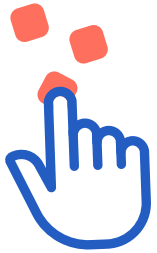
Turning research data into powerful visuals

Visualizing scientific research

Koen Van den Eeckhout - Baryon



All the slides and all the links:

baryon.be/dataviz-resources

Session 1

Communicating with data

Graphical representation of data

homework assignment part 1

Session 2

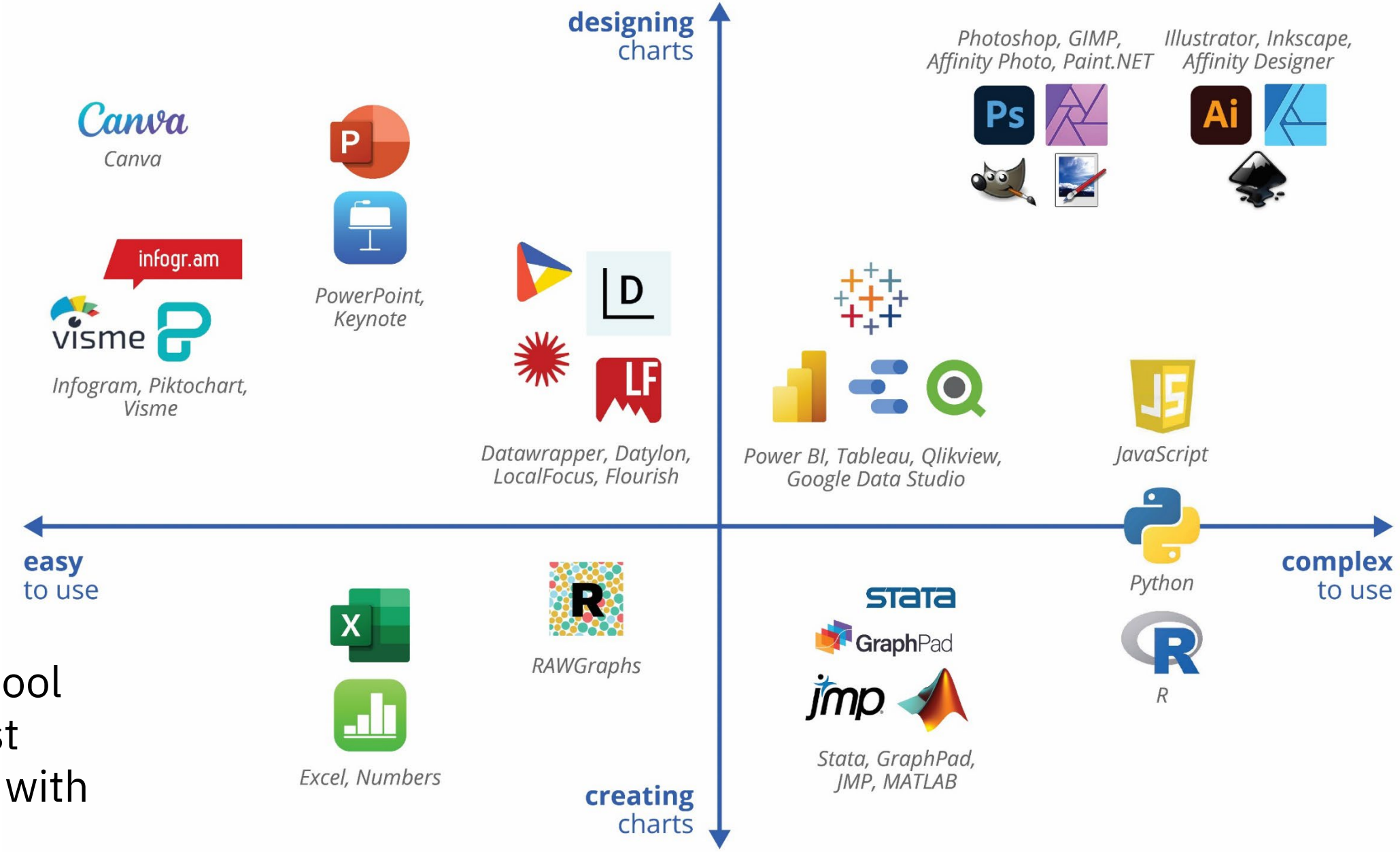
Producing and designing data visuals

homework assignment part 2

Session 3

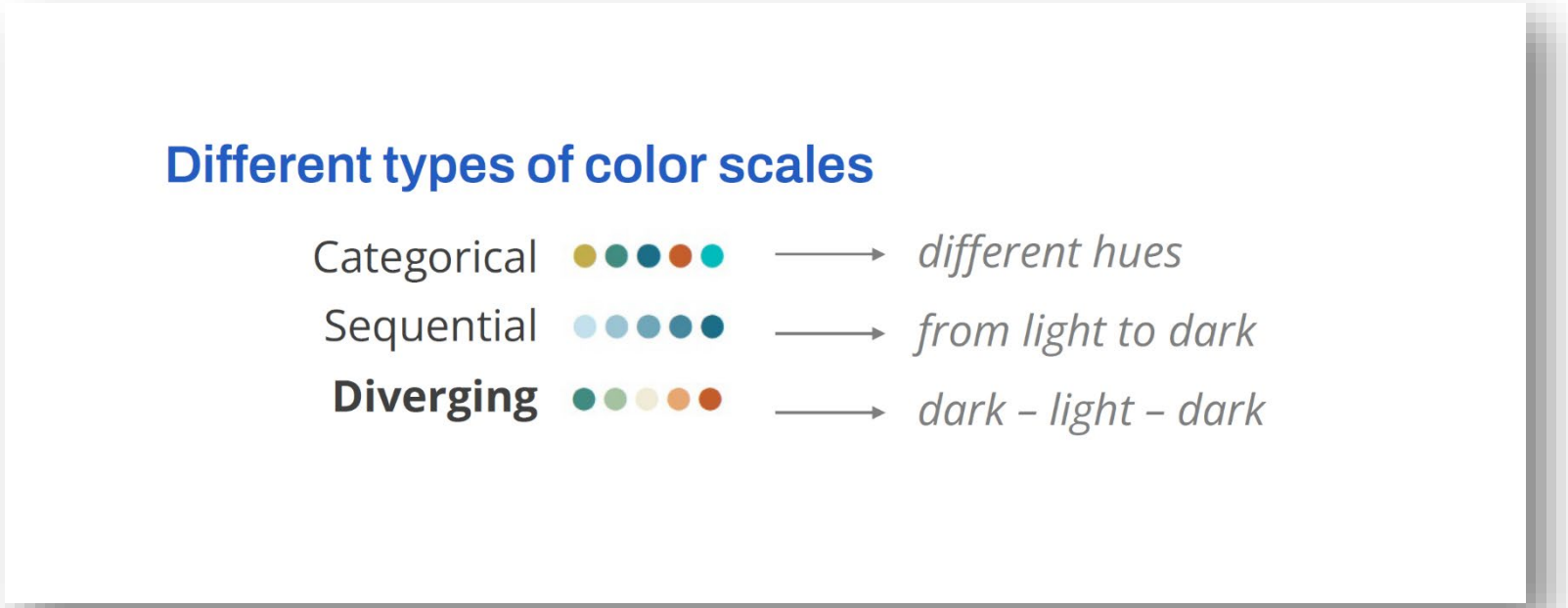
Visualizing scientific research

Tools to create data visuals



Choose the tool you feel most comfortable with

Colors and typography



Data visualization

counter

Readability at small font sizes!

