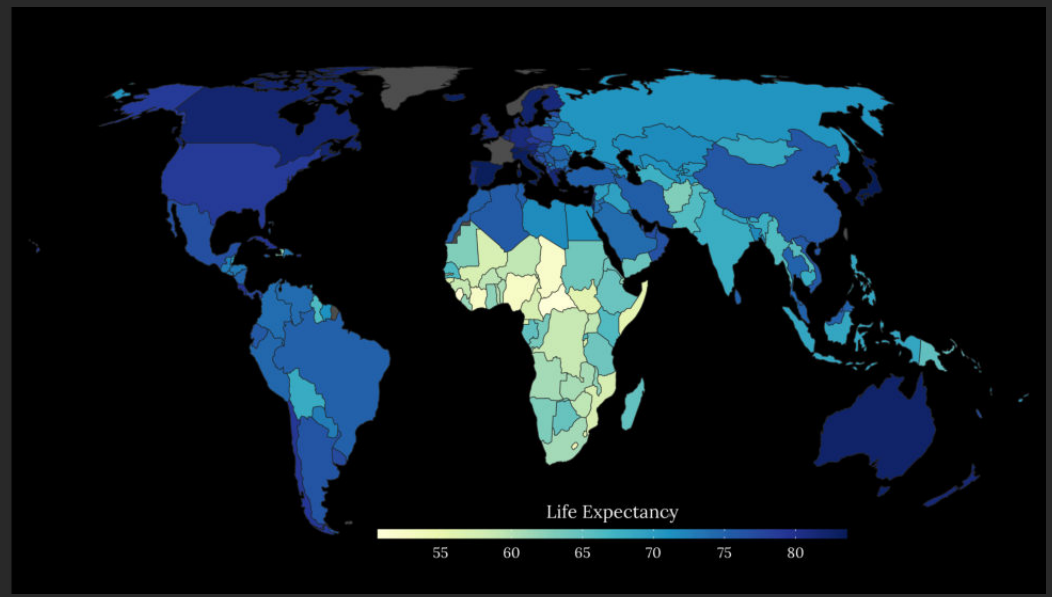
Sequentiell: Dunkel entspricht mehr (?)





Sequentiell: Dunkel entspricht mehr (?)





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verwende den höchsten Kontrast für die wichtigsten Informationen

entweder einfarbige oder mehrfarbige Farbpaletten

Divergierend

Beispiel

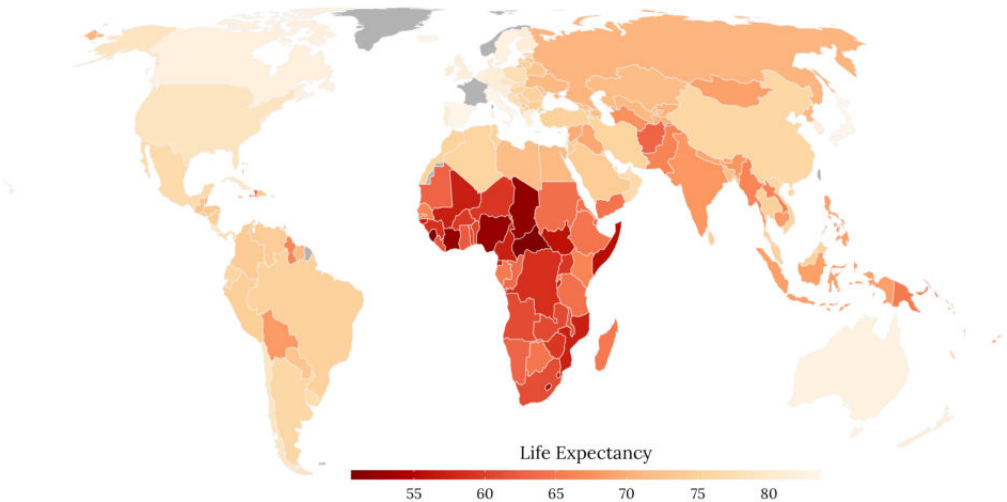
Graustufen

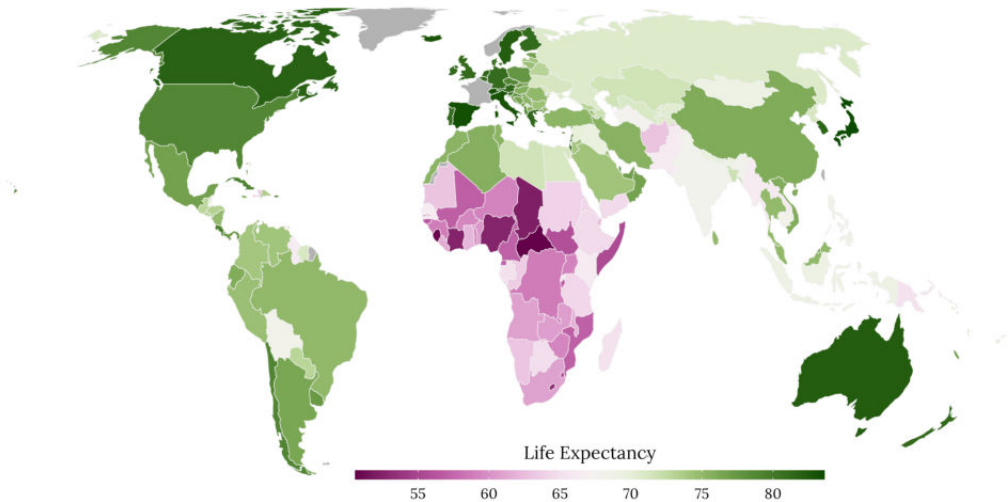
numerische Informationen mit kritischem Mittelpunkt

verwende einen bedeutsamen Mittelpunkt und nutze ausgewogene Extremwerte

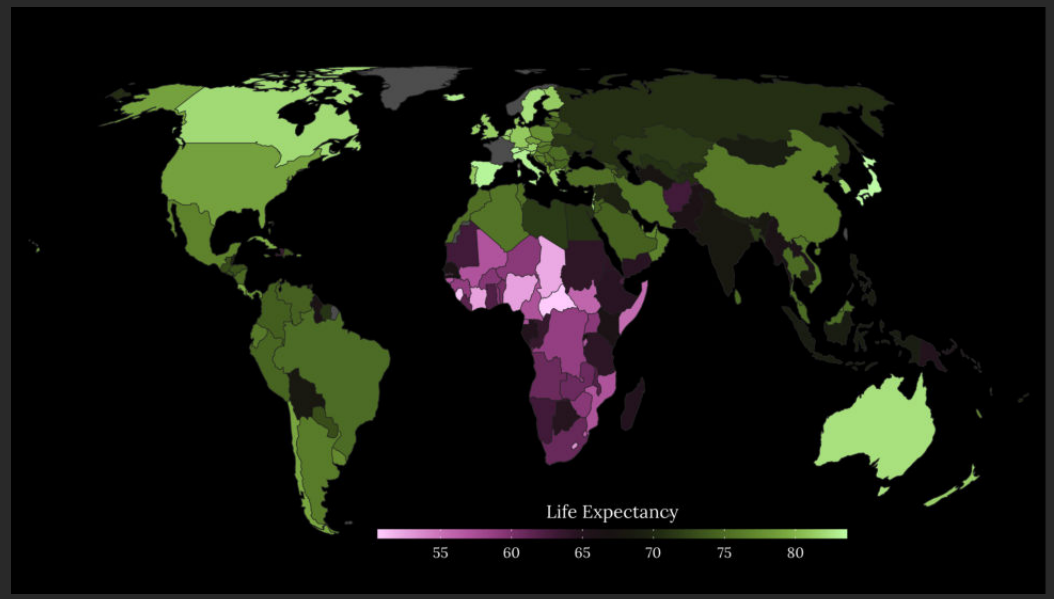
Kombination von zwei sequentiellen Farbpaletten

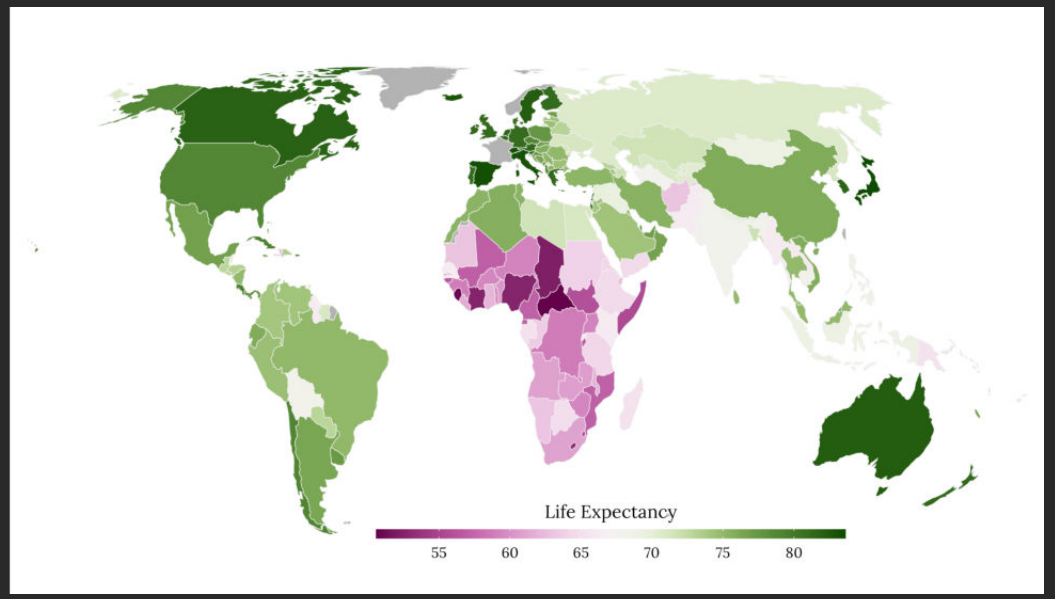
Aber welche: Sequentiell oder divergierend?



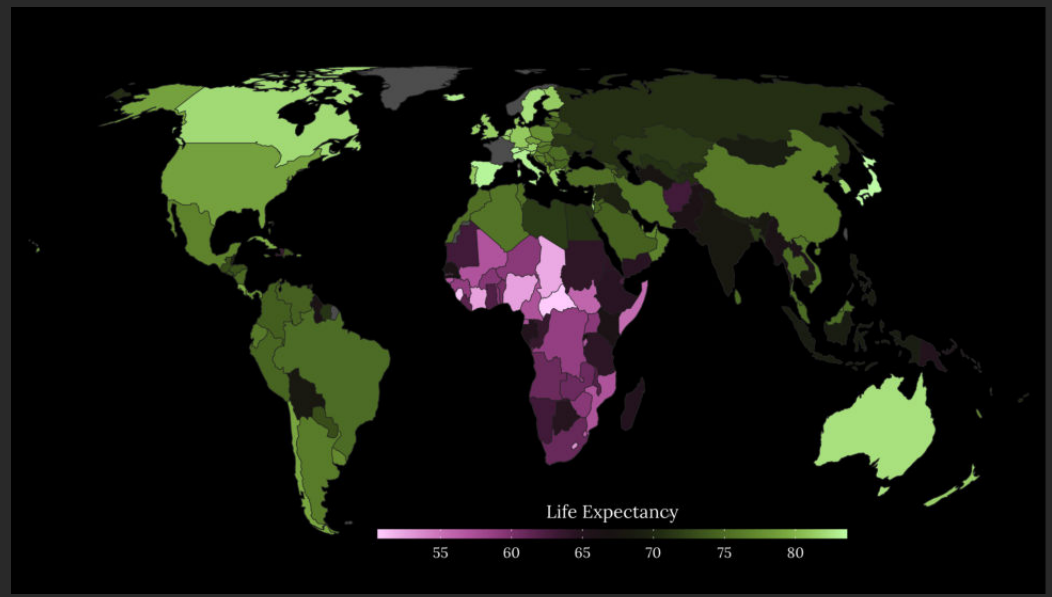


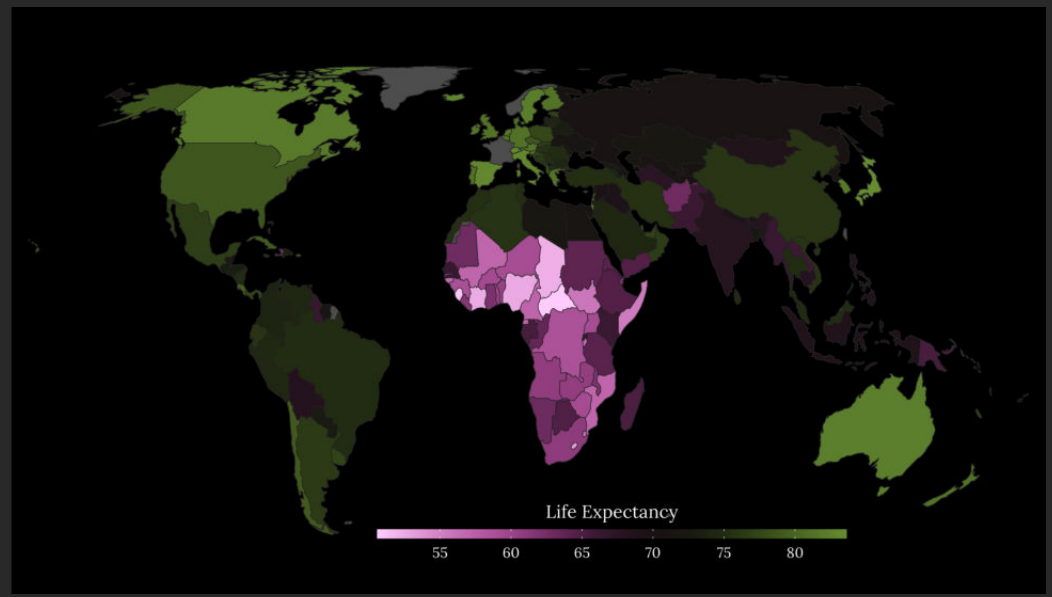
Divergierend auf dunklem Hintergrund

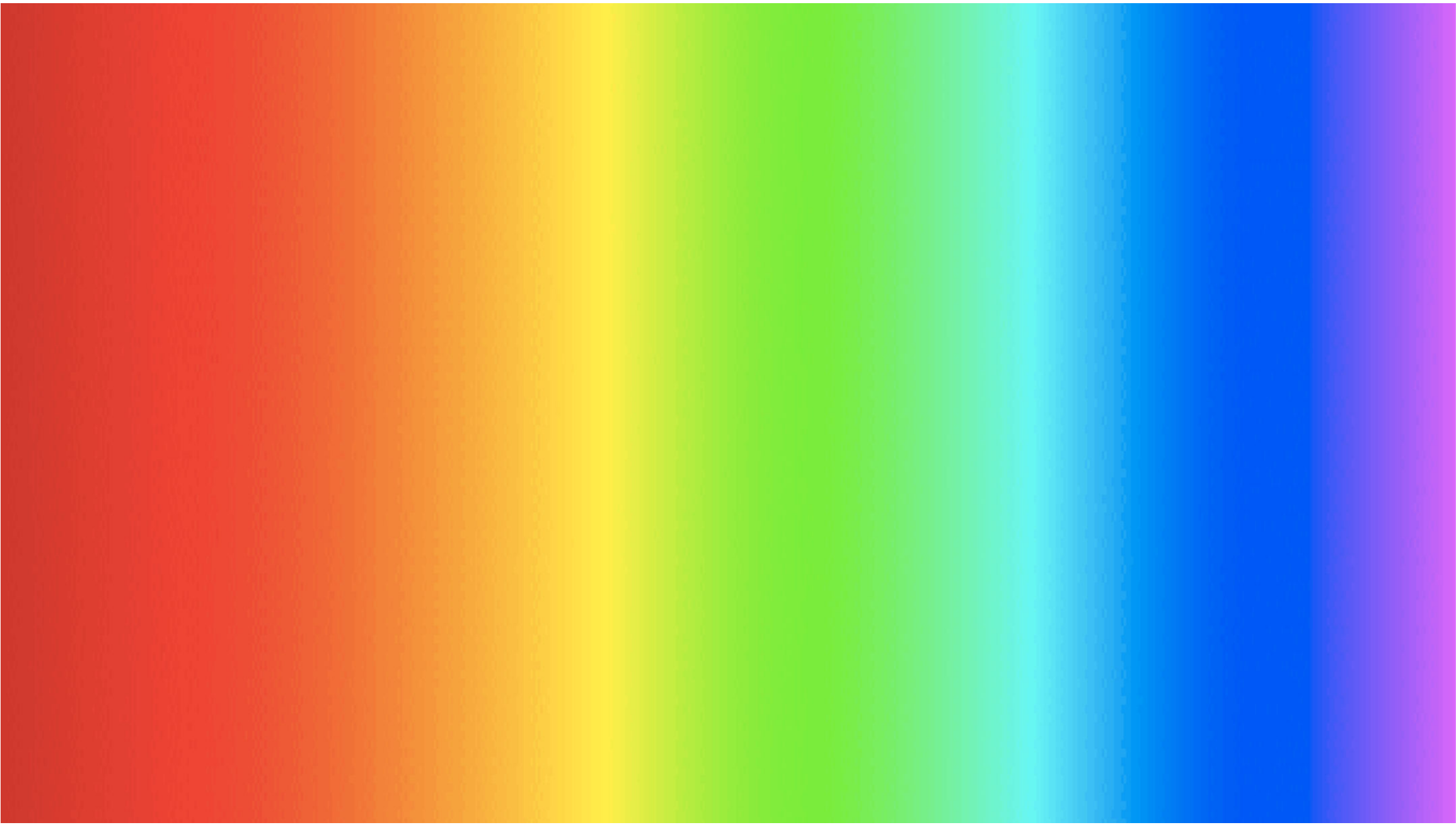




Divergierend: Der *richtige* Mittelpunkt







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)]

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

Russell M. Taylor II, University of North Carolina at Chapel Hill

10 March 2017

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

Frédérique Chesterman, Hannah Manssens, Céline Morel, Guillaume Serrell, Bastian Piepers, Tom Kimpe

Author Affiliations +

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

Event: SPIE Medical Imaging, 2017, Orlando, Florida, United States

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

PMCID: PMC5148121 | PMID: 26127048

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

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

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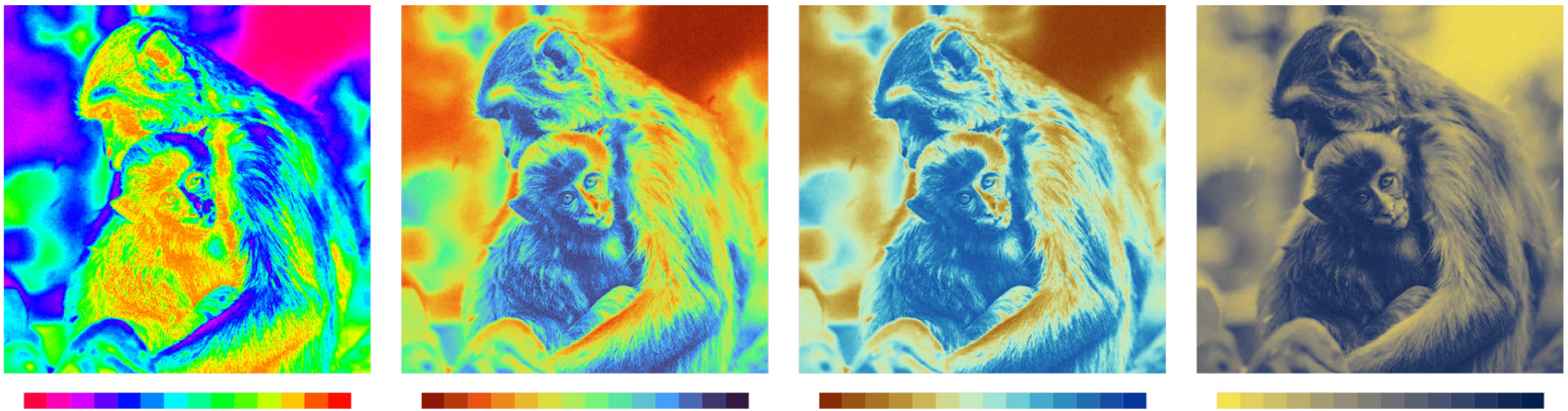
"The ad hoc manner in which color is handled and the lack of standard approaches have been associated with suboptimal and **inconsistent diagnostic decisions with a negative impact on patient treatment and prognosis**."

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

[1]Faculty of Environment and Natural Resources, University of Freiburg, Freiburg, Germany
[2]Department of Civil Engineering, University of Bristol, Bristol, UK


Non
Uniform
Distances

Hinter dem Regenbogen



Inspiriert von Fabio Crameri | Original Fotografie von Richard Strozynski

Arten von Farbpaletten

Sequentiell

Beispiel

Graustufen

numerische Informationen mit steigender Reihenfolge

verwende den höchsten Kontrast für die wichtigsten Informationen

entweder einfarbige oder mehrfarbige Farbpaletten

Divergierend

Beispiel

Graustufen

numerische Informationen mit kritischem Mittelpunkt

verwende einen bedeutsamen Mittelpunkt und nutze ausgewogene Extremwerte

Kombination von zwei sequentiellen Farbpaletten

Qualitativ

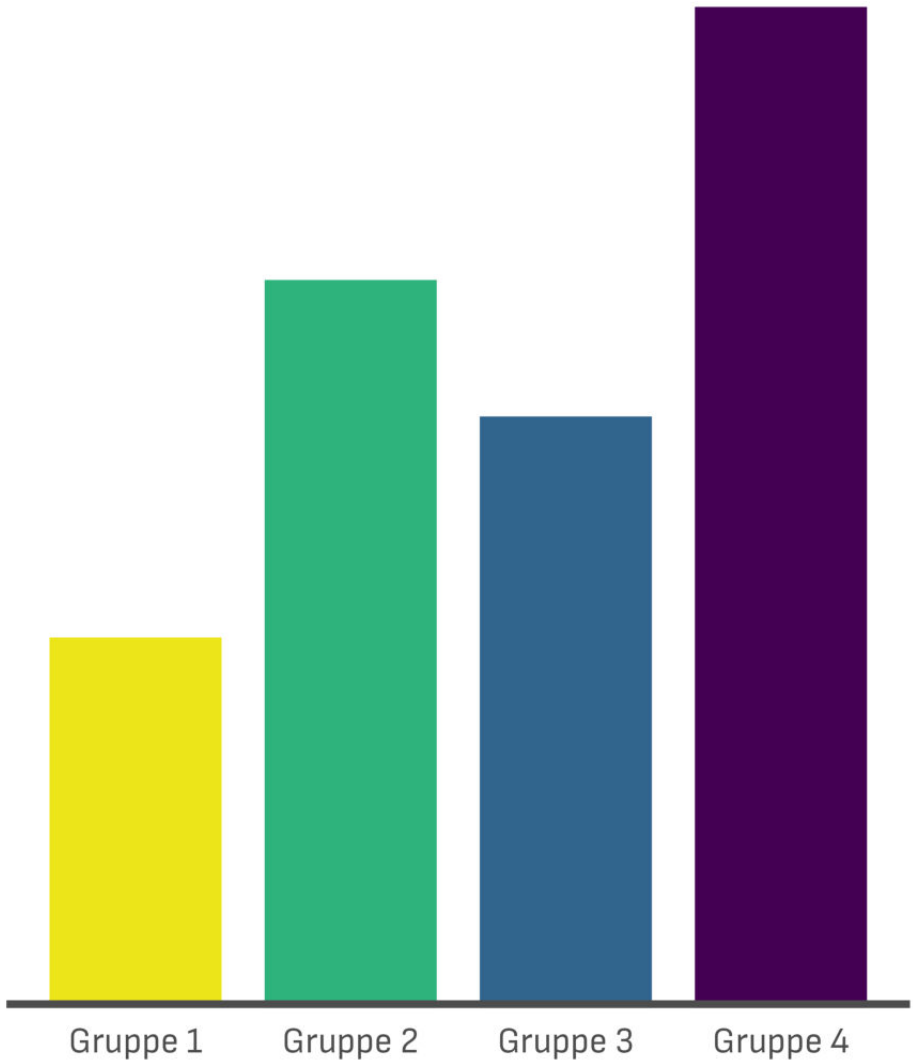
Beispiel

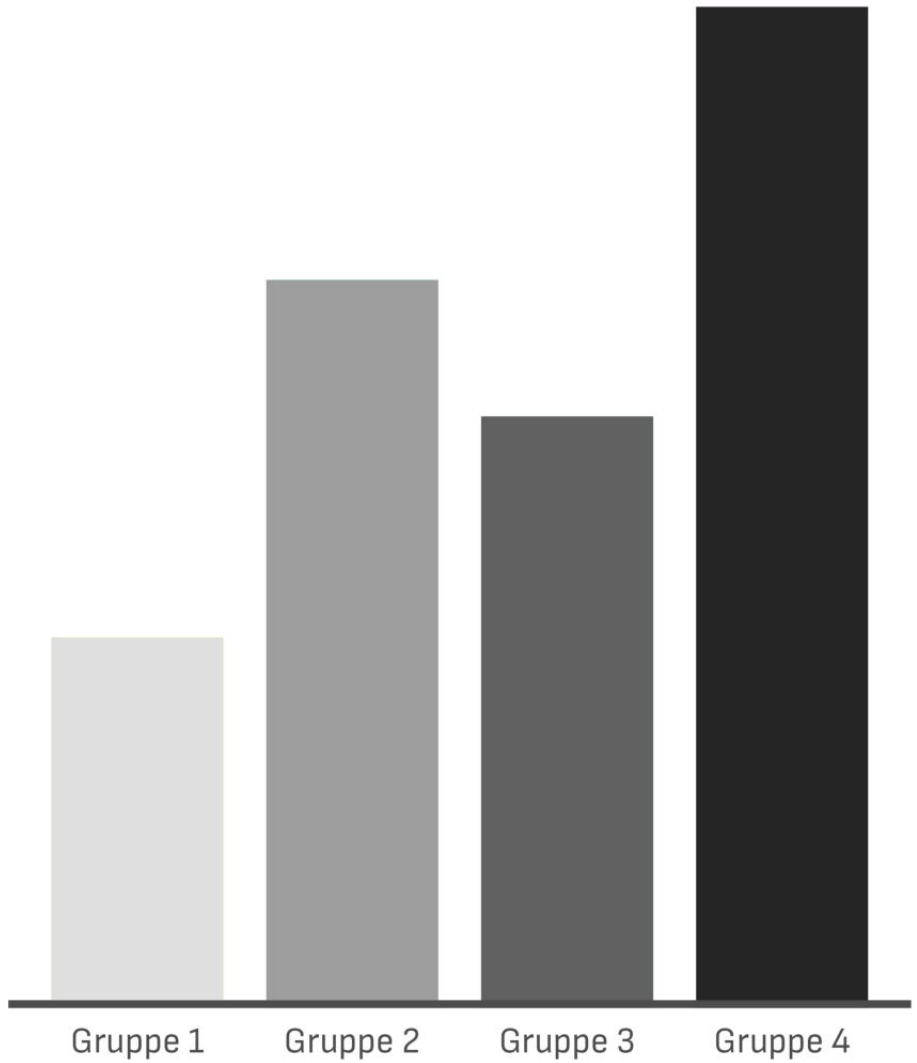
Graustufen

kategorische Informationen *(ohne Reihenfolge)*

wähle verschiedene Farben mit demselben Wahrnehmungsgewicht

Anzahl auf 6 bis 8 Kategorien begrenzen


Gruppe 1
Gruppe 2
Gruppe 3
Gruppe 4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Gruppe 3
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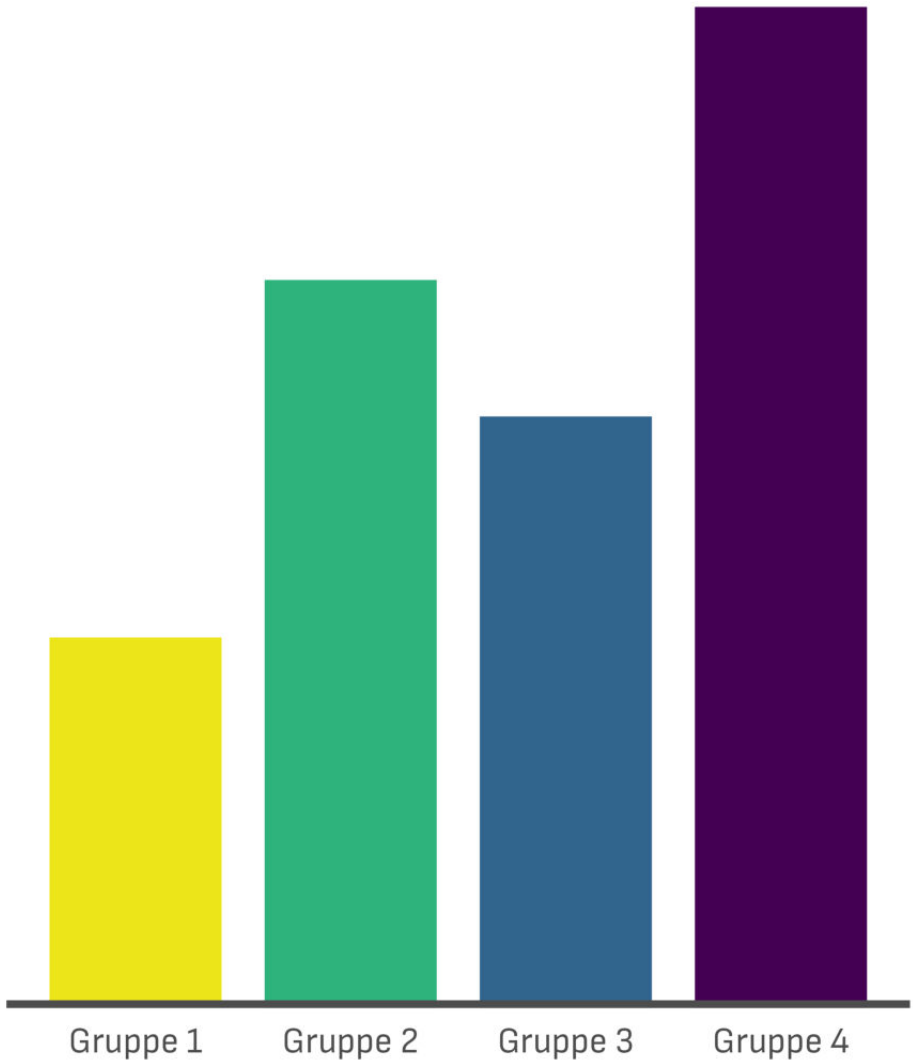
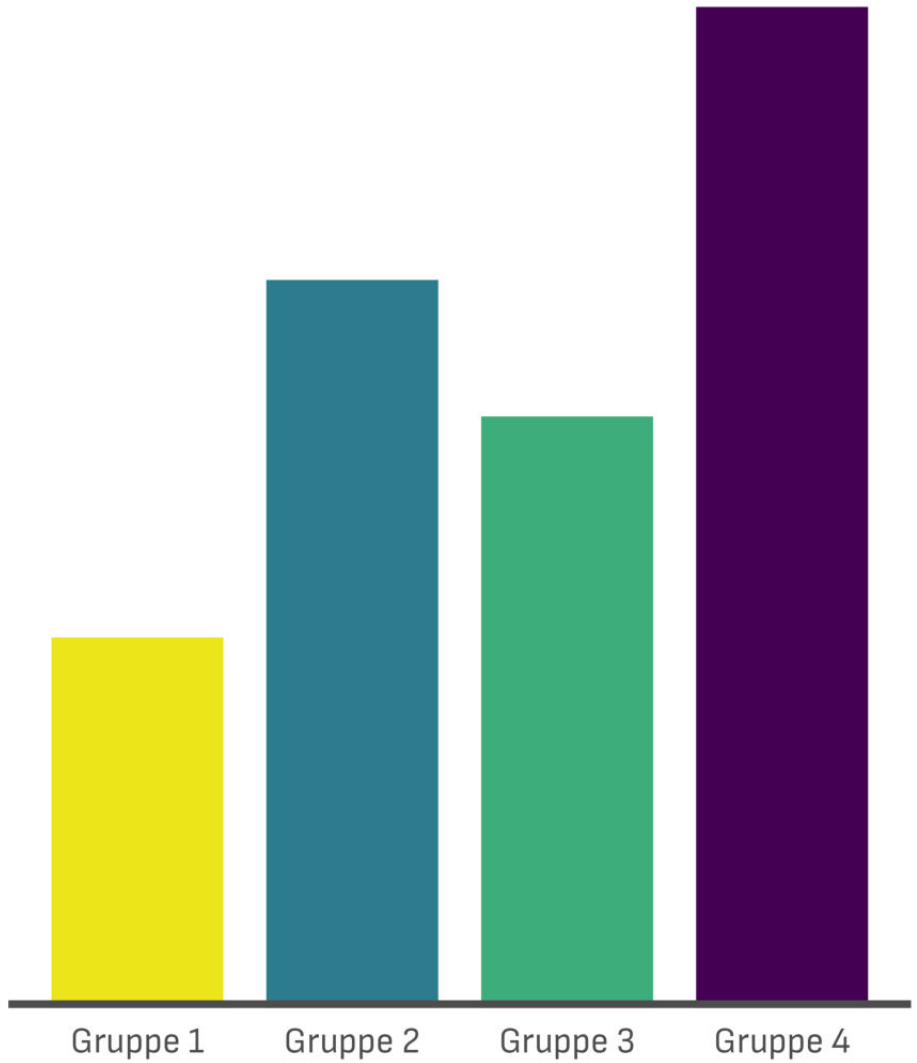

Gruppe 1
Gruppe 2
Gruppe 3
Gruppe 4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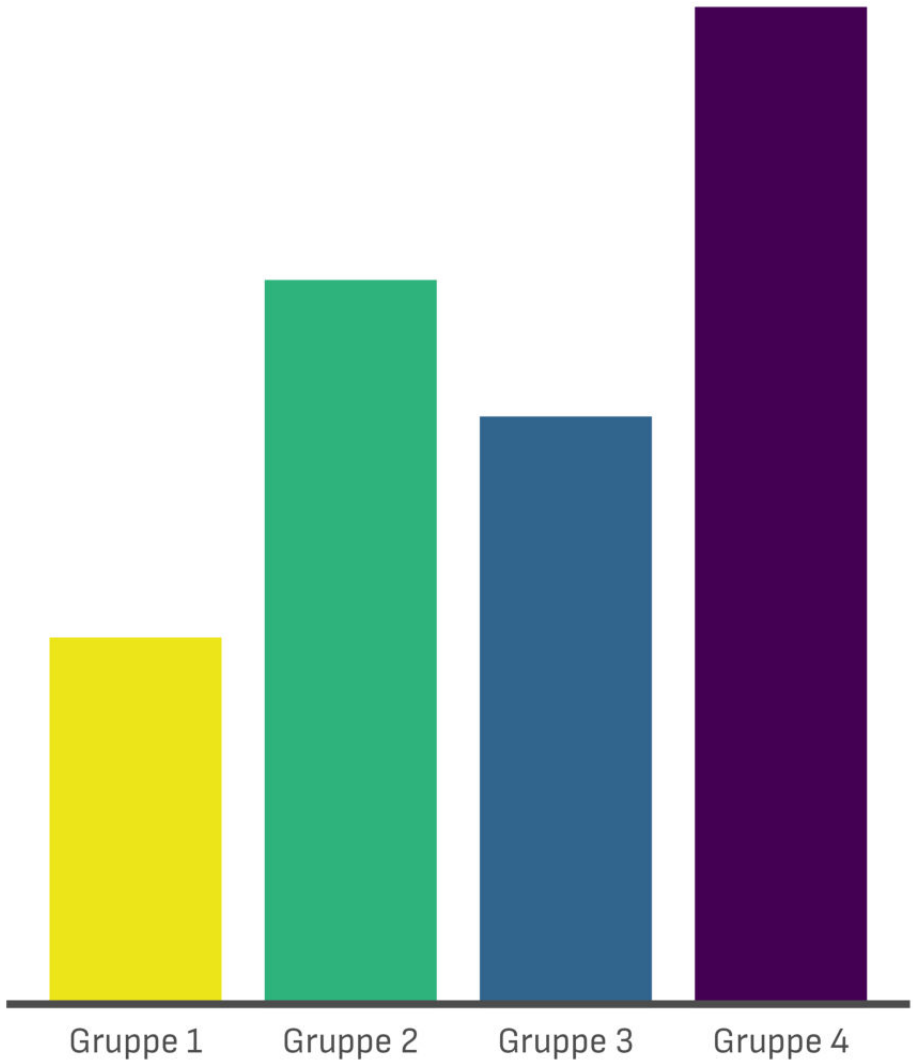
Gruppe 4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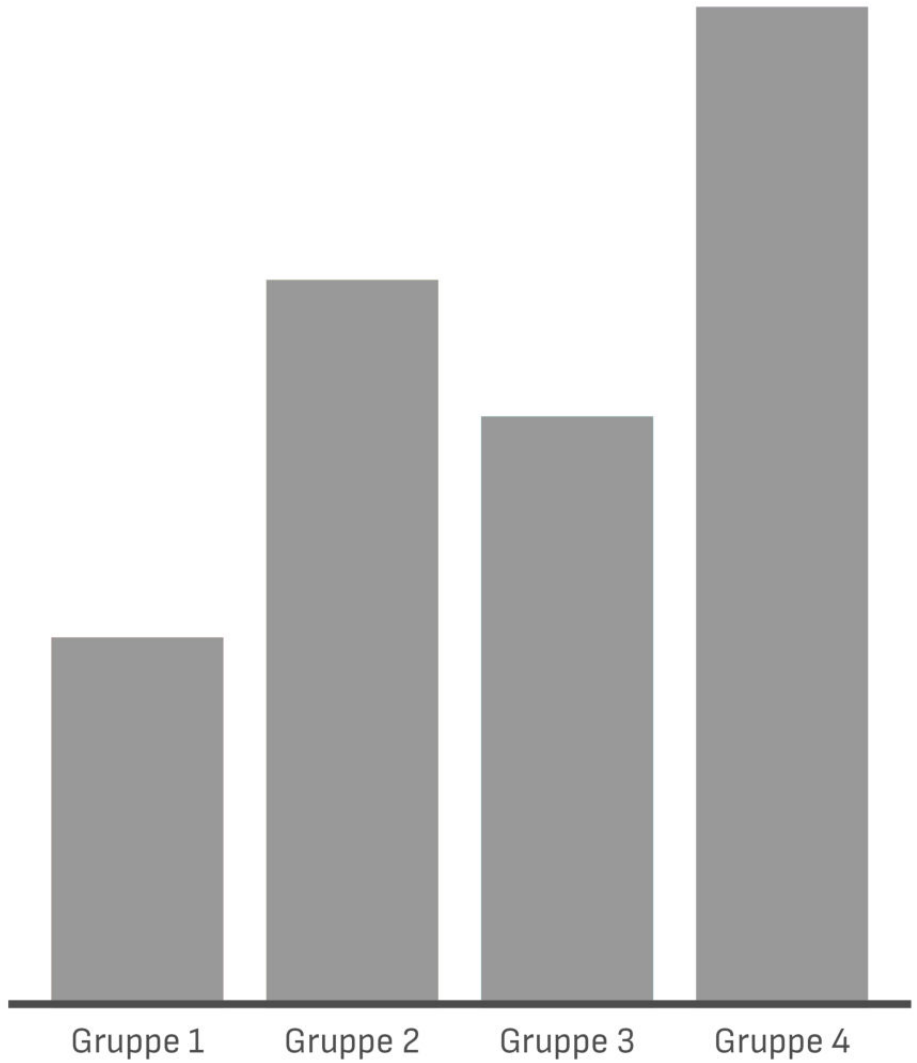
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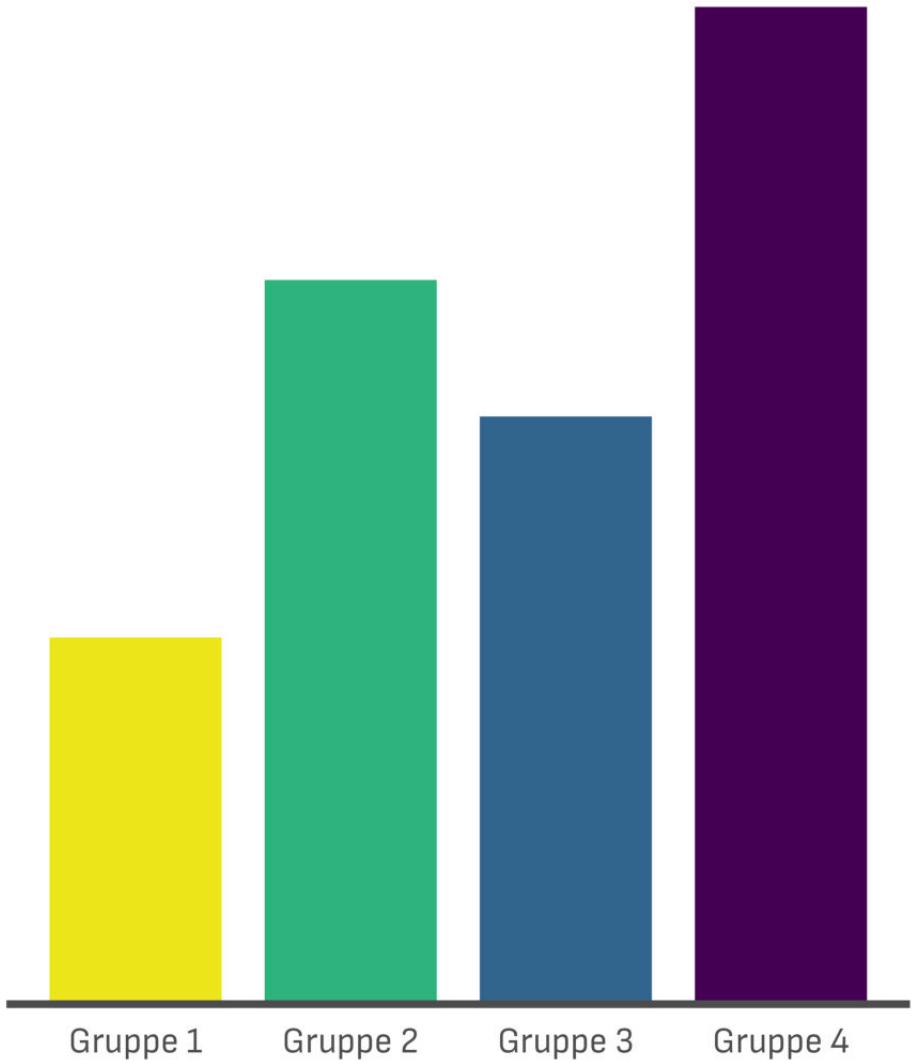
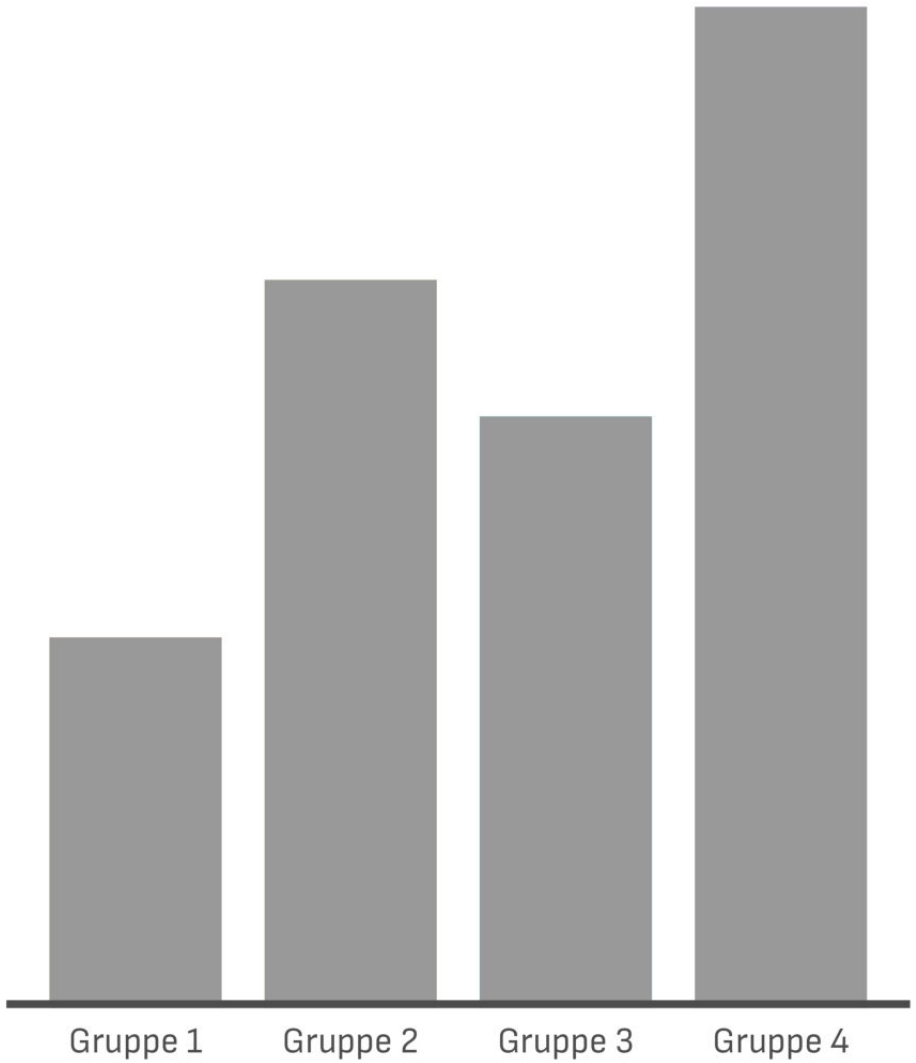