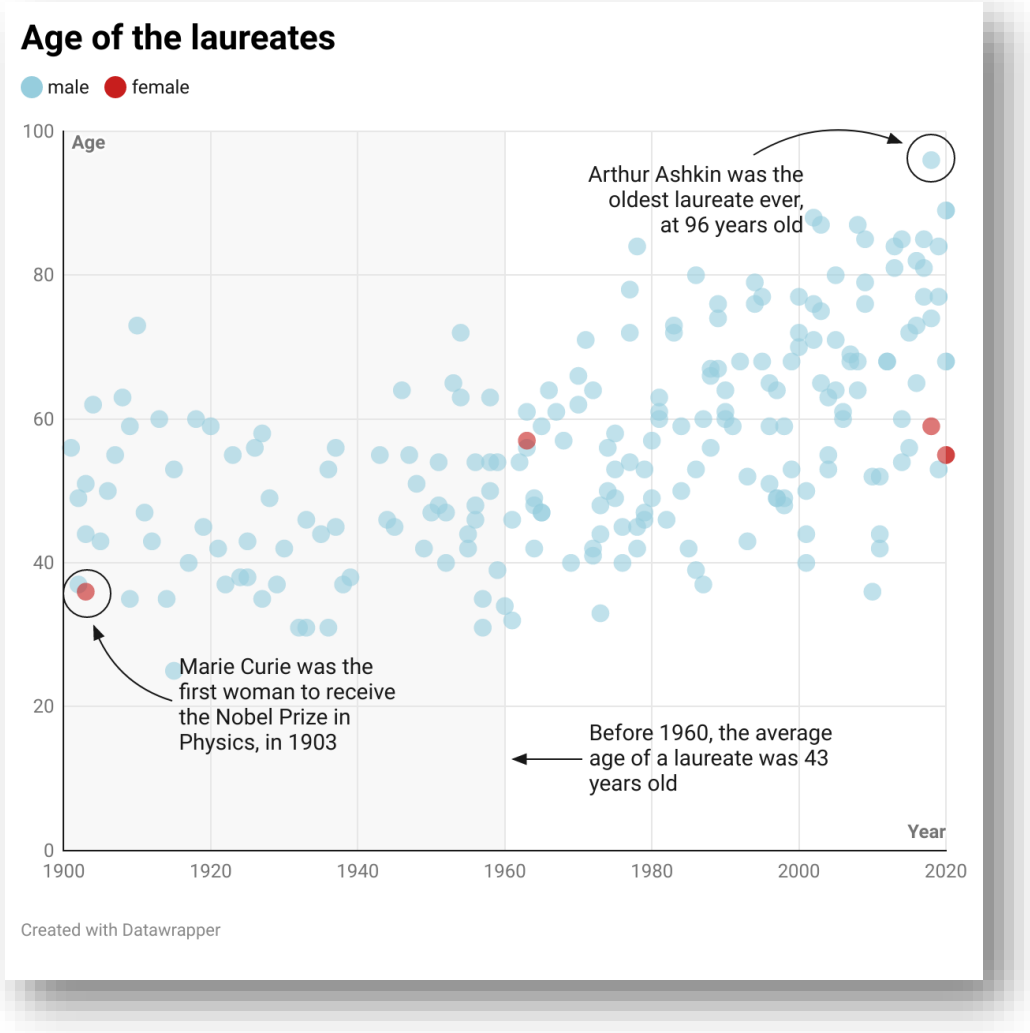
Interactive data visuals

Types of interactivity

tooltips

filtering and navigation

storytelling



Feedback

Feedback on homework assignment part 2

15’ break

Use cases

Dealing with outliers

Qualitative charts

Creating better tables

Projections and missing data

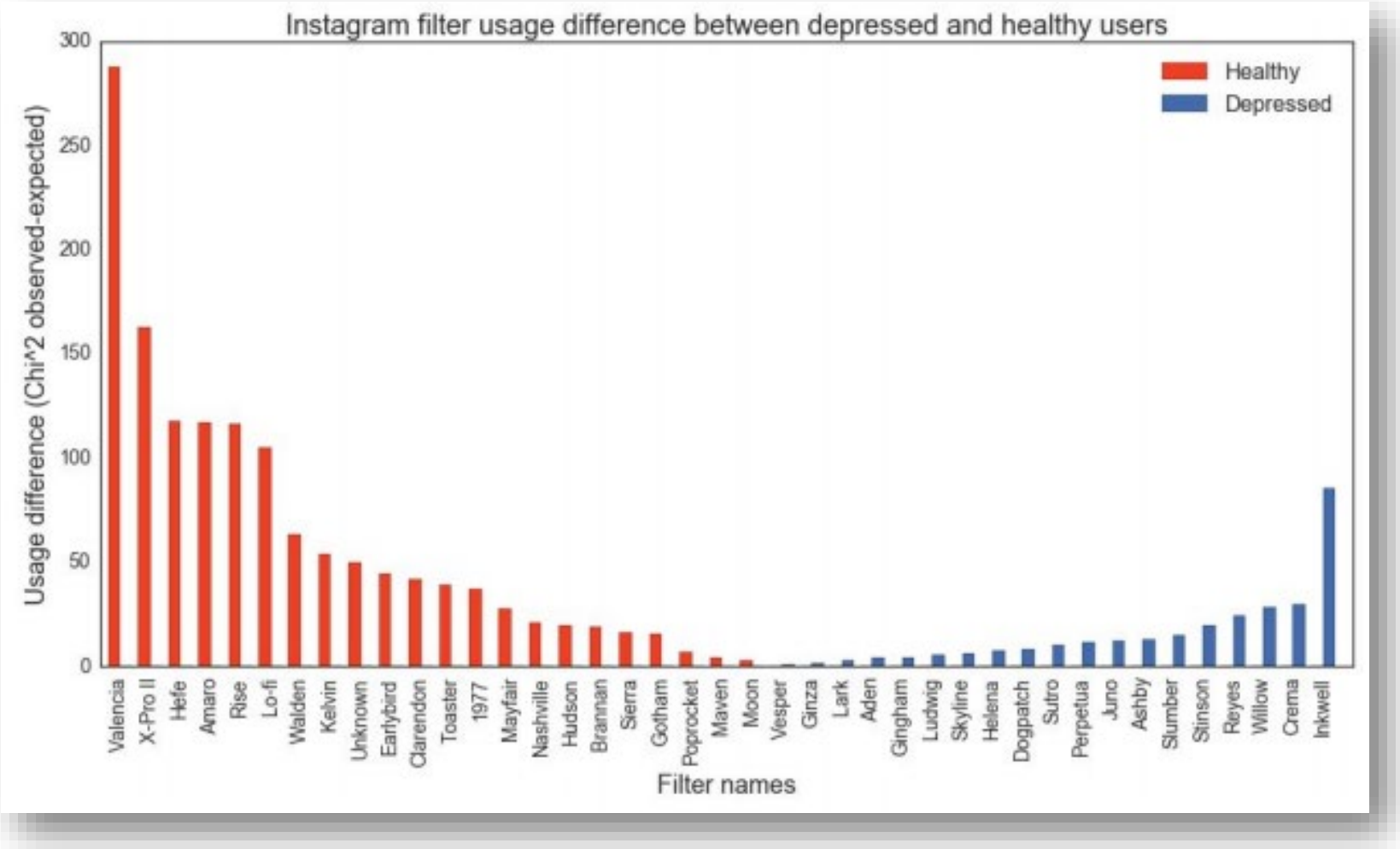
Visuals for posters and presentations

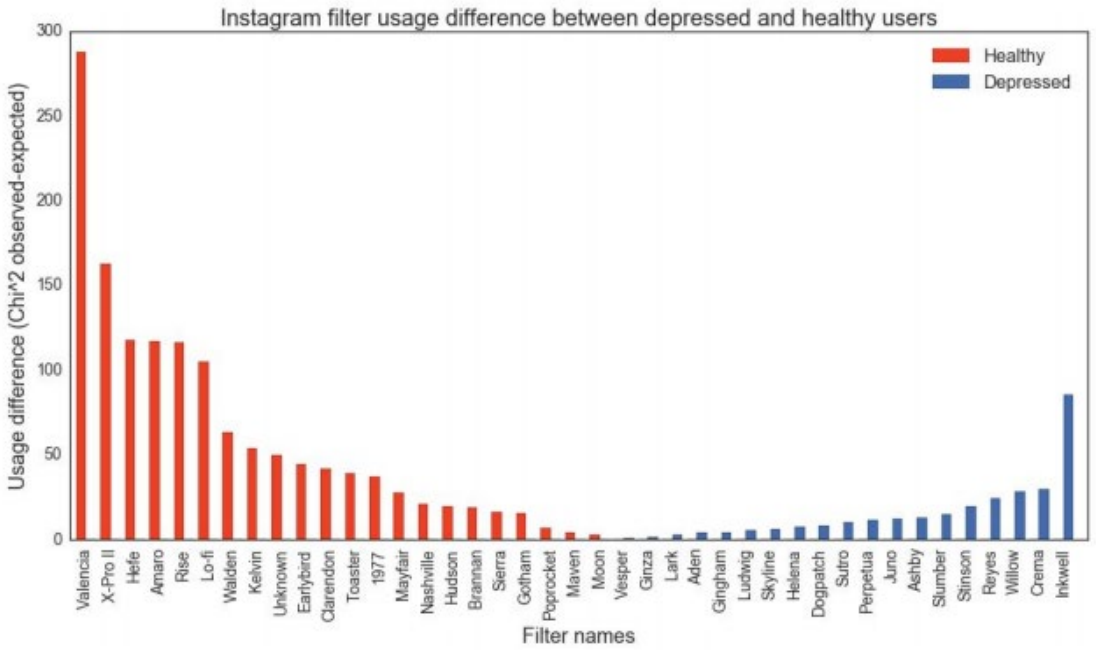
Feedback

How would you do it?

Share what you **don't like** about this visual

What would you change to **improve it**?