Gruppe 1
Gruppe 2
Gruppe 3
Gruppe 4


Gruppe 1
Gruppe 2
Gruppe 3
Gruppe 4


Gruppe 1
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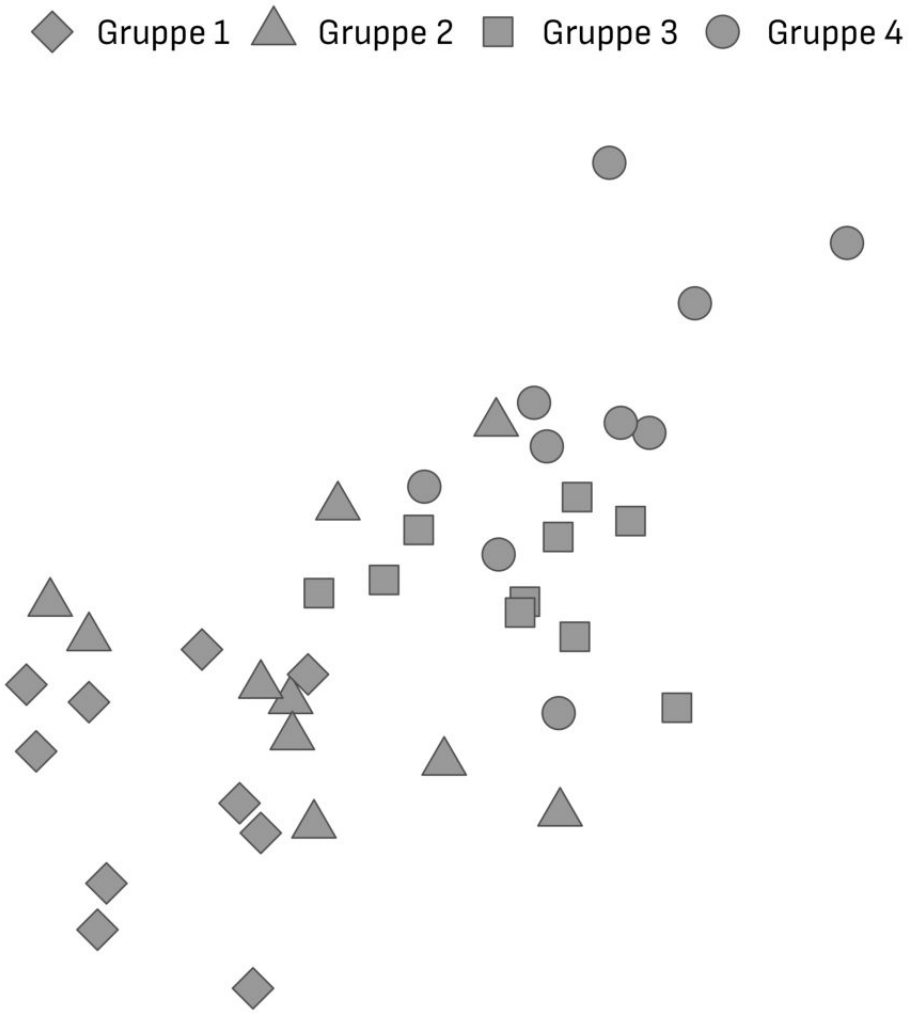
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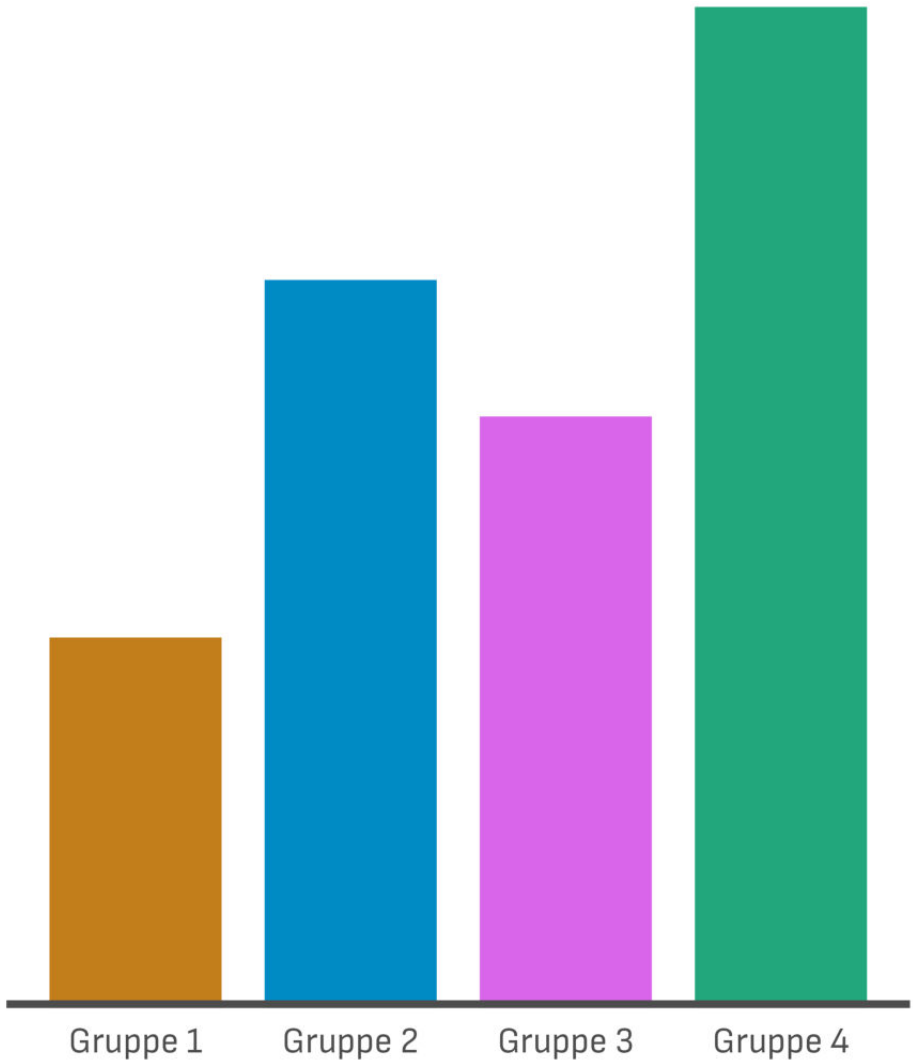
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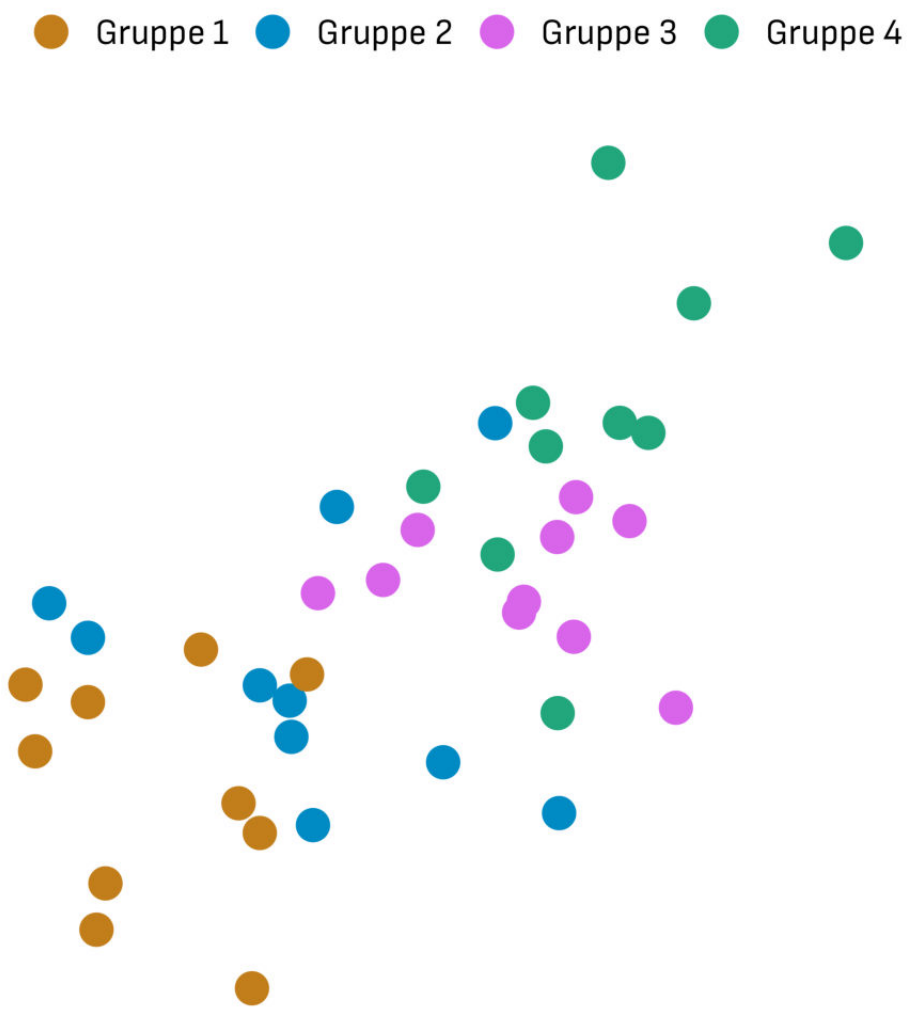
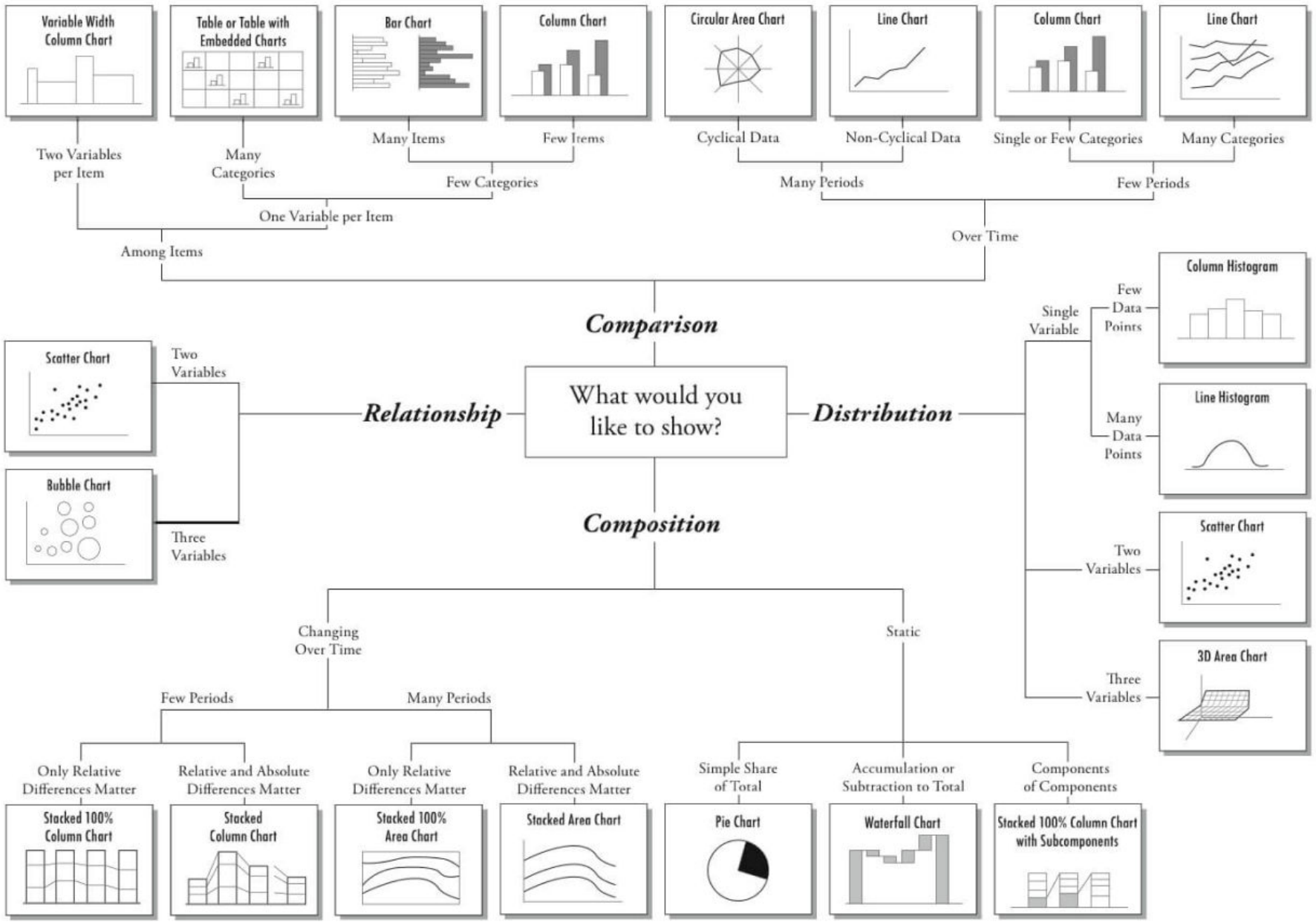
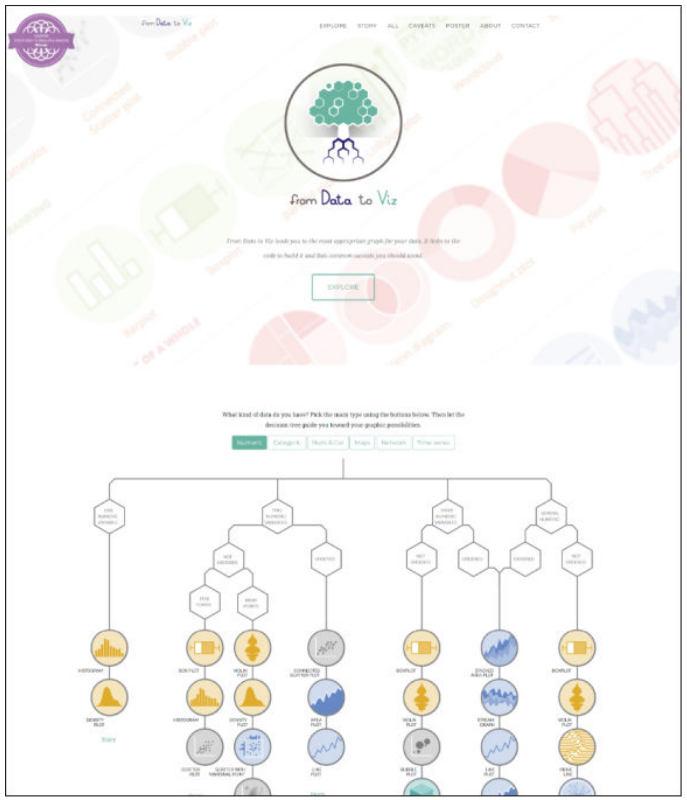
Gruppe 4


Gruppe 1
Gruppe 2
Gruppe 3
Gruppe 4

Auswahl des Diagrammtyps

Chart Suggestions—A Thought-Starter

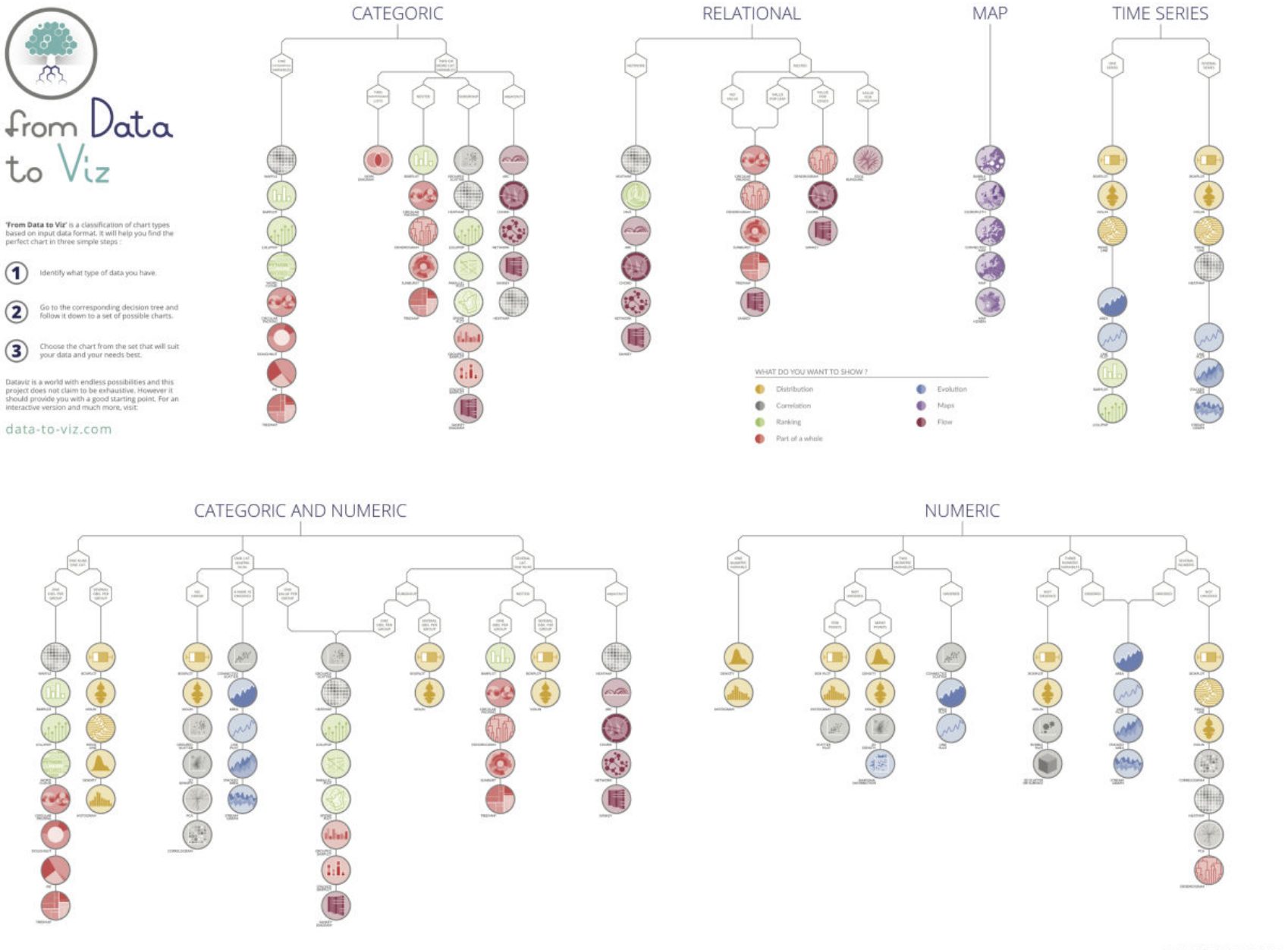




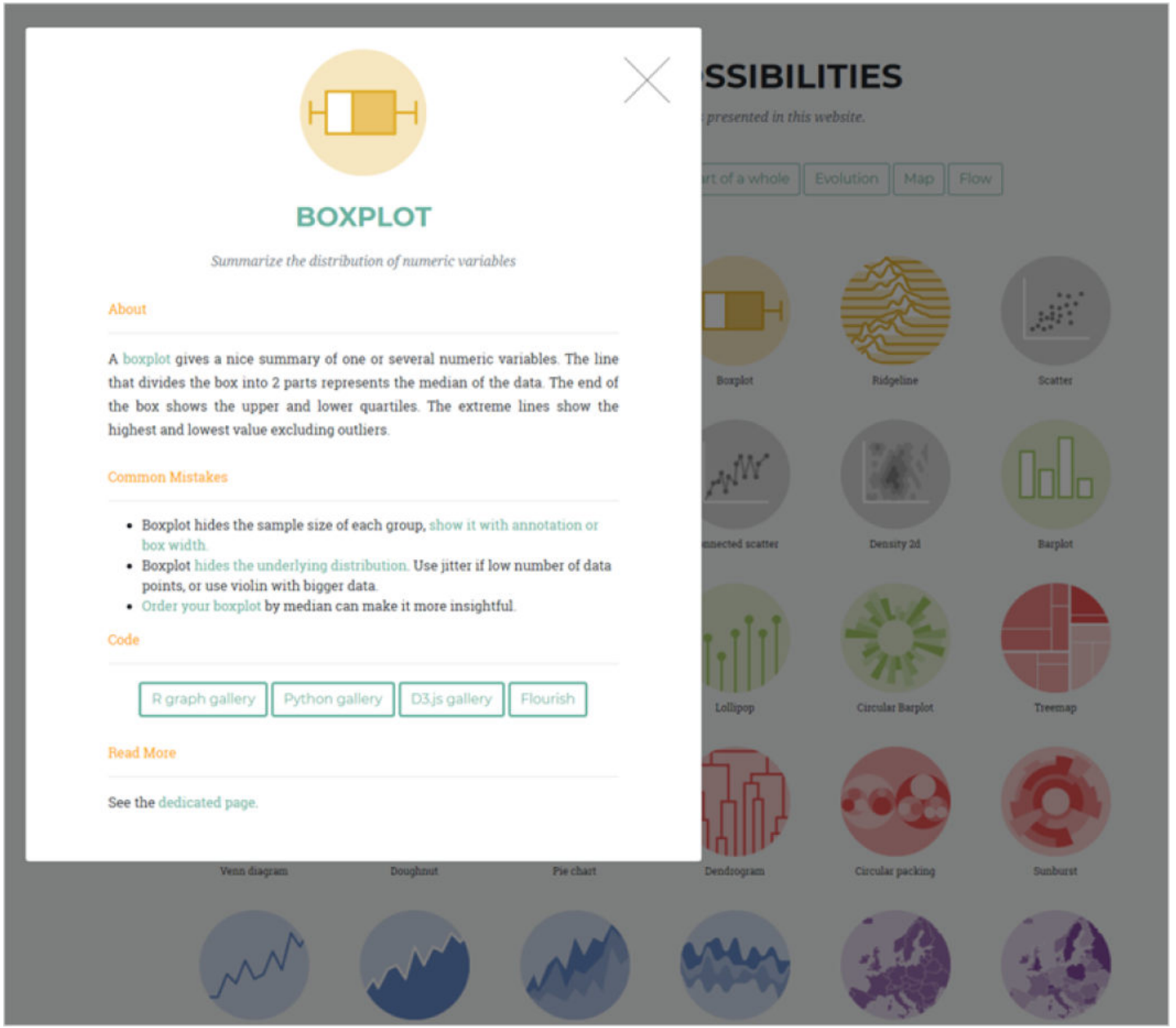
data-to-viz.com

datavizproject.com

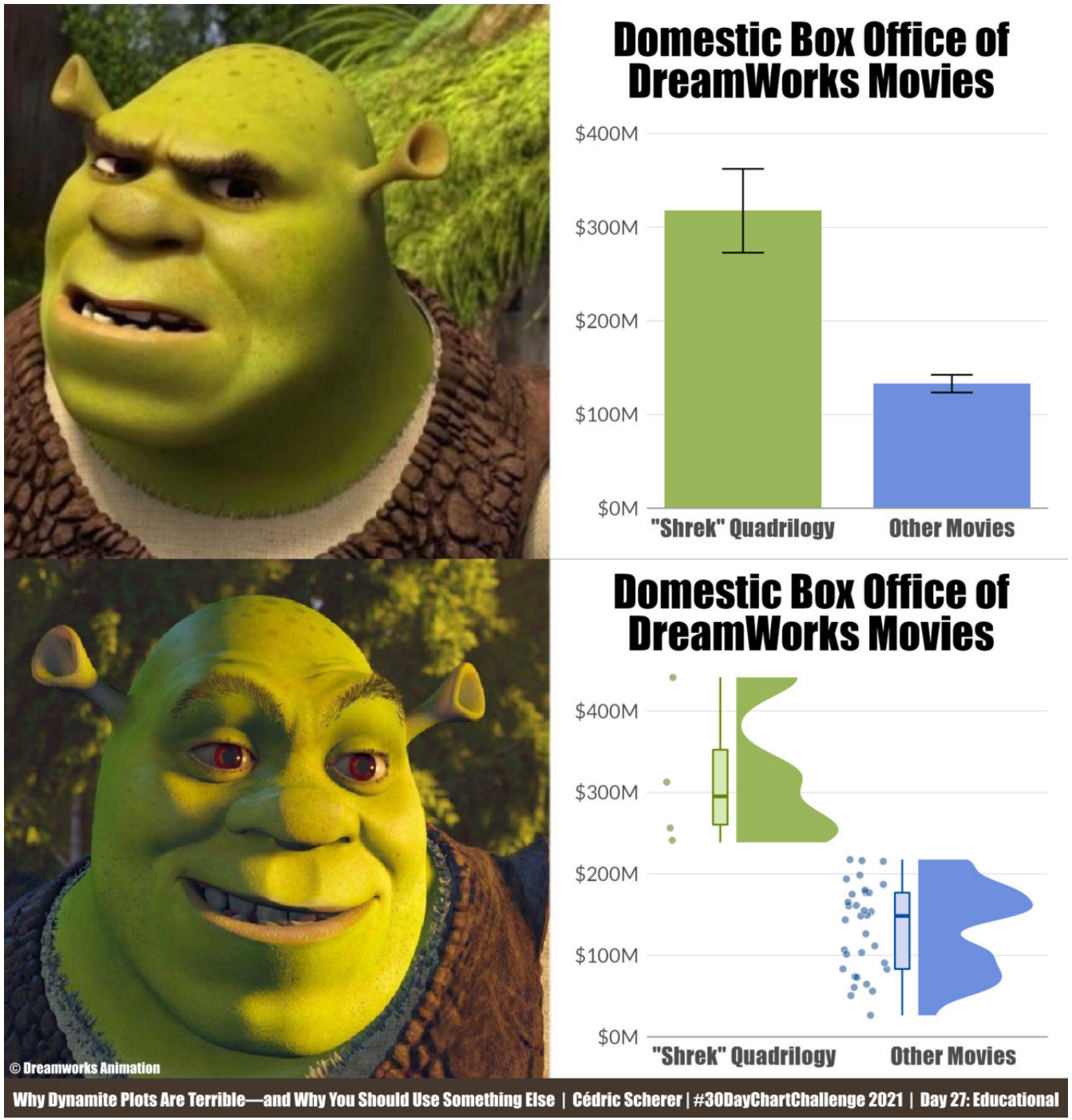
visualizationuniverse.com



Quelle: Data to Viz



Quelle: Data to Viz


Domestic Box Office of DreamWorks Movies
$400M
$300M
$200M
$100M
$0M
"Shrek" Quadrilogy
Other Movies
Domestic Box Office of DreamWorks Movies
$400M
$300M
$200M
$100M
$0M
"Shrek" Quadrilogy
Other Movies
© Dreamworks Animation
Why Dynamite Plots Are Terrible—and Why You Should Use Something Else | Cédric Scherer | #30DayChartChallenge 2021 | Day 27: Educational

PLOS | BIOLOGY

PERSPECTIVE

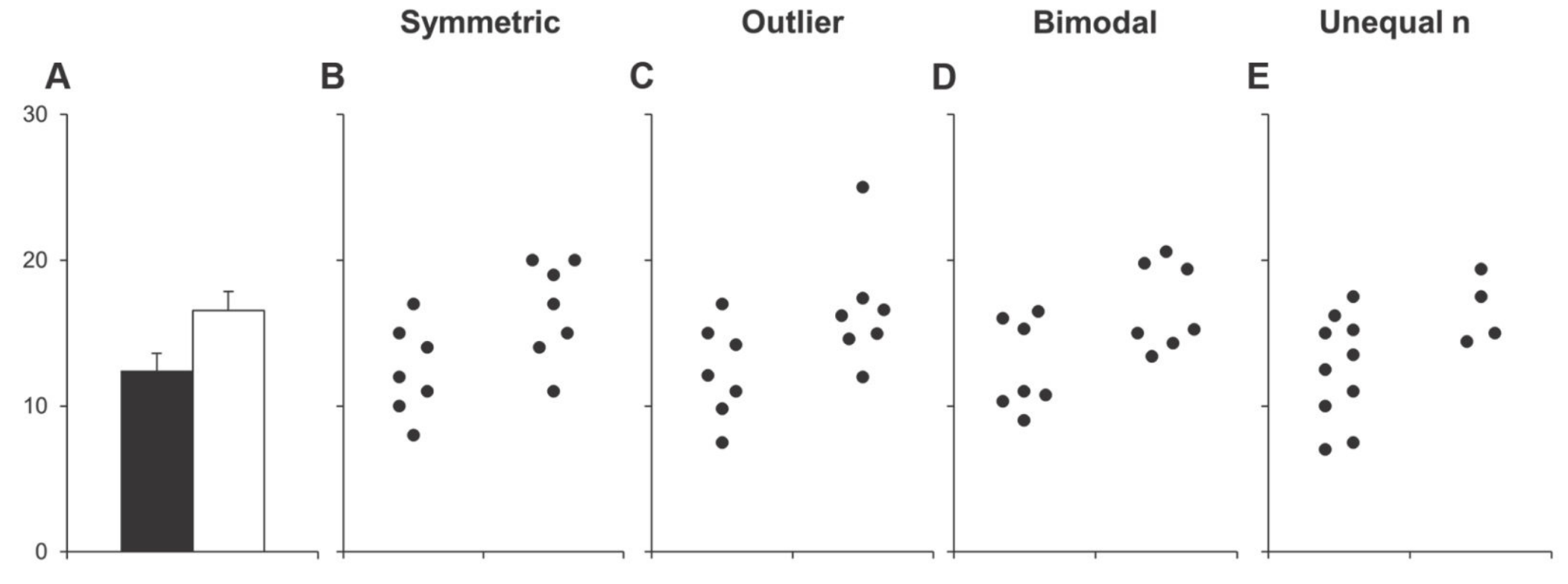
Beyond Bar and Line Graphs: Time for a New Data Presentation Paradigm

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

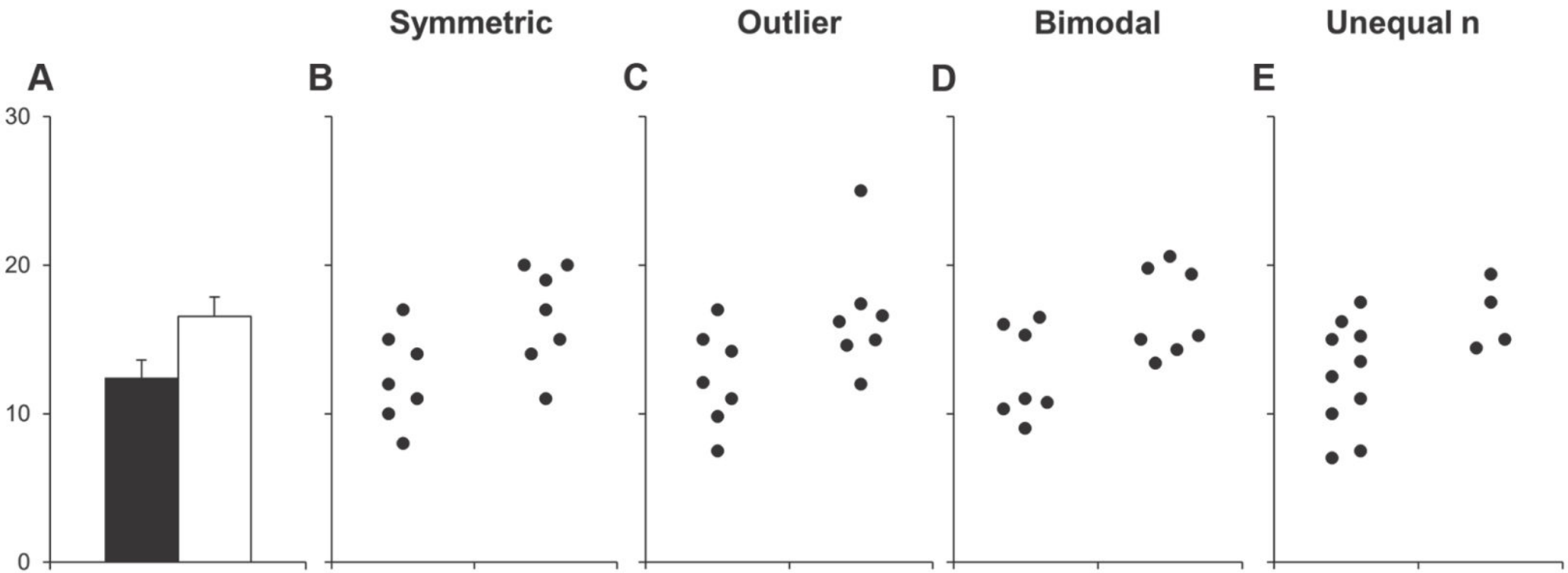
1 Division of Nephrology & Hypertension, Mayo Clinic, Rochester, Minnesota, United States of America, **2** Department of Biostatistics, Medical Faculty, University of Belgrade, Belgrade, Serbia, **3** Division of Biomedical Statistic and Informatics, Mayo Clinic, Rochester, Minnesota, United States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

* weissgerber.tracey@mayo.edu

Weissgerber et al. (2015) PLoS Biology

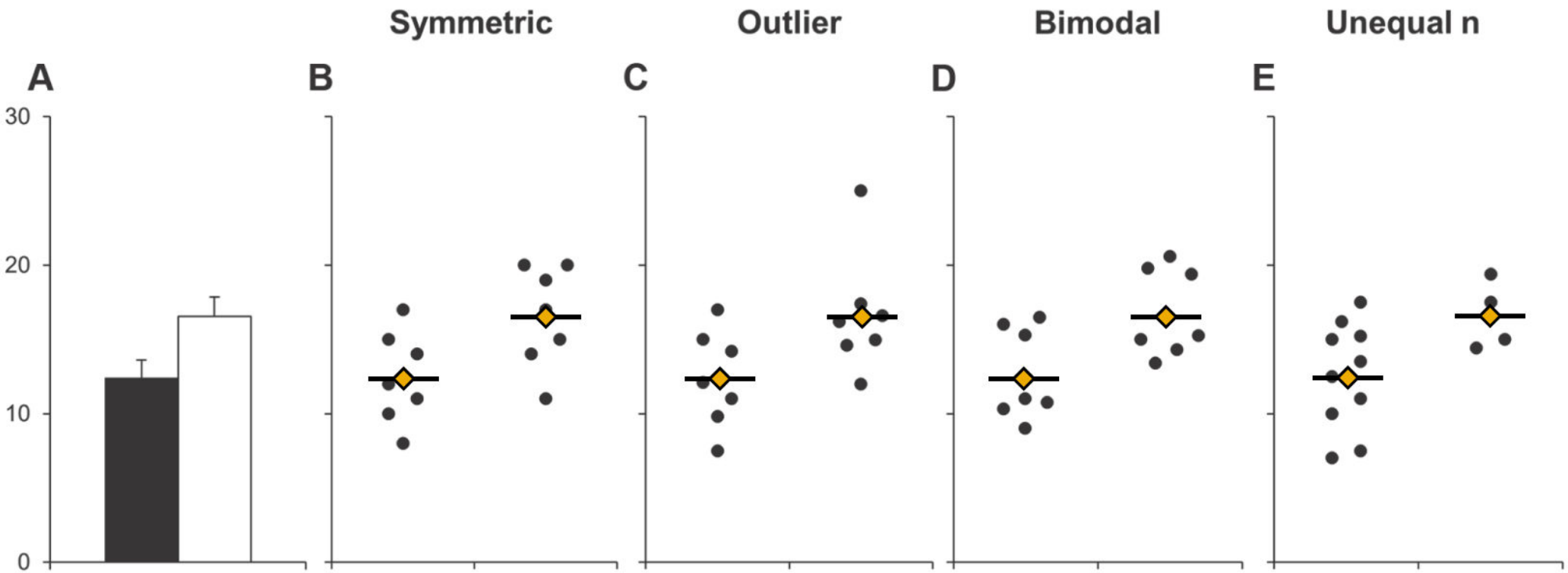


Modifiziert nach Weissgerber et al. (2015) PLoS Biology



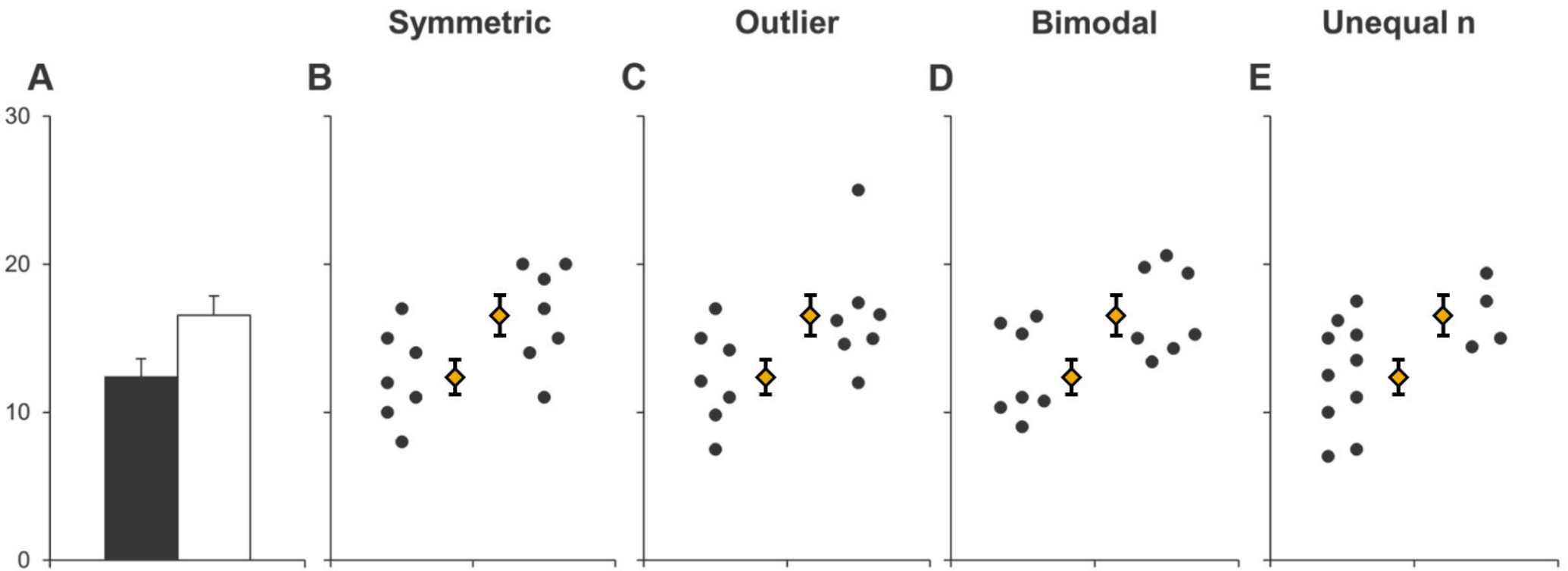
Test	p value			
T-test: Equal var.	0.035	0.050	0.026	0.063
T-test: Unequal var.	0.035	0.050	0.026	0.035
Wilcoxon	0.054	0.073	0.128	0.103

Weissgerber et al. (2015) PLoS Biology (modifiziert)



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

Weissgerber et al. (2015) PLoS Biology (modifiziert)



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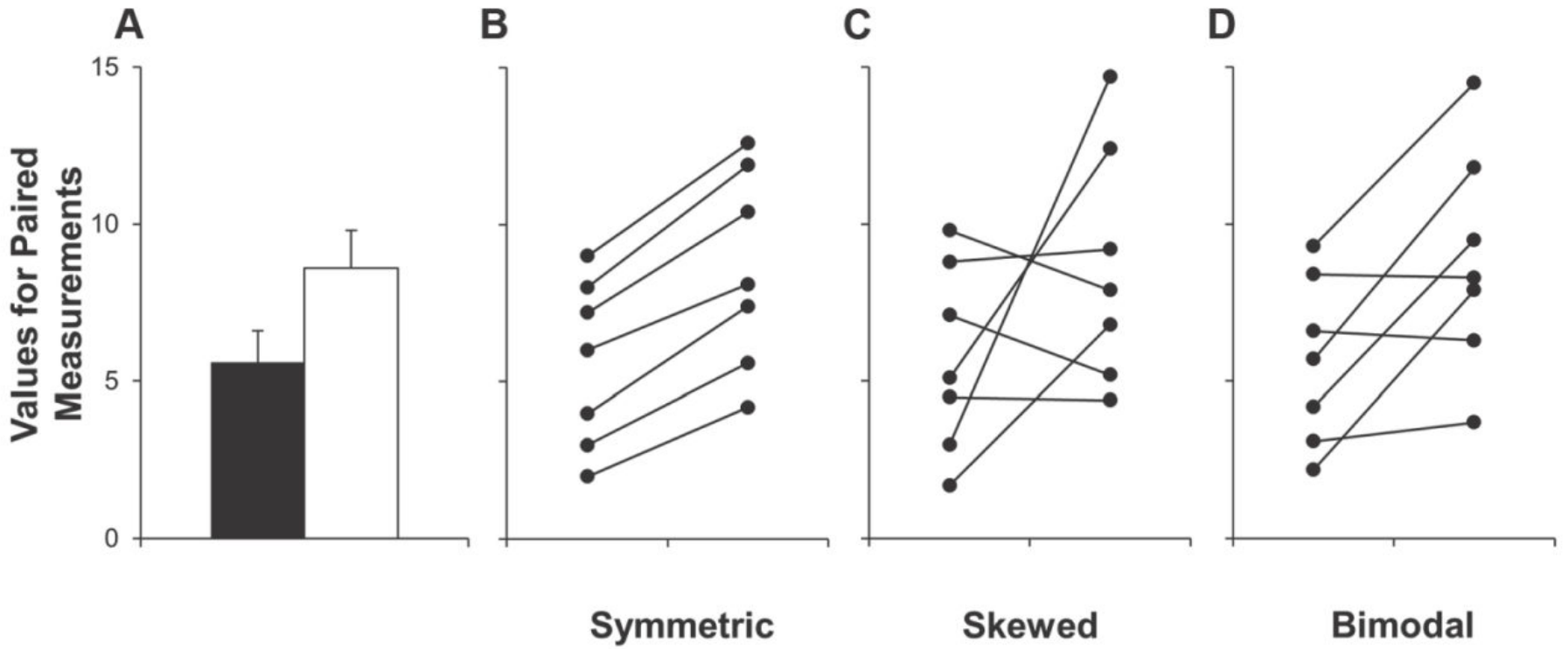
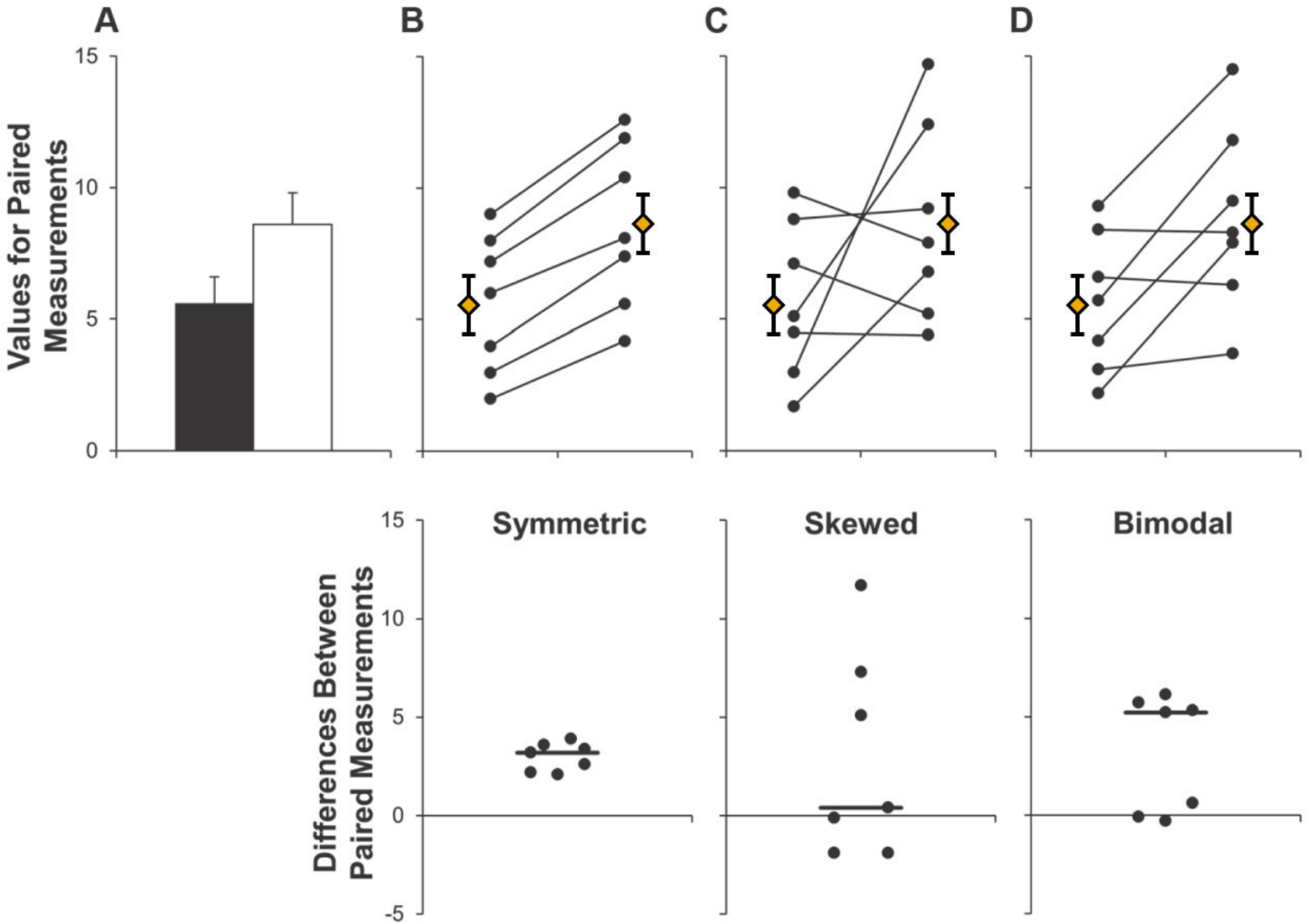
Weissgerber et al. (2015) PLoS Biology (modifiziert)