Instagram filter usage difference between depressed and healthy users
Usage difference (Chi^2 observed-expected)
Filter names
Healthy
Depressed
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Lo-fi
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Kelvin
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Toaster
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Mayfair
Nashville
Hudson
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Poprocket
Maven
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Gingham
Ludwig
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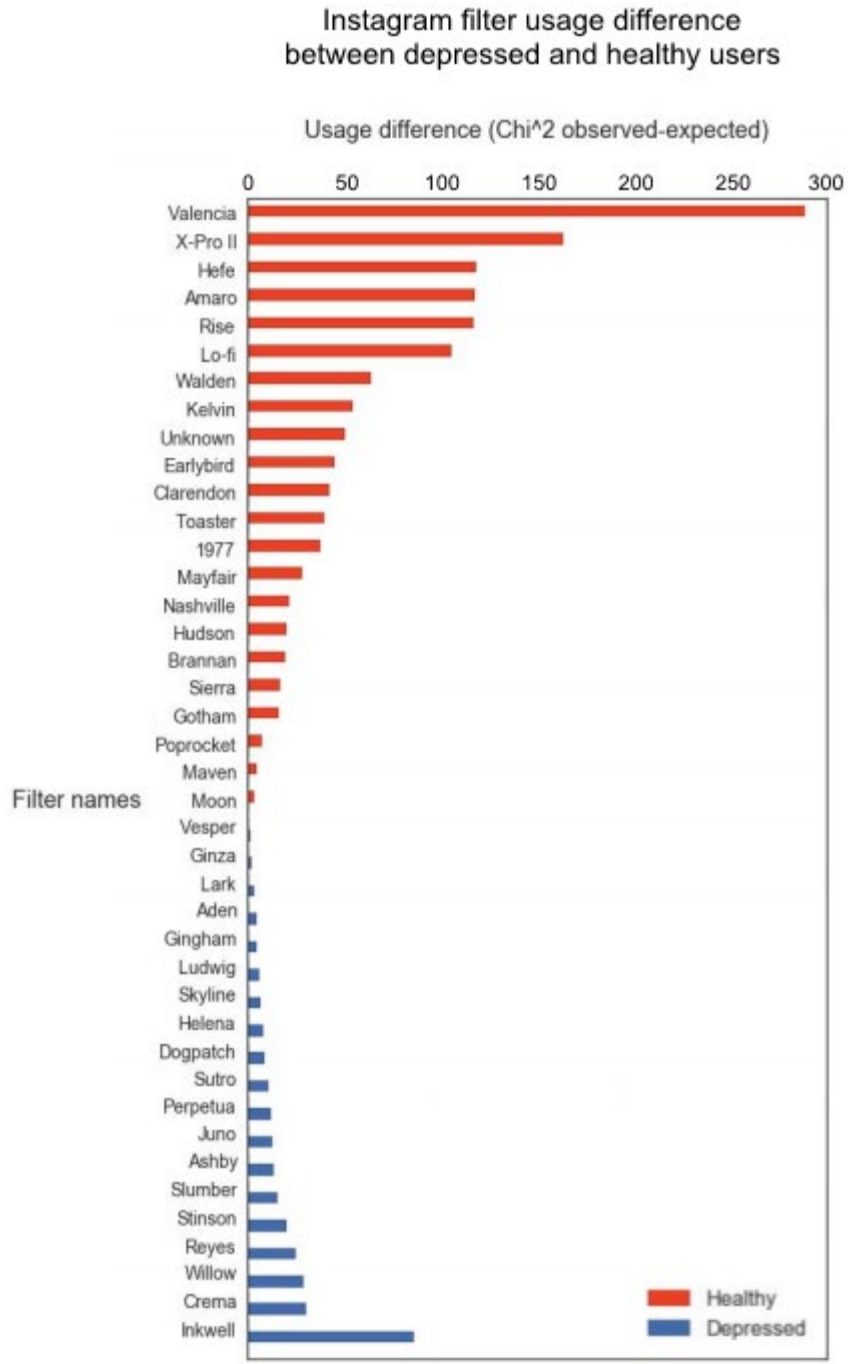
Inkwell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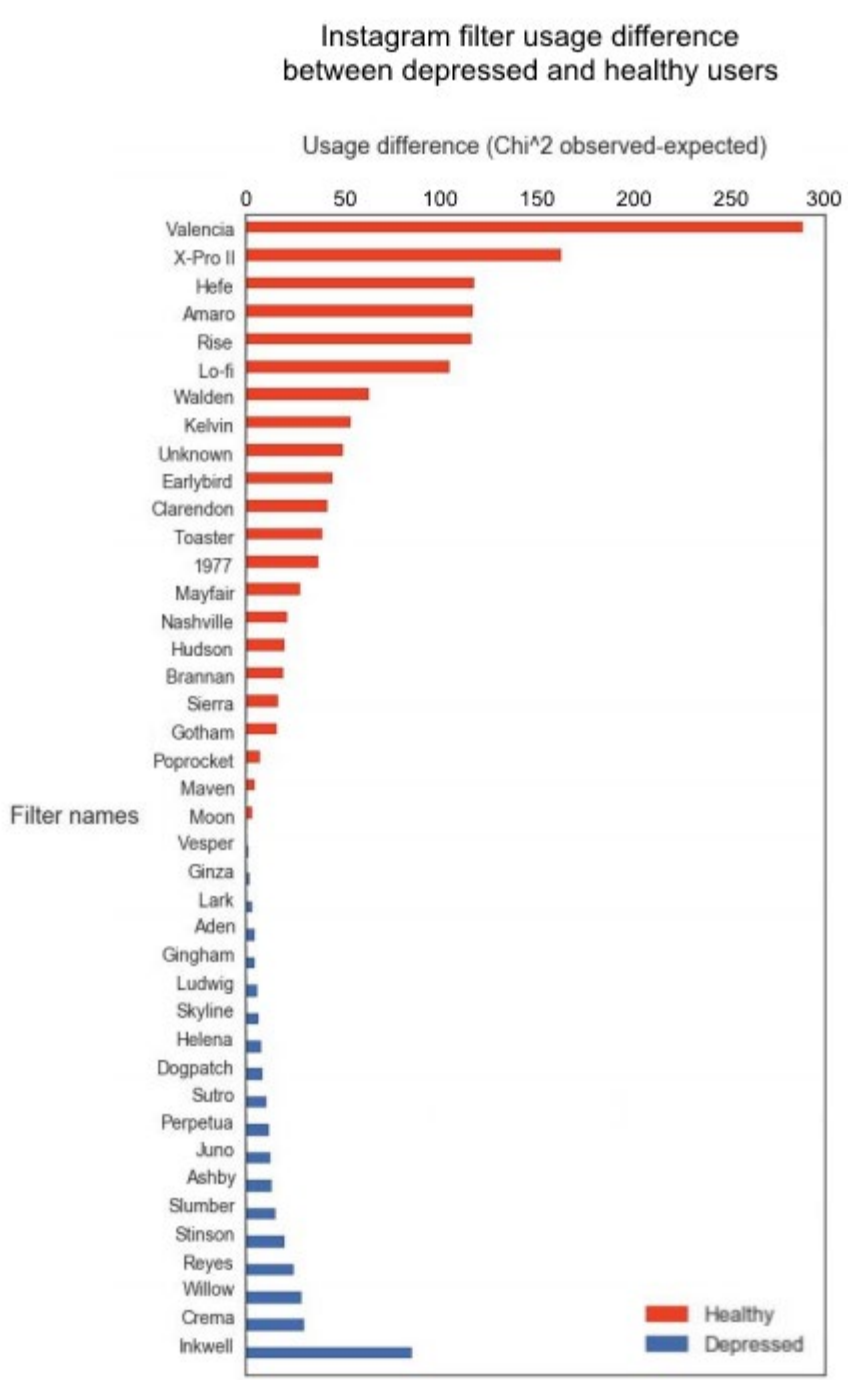
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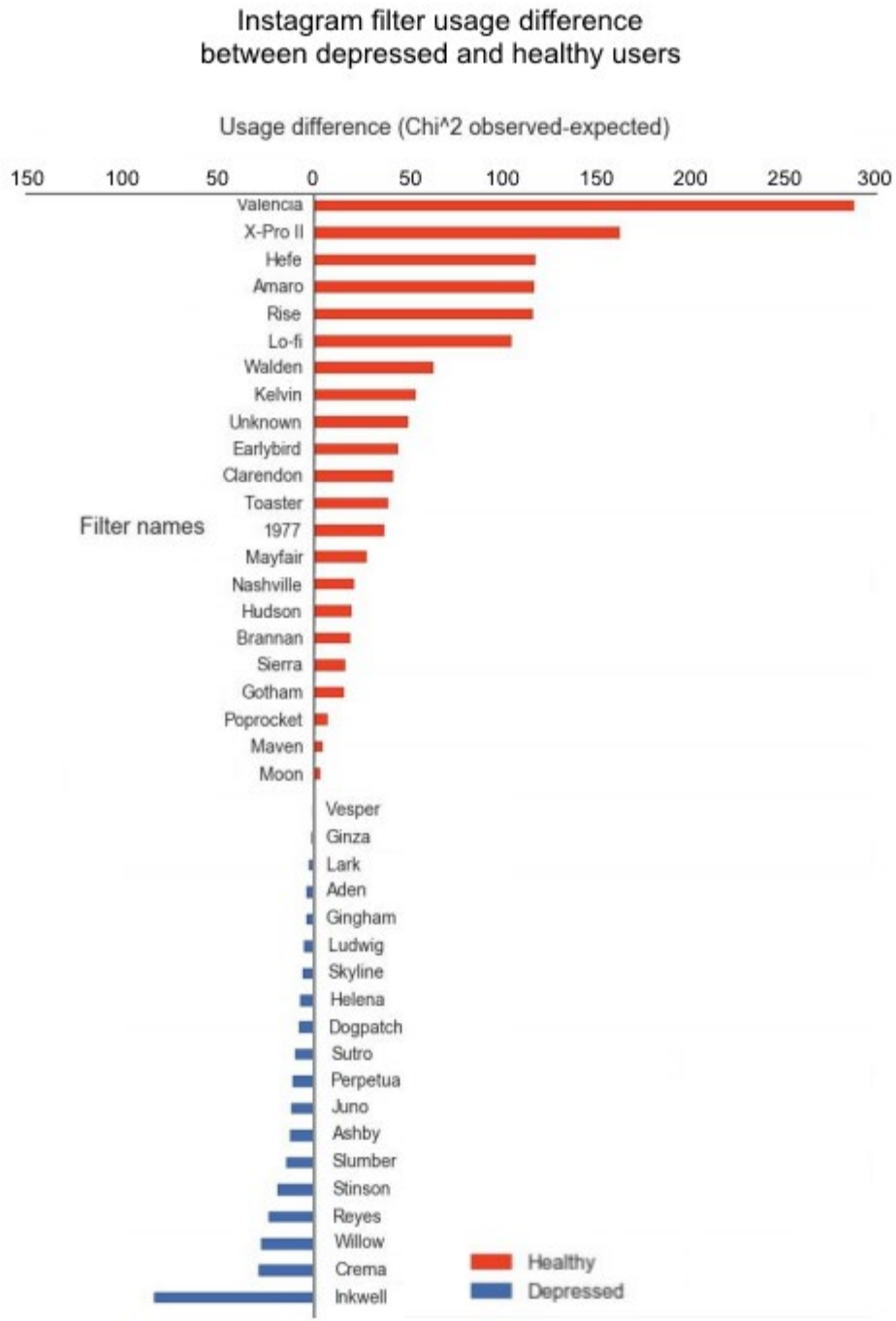
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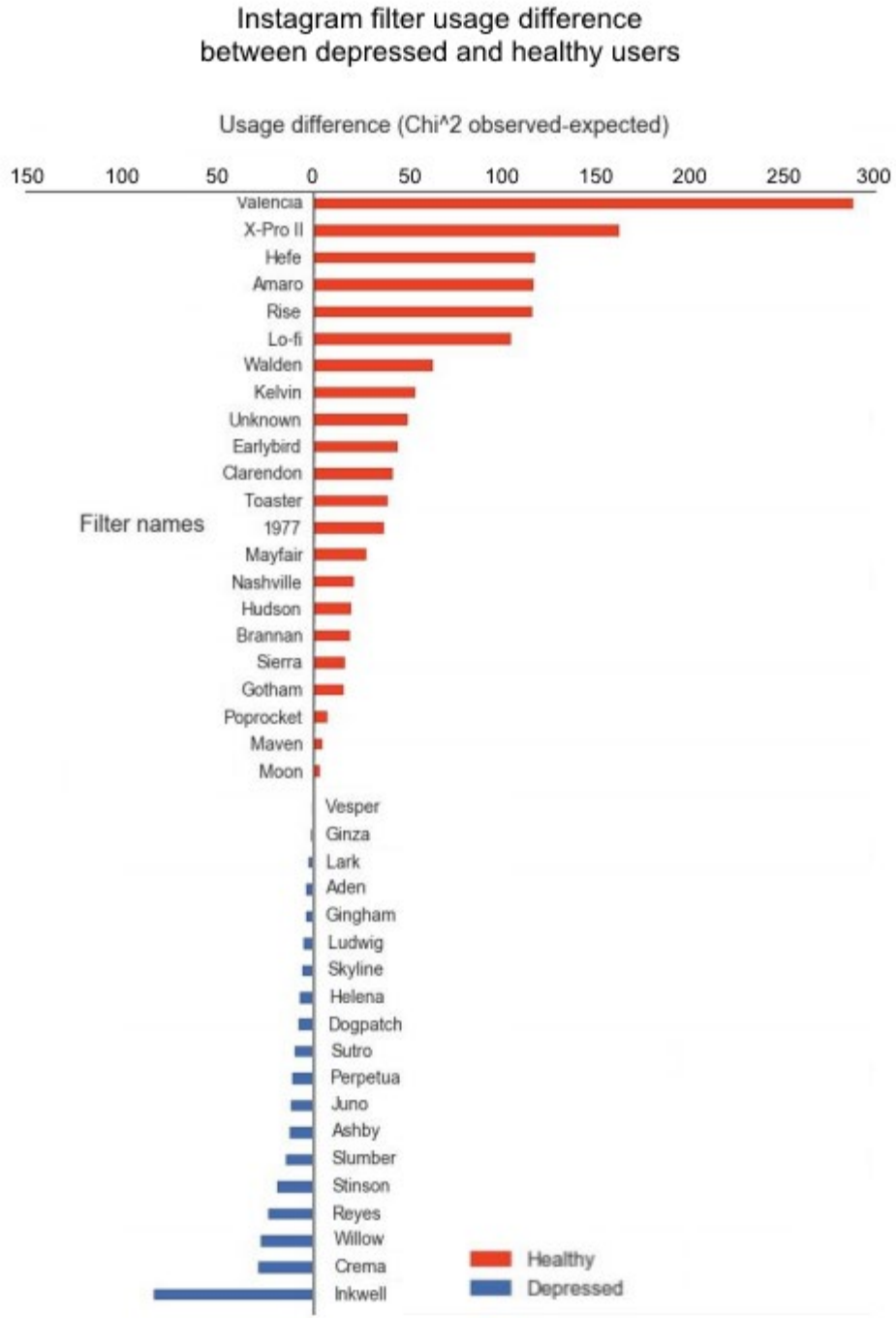