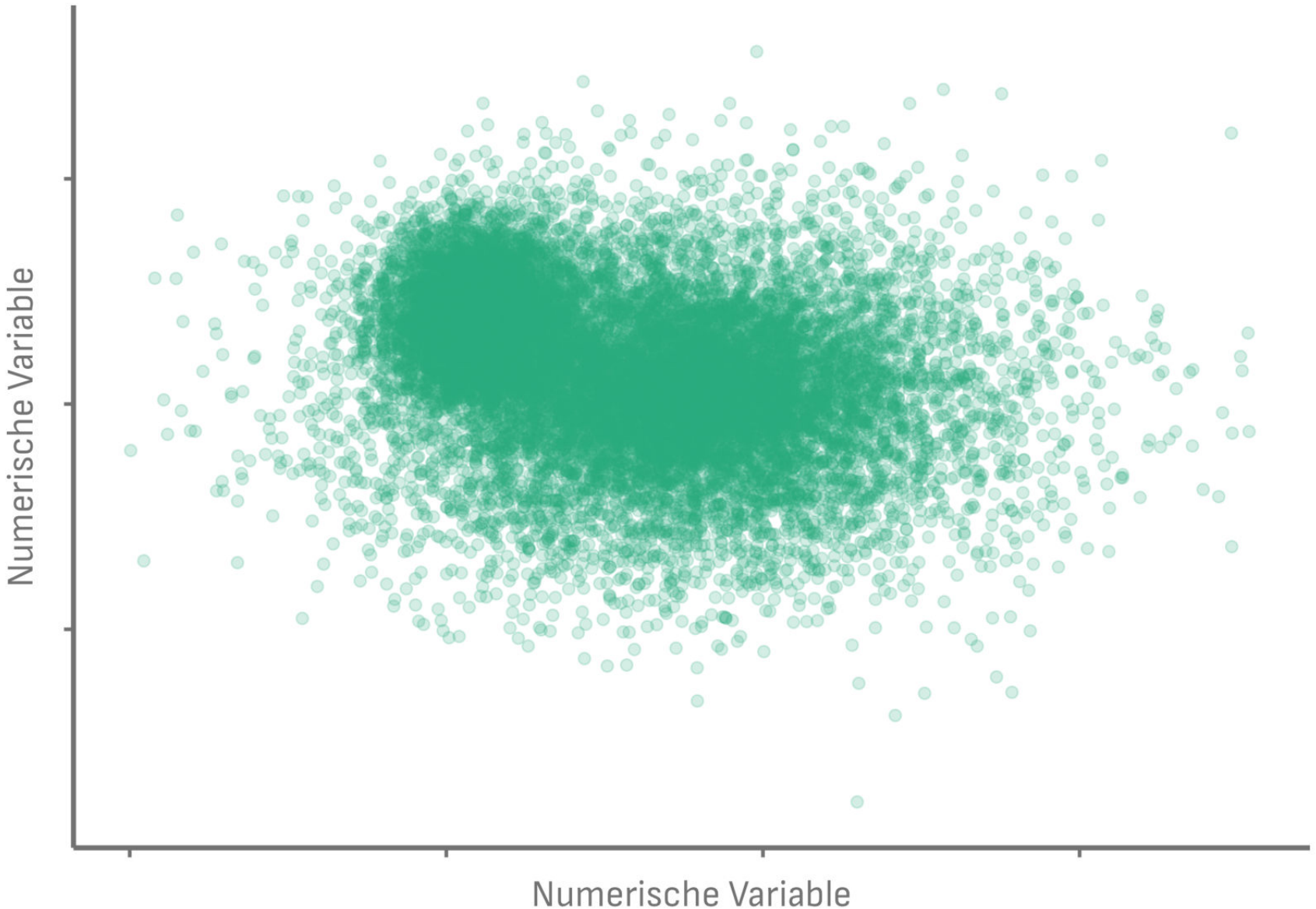
Modified from Weissgerber et al. (2015) PLoS Biology



Weissgerber et al. (2015) PLoS Biology (modifiziert)

Häufige Probleme bei der Darstellung von Daten

Zu viele Punkte



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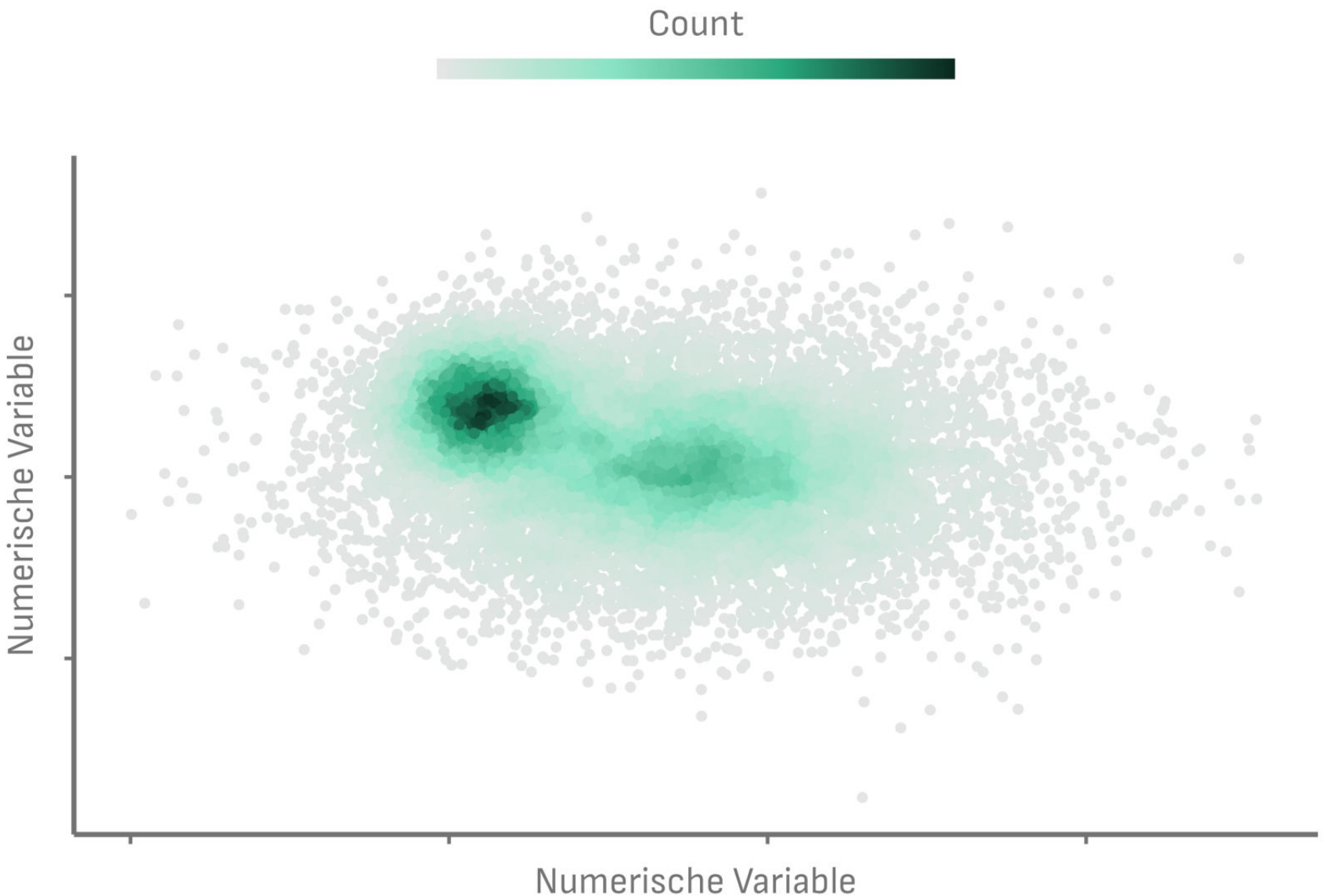
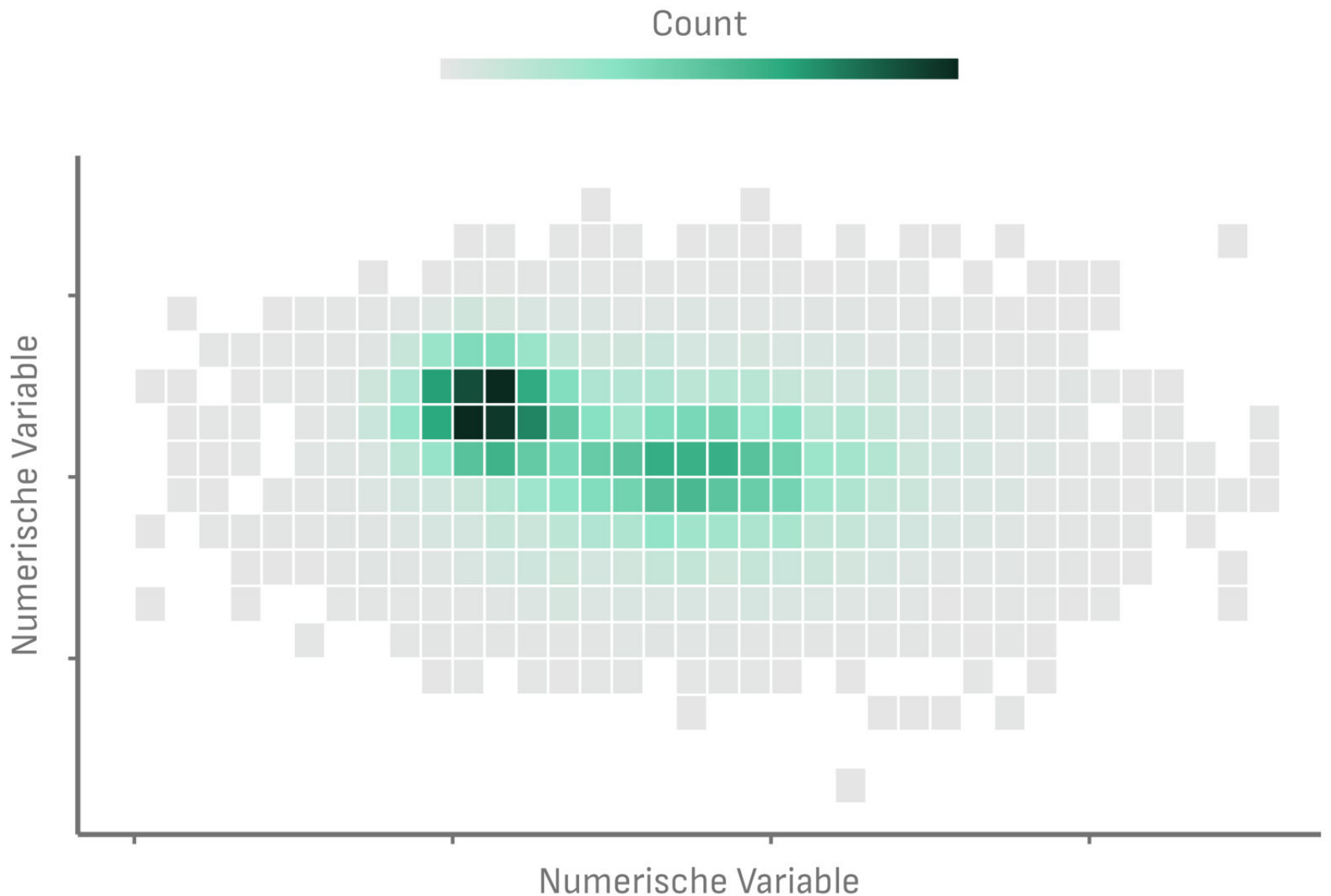
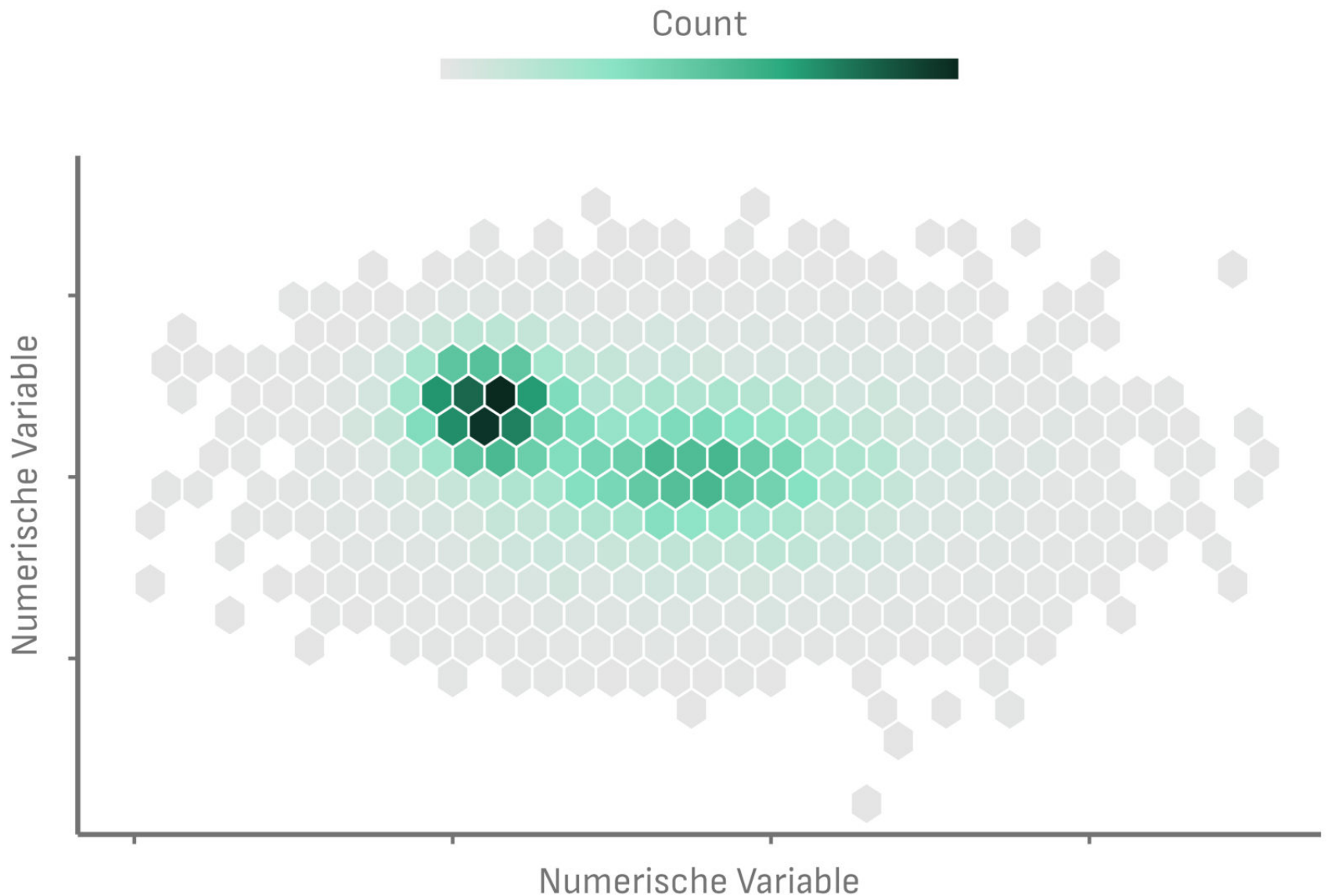


Zu viele Punkte



Zu viele Punkte



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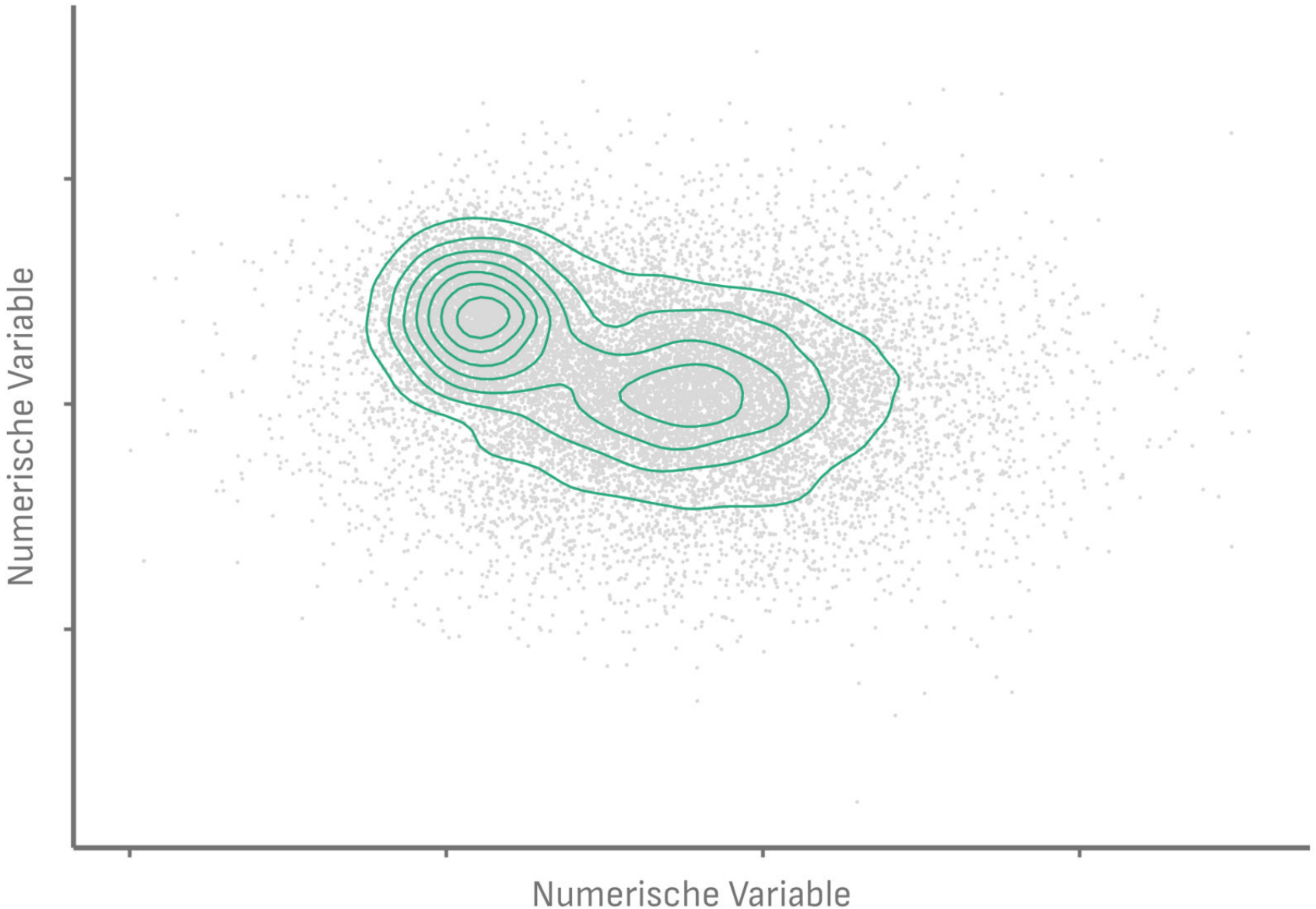
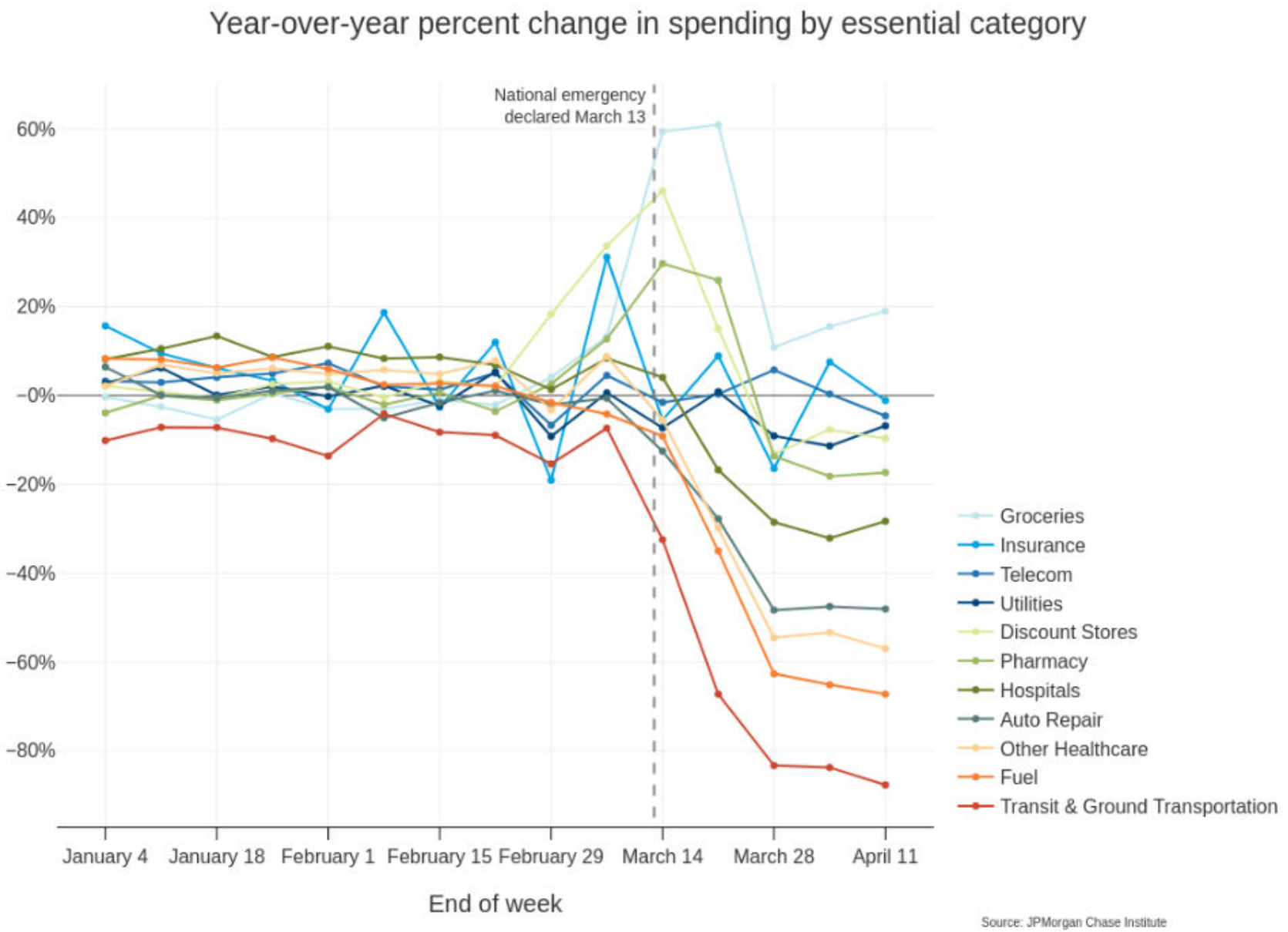


Zu viele Linien



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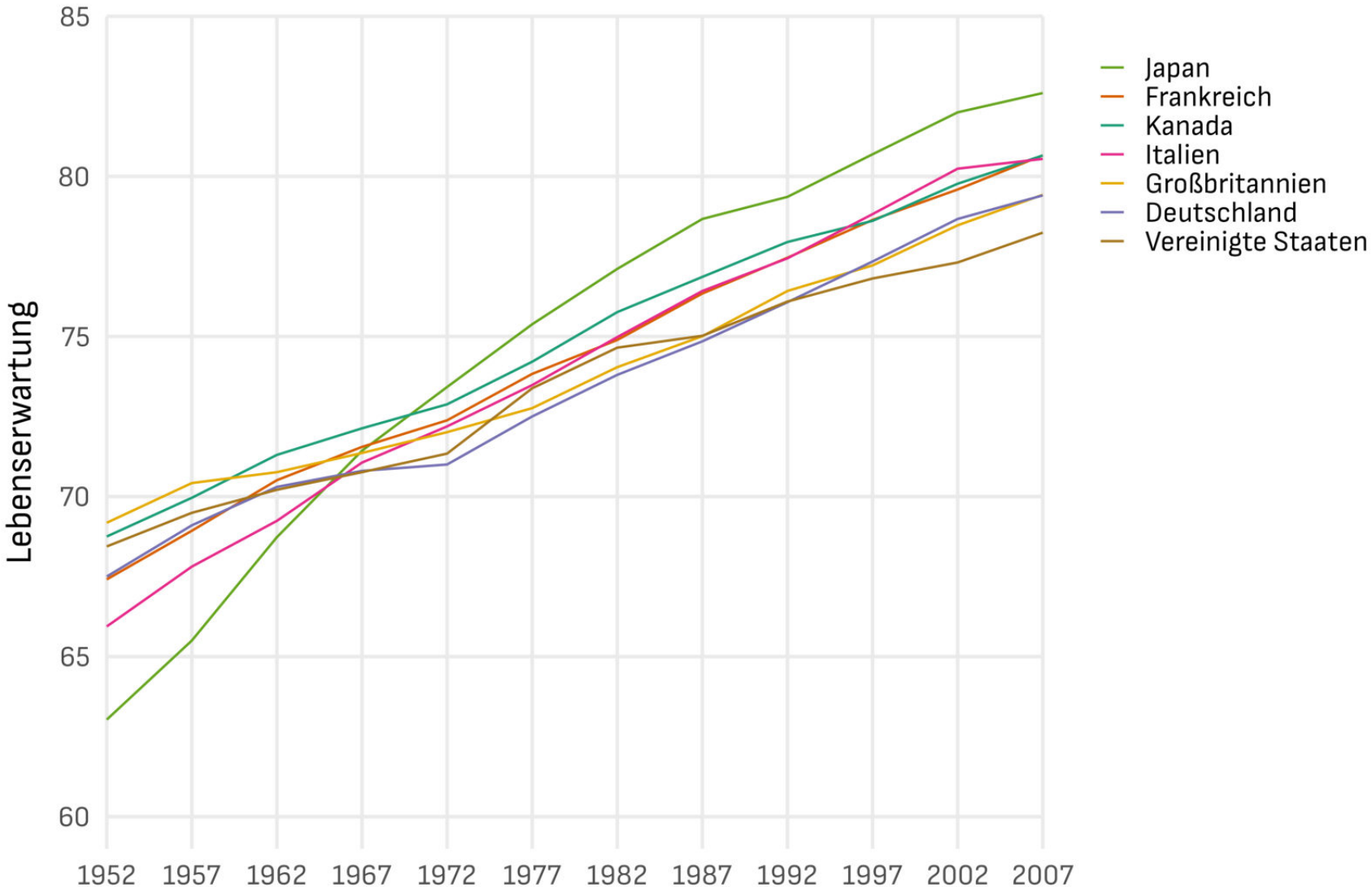

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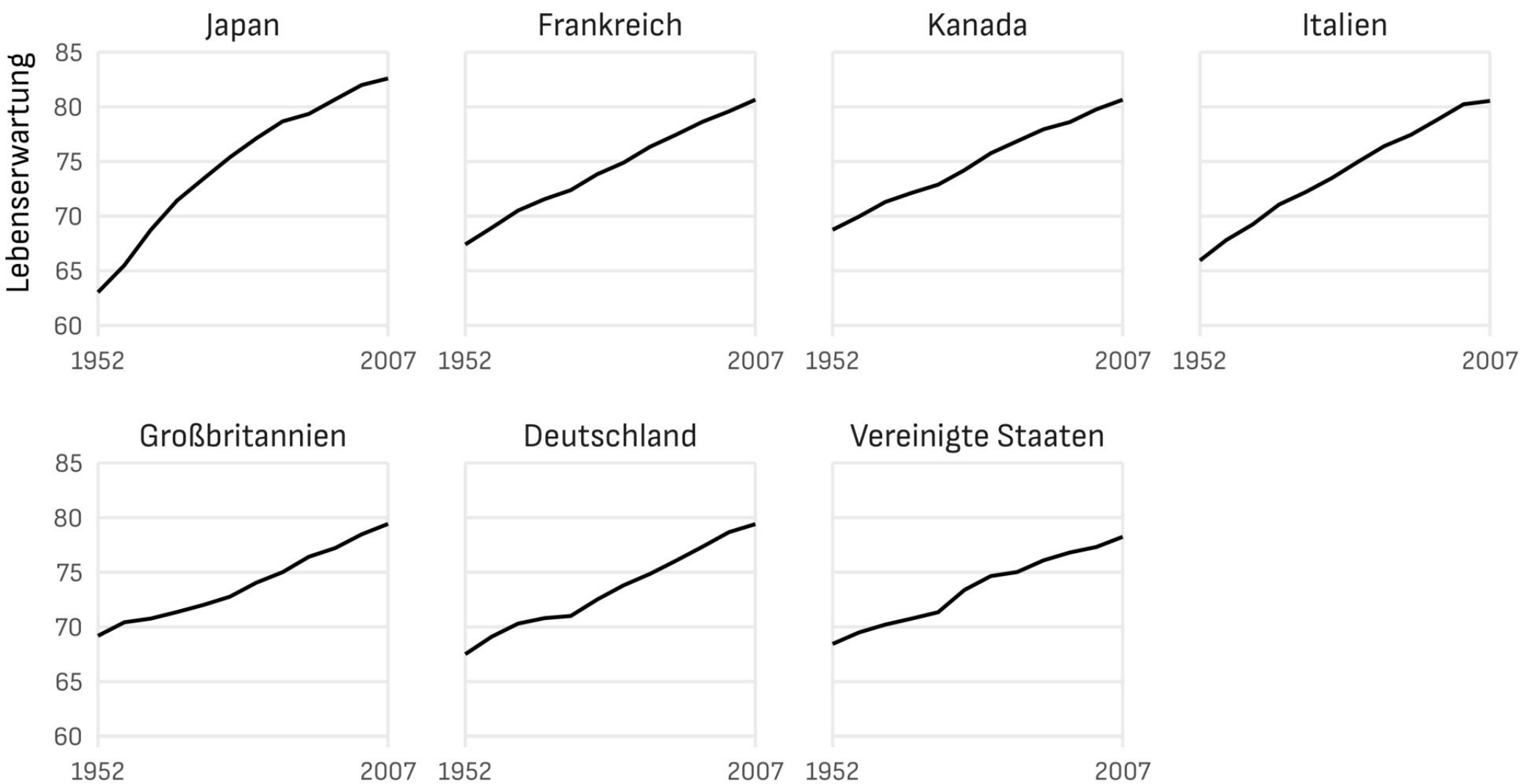

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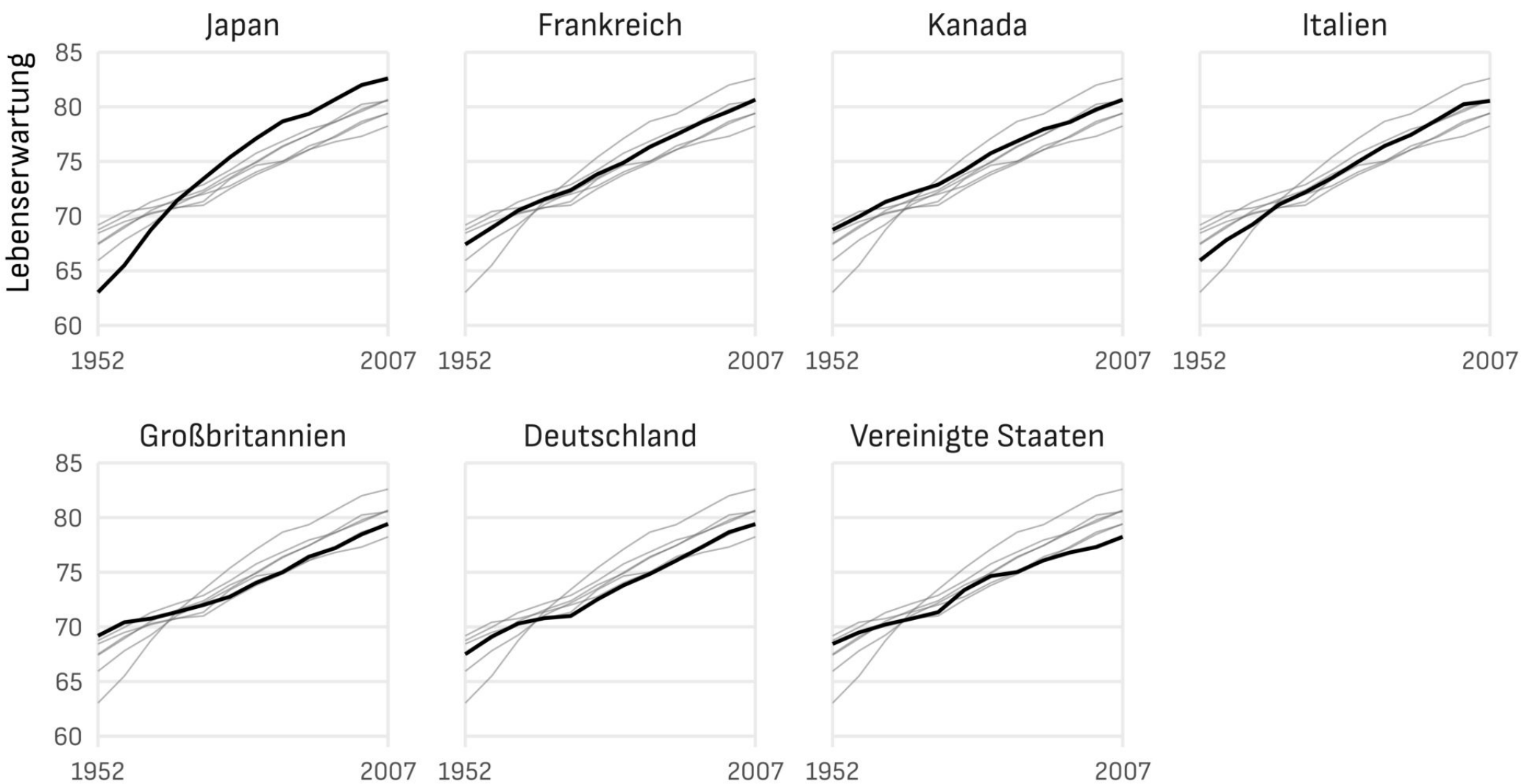
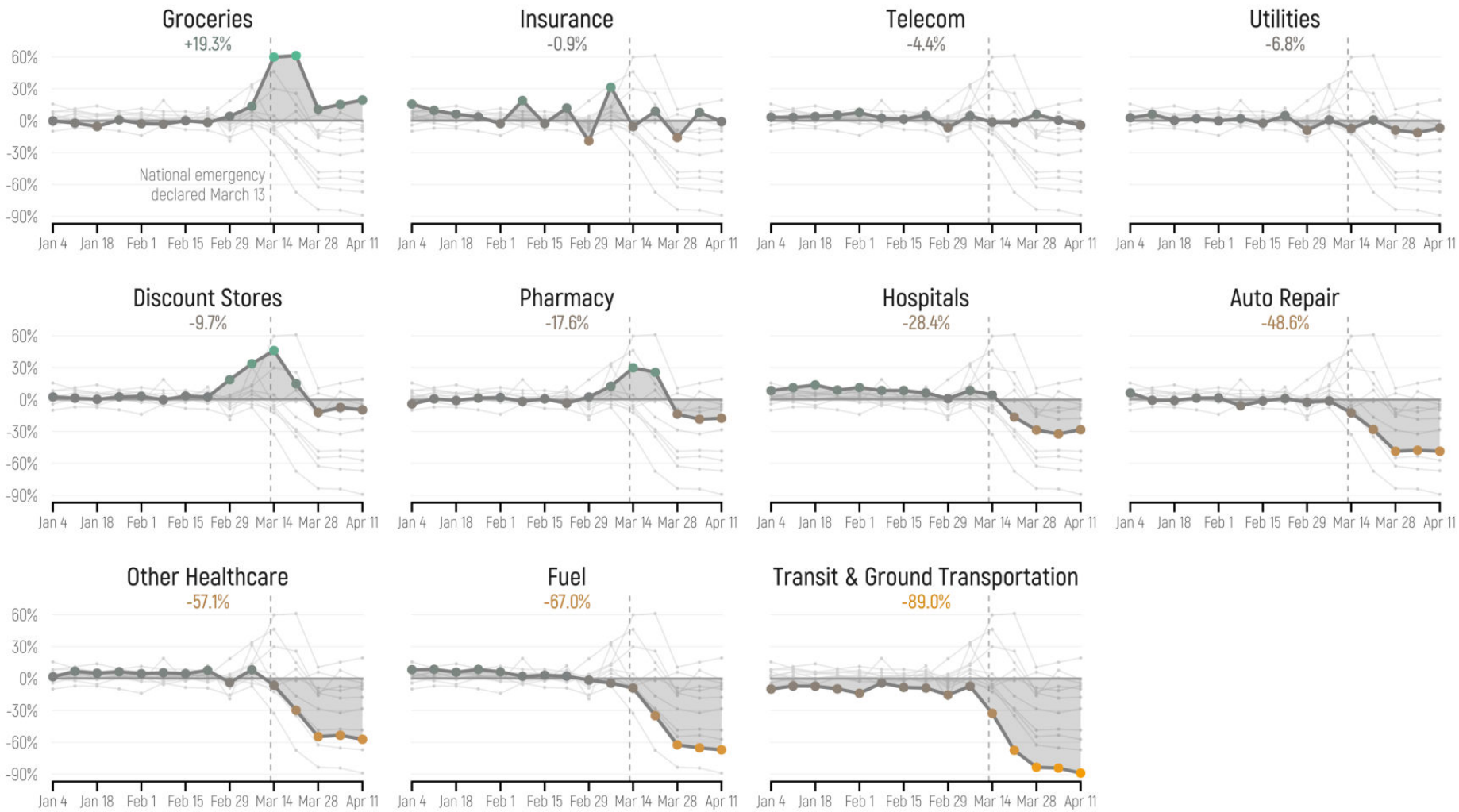
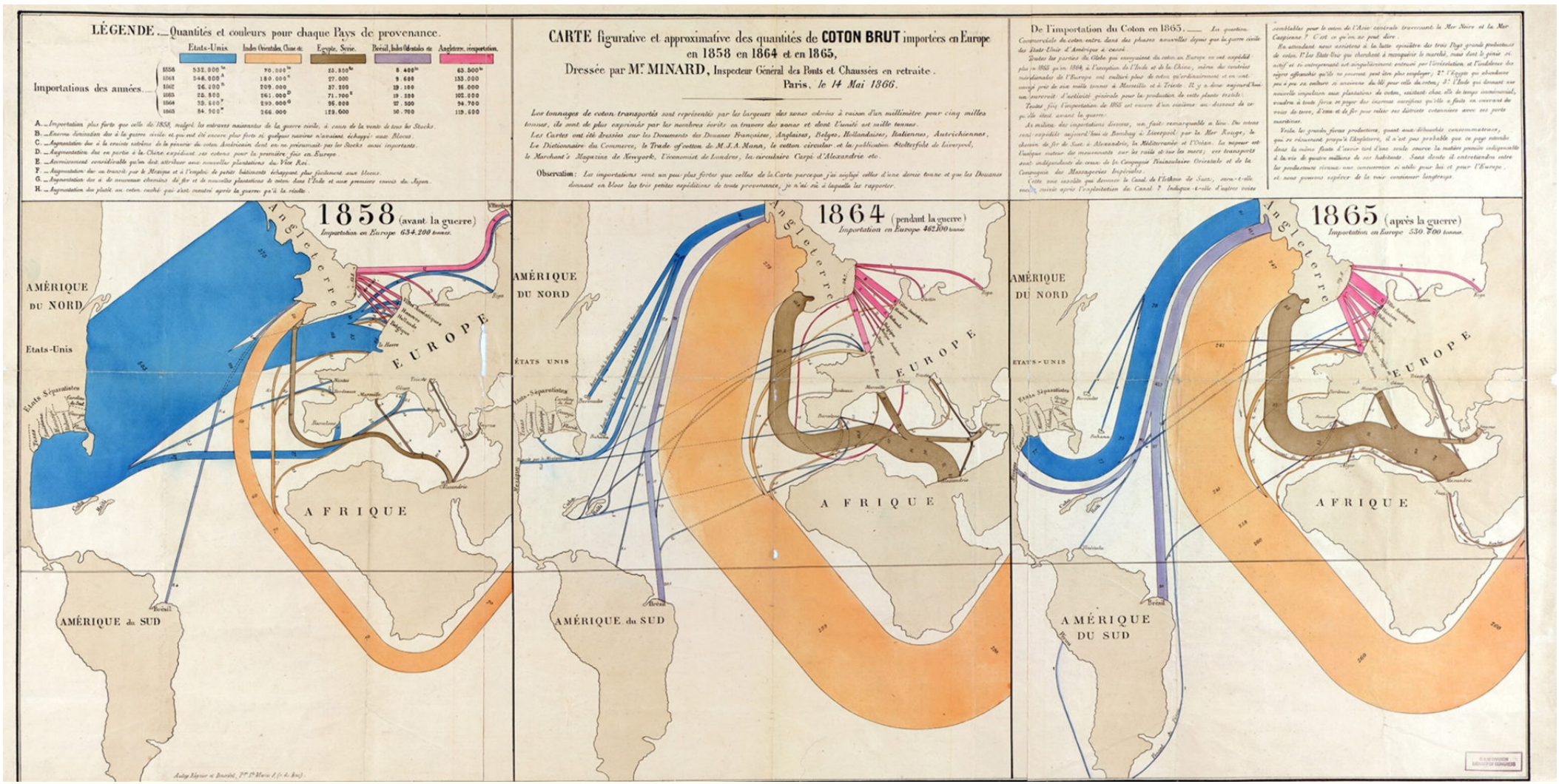


Zu viele Linien

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.

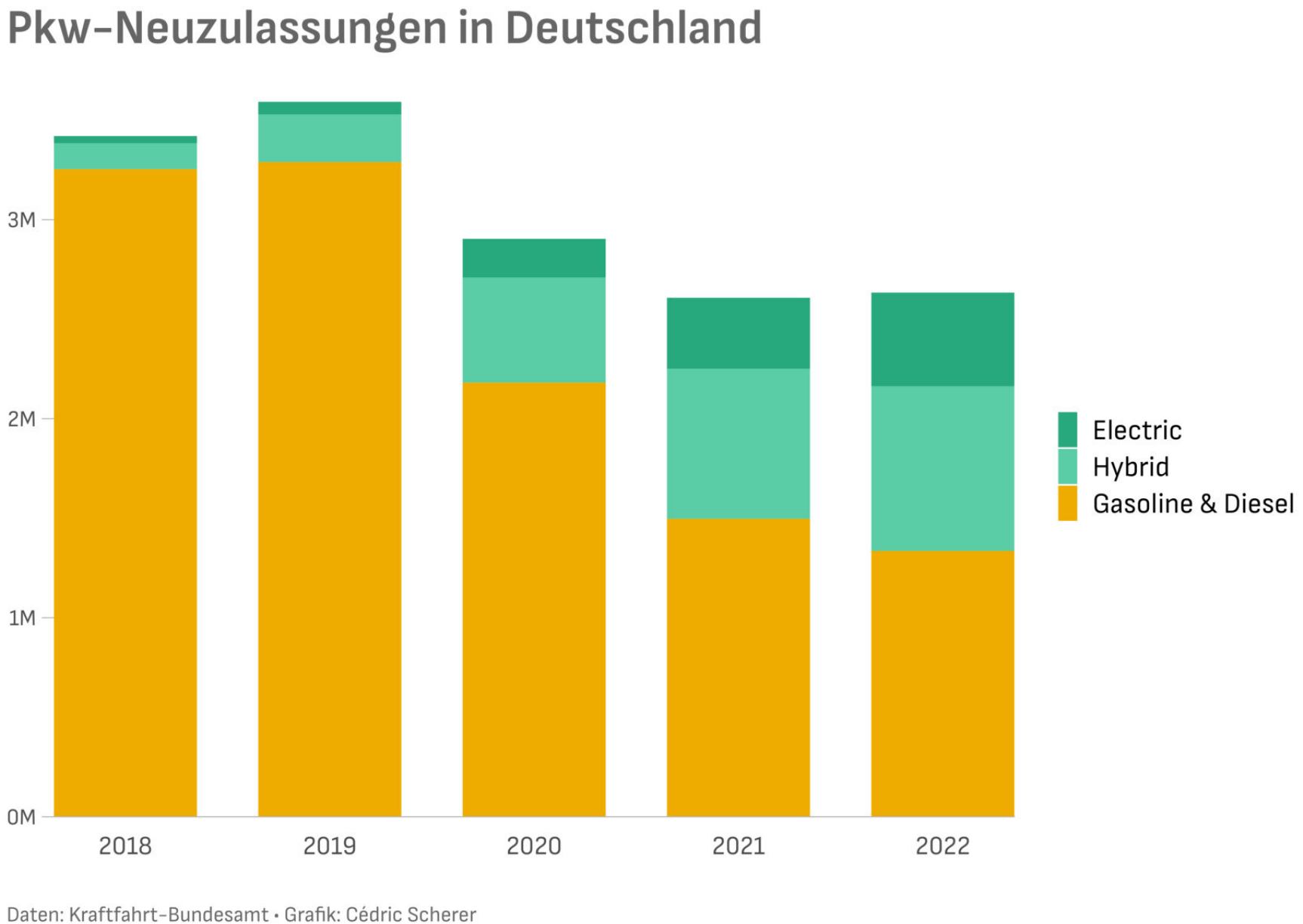


Source: JPMorgan Chase Institute | Makeover: Cedric Scherer



"Carte figurative et approximative des quantités de coton brut importées en Europe en 1858, en 1864 et en 1865" von Charles Joseph Minard (1866)

Gestapelte Balken



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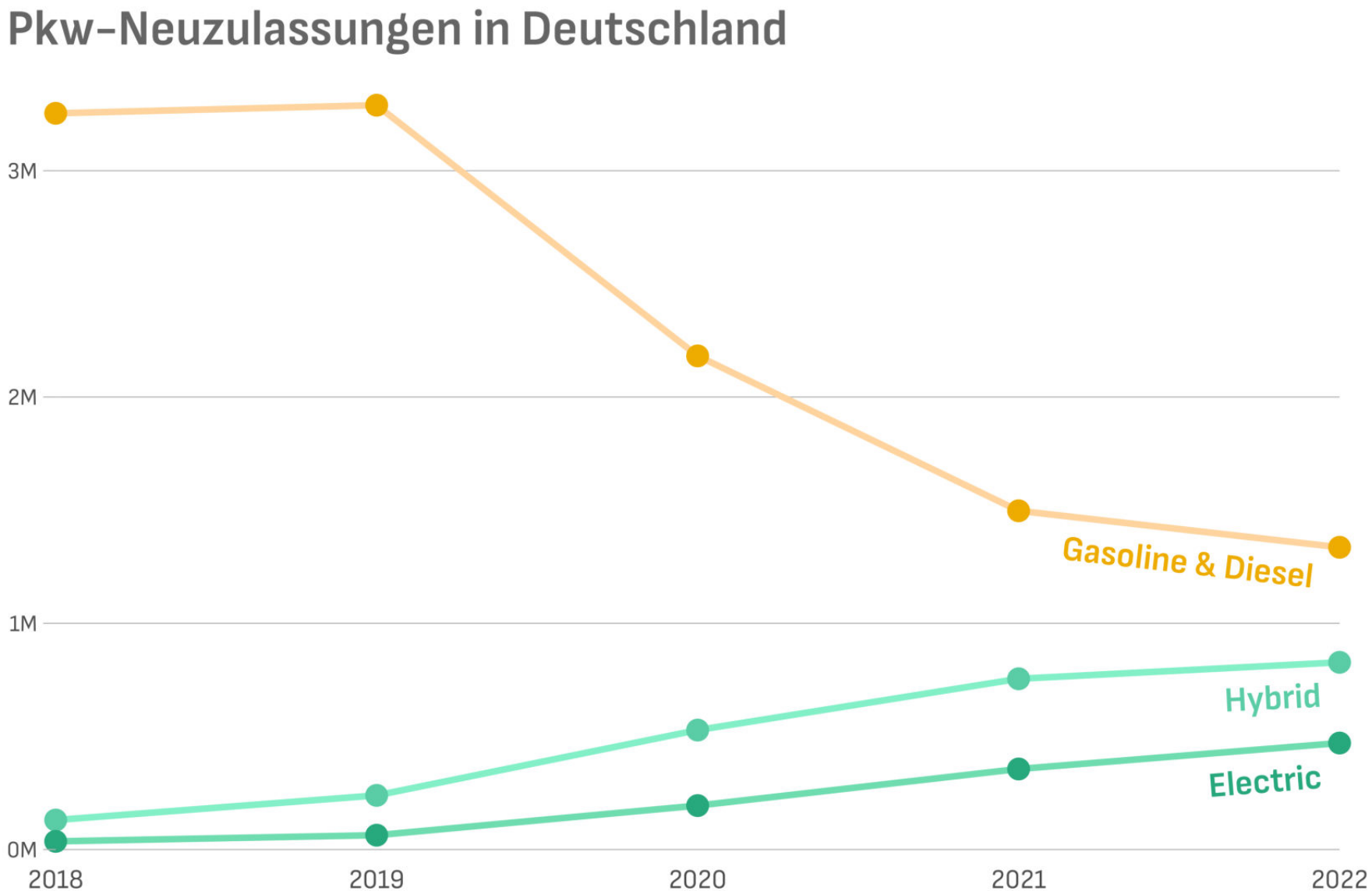

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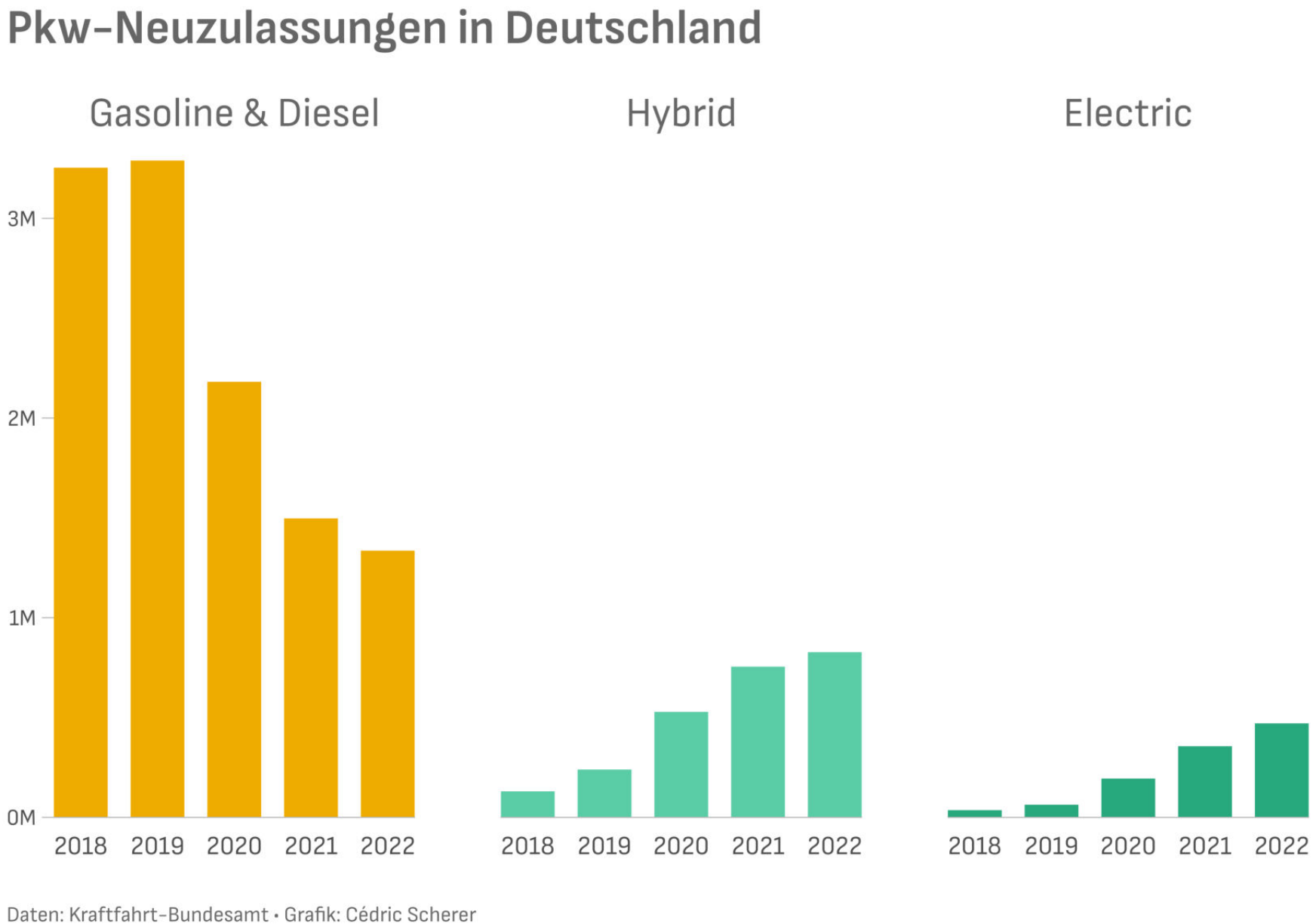

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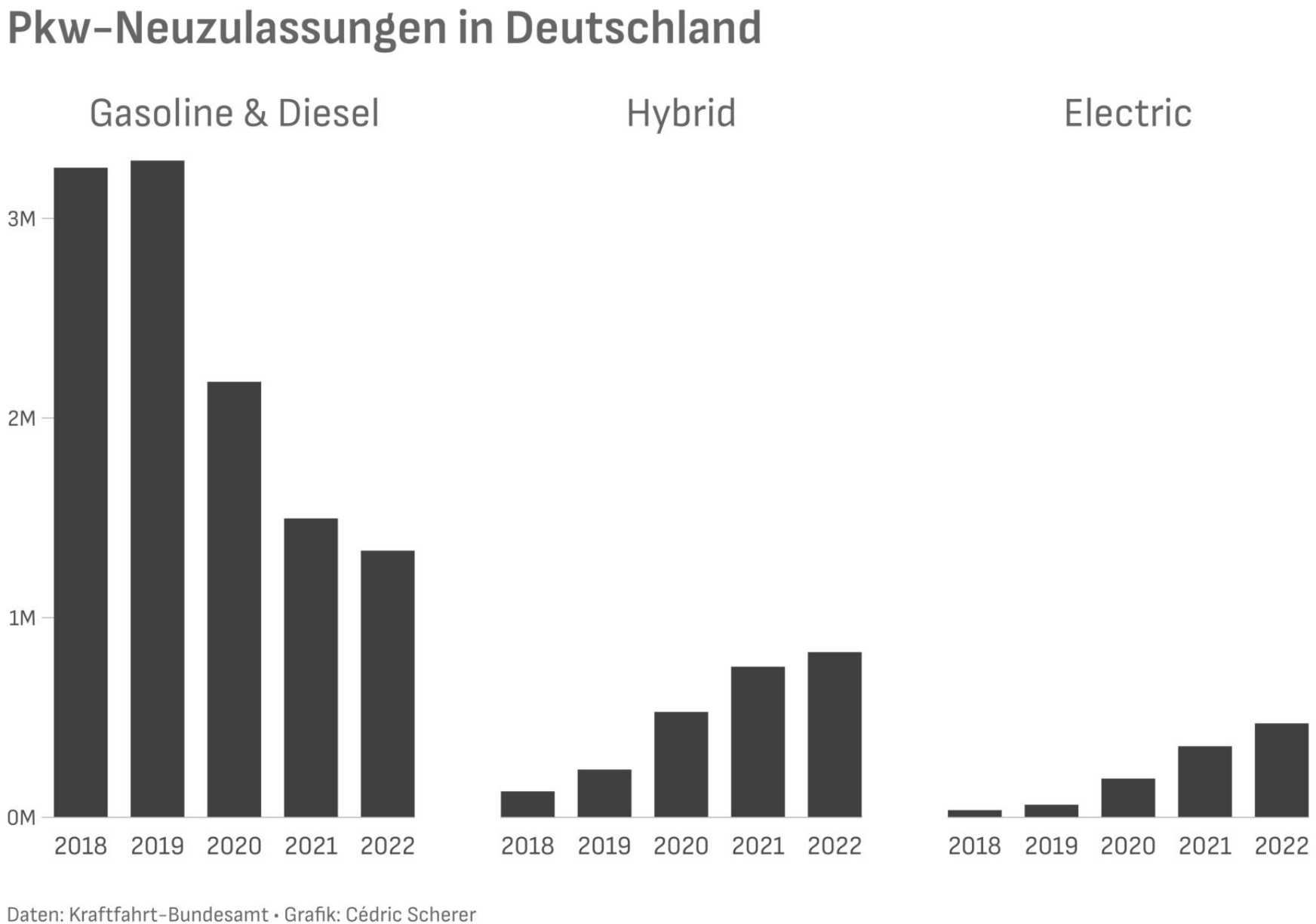

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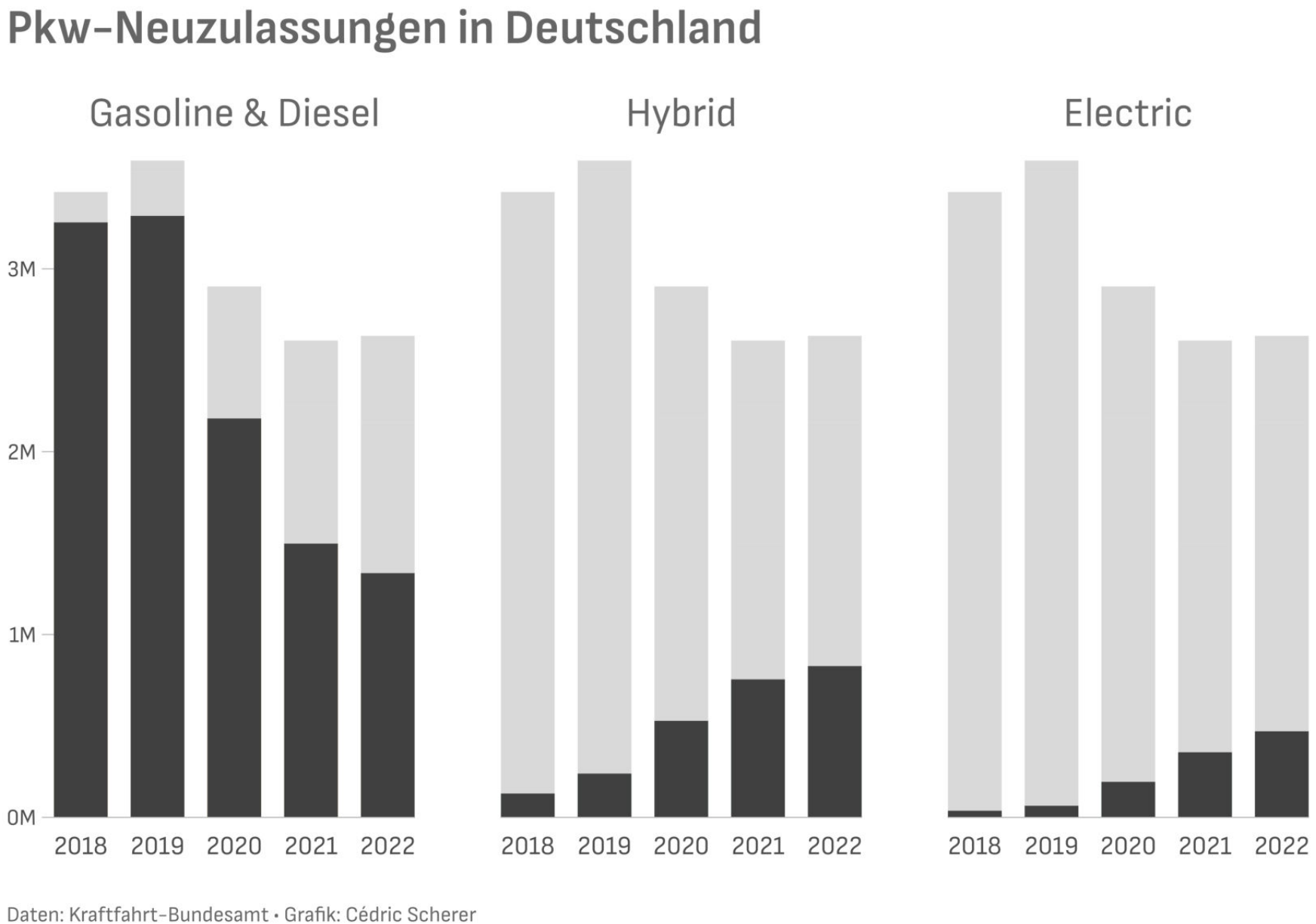
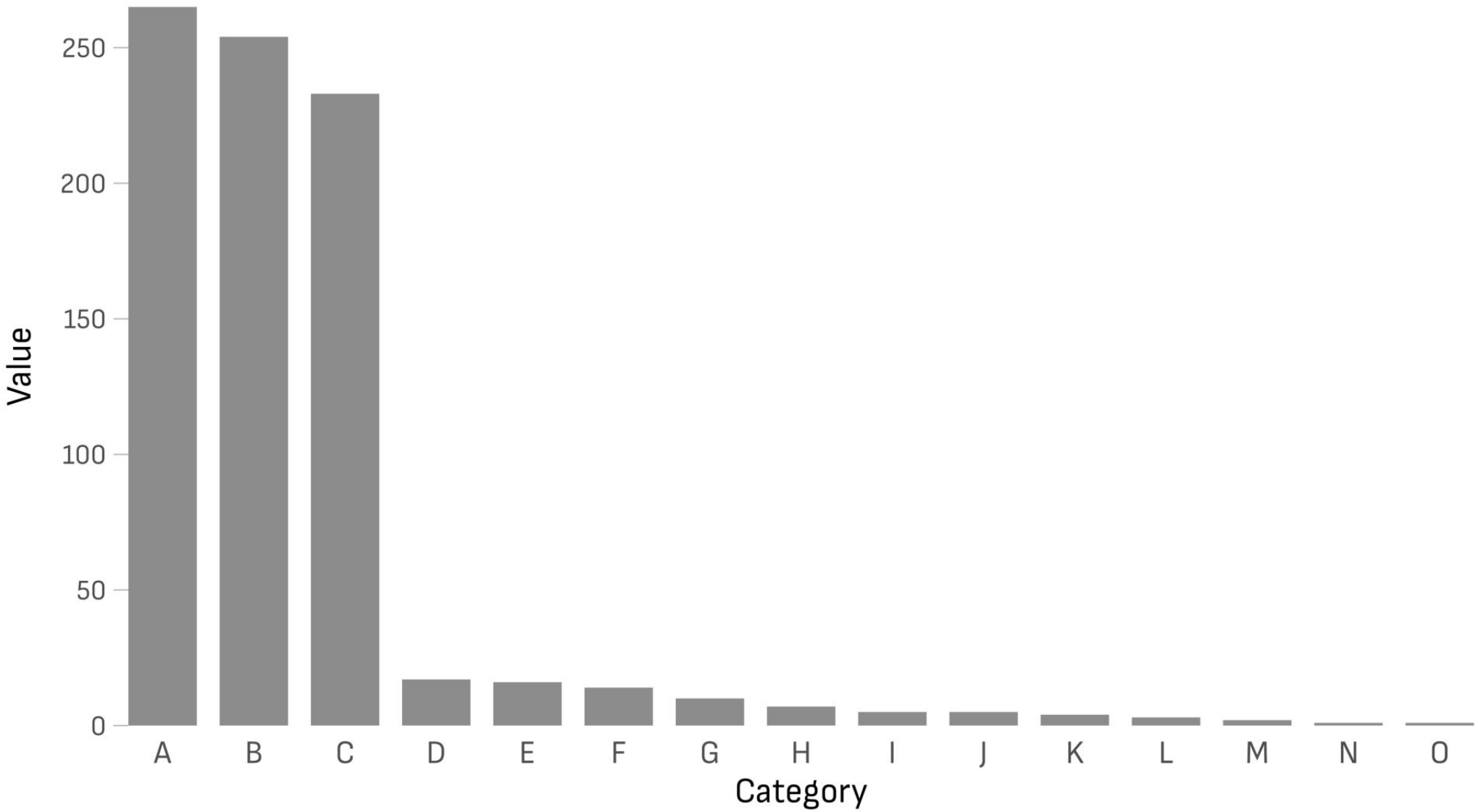


Schiefe Datenverteilung



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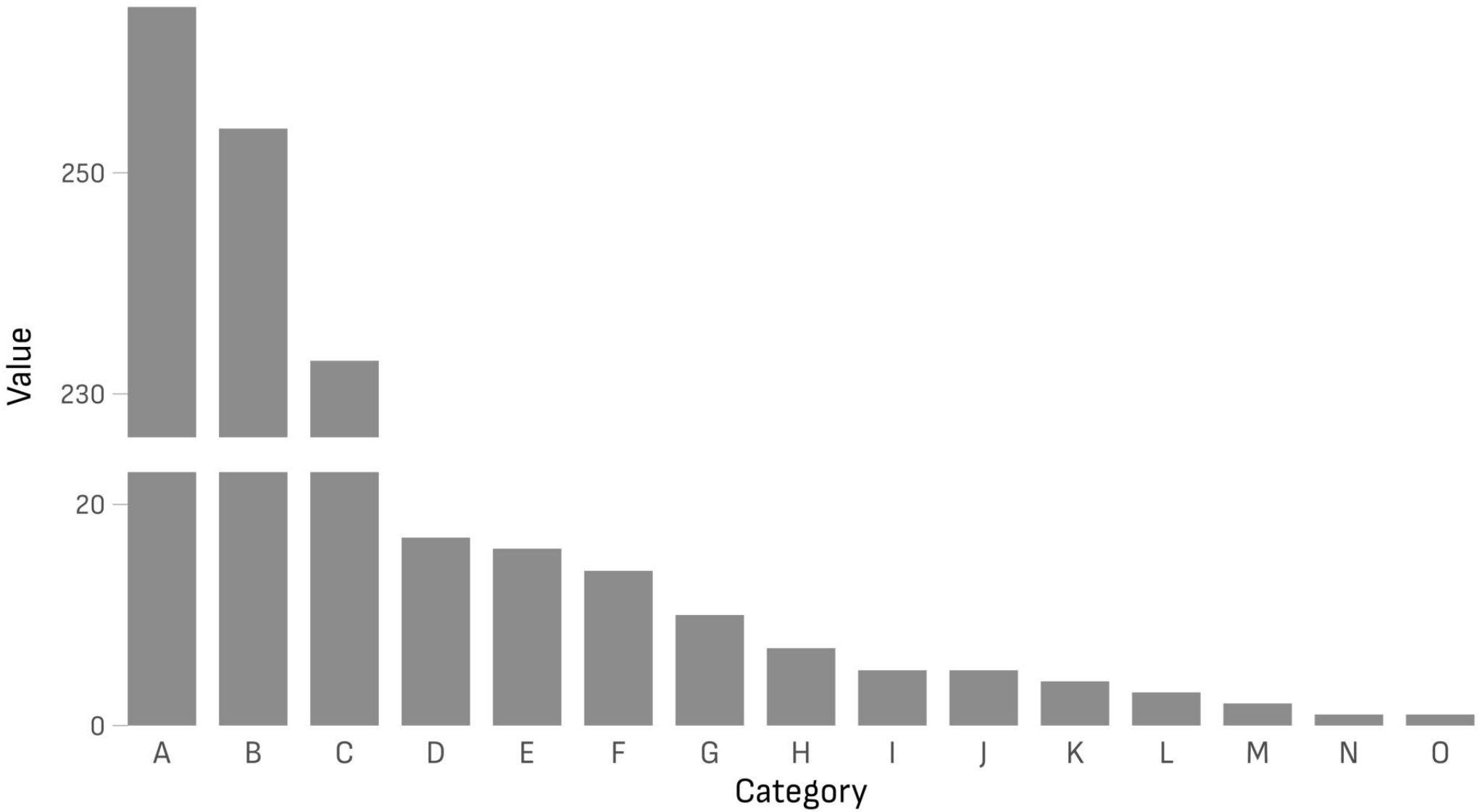

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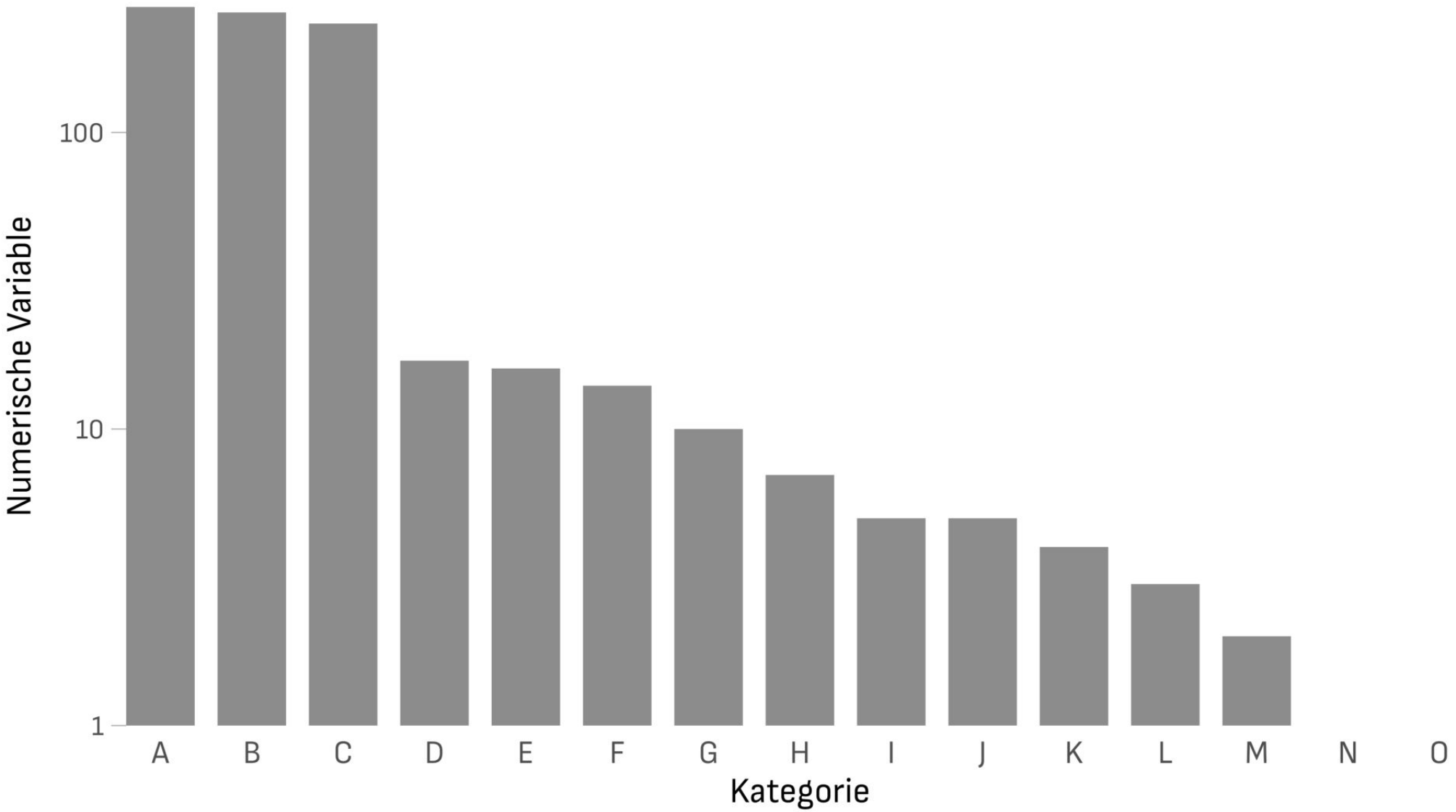

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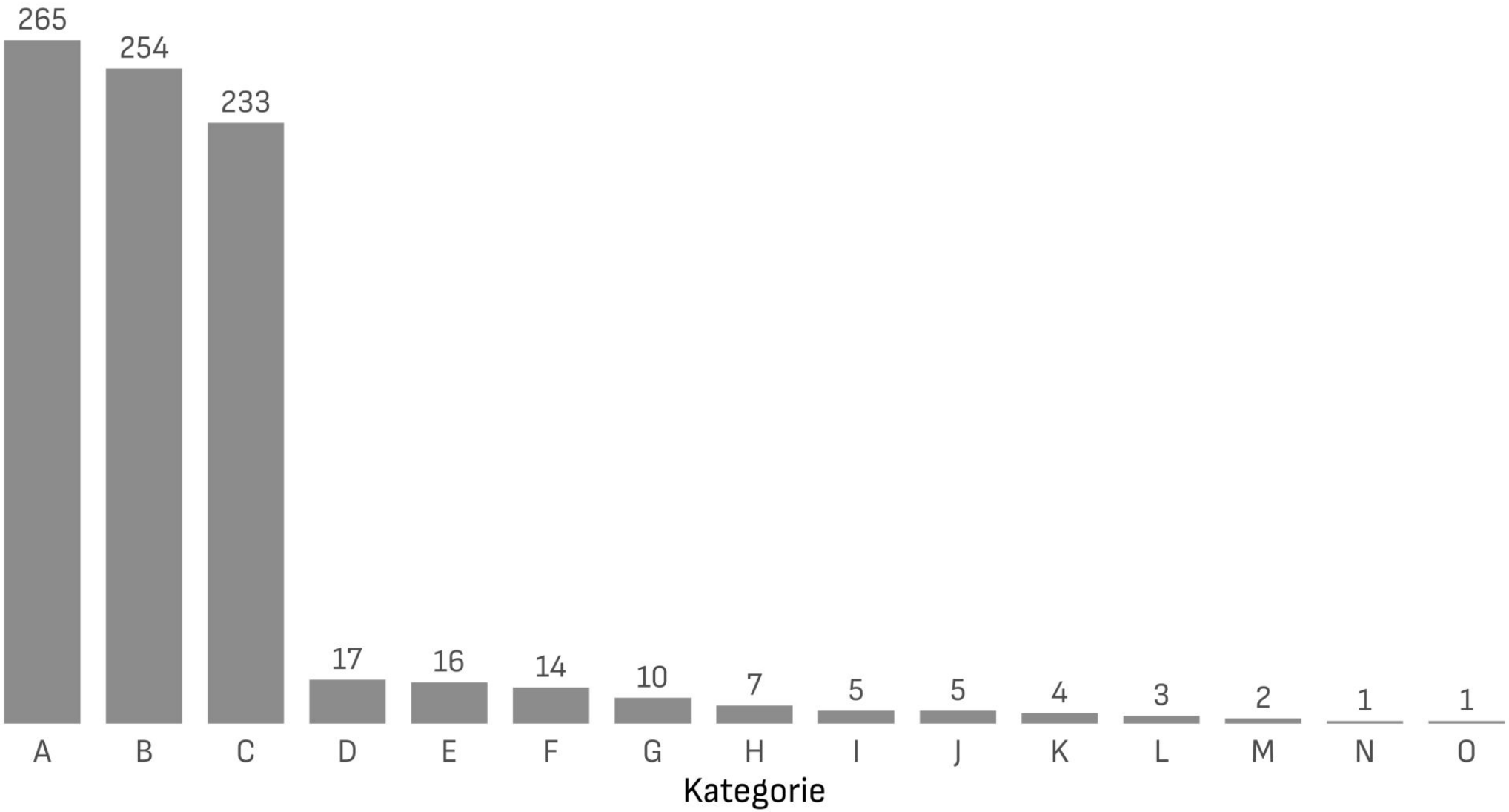
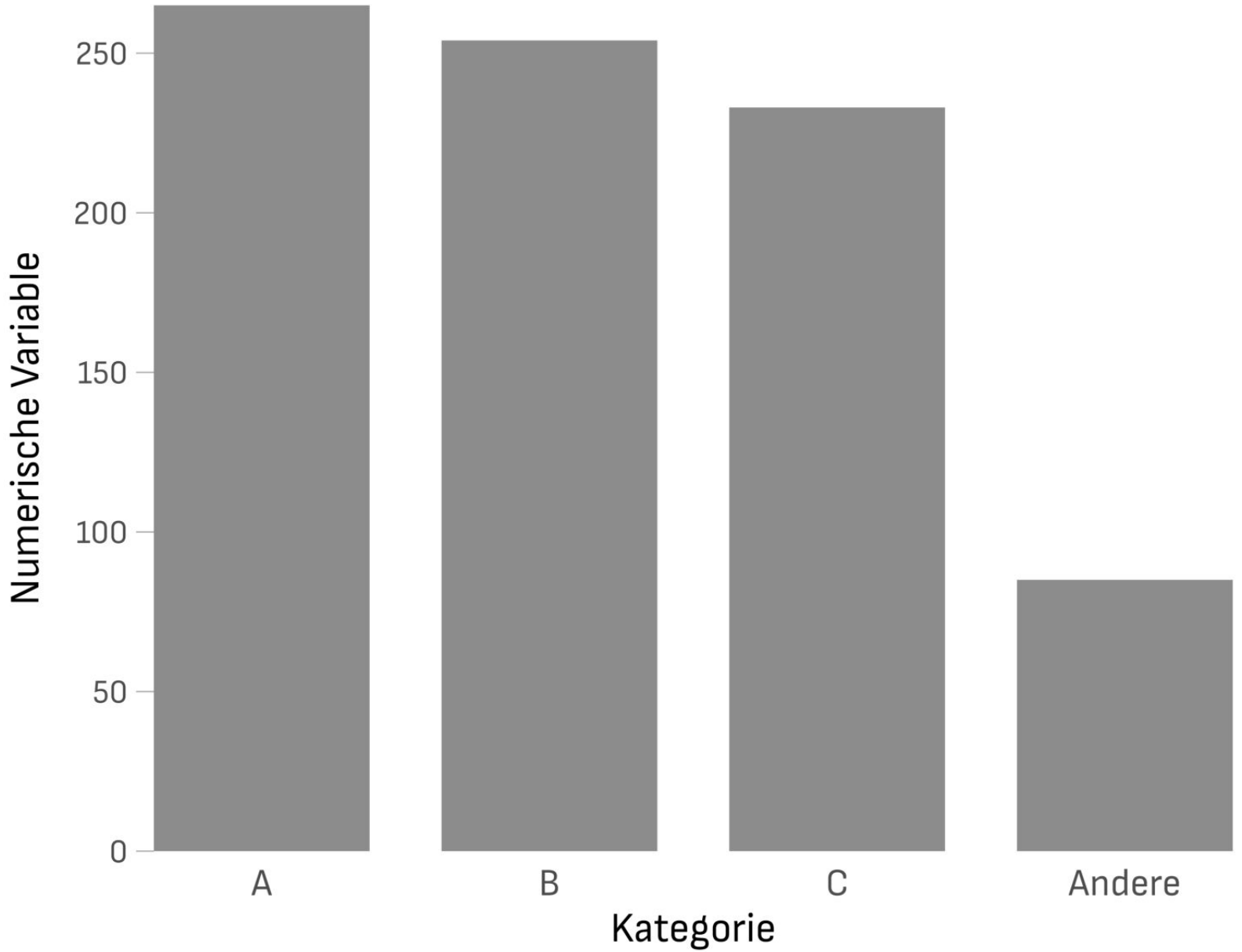
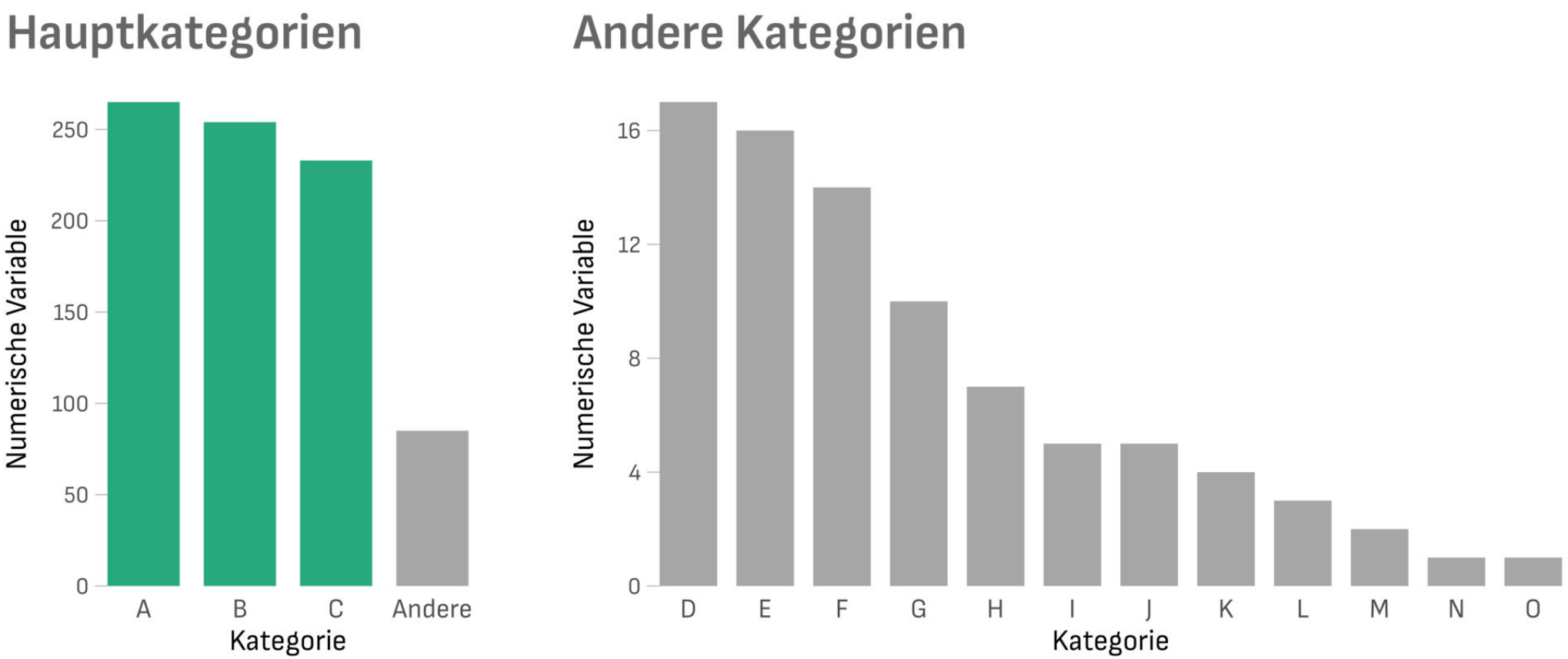


Schiefe Datenverteilung

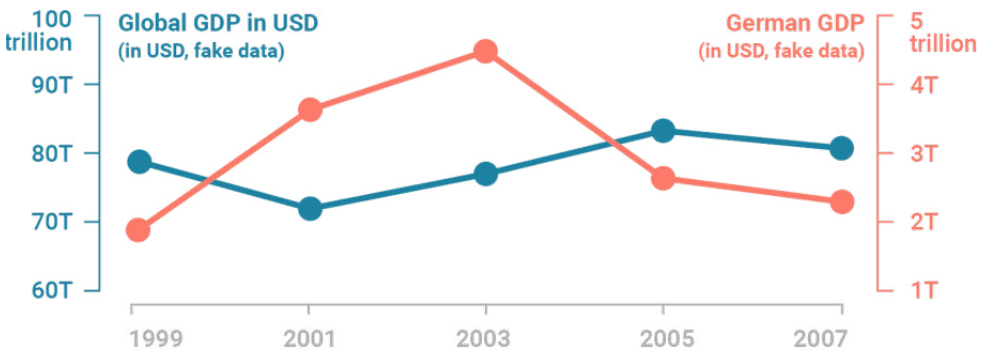


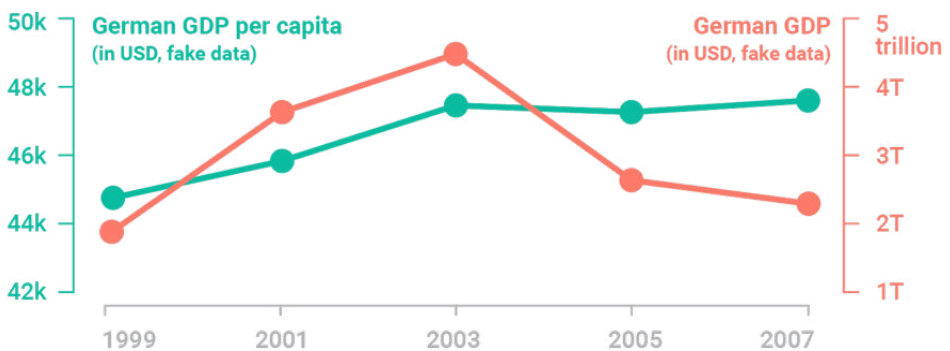
Schiefe Datenverteilung

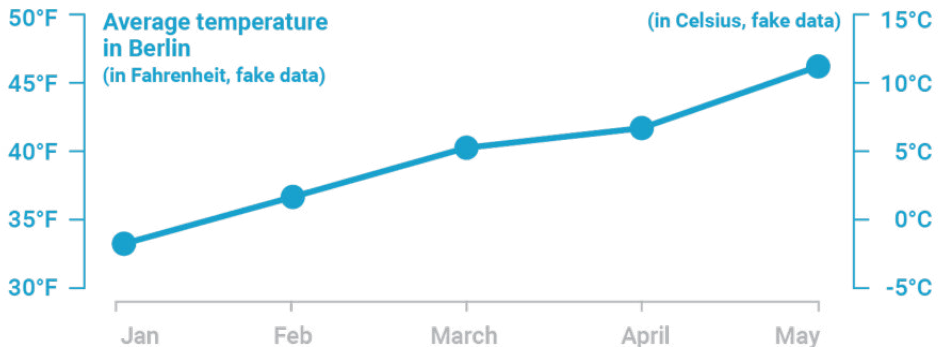


Doppelachsen

Beispiele von Lisa Charlotte Muth, DataWrapper Blog







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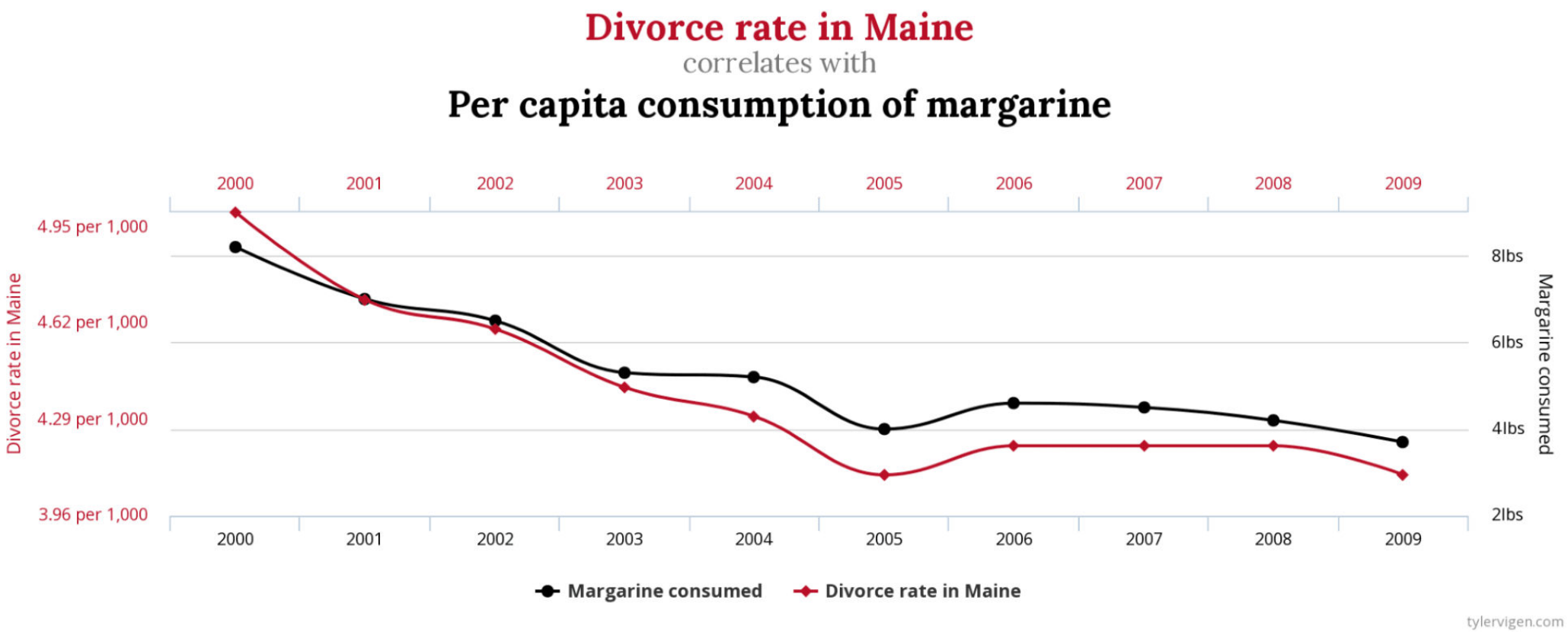
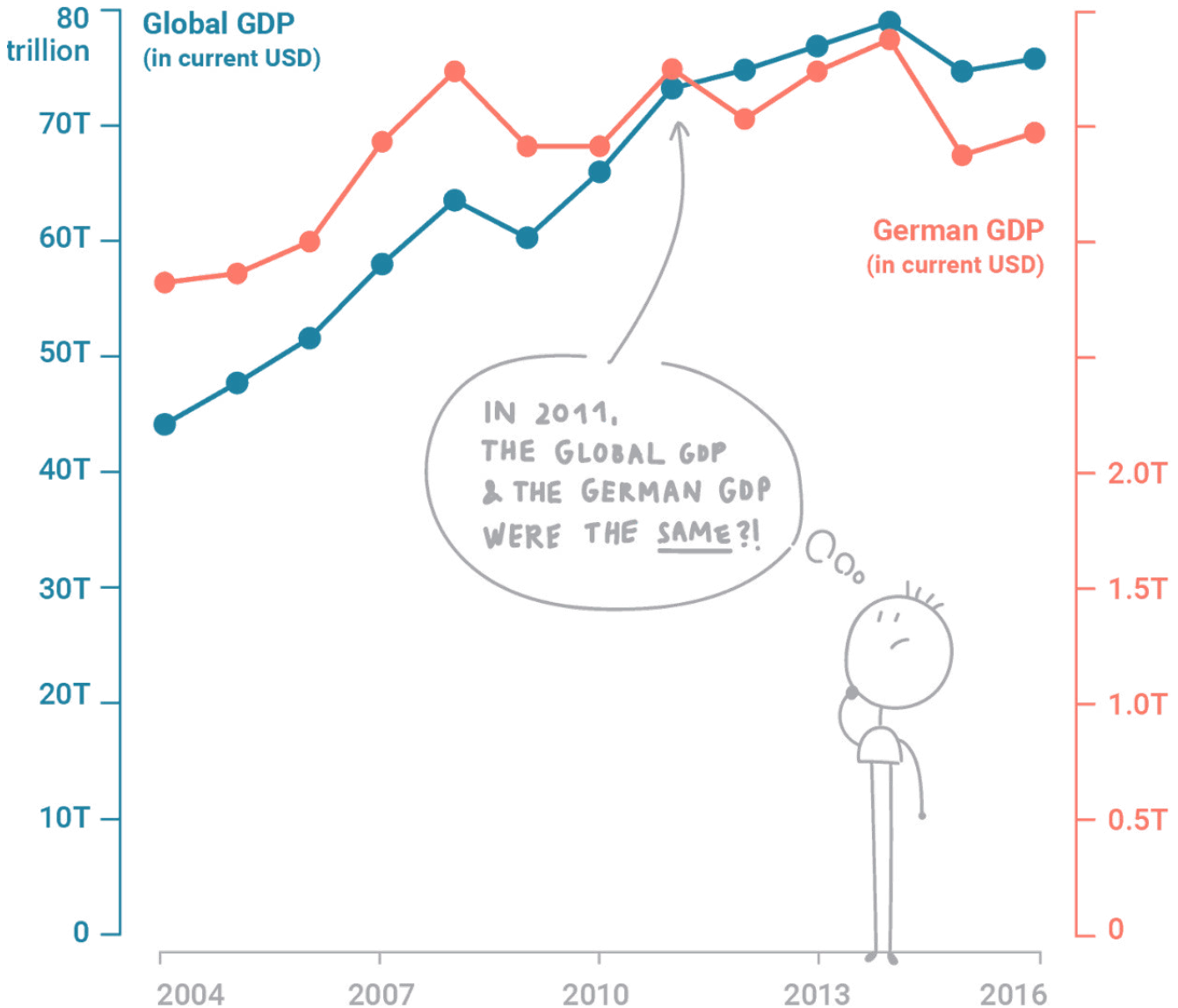


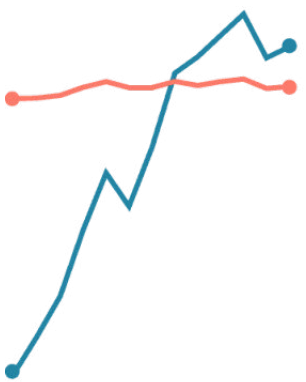
Quelle: Spurious Correlations

Doppelachsen

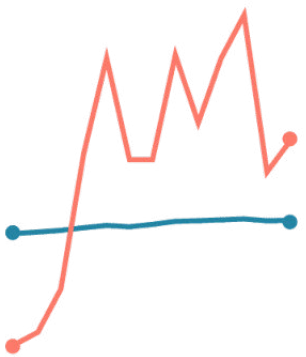


Quelle: Lisa Charlotte Muth, DataWrapper Blog

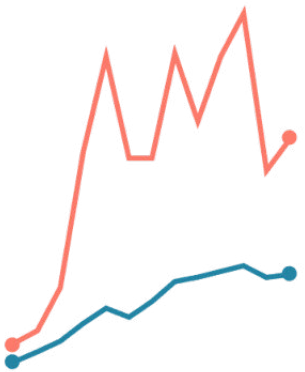
Doppelachsen



Orange steady,
Blue massively increasing.