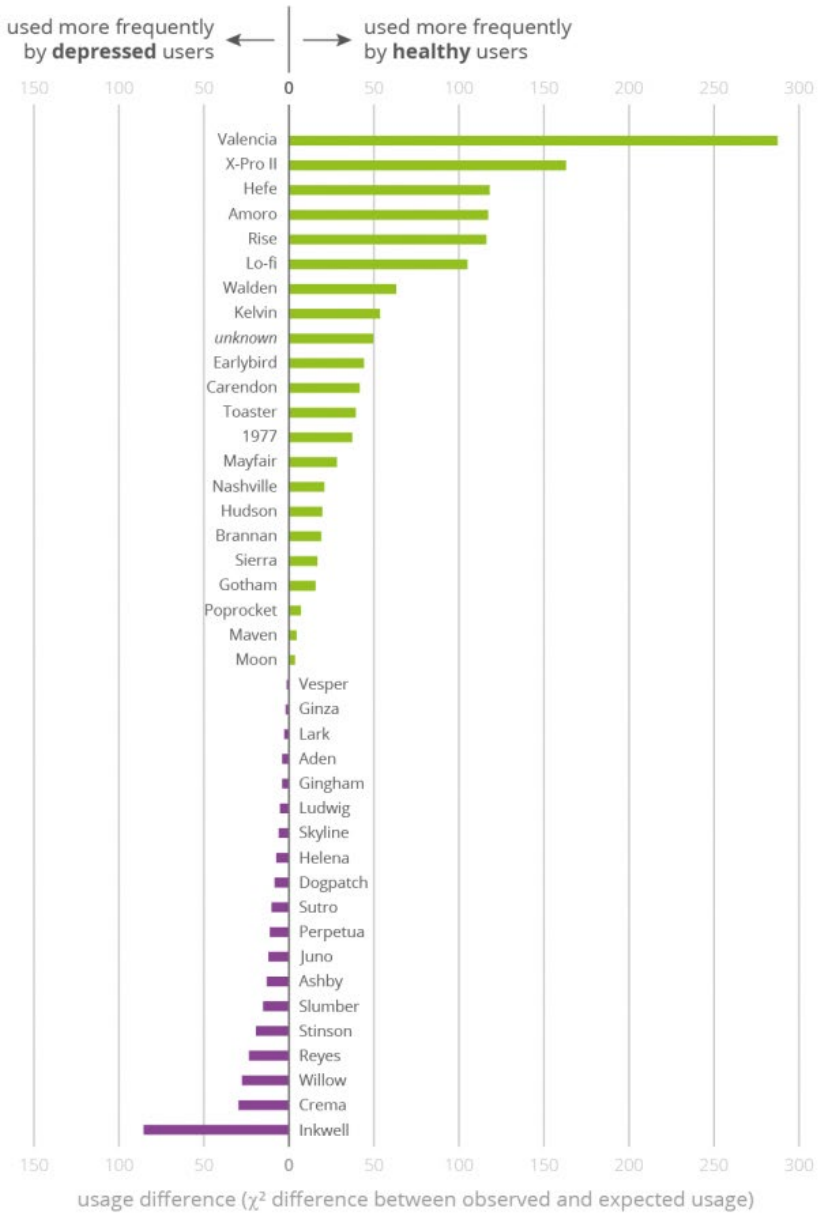

* ***Source:*** *Instagram photos reveal predictive markers of depression, Reece and Danforth, arXiv:1608.03282*