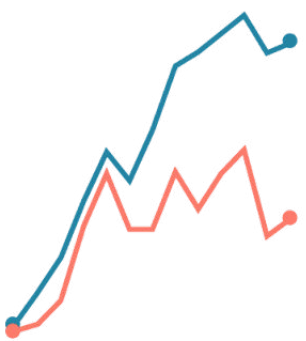


Blue steady,
Orange increasing.



Both started at the same level, but Orange increased far more than Blue.

Both started at the same level, but Blue increased far more than Orange.

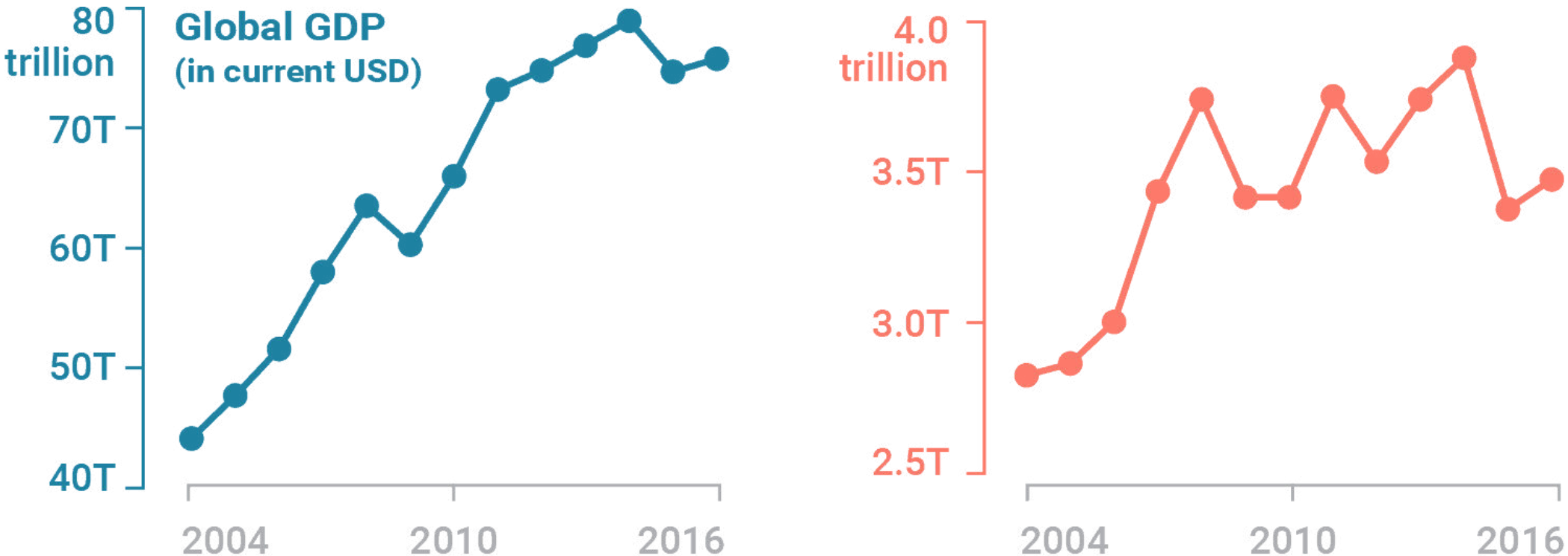


Both started with the same increase, then Blue raced to the top.

Both steady.

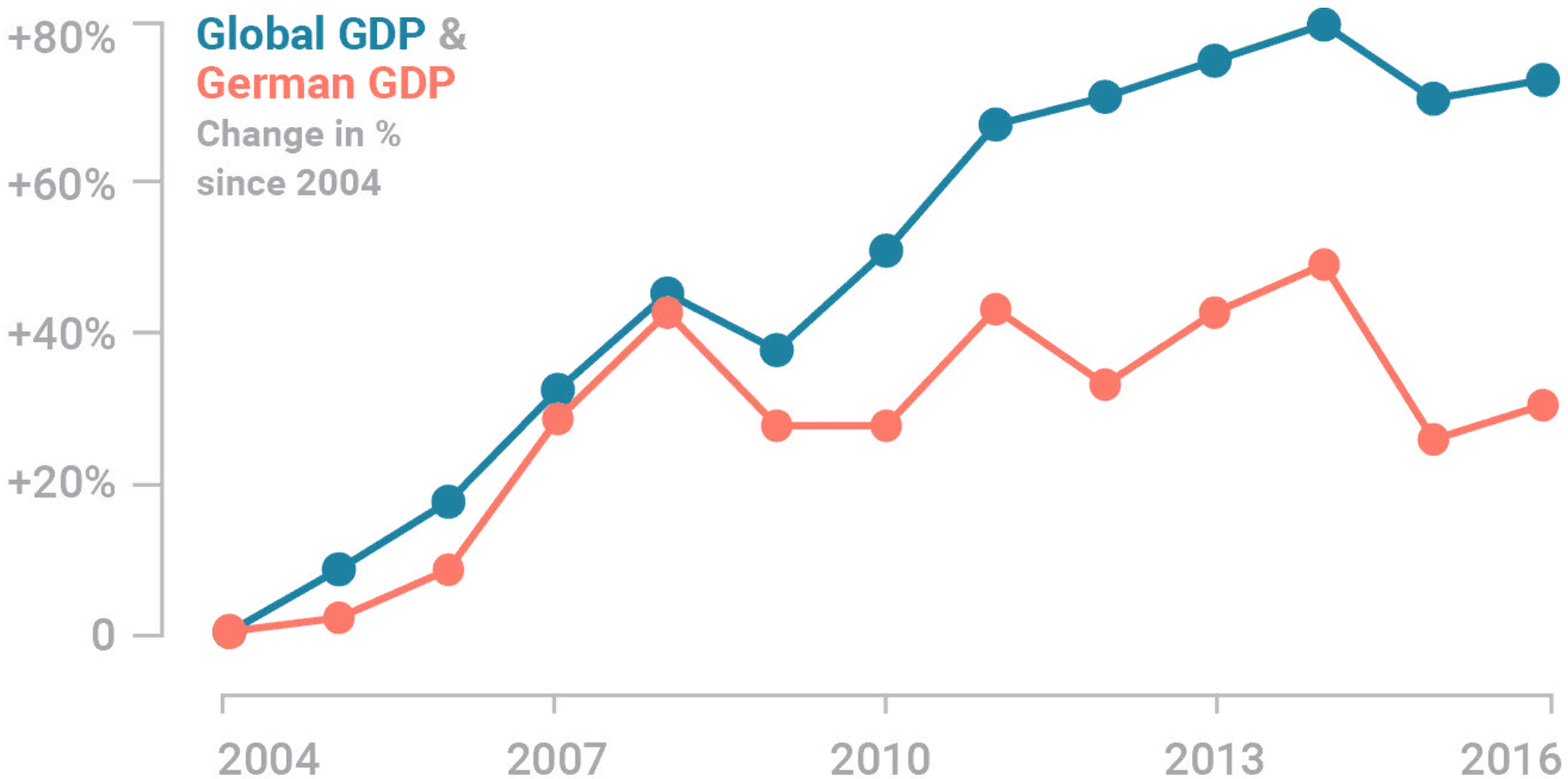
Quelle: Lisa Charlotte Muth, DataWrapper Blog

Doppelachsen



Quelle: Lisa Charlotte Muth, DataWrapper Blog

Doppelachsen



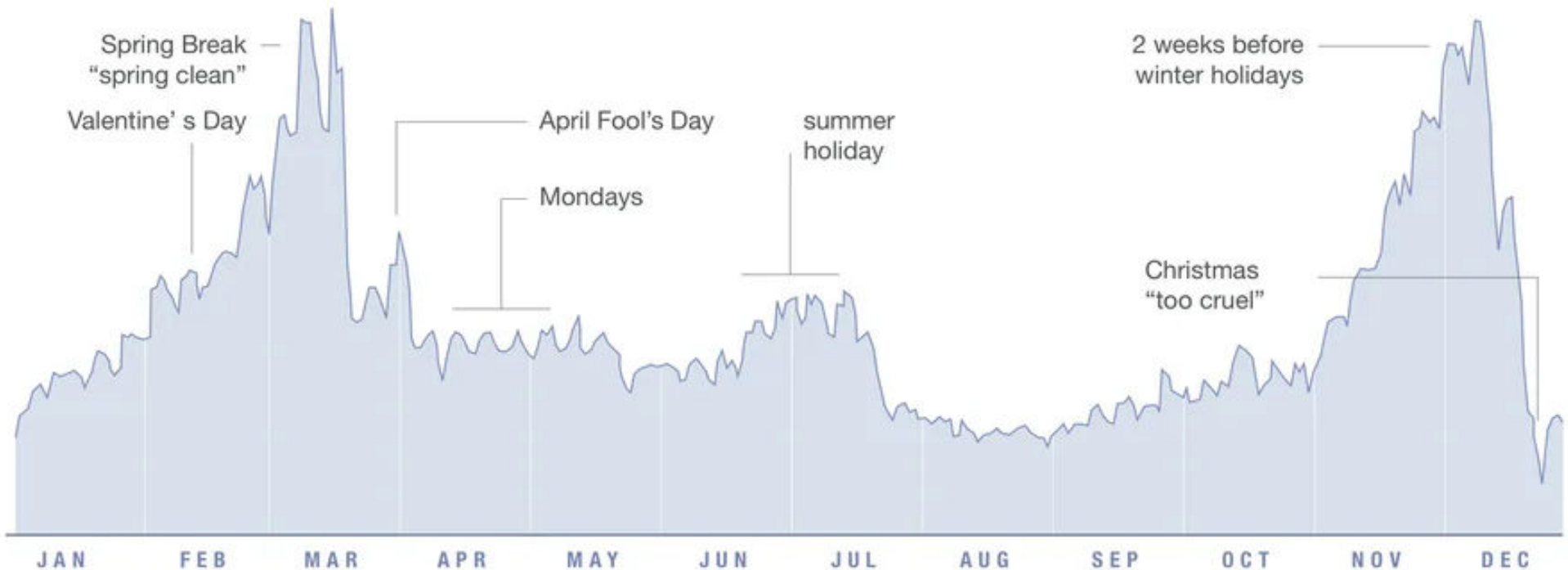
Quelle: Lisa Charlotte Muth, DataWrapper Blog


ONE
WAY
ONE
WAY
Guide the
Viewer

Quelle: David McCandless & Lee Byron, Information is Beautiful (modifiziert)

Peak Break-Up Times

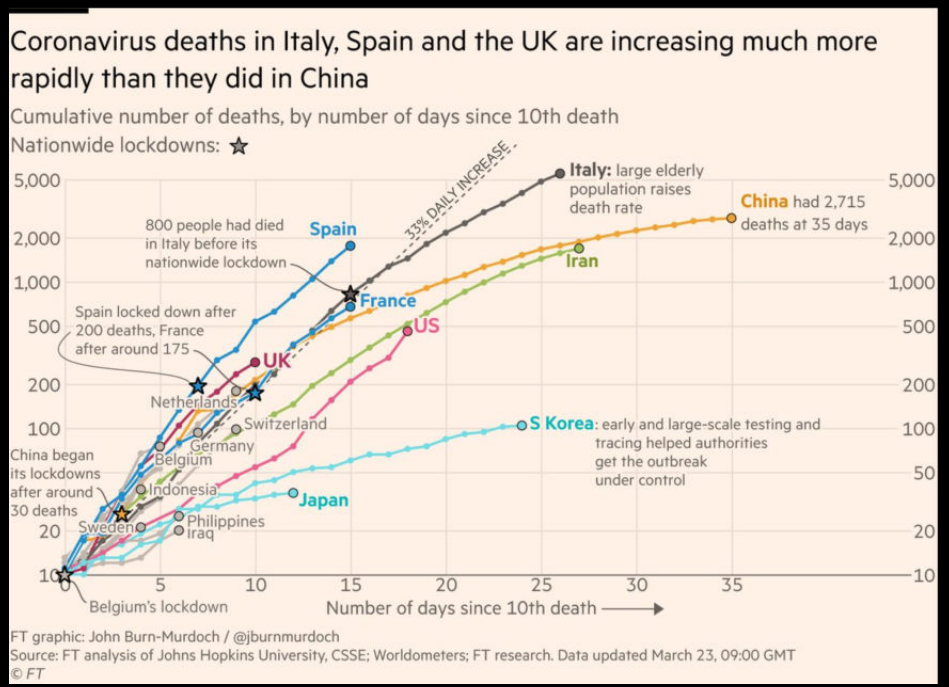
According to Facebook status updates

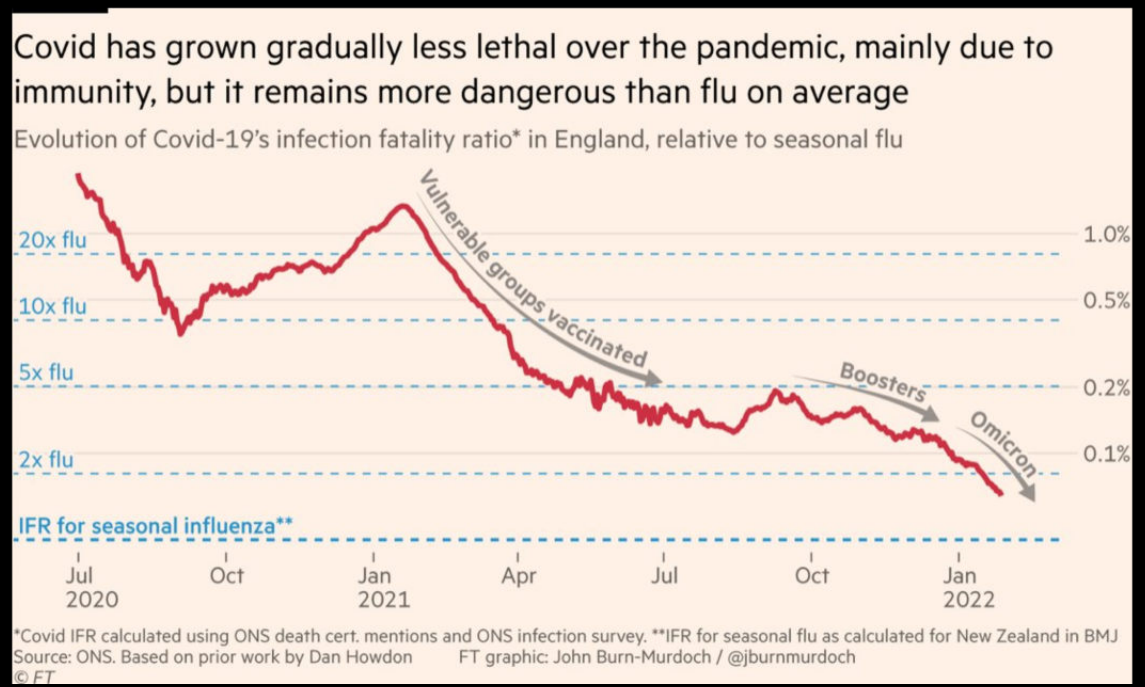


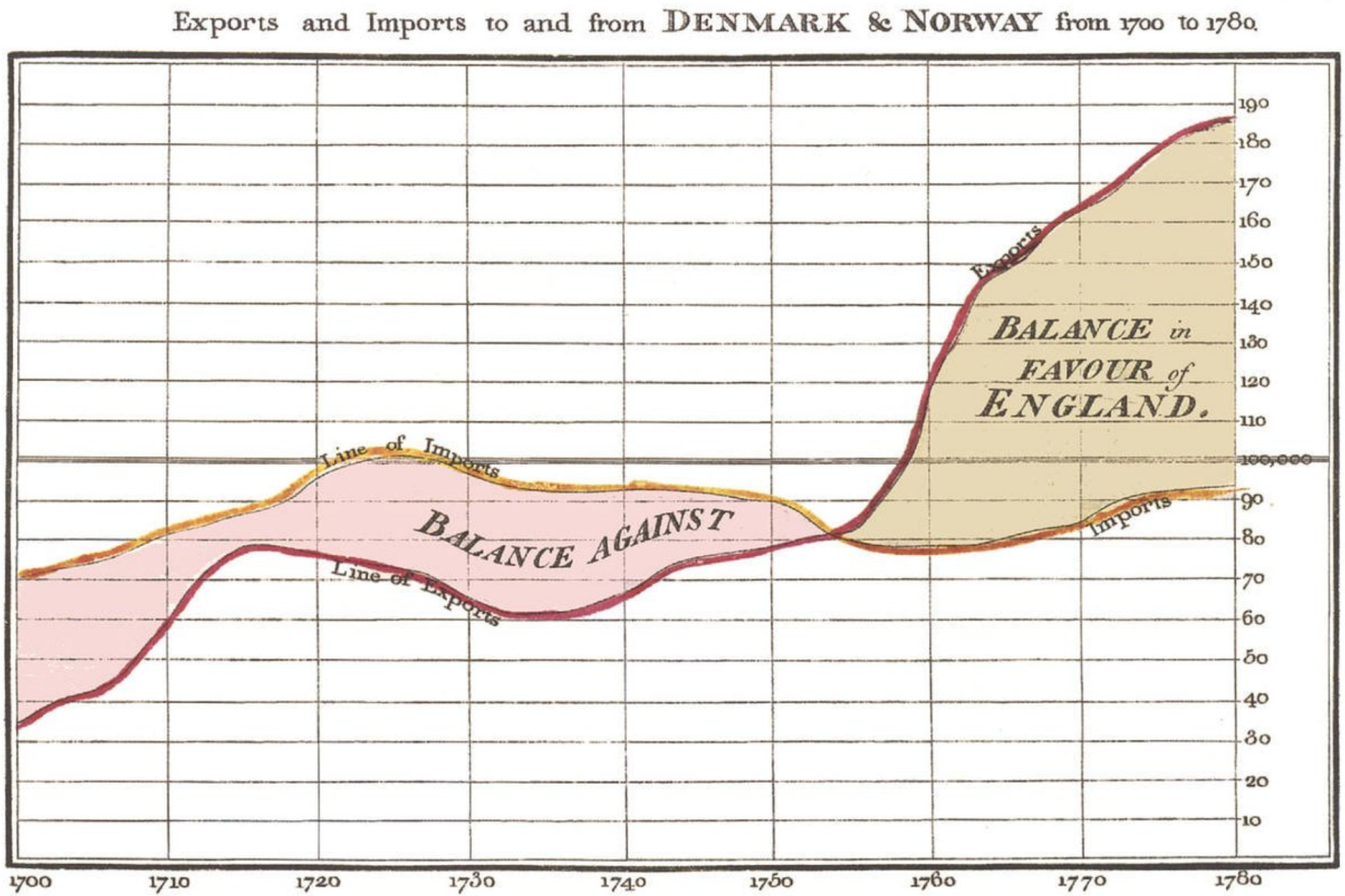
Quelle: David McCandless & Lee Byron, Information is Beautiful

"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.**"

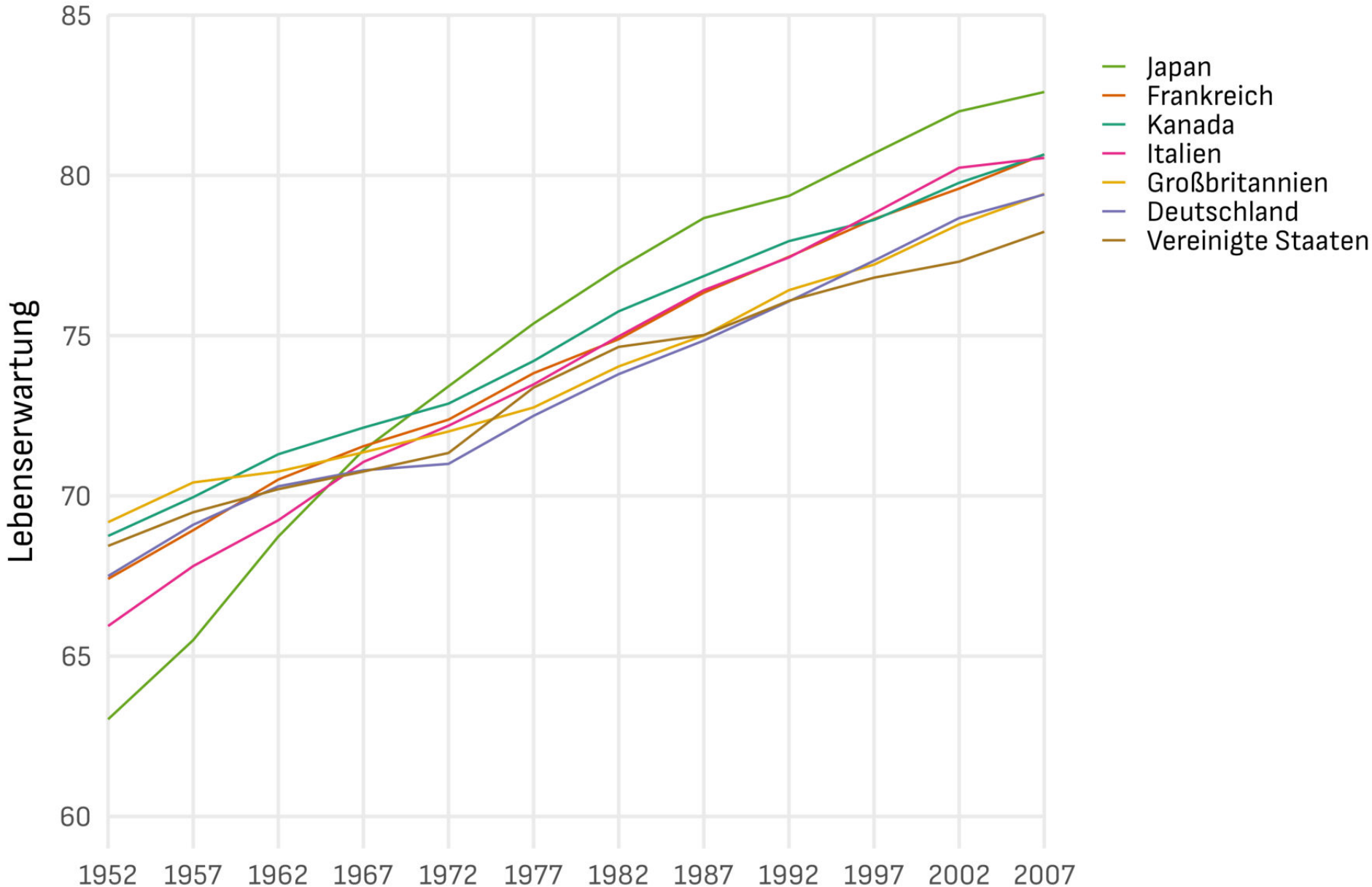
John Burn-Murdoch, Financial Times







Zeitreihen mit Anmerkungen von William Playfair aus "The Commercial and Political Atlas and Statistical Breviary" (1786)


Lebenserwartung
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75
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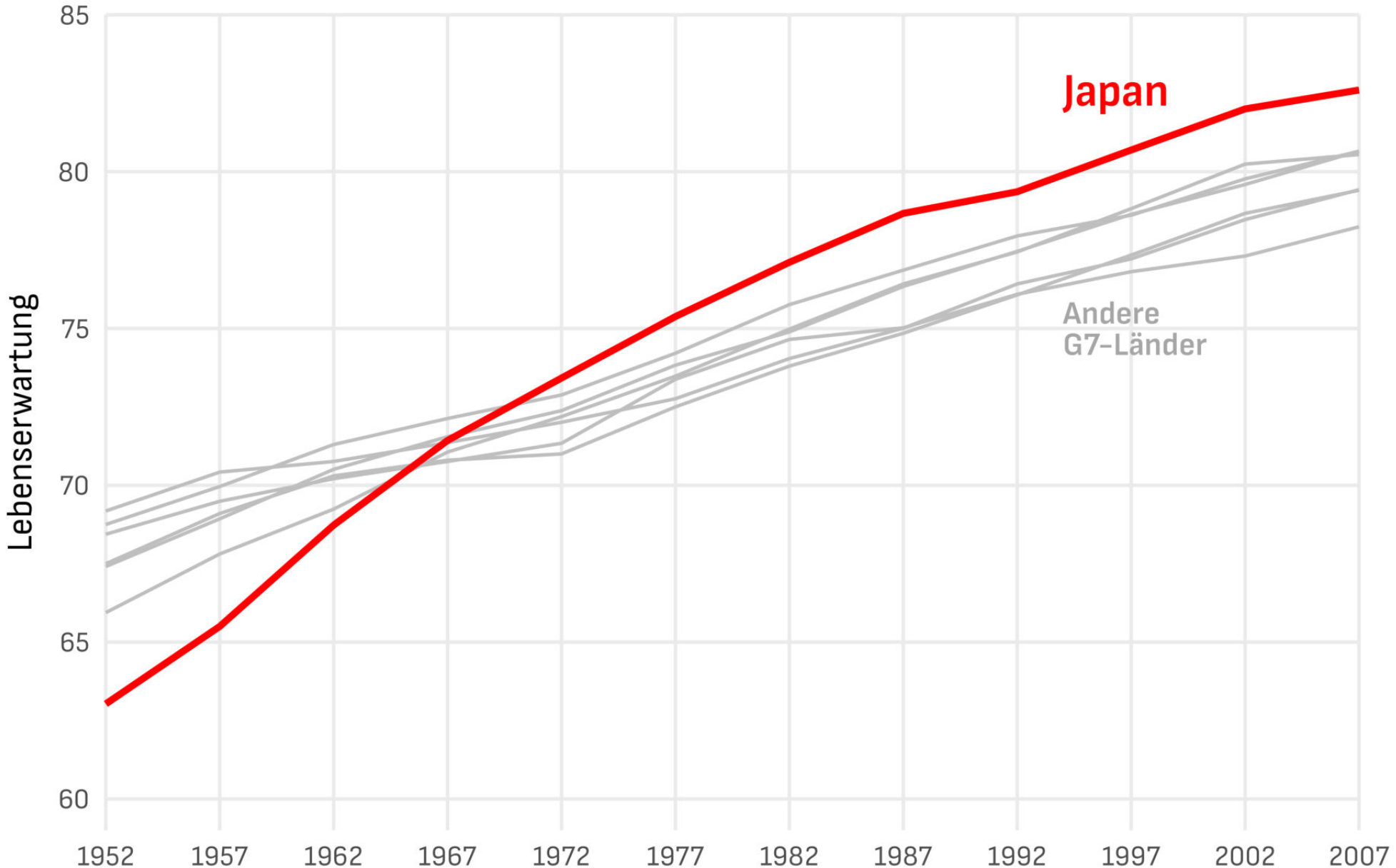
Japan
Frankreich
Kanada
Italien
Großbritannien
Deutschland
Vereinigte Staaten


Lebenserwartung
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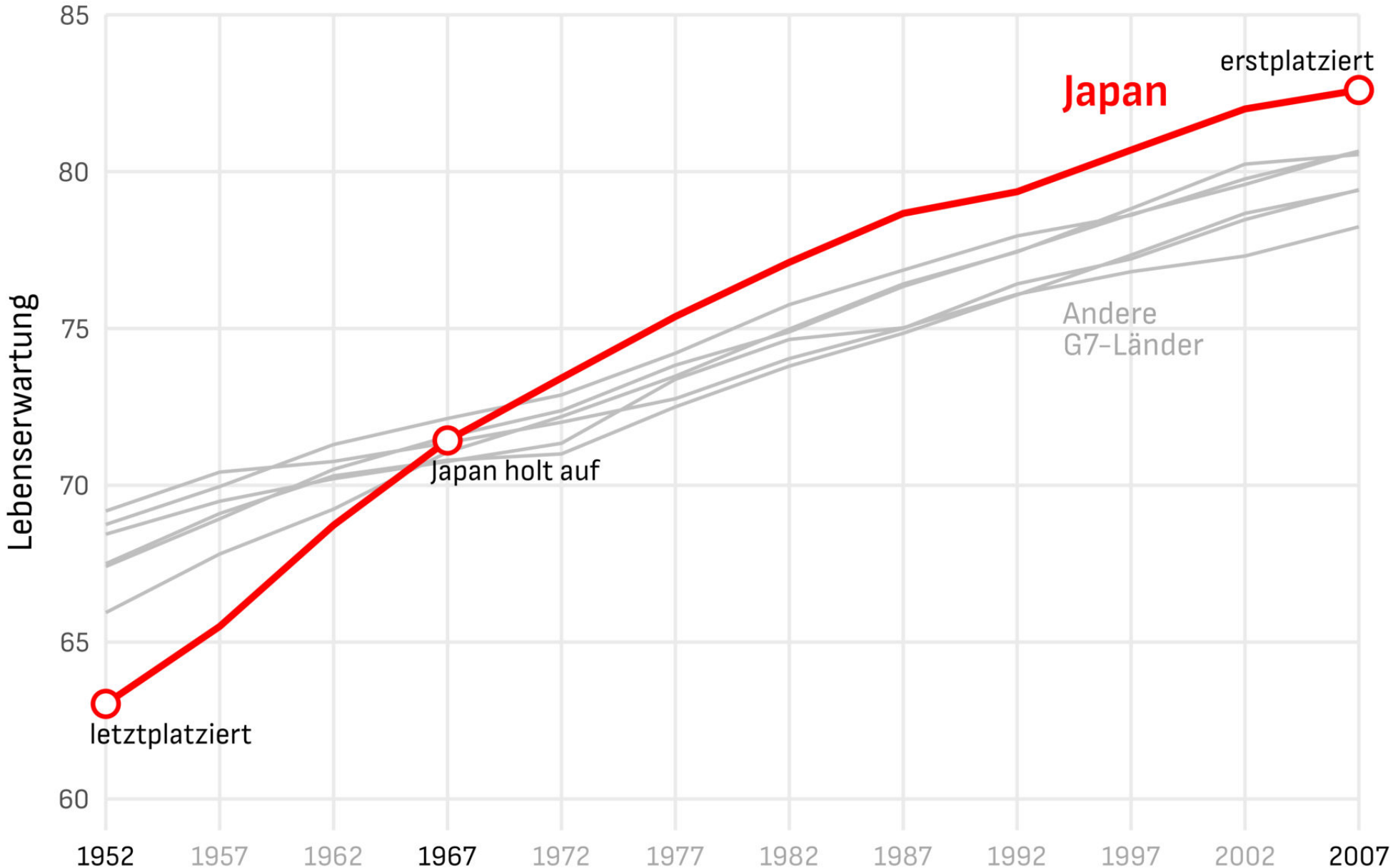
Andere
G7-Länder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Lebenserwartung
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erstplatziert
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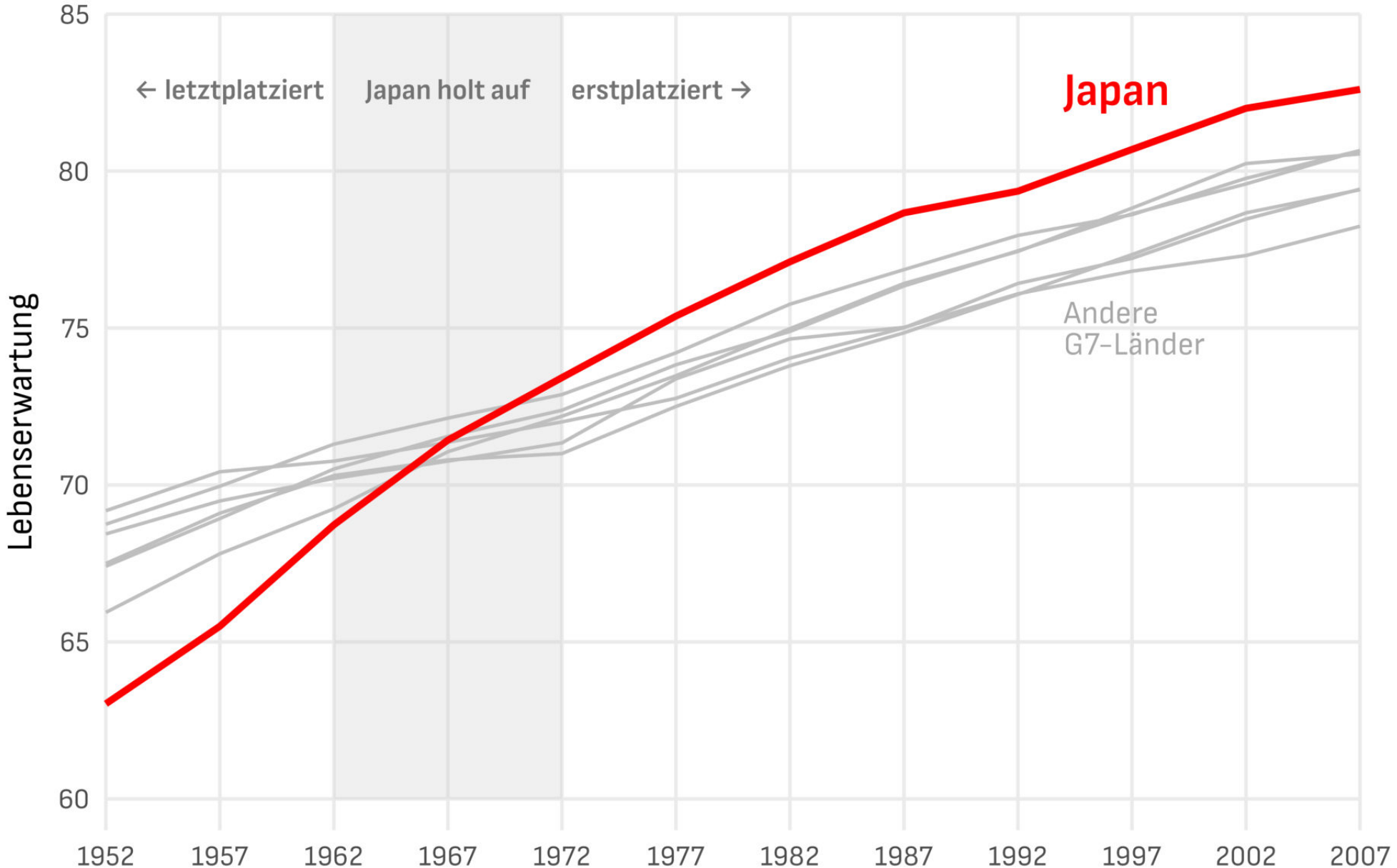
Japan holt auf
Andere
G7-Länder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Lebenserwartung
← letztplatziert
Japan holt auf
erstplatziert →
Japan
Andere
G7-Länder
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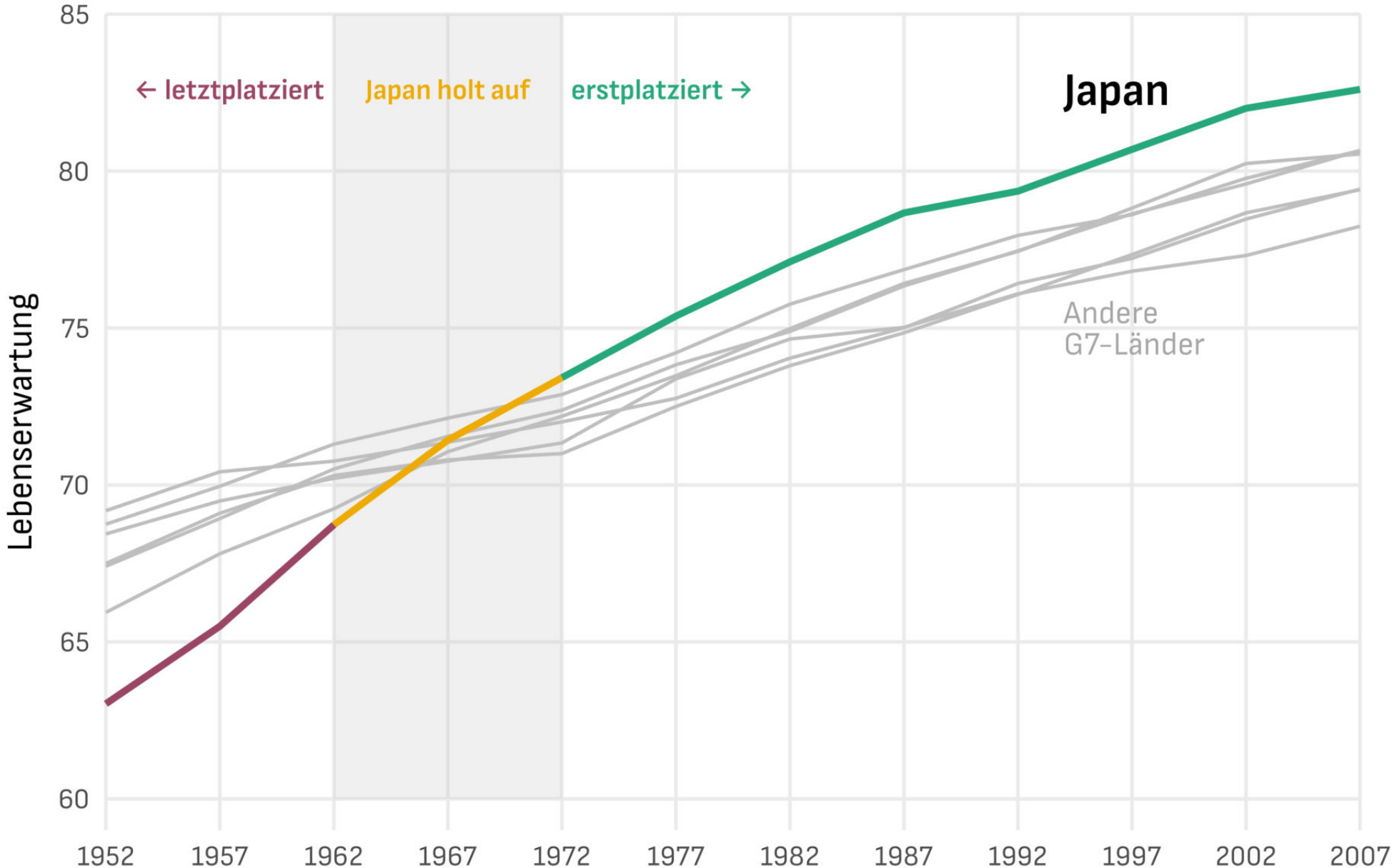
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Lebenserwartung
← letztplatziert
Japan holt auf
erstplatziert →
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Andere
G7-Länder
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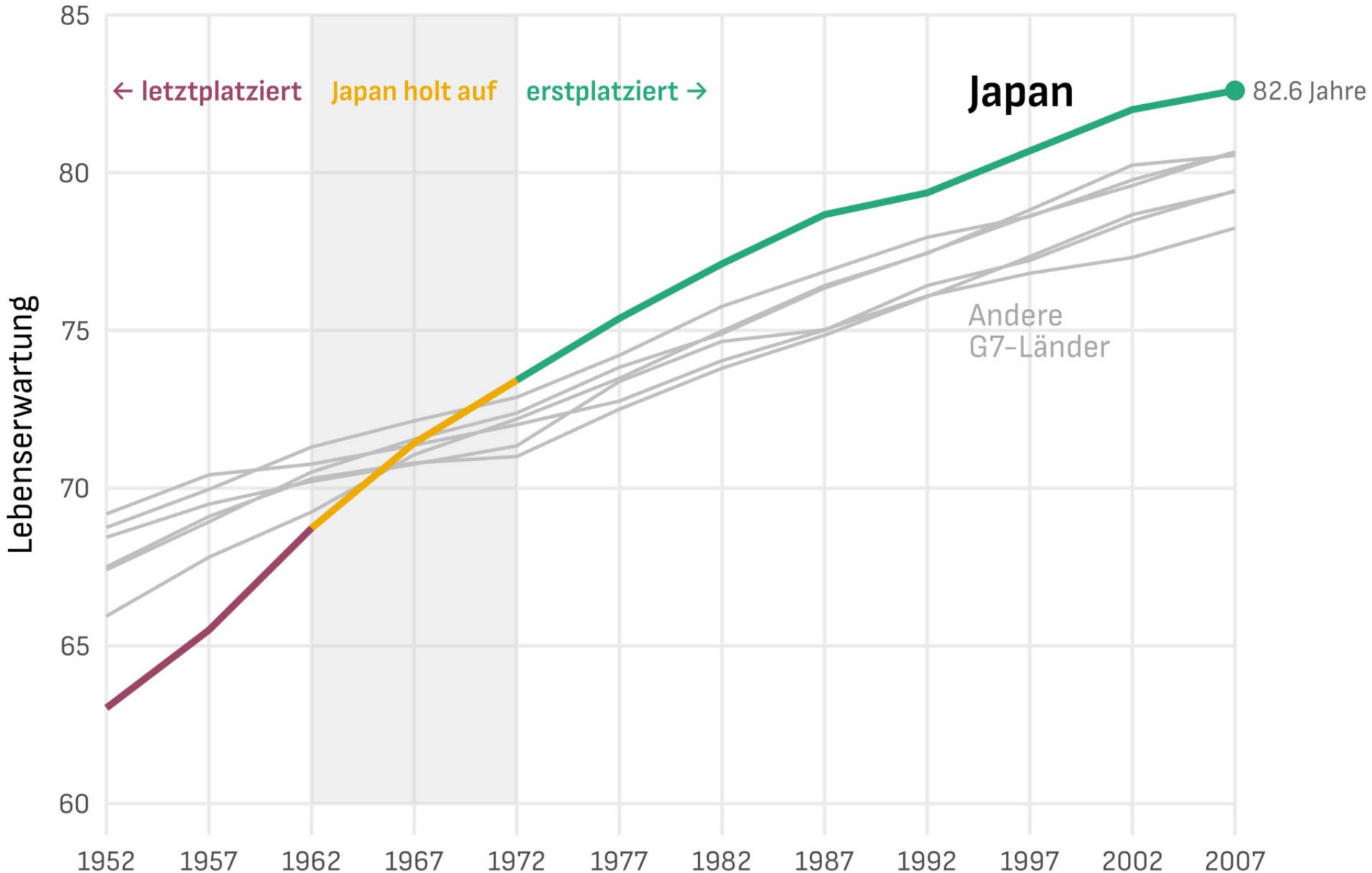
85
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Lebenserwartung
← letztplatziert
Japan holt auf
erstplatziert →
Japan
82.6 Jahre
Andere
G7-Länder
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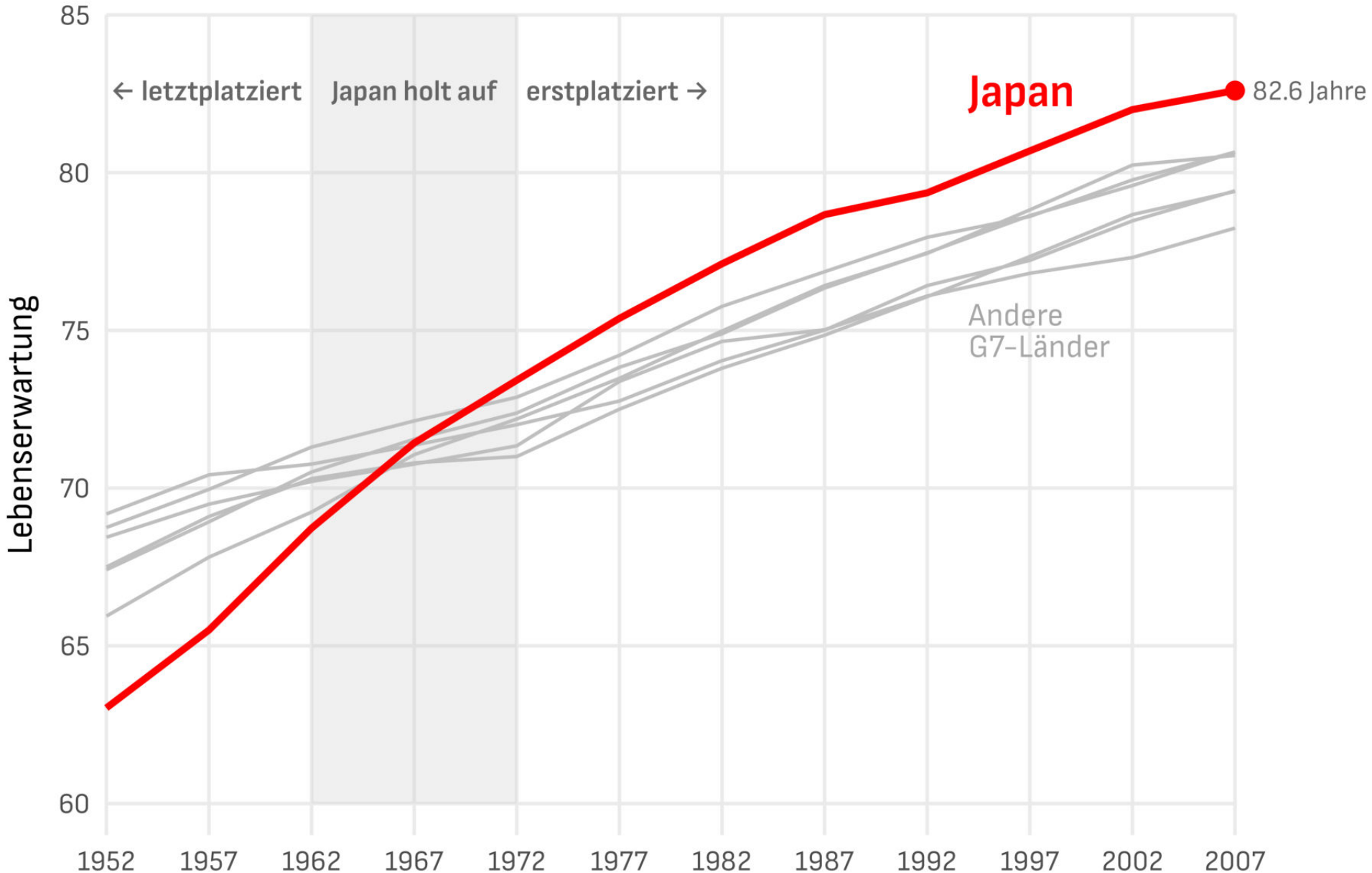
2002
2007


85
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75
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Lebenserwartung
← letztplatziert
Japan holt auf
erstplatziert →
Japan
82.6 Jahre
Andere
G7-Länder
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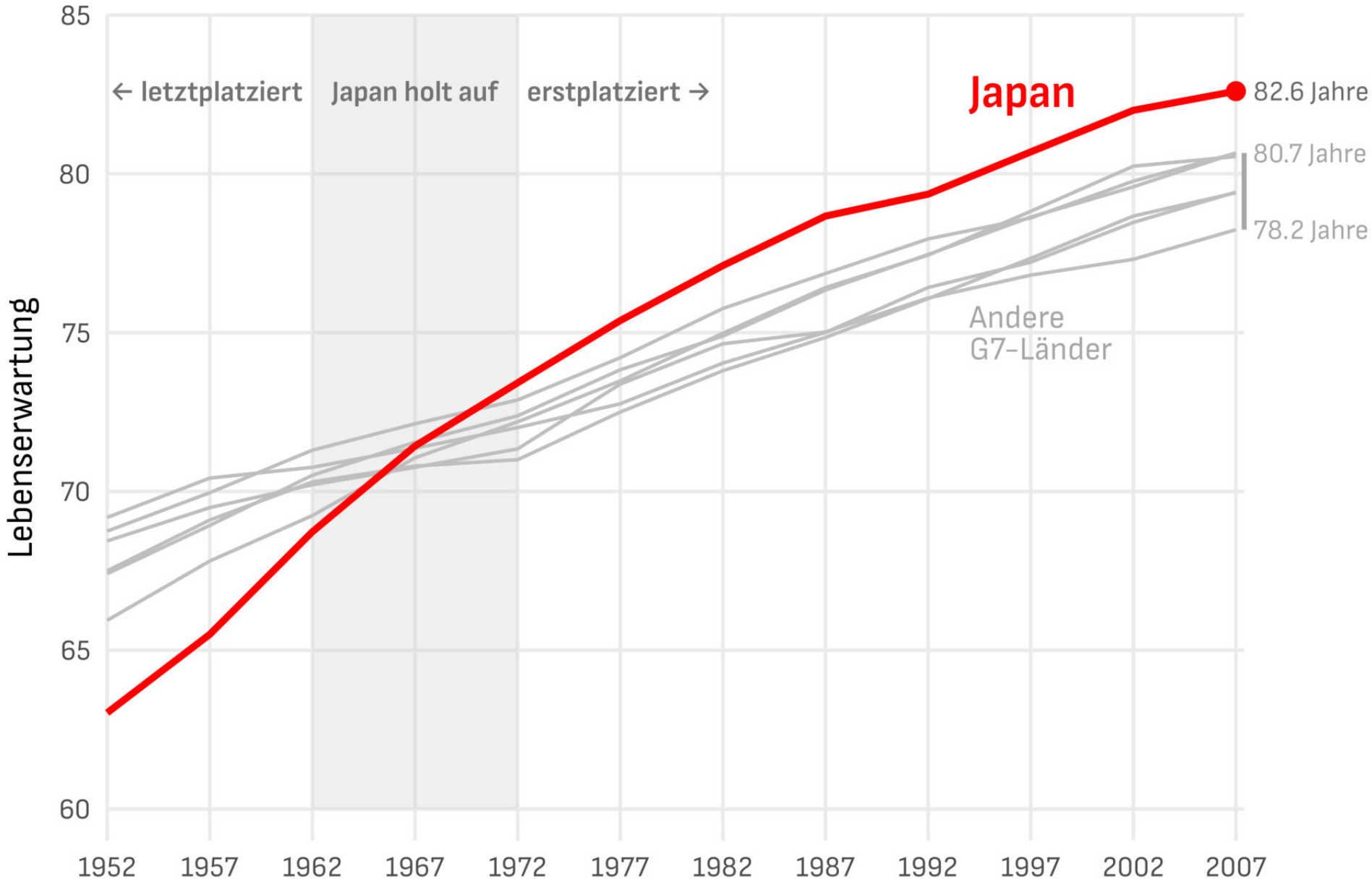
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Lebenserwartung
← letztplatziert
Japan holt auf
erstplatziert →
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80.7 Jahre
78.2 Jahre
Andere
G7-Länder
1952
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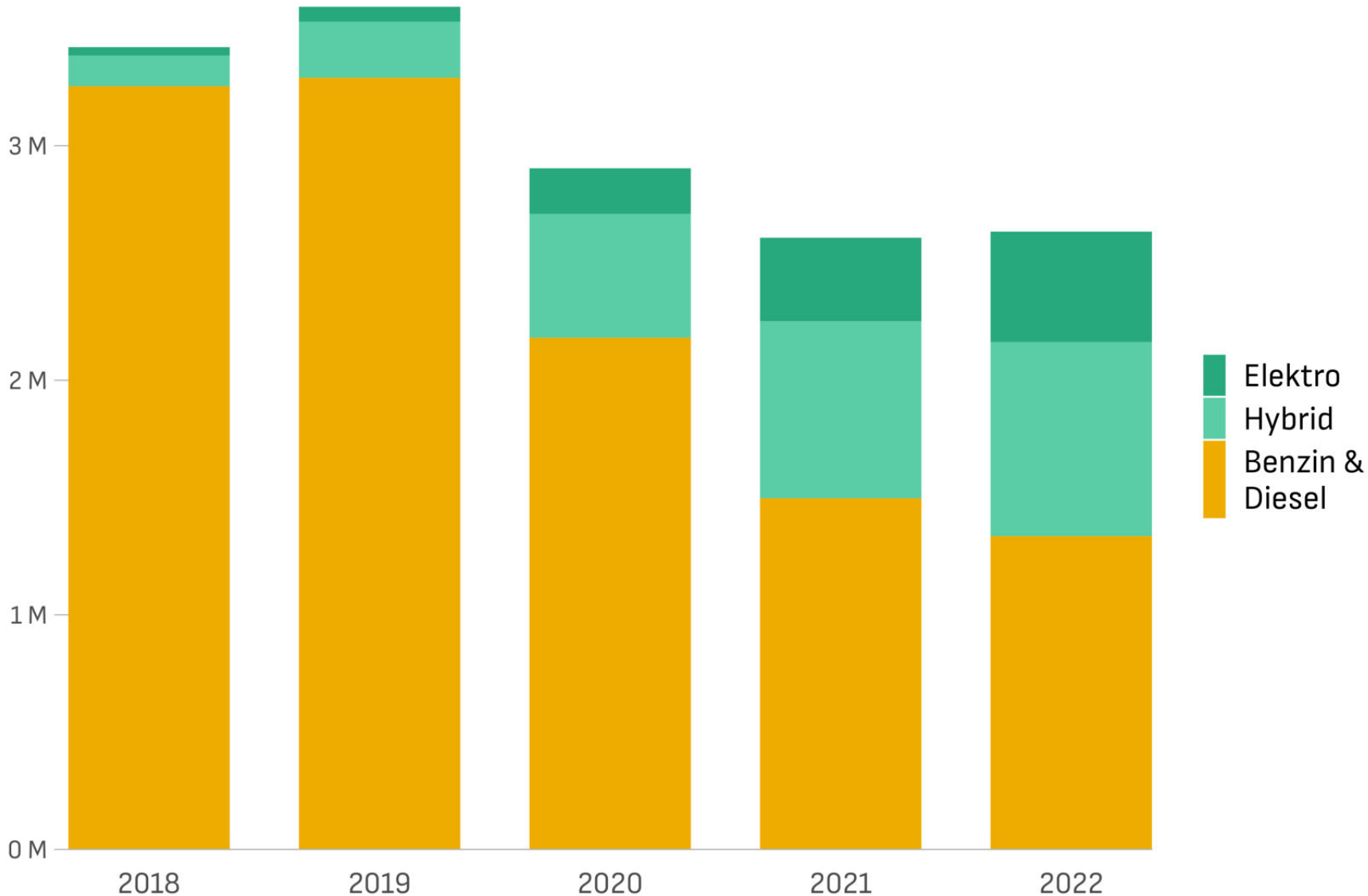
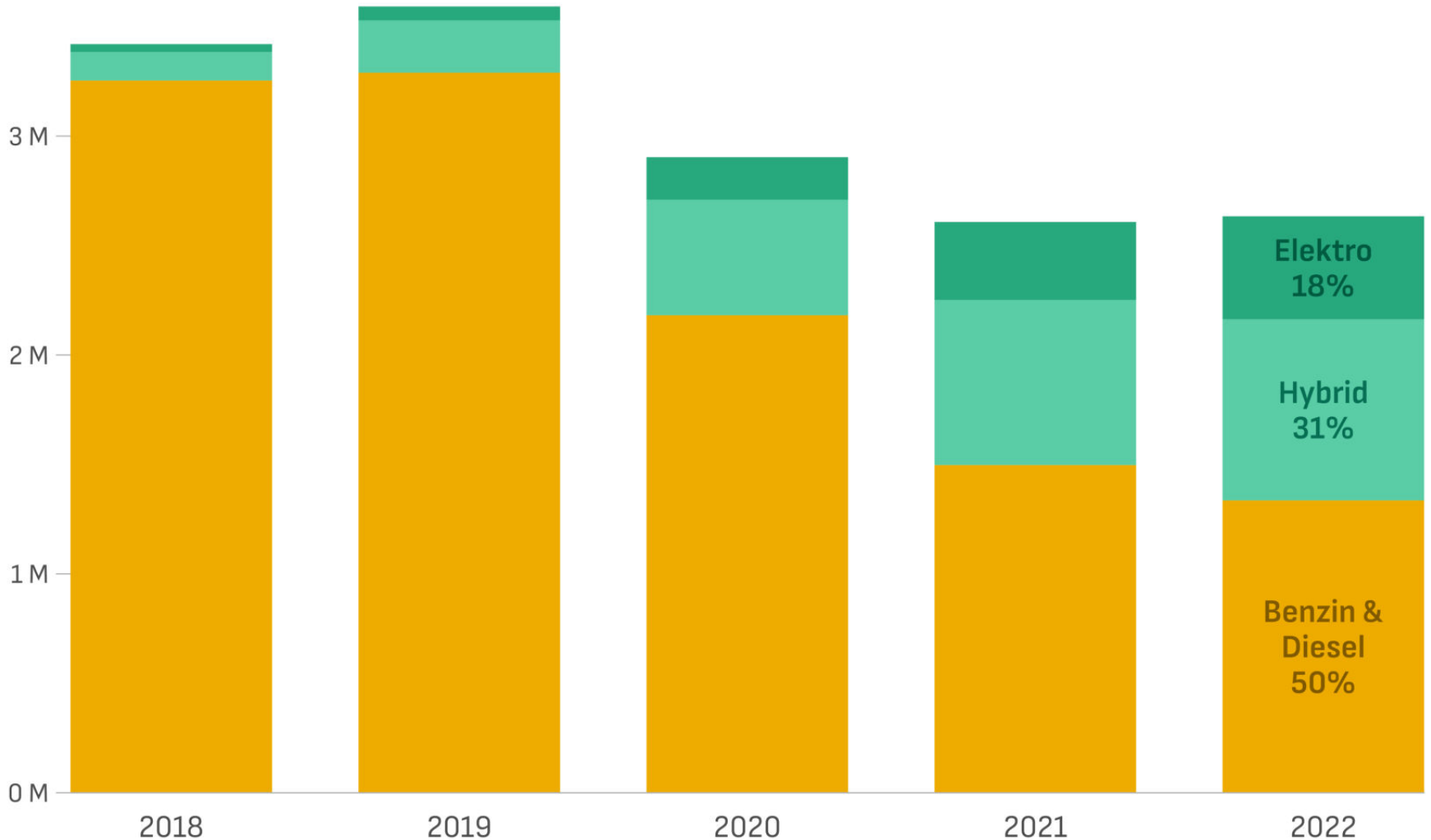
1997
2002
2007

Pkw-Neuzulassungen in Deutschland



Daten: Kraftfahrt-Bundesamt • Grafik: Cédric Scherer

Im Jahr 2022 machen Benzin- und Dieselfahrzeuge nur die Hälfte aller Neuzulassungen in Deutschland aus — Hybrid- und Elektrofahrzeuge setzen ihren Anstieg fort.



Daten: Kraftfahrt-Bundesamt • Grafik: Cédric Scherer

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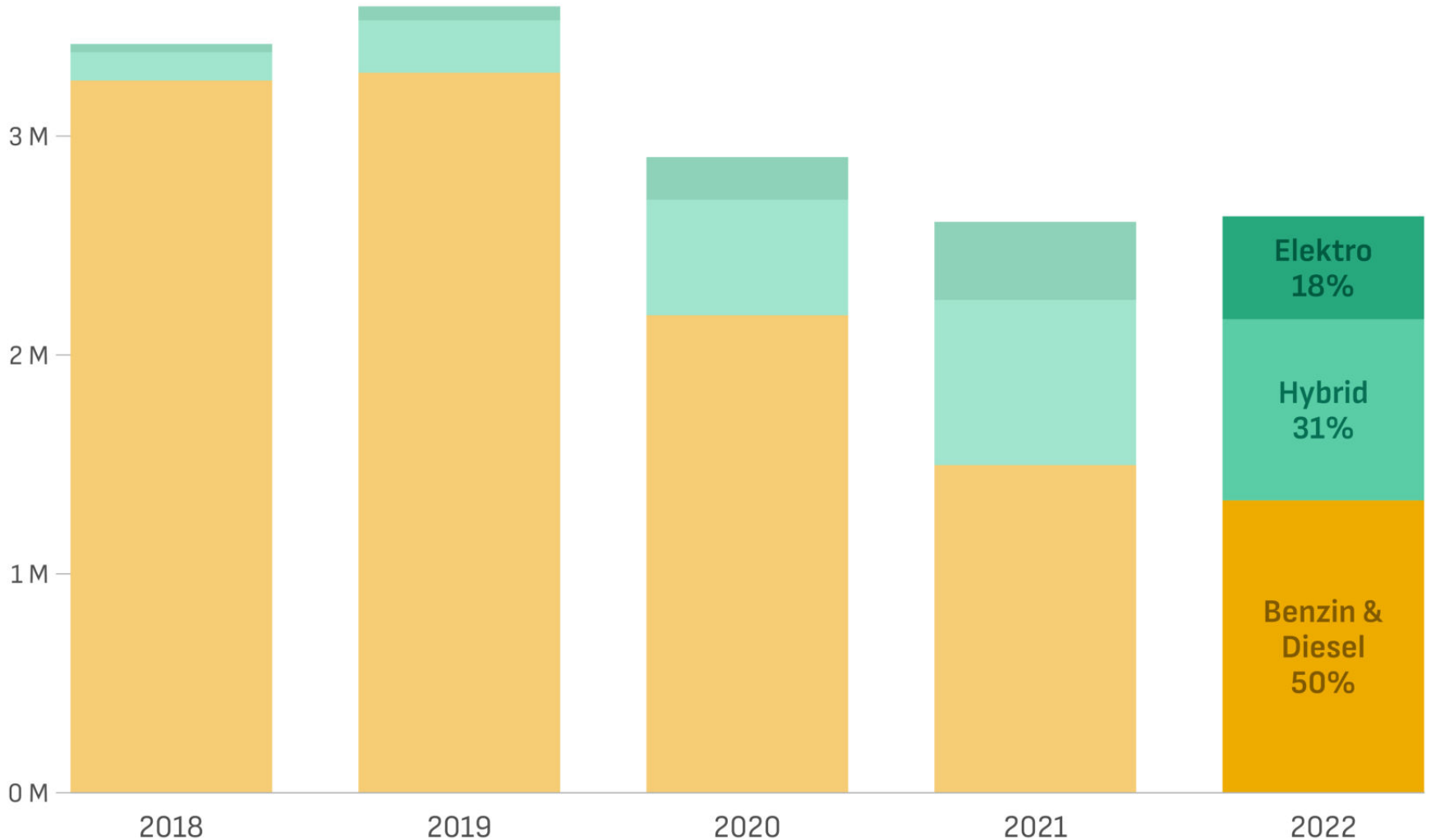
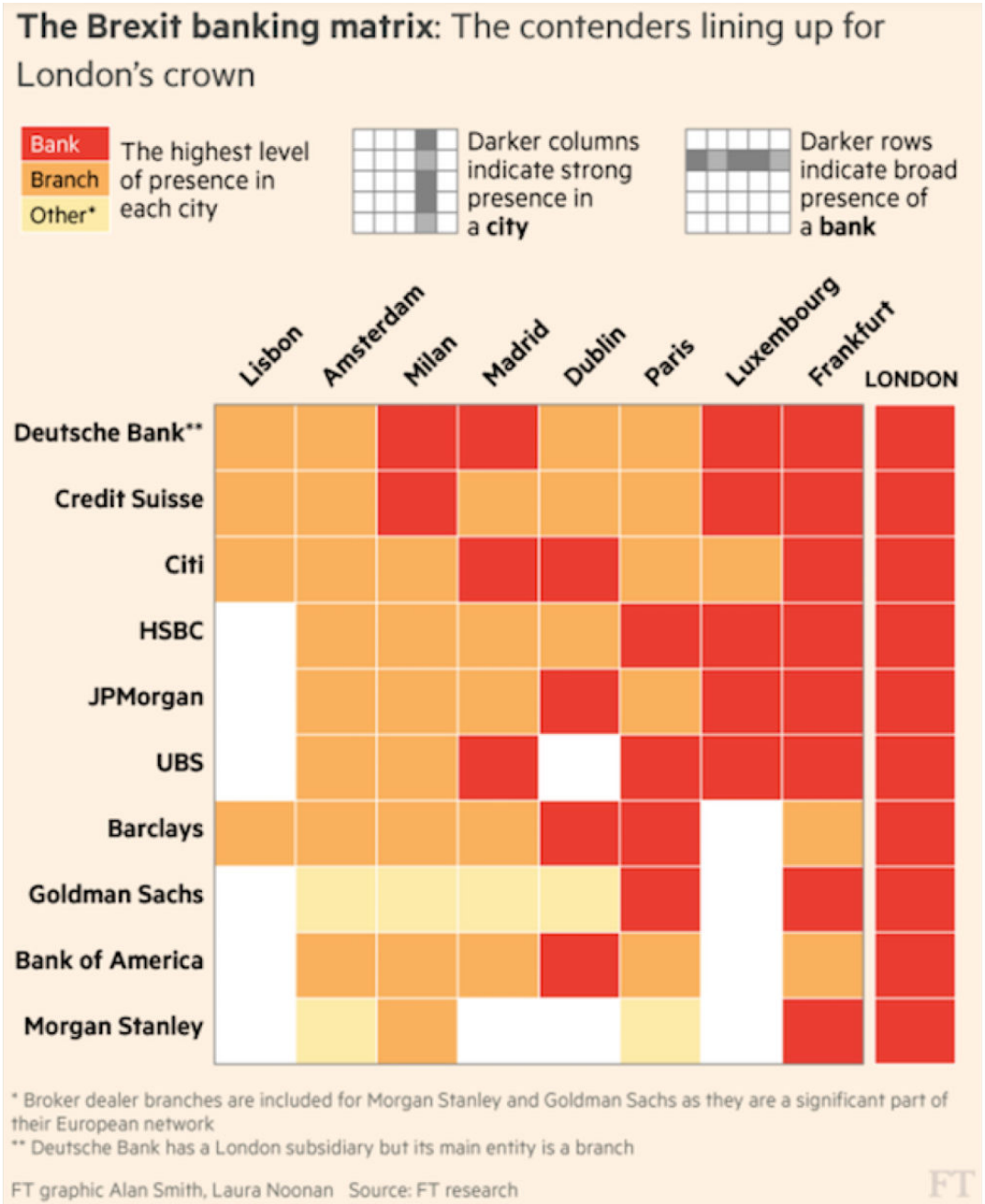
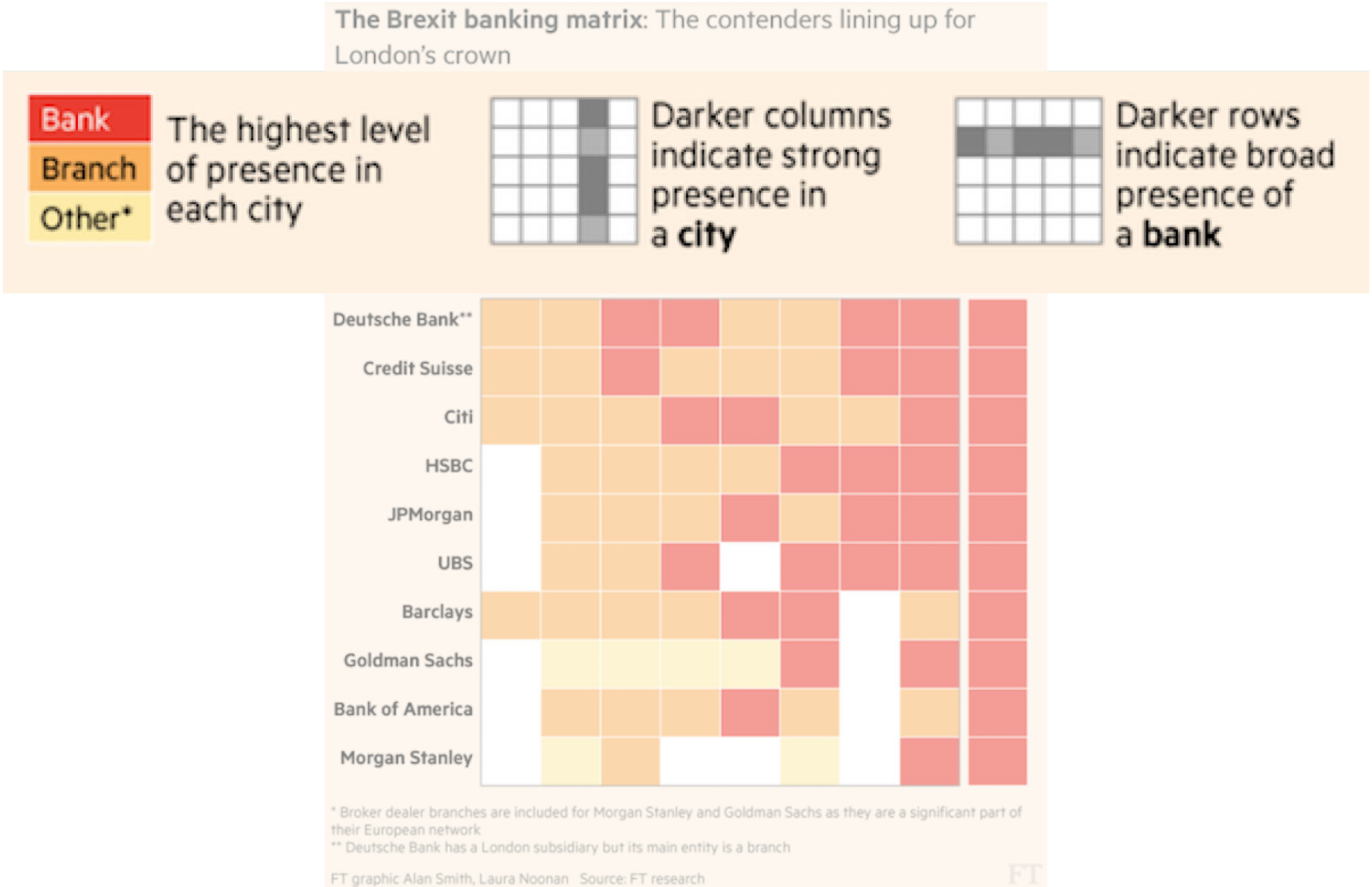


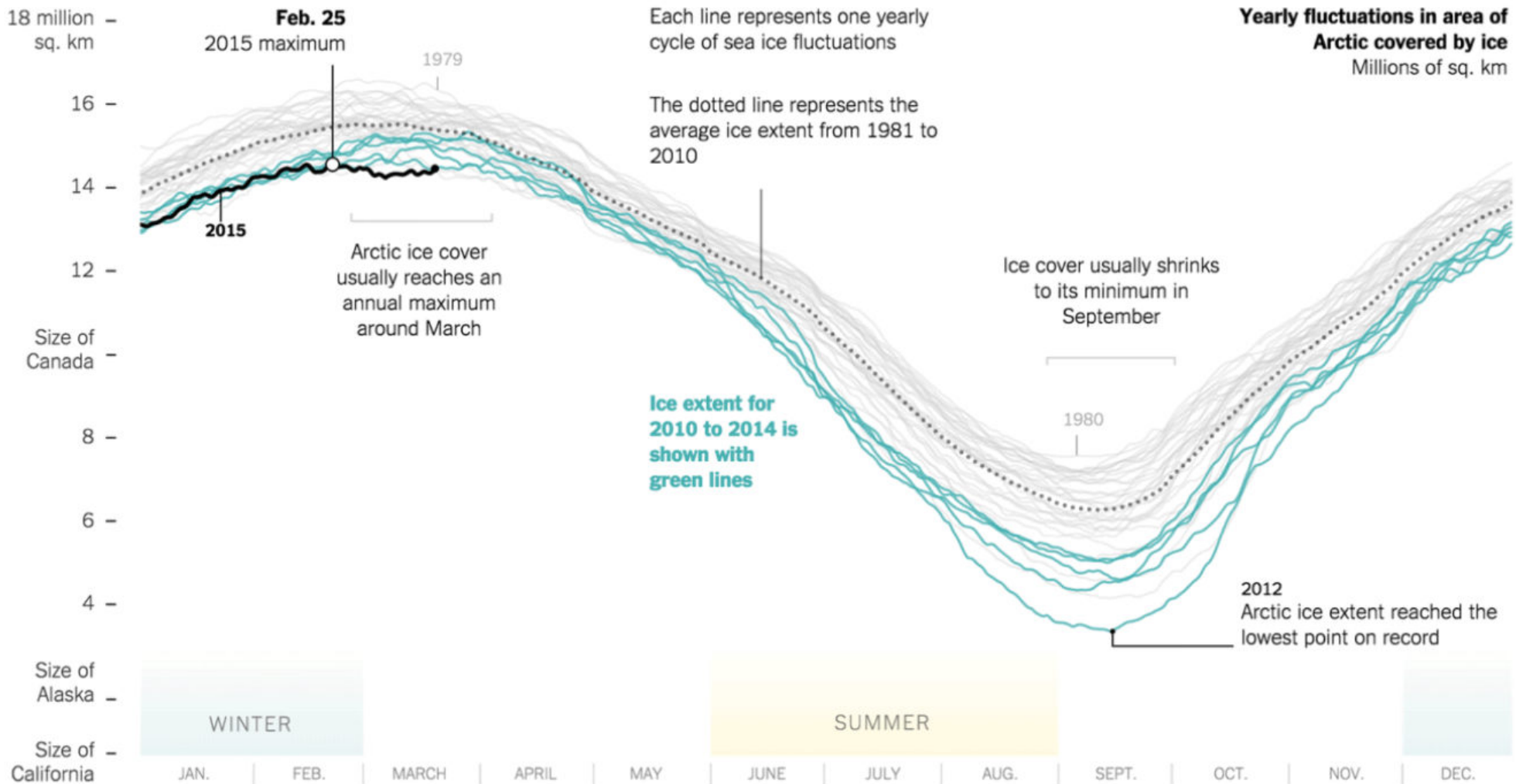
Daten: Kraftfahrt-Bundesamt • Grafik: Cédric Scherer



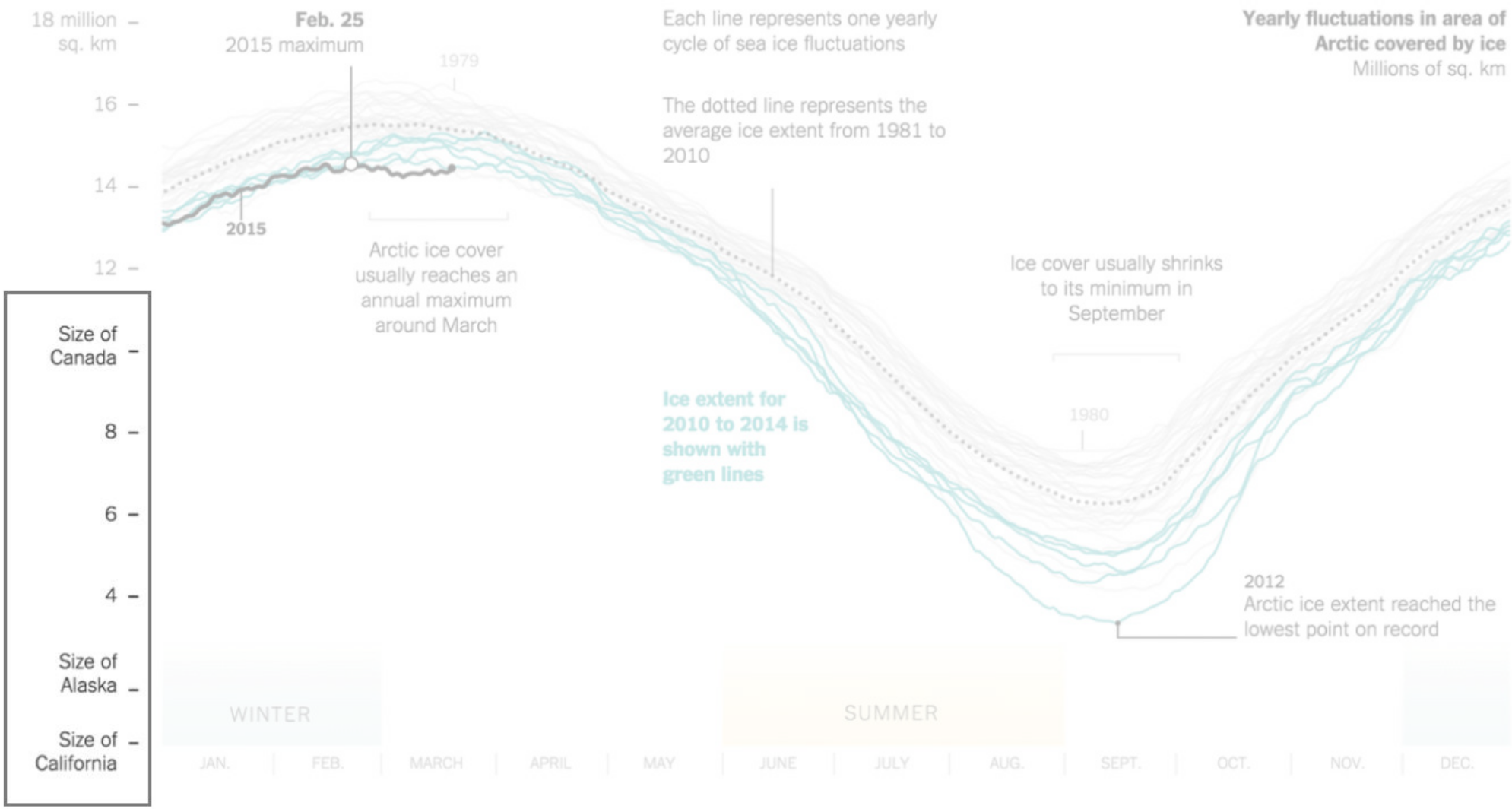
"Frankfurt vies for UK banking jobs post-Brexit" von Alan Smith & Laura Noonan (Financial Times)



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



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



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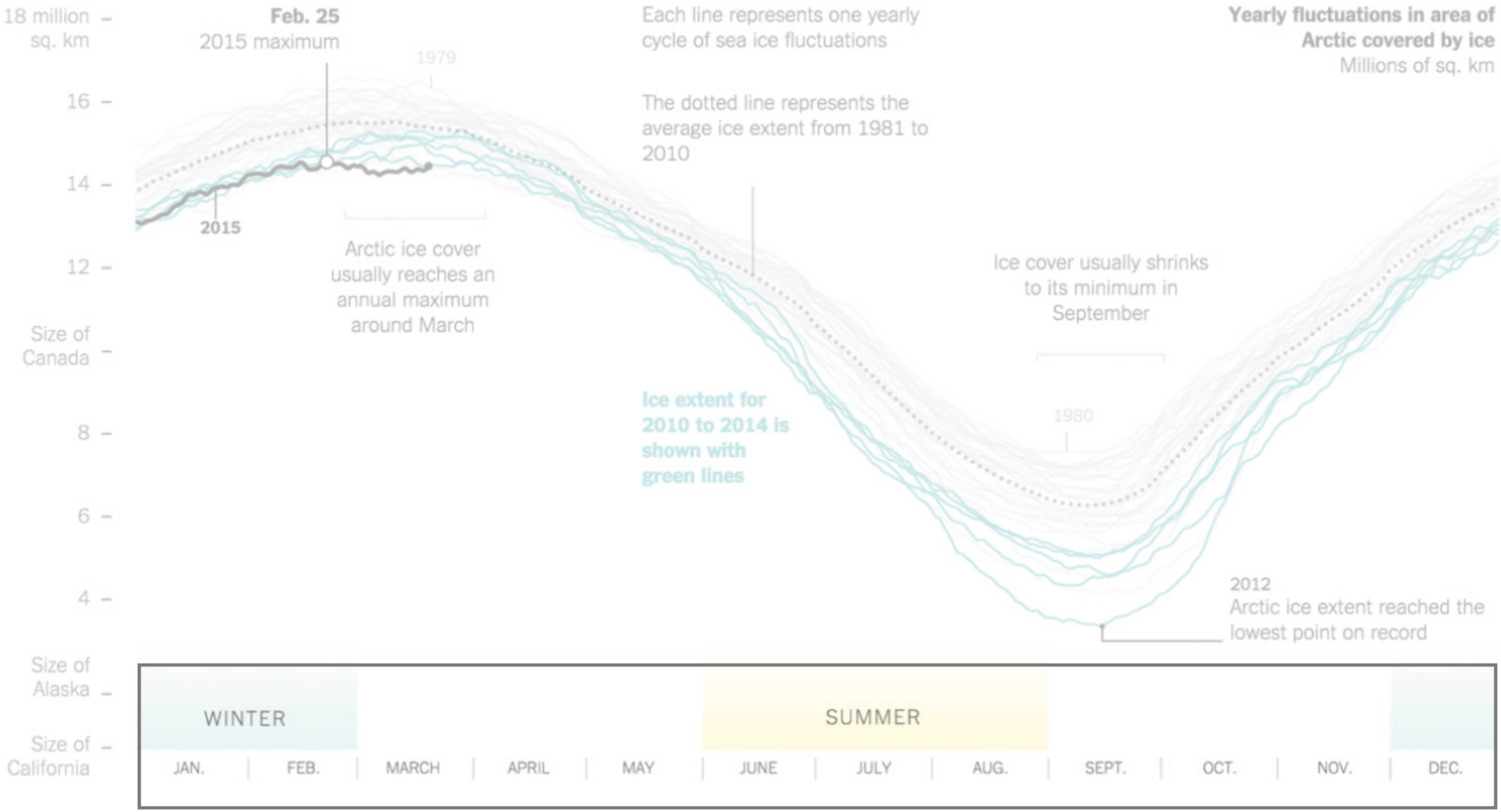

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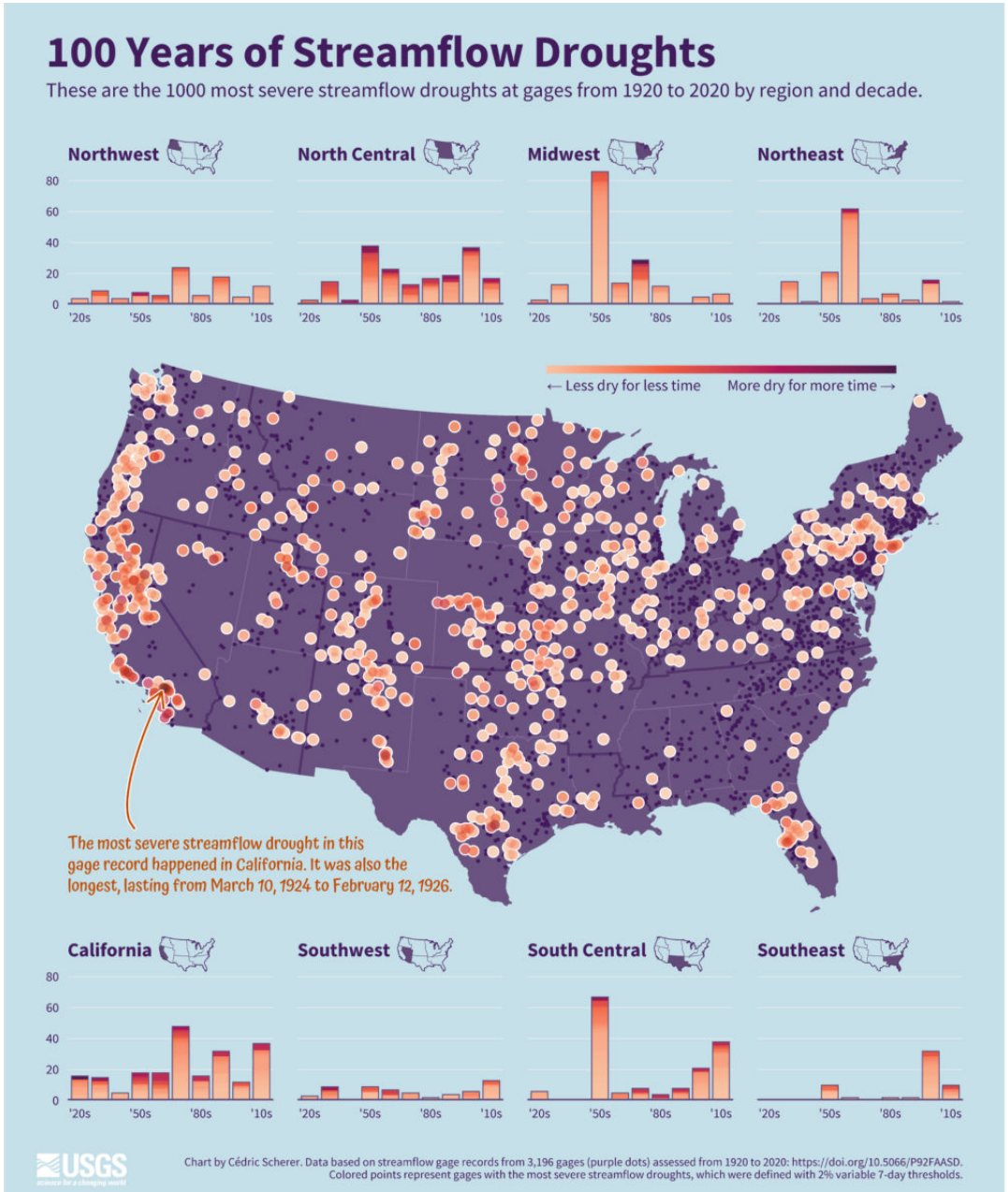
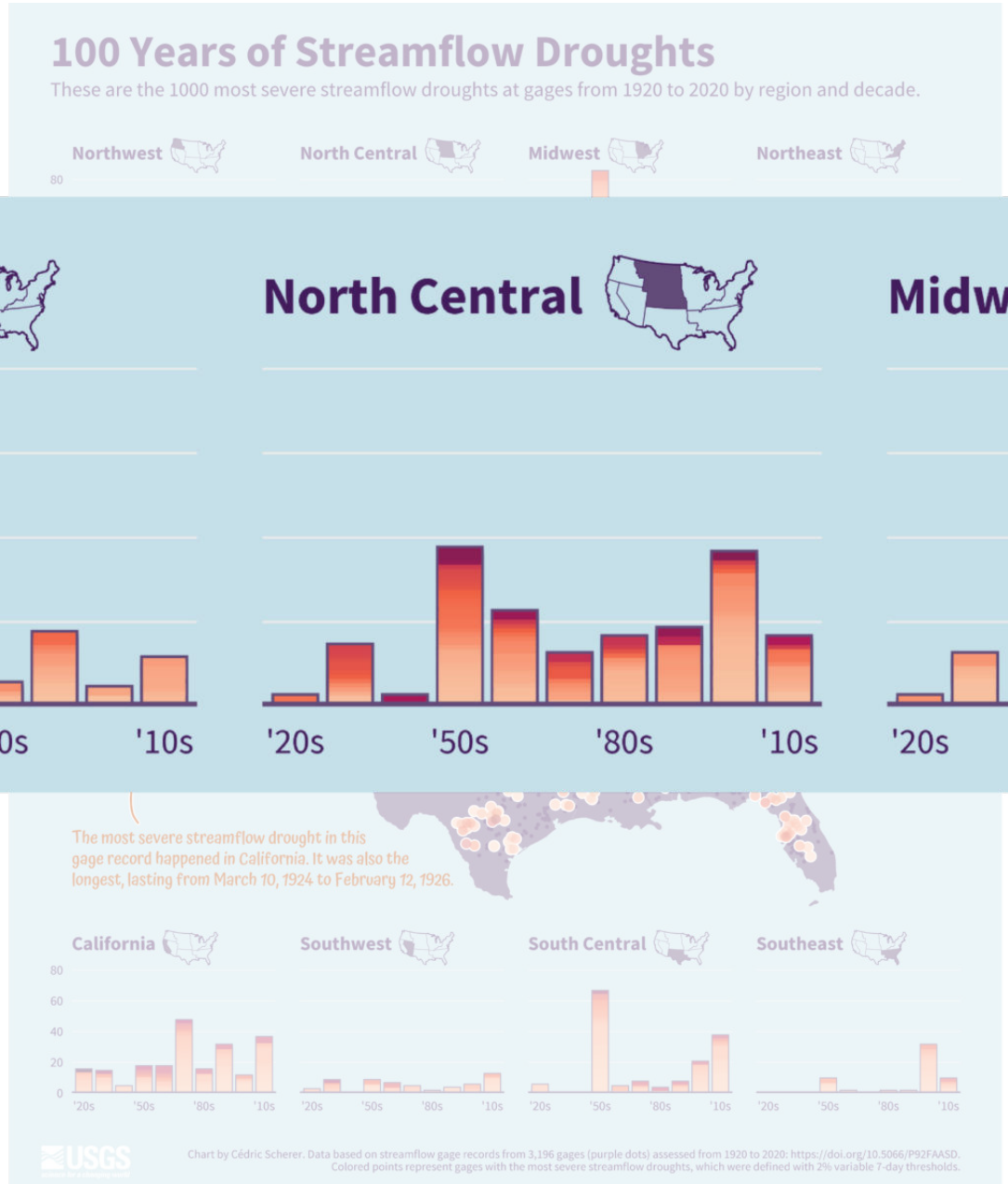
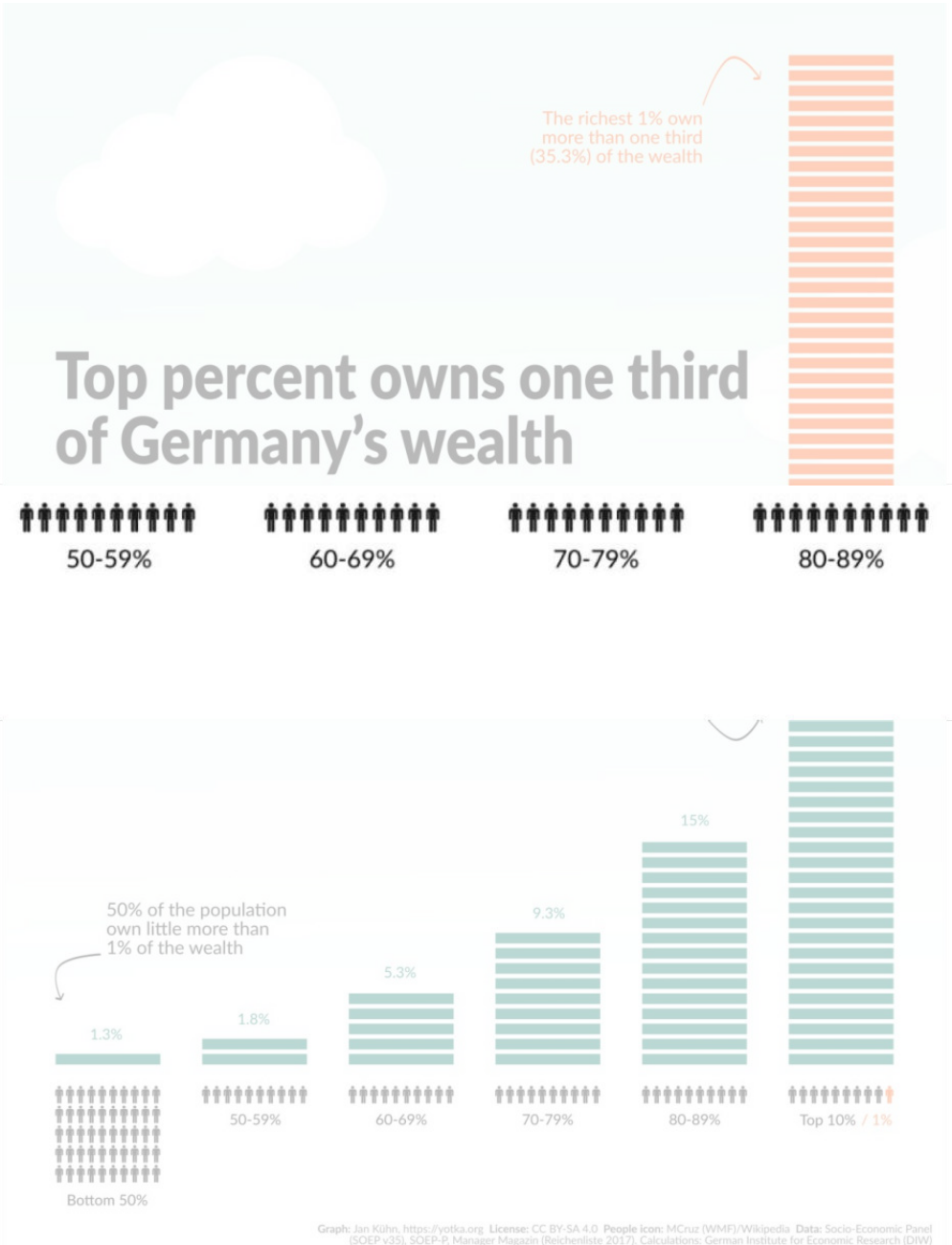