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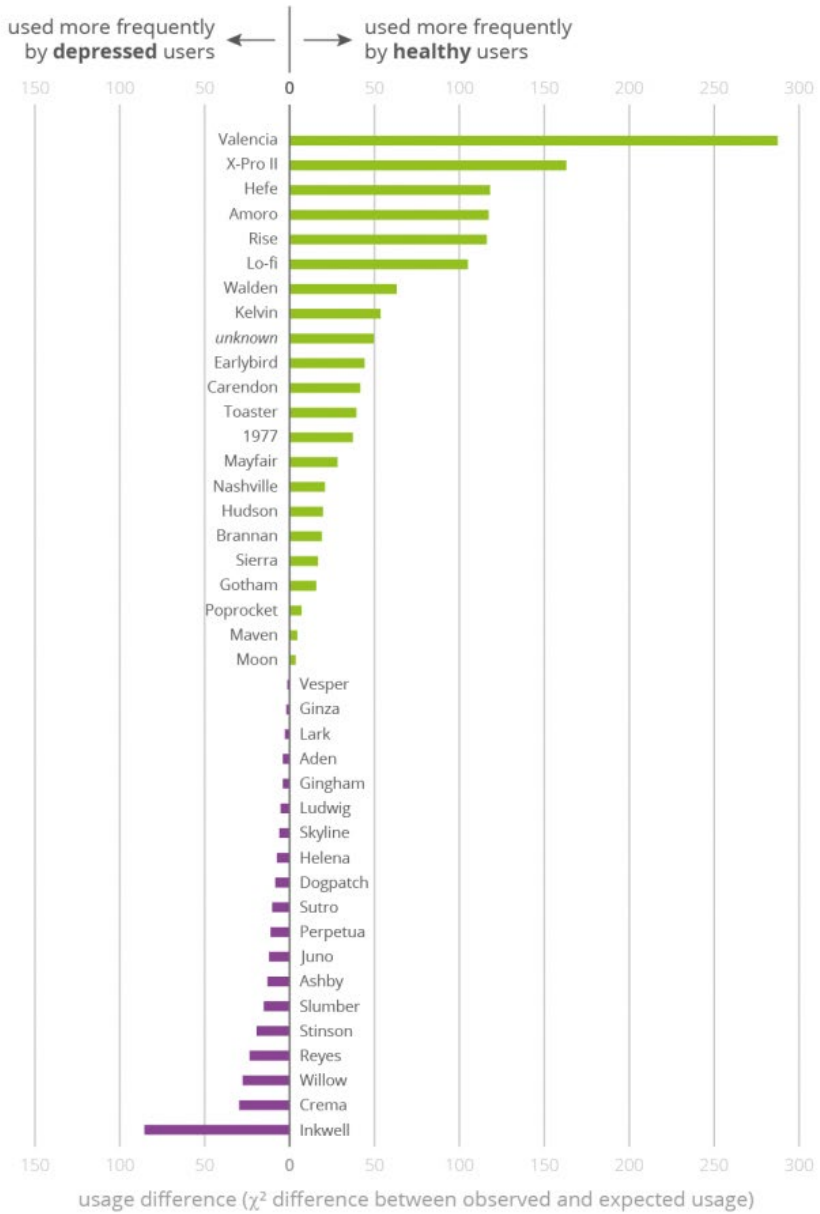

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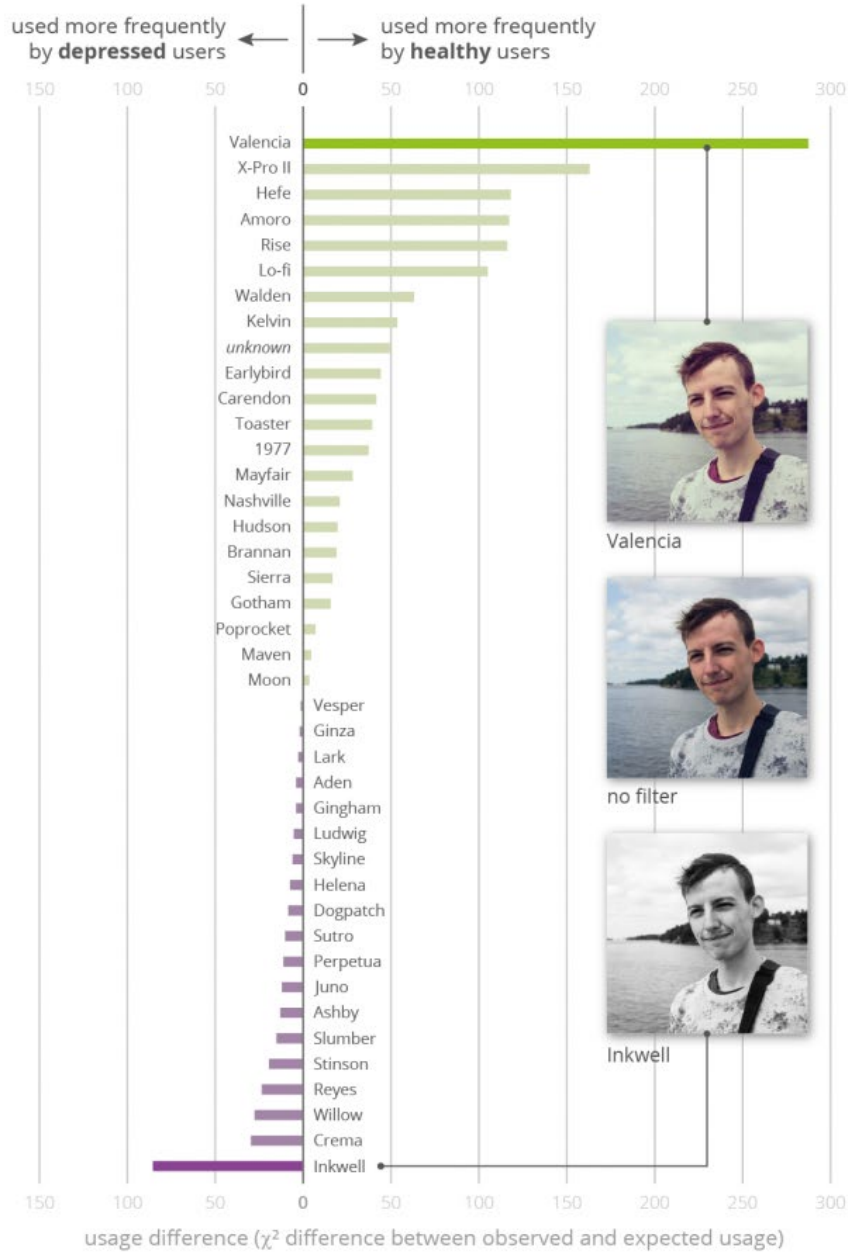
Healthy and depressed Instagram users tend to choose different photo filters*