"100 Years of Streamflow Drought", in Kollaboration mit United States Geological Survey (USGS)



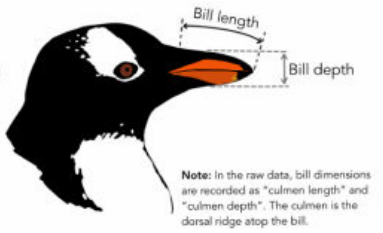
"100 Years of Streamflow Drought", in Kollaboration mit United States Geological Survey (USGS)



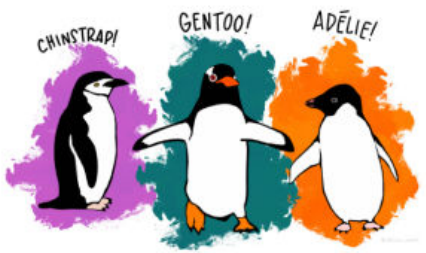
Quelle: Jan Kühn

BILL DIMENSIONS OF BRUSH-TAILED PENGUINS

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

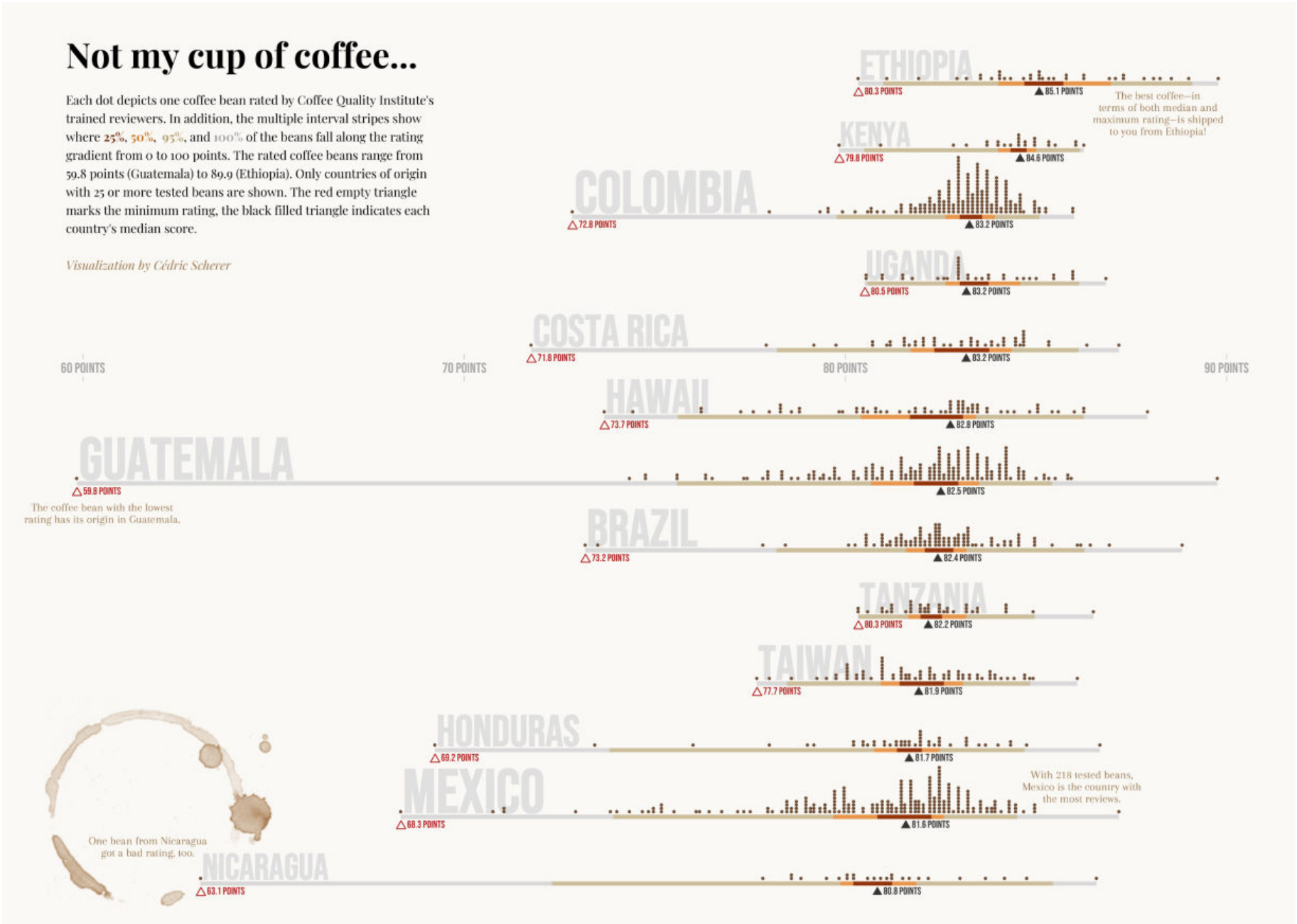


Distribution of the bill ratio, estimated as bill length divided by bill depth



Note: In the original data, bill dimensions are recorded as "culmen length" and "culmen depth". The culmen is the dorsal (upper) ridge of a bird's bill.
Visualization: Cédric Scherer • Data: Gorman, Williams & Fraser (2014) DOI: 10.1371/journal.pone.0090081 • Illustrations: Allison Horst

"Bill Dimensions of Brush-tailed Penguins" (modifiziert) | Illustration: Allison Horst

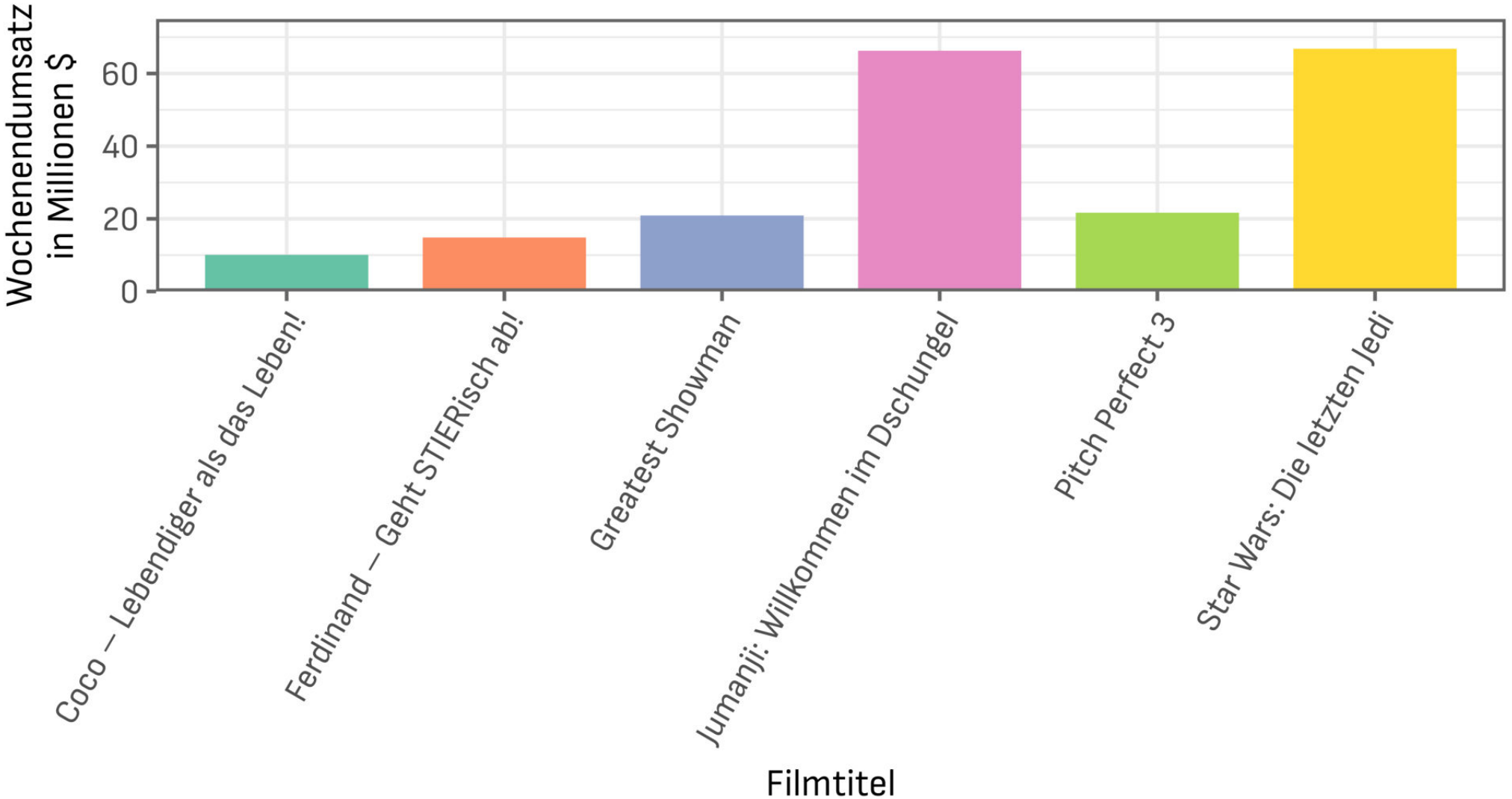


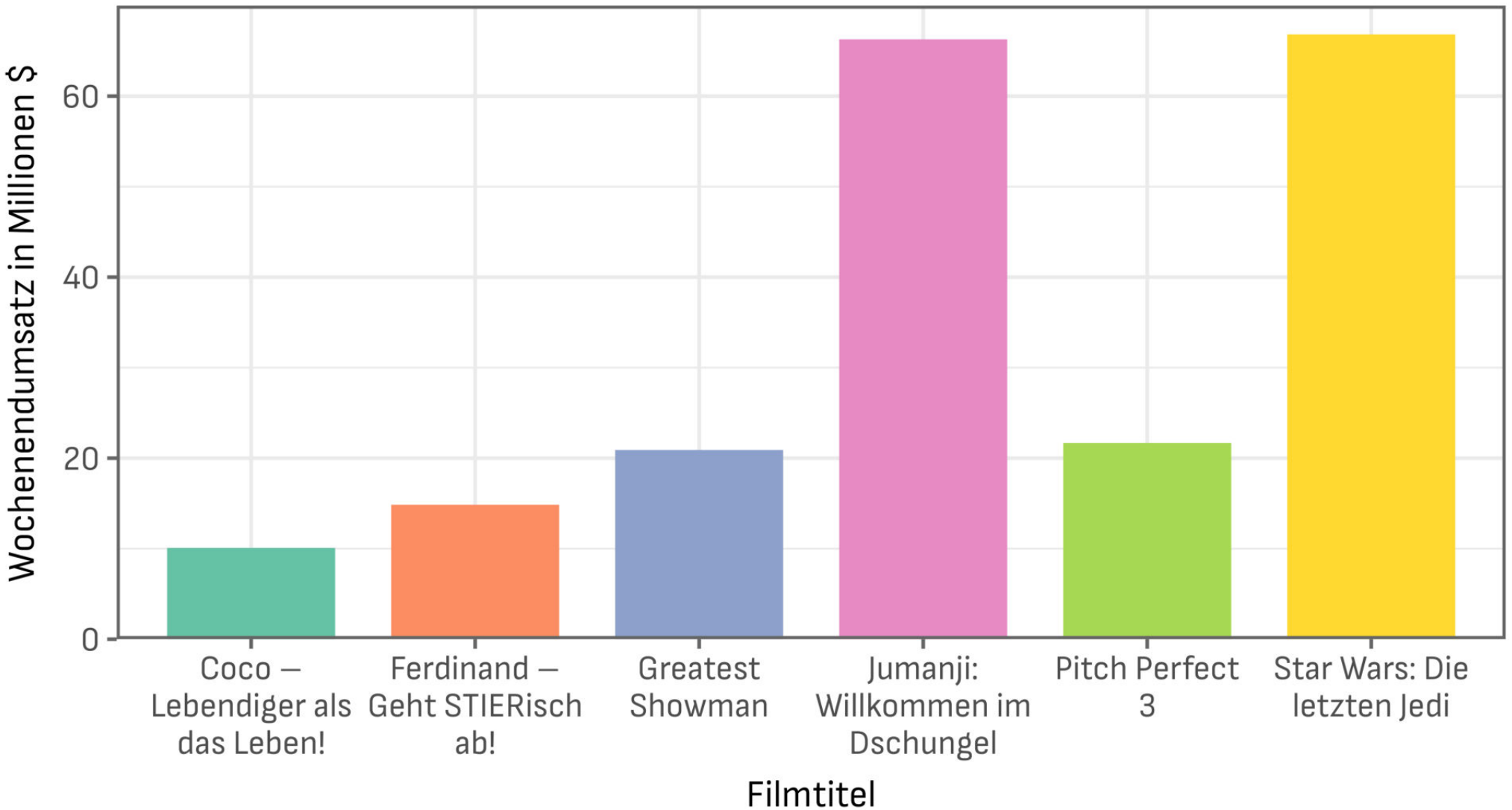
"Not my Cup of Coffee"

Designing Charts

Ein illustrierendes Beispiel

Cédric Scherer // Data Visualization & Information Design


Wochenendumsatz in Millionen $
0
20
40
60
Coco – Lebendiger als das Leben!
Ferdinand – Geht STIERisch ab!
Greatest Showman
Jumanji: Willkommen im Dschungel
Pitch Perfect 3
Star Wars: Die letzten Jedi
Filmtitel


Wochenendumsatz in Millionen $
60
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Coco – Lebendiger als das Leben!
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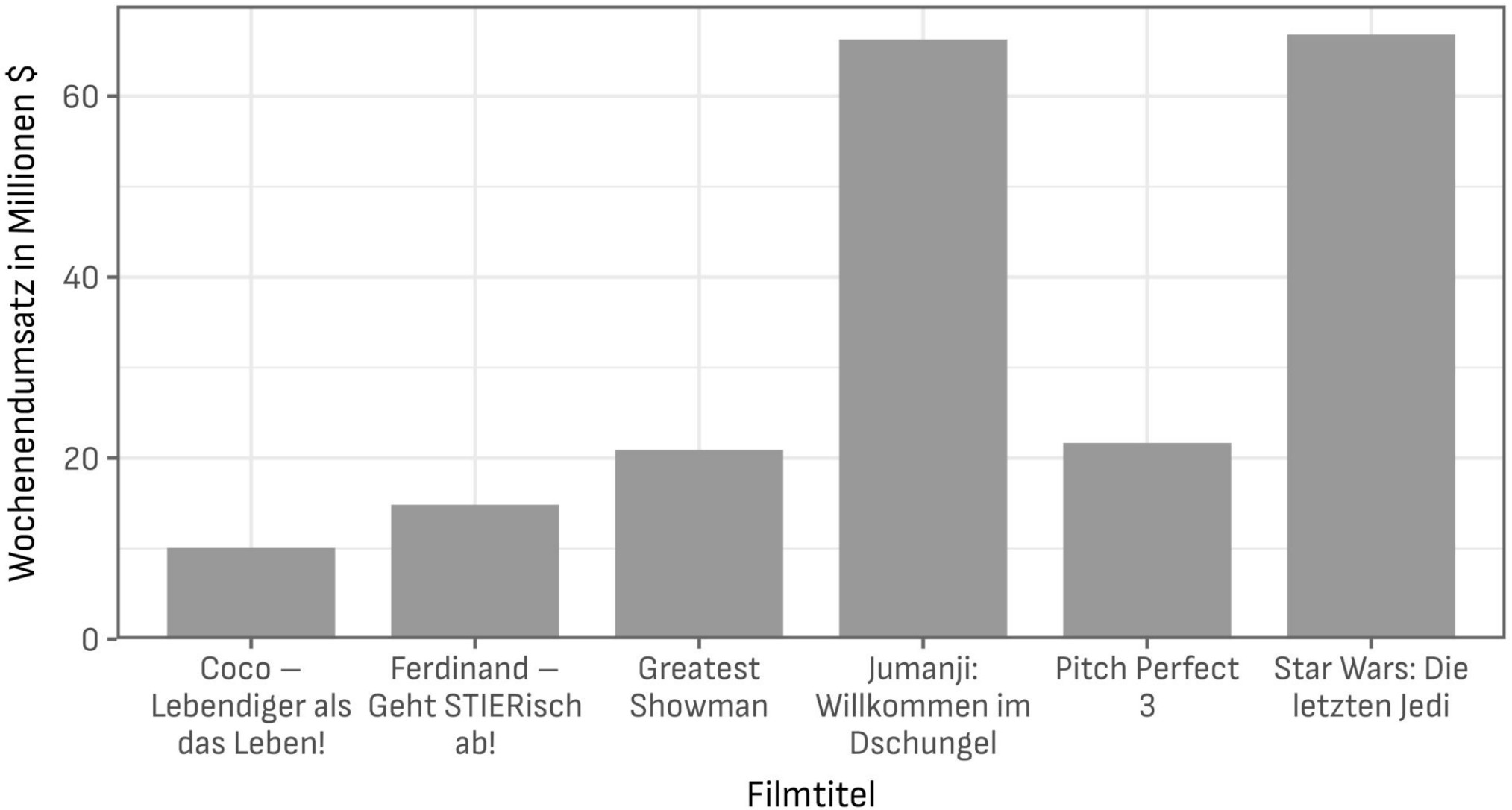
Wochenendumsatz in Millionen $
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Coco – Lebendiger als das Leben!
Ferdinand – Geht STIERisch ab!
Greatest Showman
Jumanji: Willkommen im Dschungel
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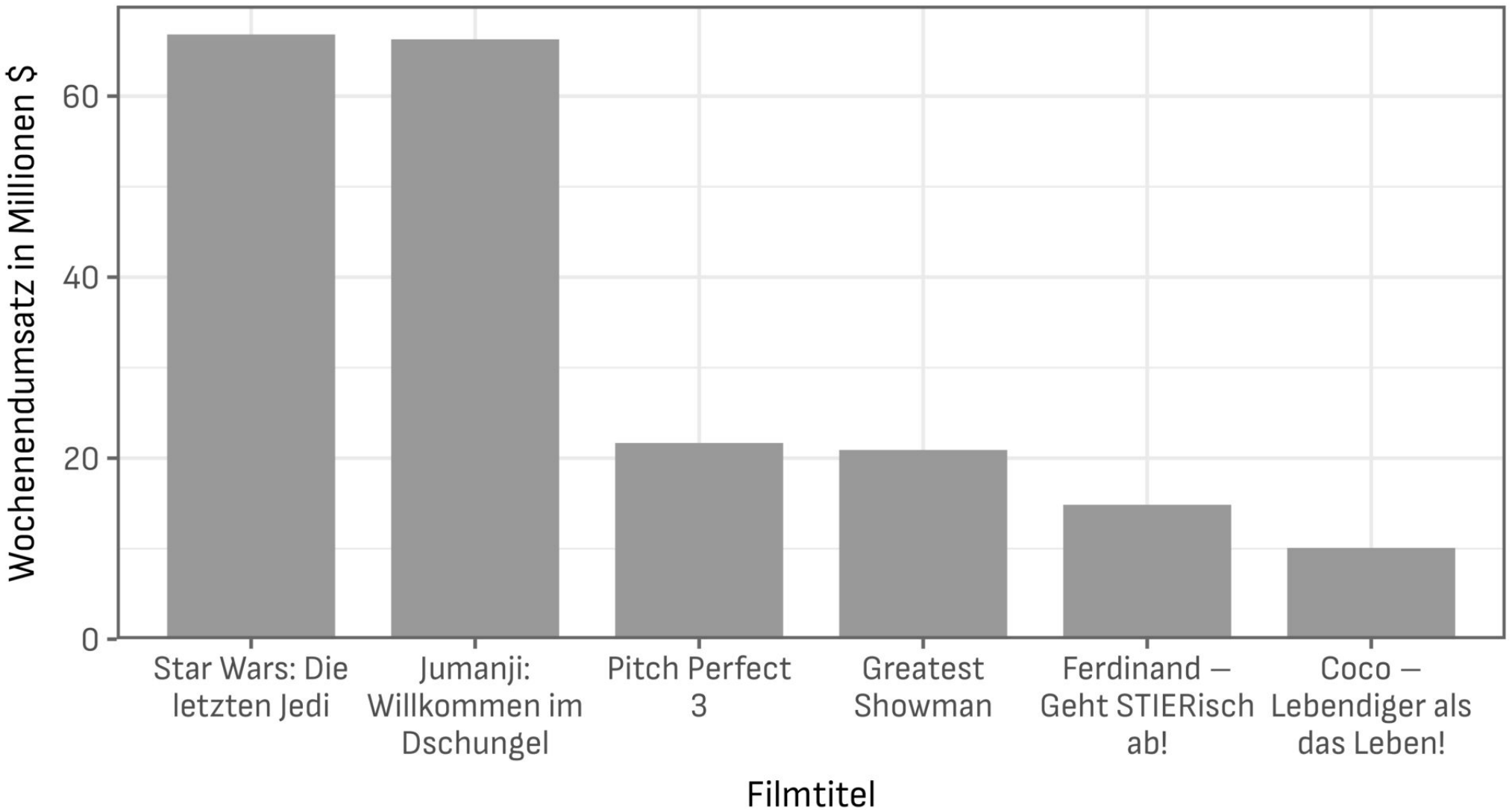
Wochenendumsatz in Millionen $
60
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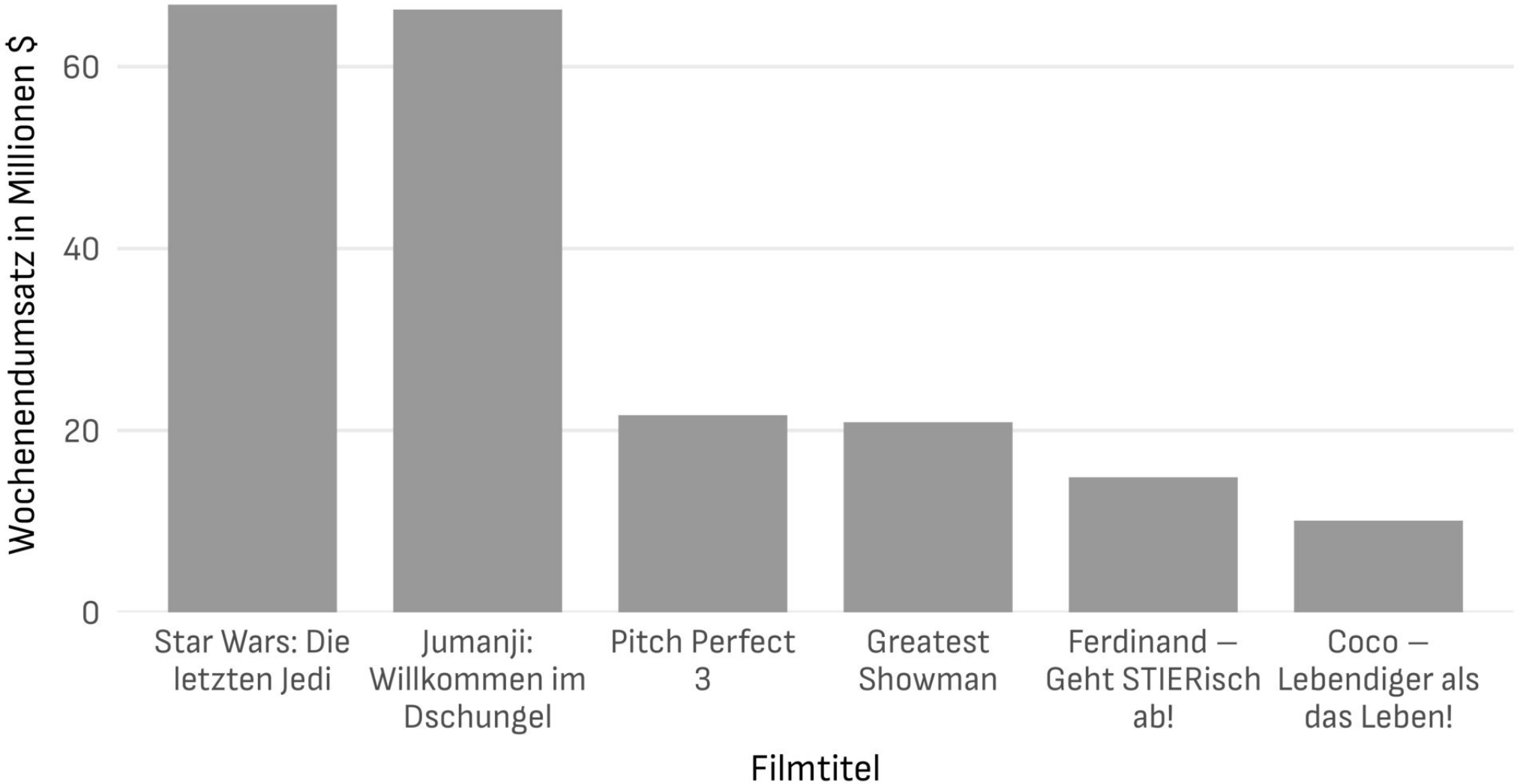
Star Wars: Die letzten Jedi
Jumanji: Willkommen im Dschungel
Pitch Perfect 3
Greatest Showman
Ferdinand – Geht STIERisch ab!
Coco – Lebendiger als das Leben!
Filmtitel


Wochenendumsatz in Millionen $
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Star Wars: Die letzten Jedi
Jumanji: Willkommen im Dschungel
Pitch Perfect 3
Greatest Showman
Ferdinand – Geht STIERisch ab!
Coco – Lebendiger als das Leben!
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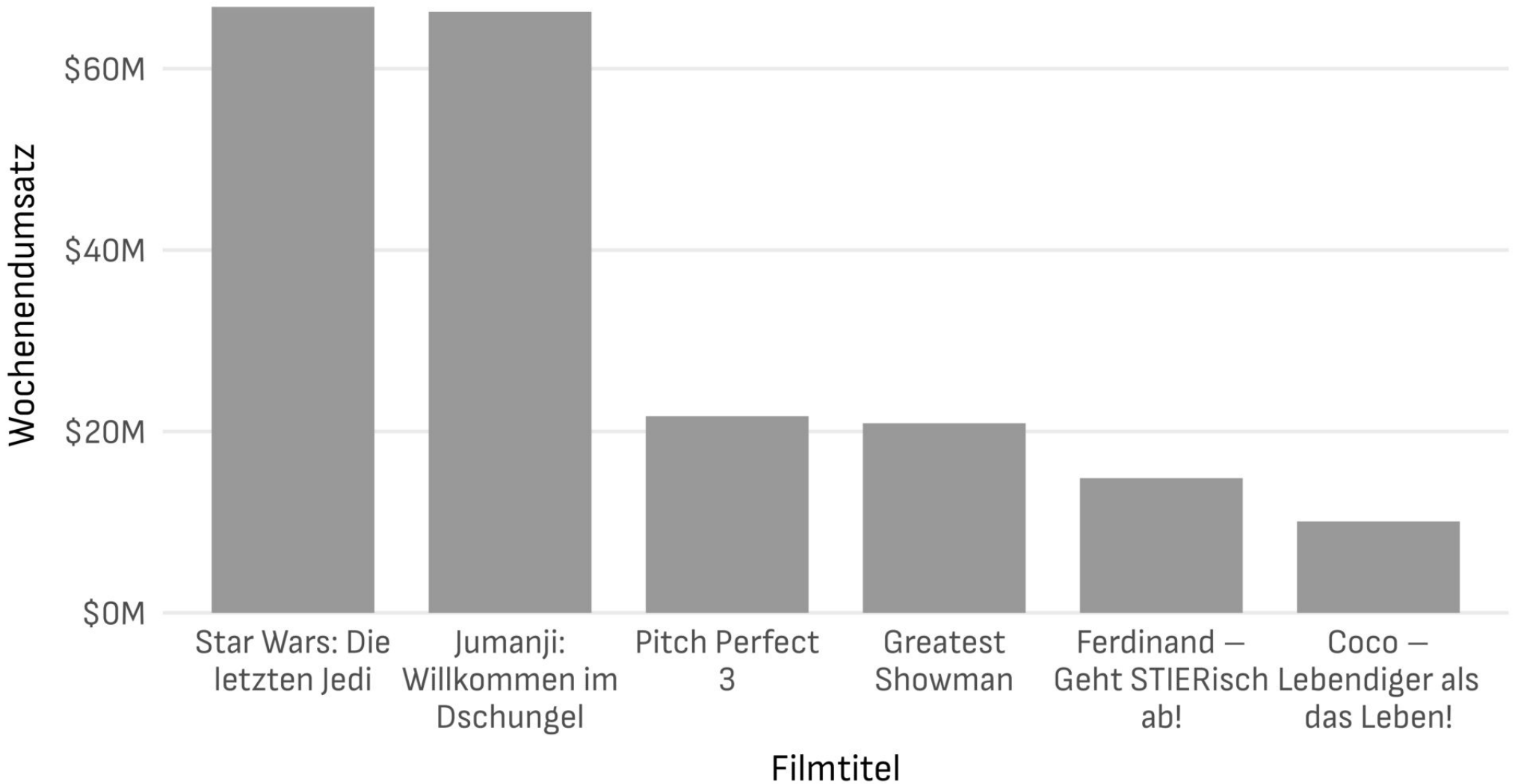
Wochenendumsatz
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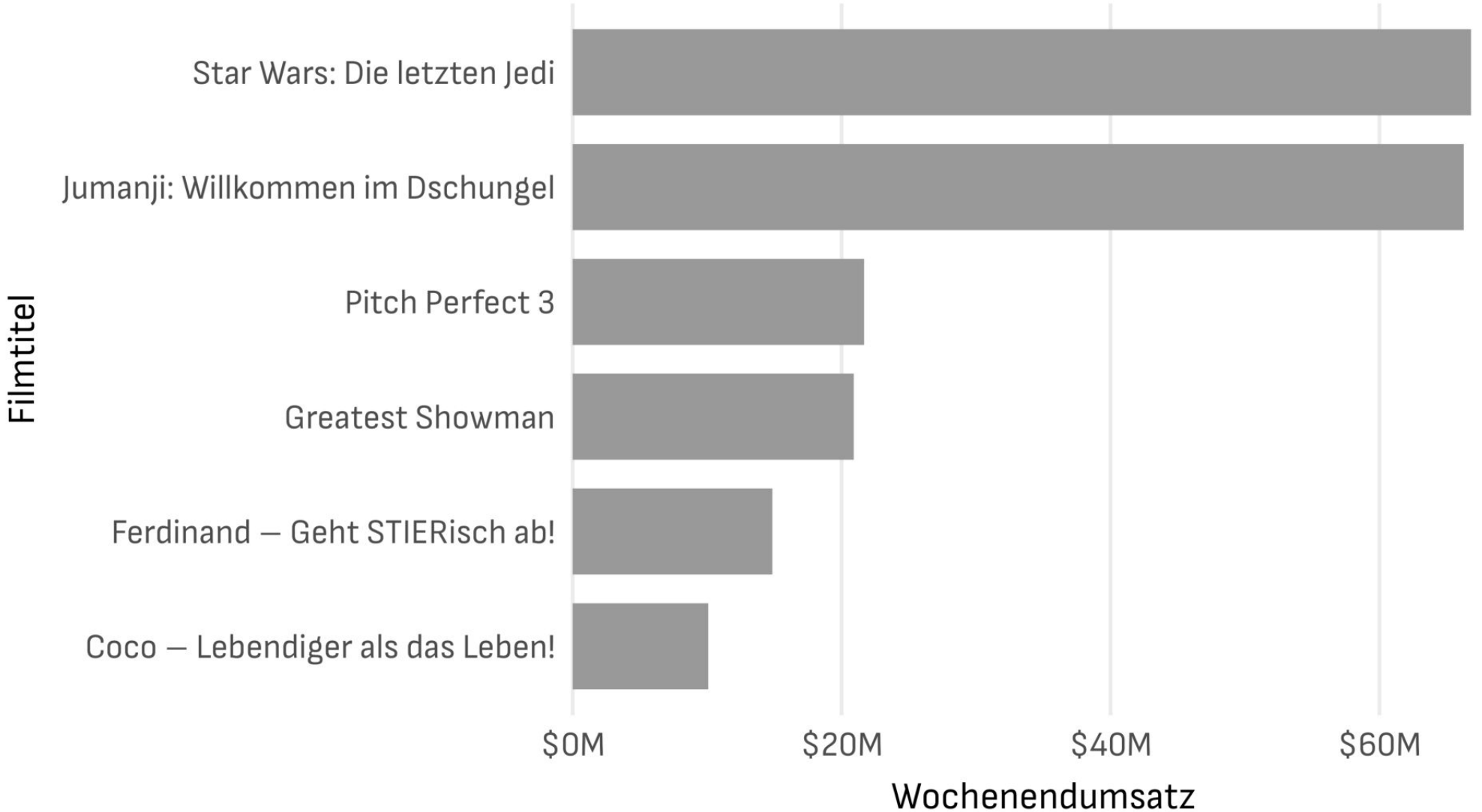
Star Wars: Die letzten Jedi
Jumanji: Willkommen im Dschungel
Pitch Perfect 3
Greatest Showman
Ferdinand – Geht STIERisch ab!
Coco – Lebendiger als das Leben!
Filmtitel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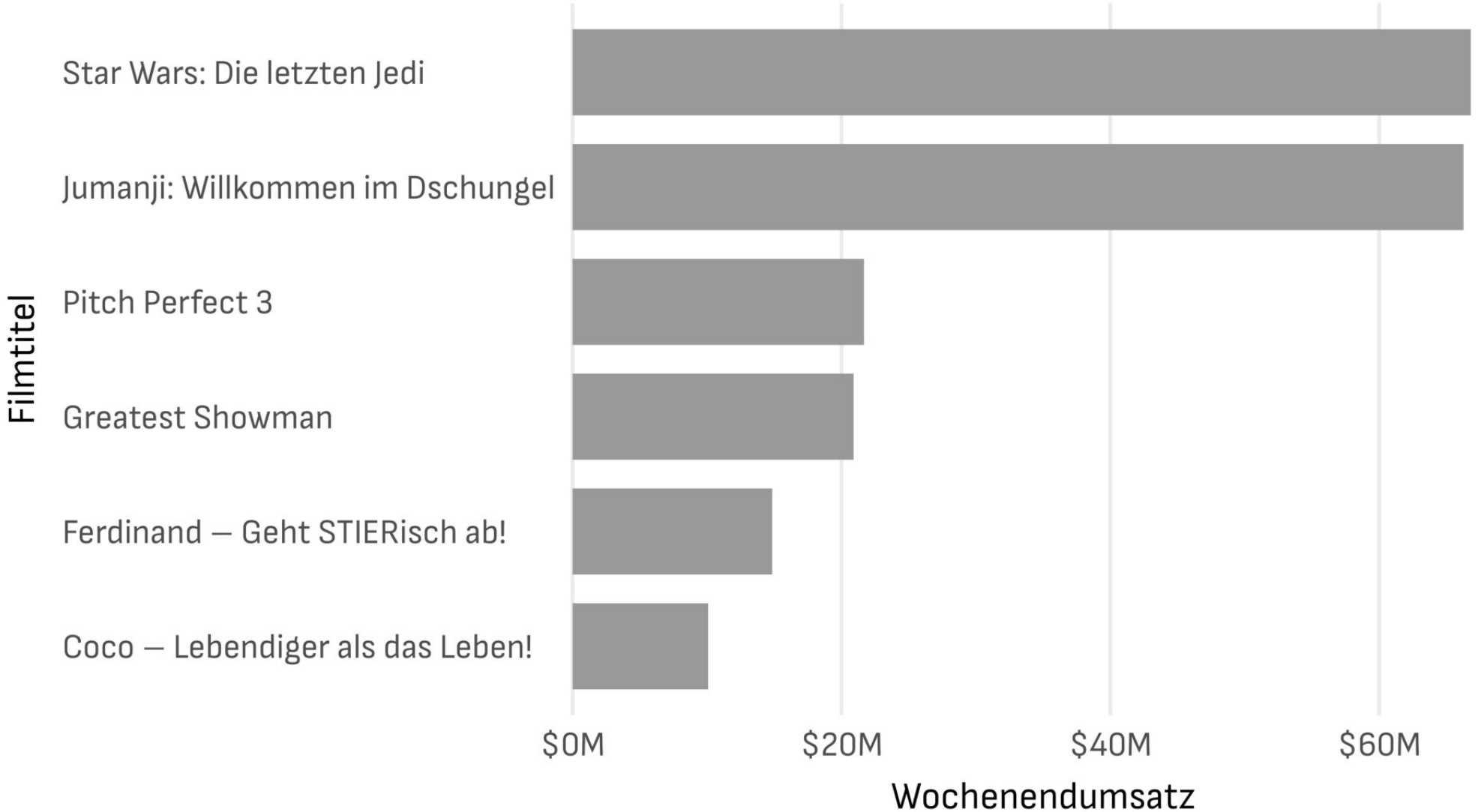
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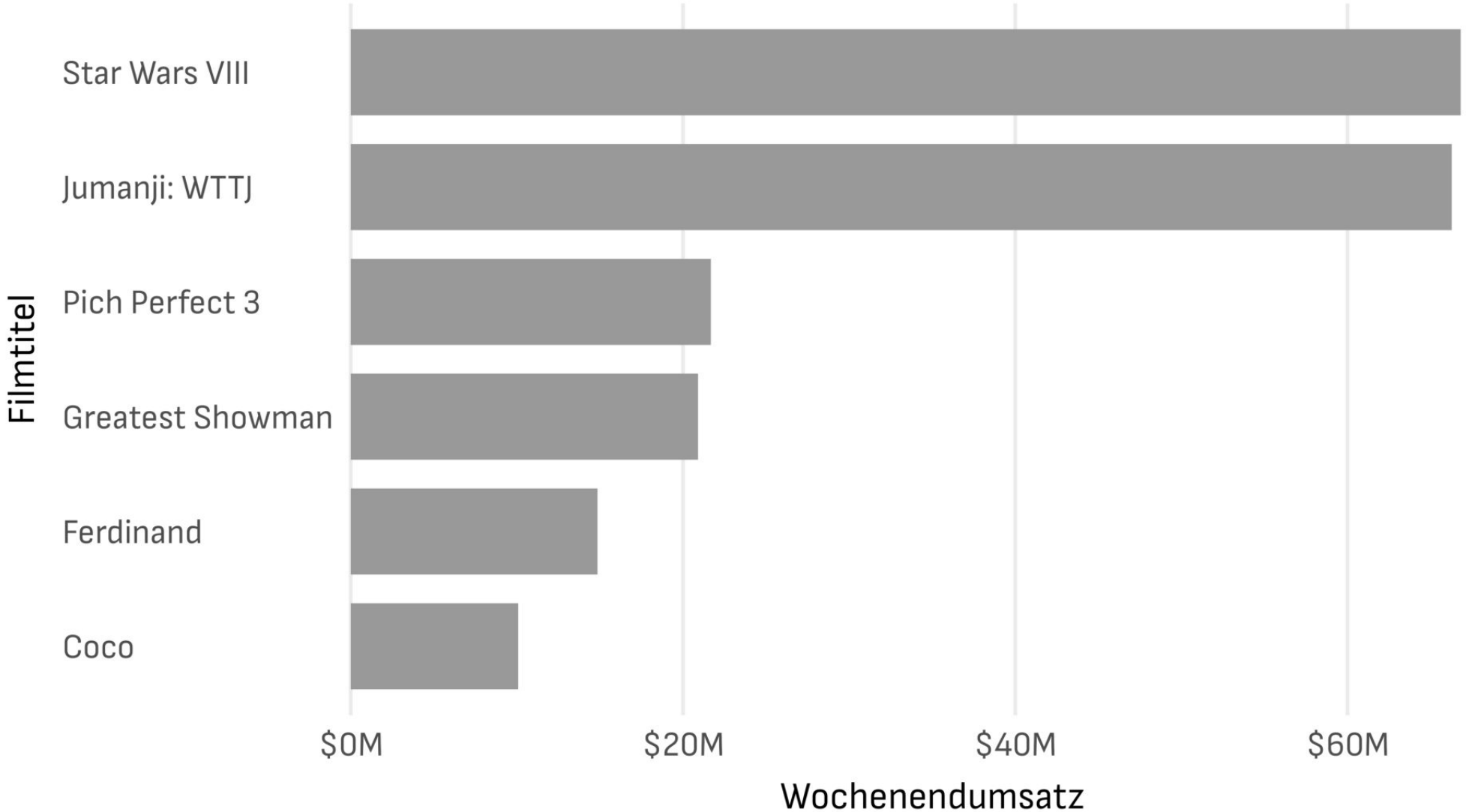
Star Wars VIII
Jumanji: WTTJ
Pich Perfect 3
Greatest Showman
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Filmtitel
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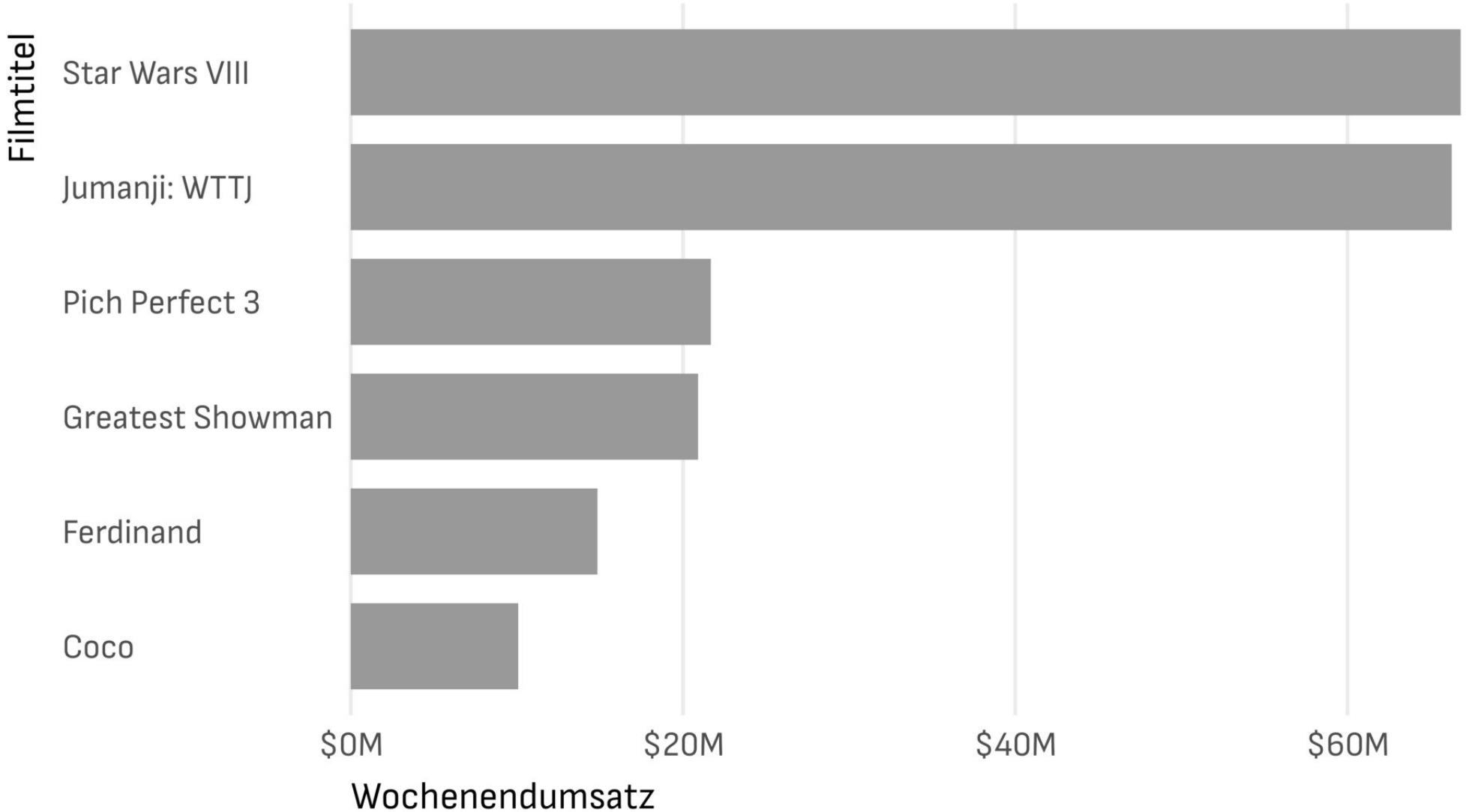
Wochenendumsatz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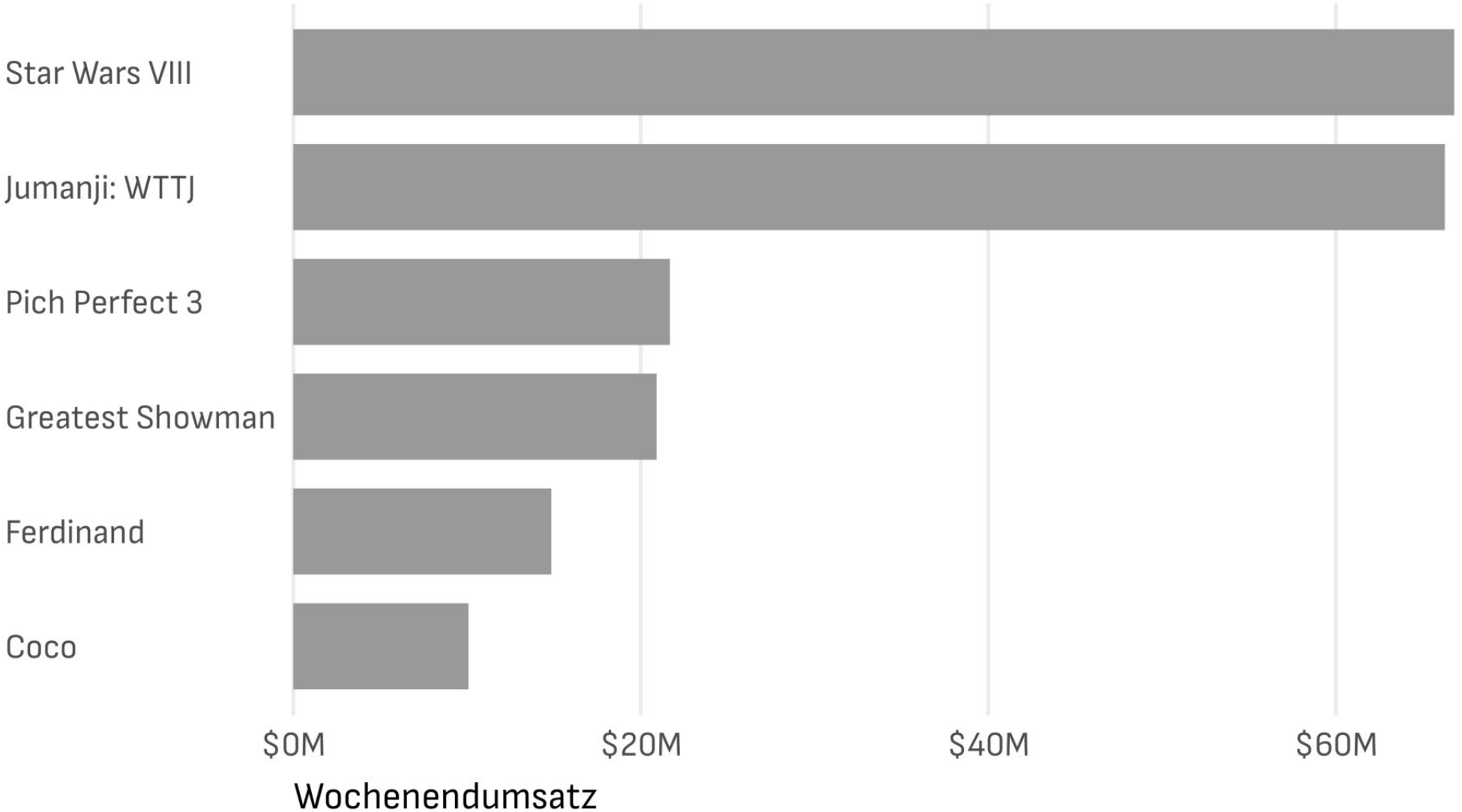
Star Wars VIII
Jumanji: WTTJ
Pich Perfect 3
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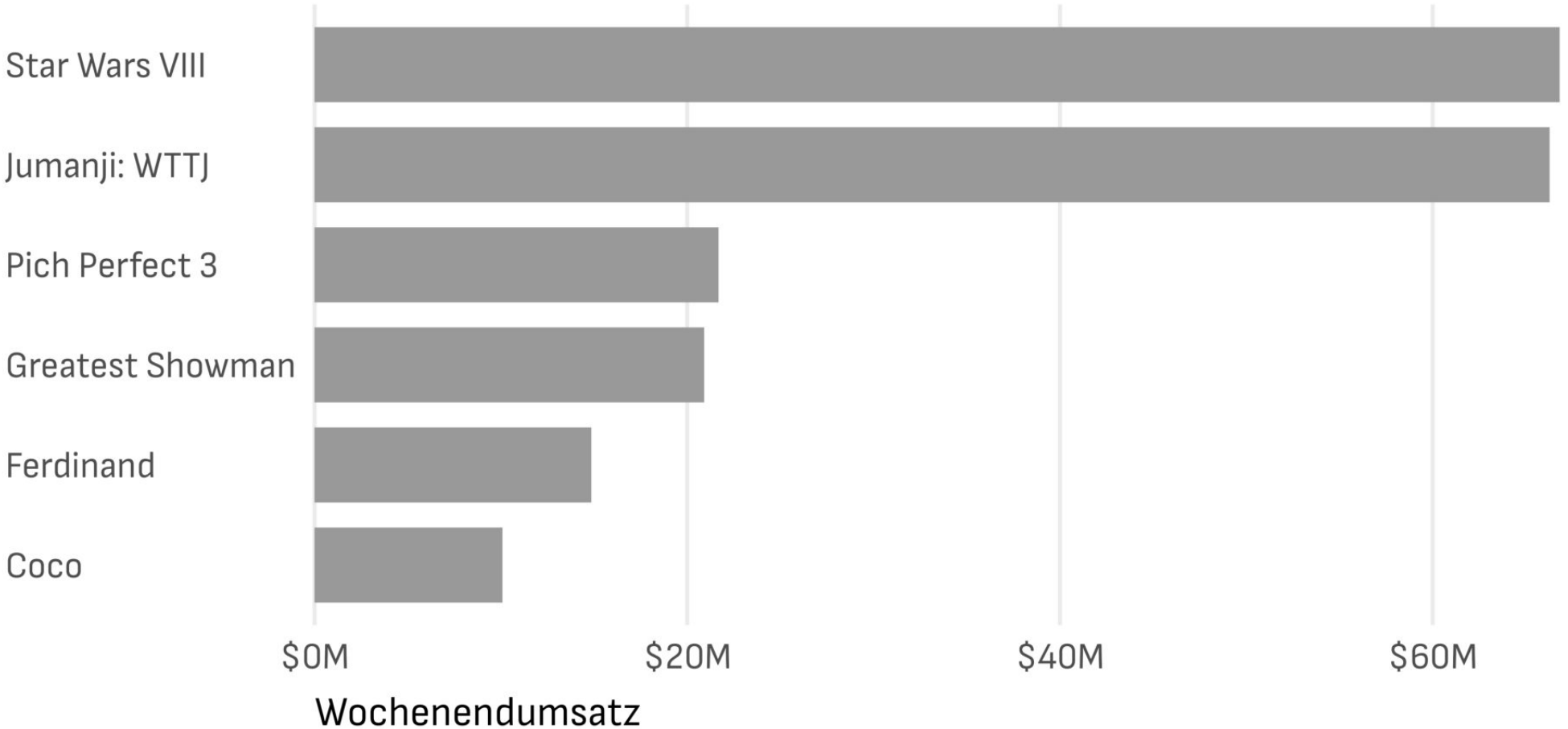
Coco
$0M
$20M
$40M
$60M
Wochenendumsatz

“Star Wars VIII” führt das dritte Wochenende in Folge die Kinocharts an, jedoch nur ganz knapp vor “Jumanji: Willkommen im Dschungel”.



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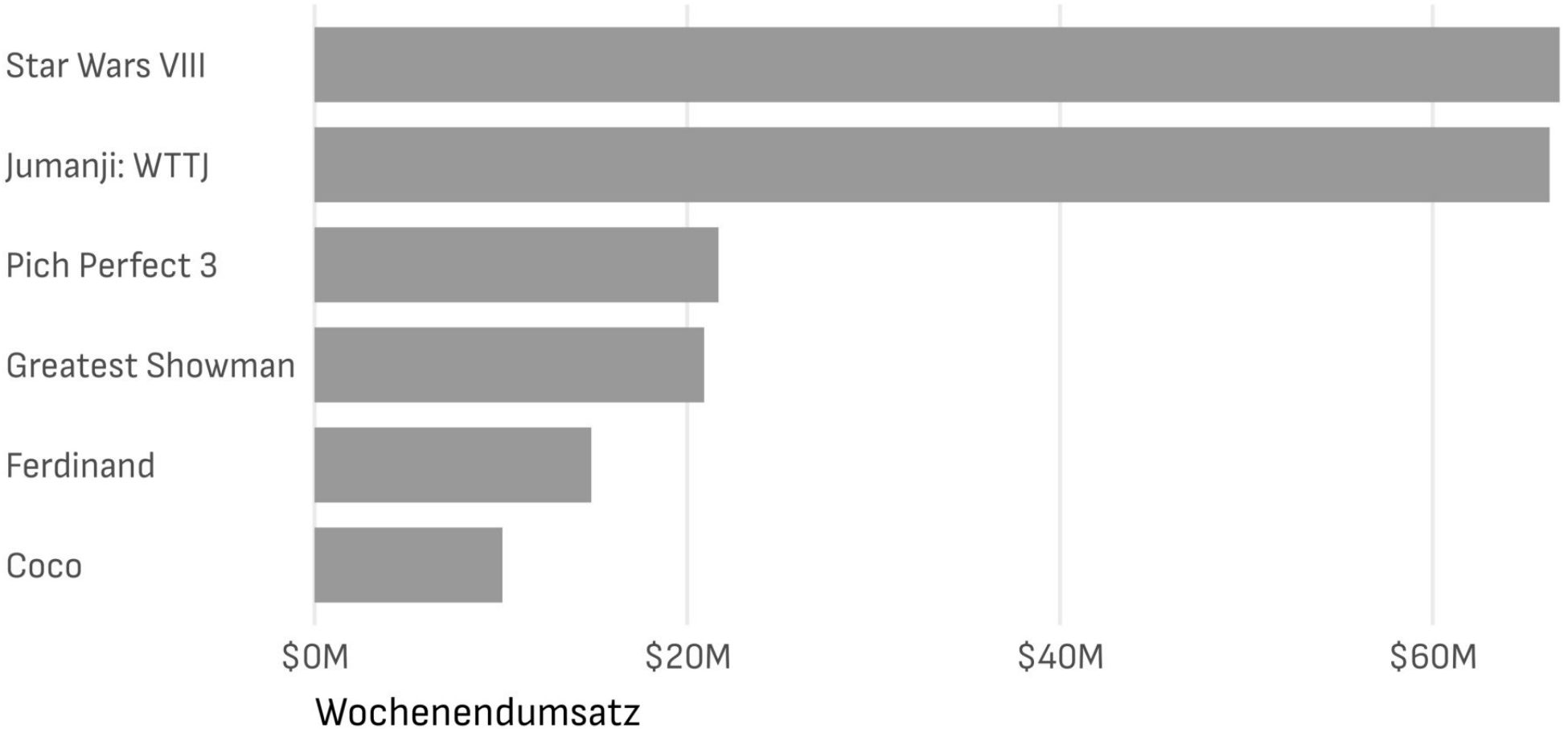

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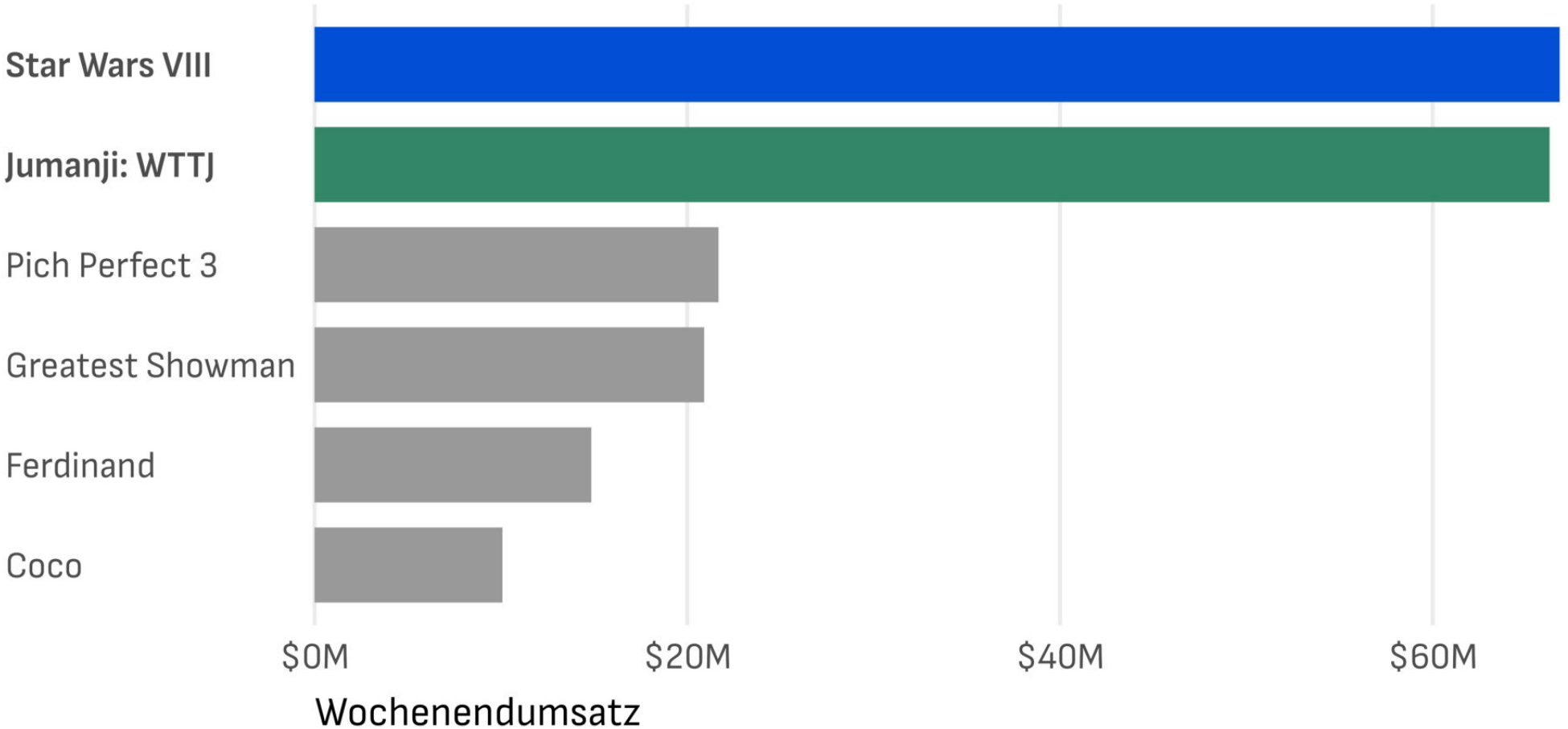

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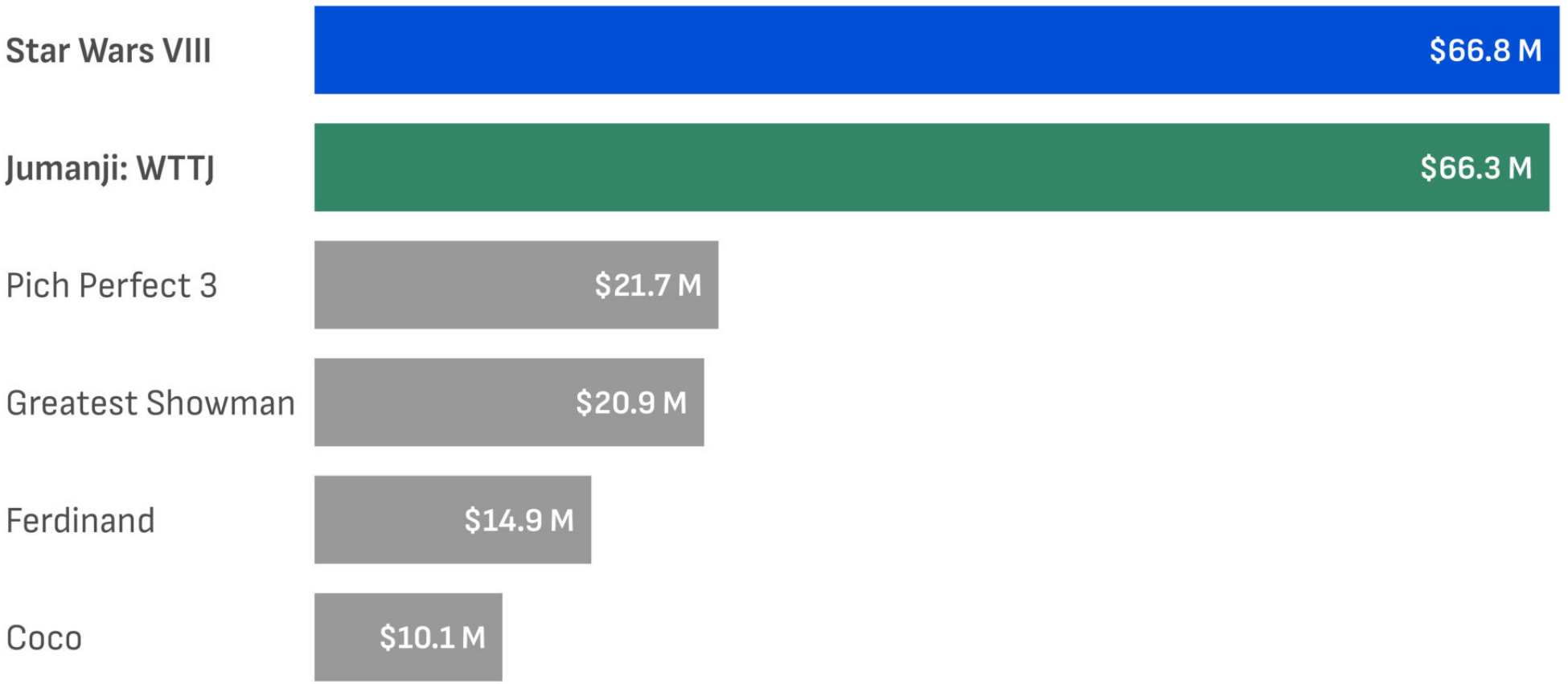
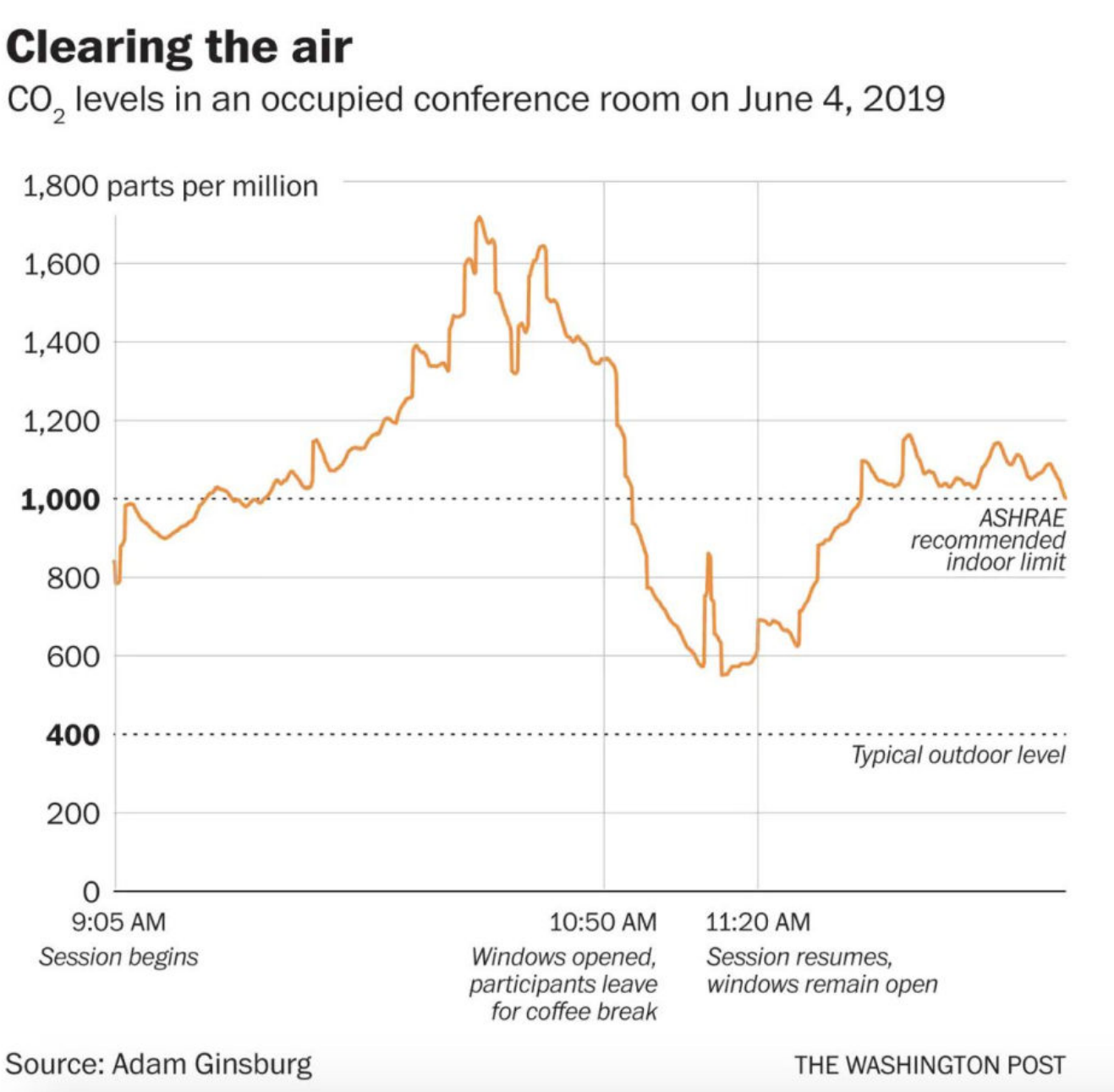


Wrap-Up



Quelle: "Clearing the Air" von Adam Ginsburg (Washington Post)

Notizen von Francis Gagnon (Voilà)

Information

Verstehe deine Daten und sei genau und ehrlich.

Erzählung

Sei dir über die gewünschte Botschaft im Klaren.

Ziel

Wähle geeignete Diagramme, um die Botschaft zu vermitteln.

Visuelle Form

Rücke die Daten in den Mittelpunkt und leite das Publikum.

Dankeschön!

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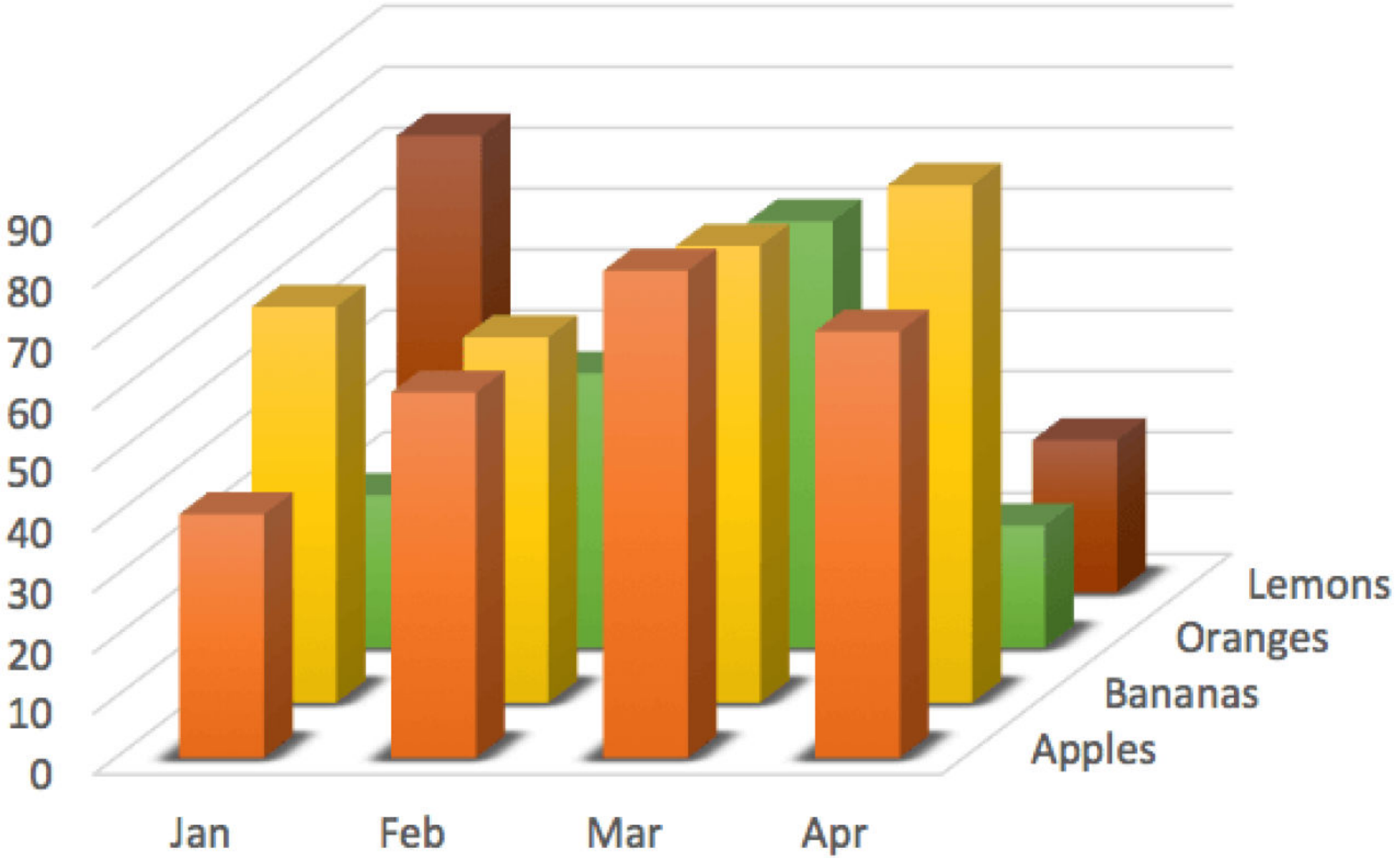
Buy me a coffee

Übung

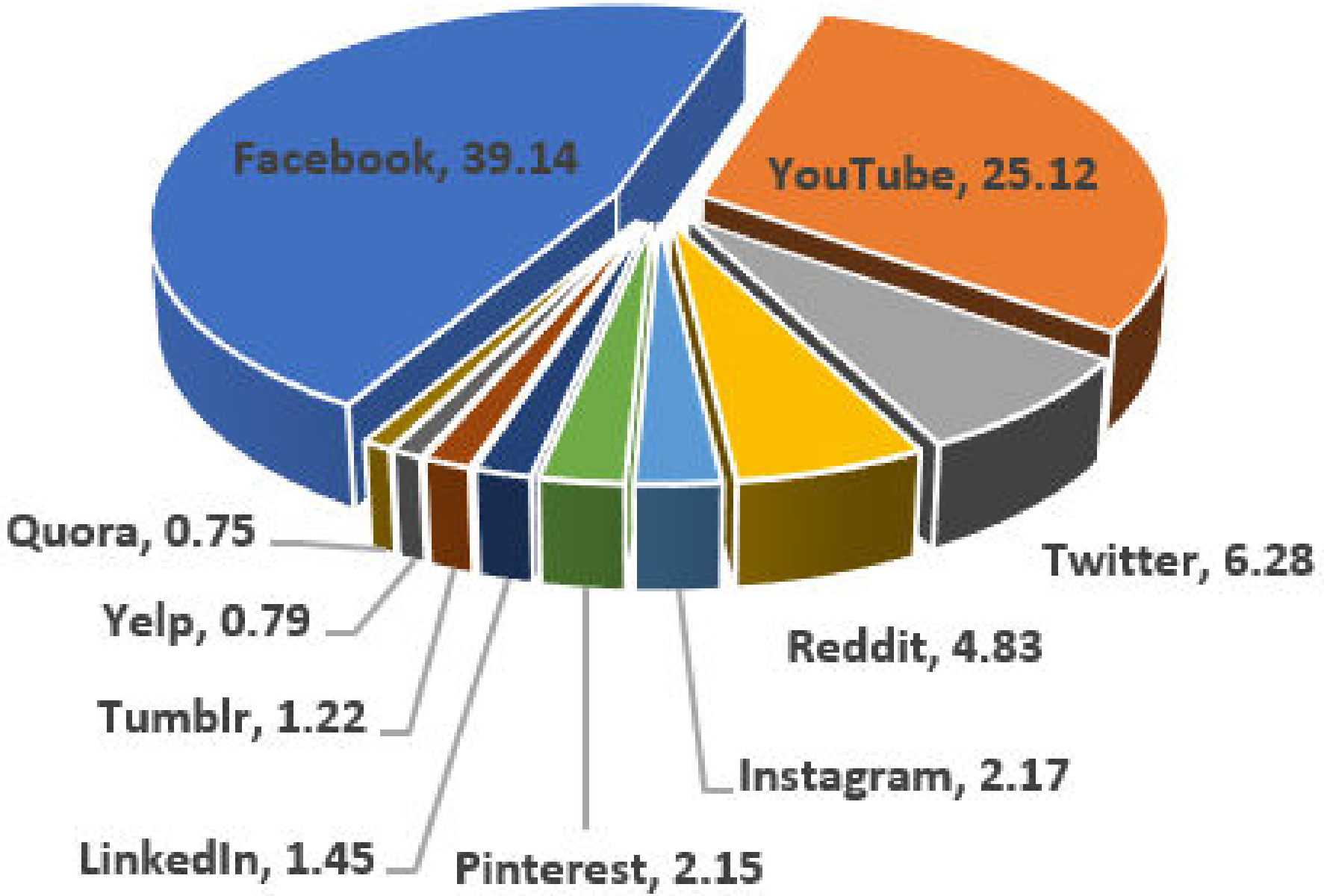
Übung

Betrachtet die folgenden Datenvisualisierungen genauer.

- Was ist die **Hauptbotschaft**, die die Grafik transportiert?
- Was ist der **Zweck** der Visualisierung? Wer ist das **Publikum**?
- Welche **Kodierung(en)** wurde(n) genutzt? Ist sie sinnvoll?
- Ist der **Fokus** klar? Falls ja: welche Attribute wurden genutzt? Falls nein: wie könnte man das Publikum besser führen?
- Bewertet die Grafiken nach den vier Kriterien:
  Information, **Erzählung**, **Ziel** und **Visuelle Form**.
- Sammelt drei Dinge, die euch auffallen, egal ob positiv oder negativ. Wie könnten die Details, die euch nicht gefallen, verbessert werden?

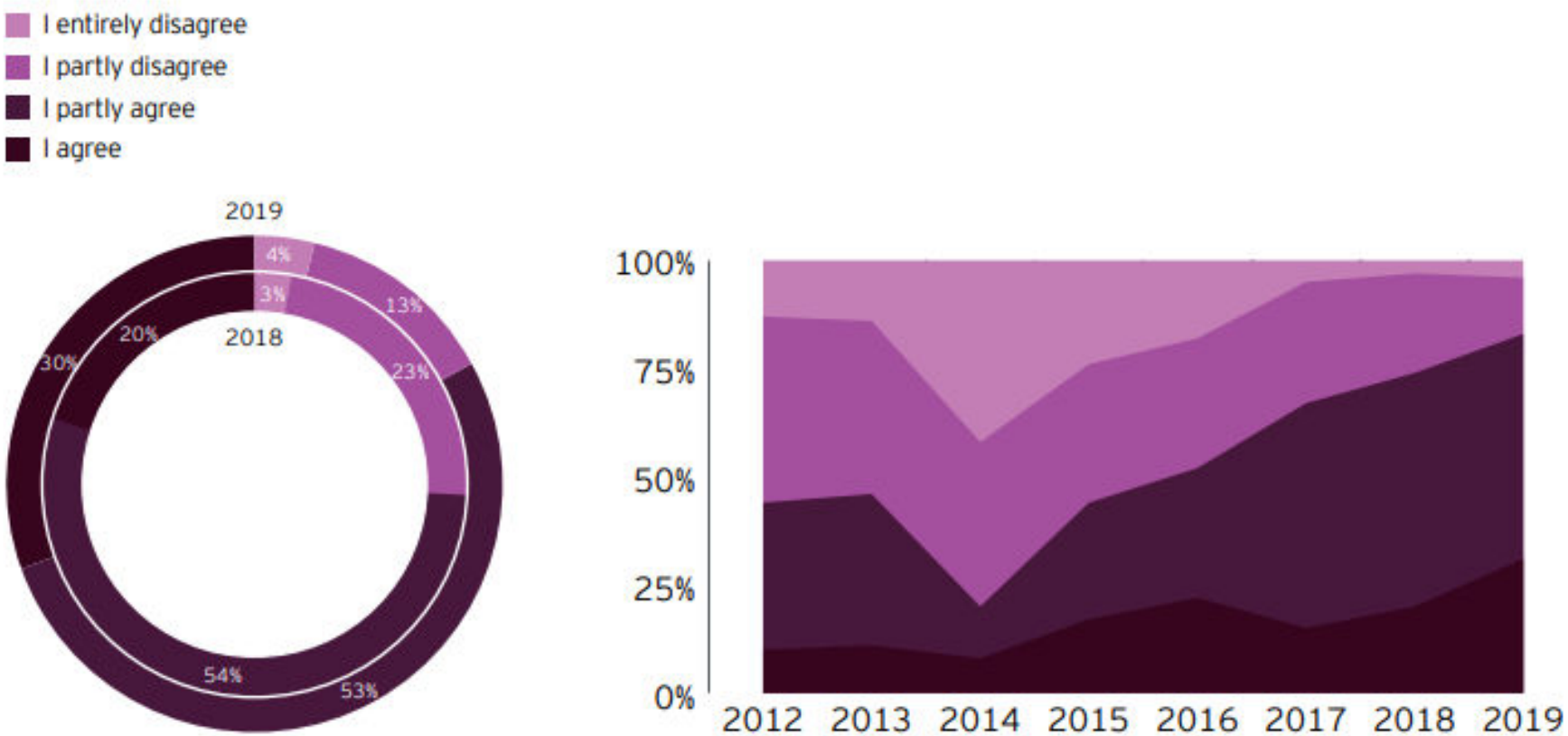


Quelle: unbekannt



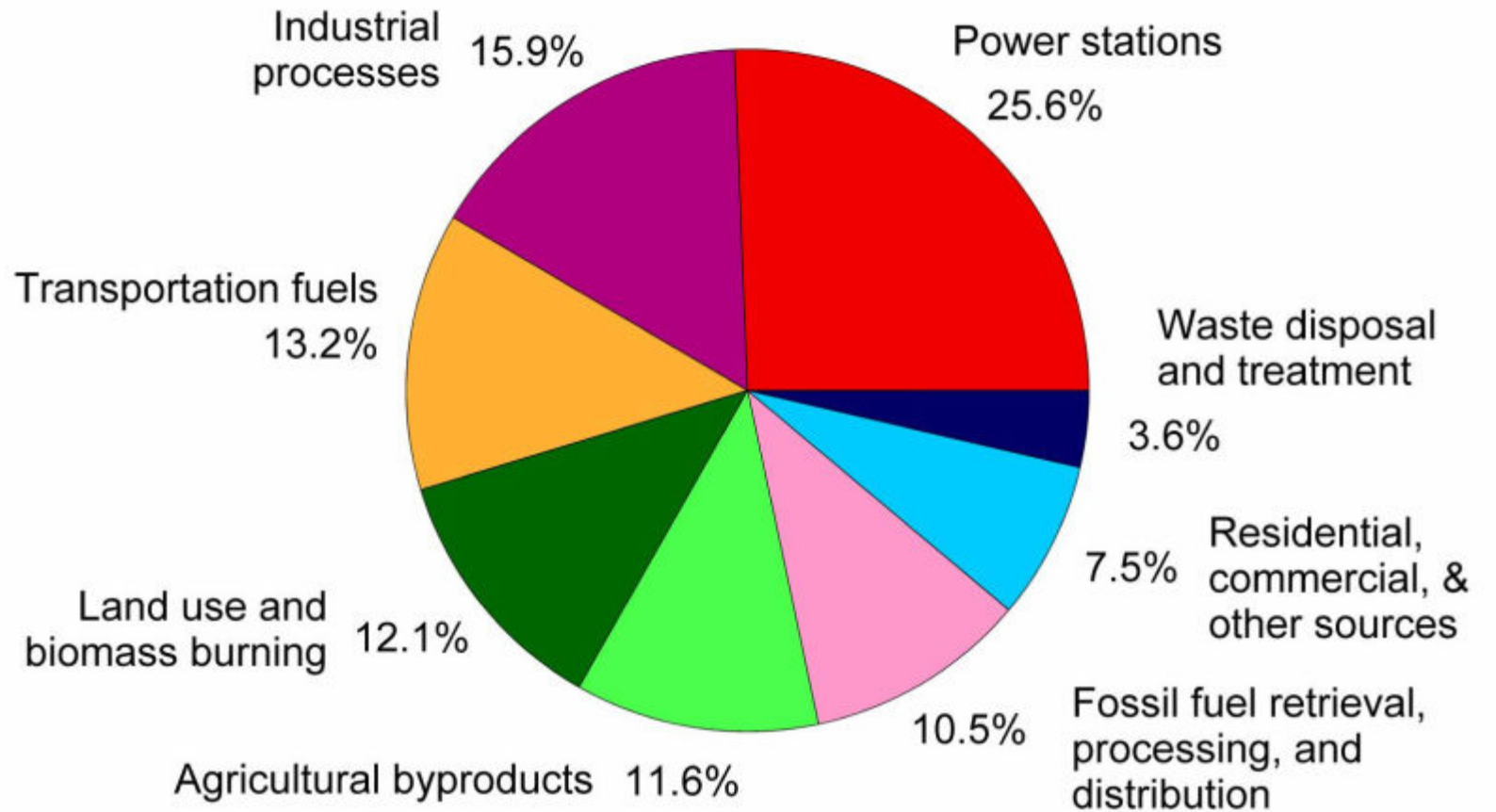
Marktanteil der Besuche auf sozialen Netzwerkseiten im November 2017,
gefunden im Blog-Beitrag über "Why you shouldn't use pie charts" der Universität Melbourne

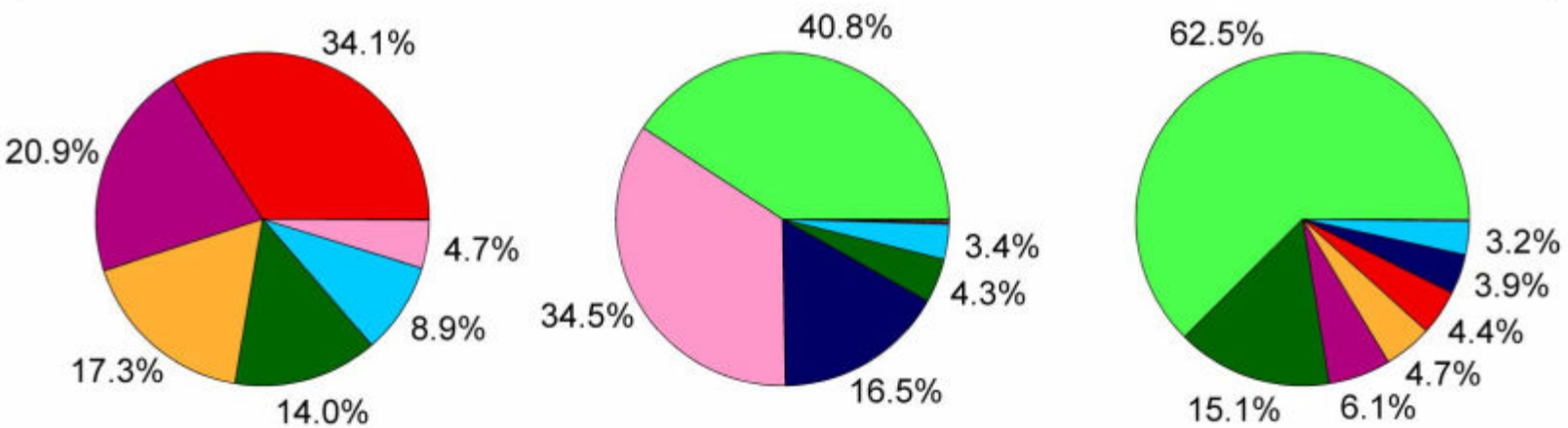
Do you agree with the following statement?
«The price of banking services will fall.»



Quelle: Ernest & Young

Annual Greenhouse Gas Emissions by Sector





Carbon Dioxide **Methane** **Nitrous Oxide**