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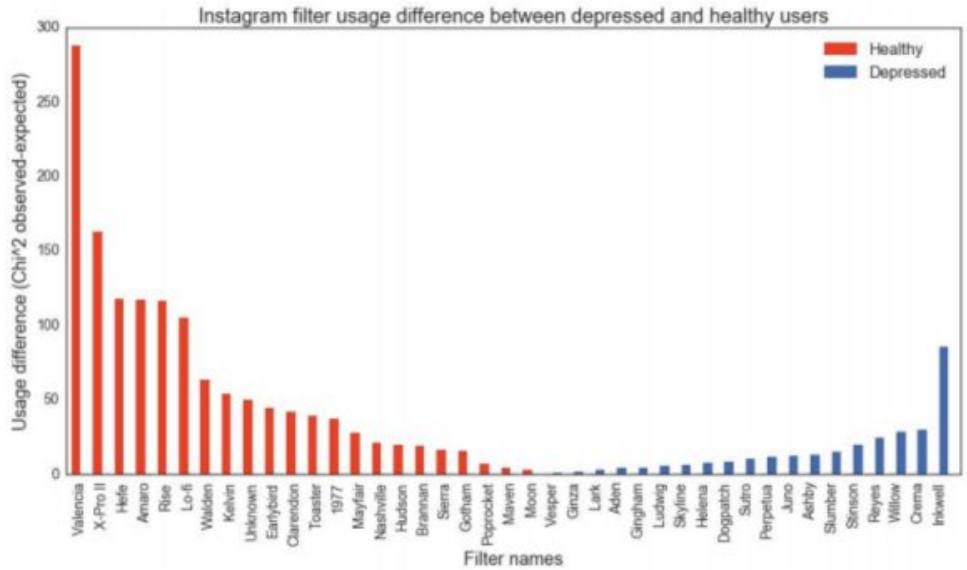
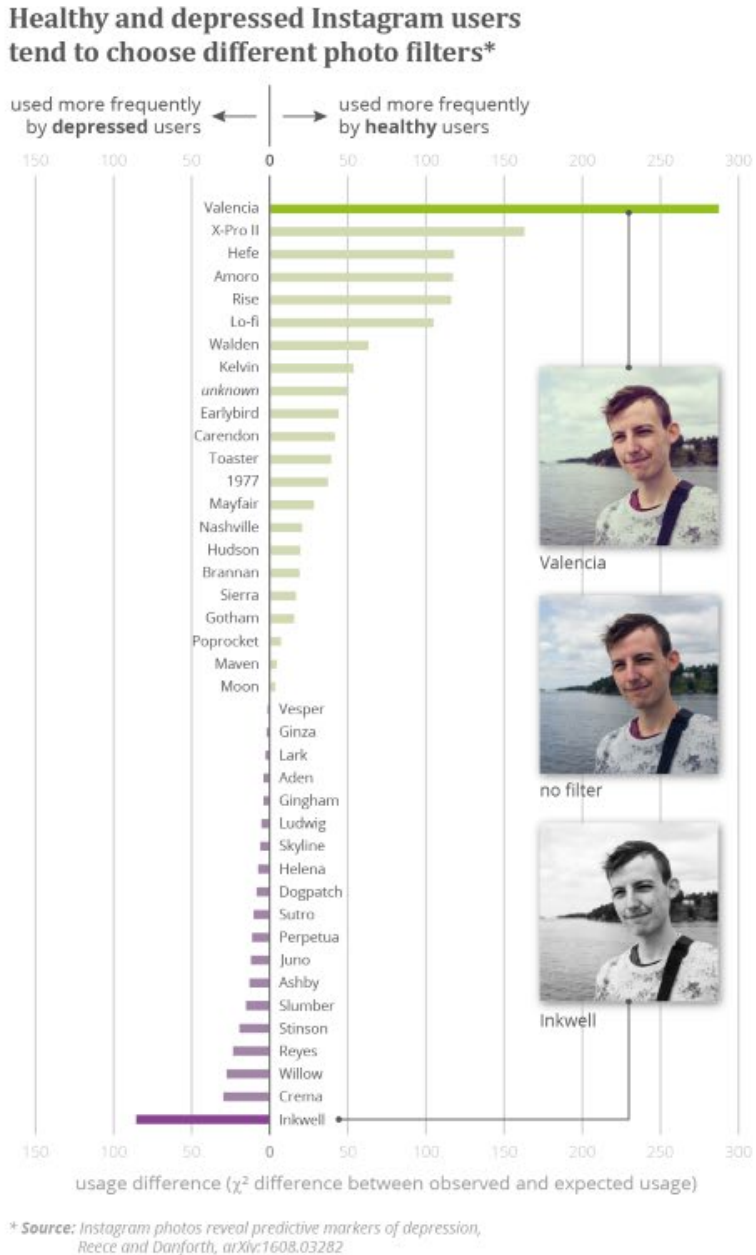


ORIGINAL



IMPROVED

Data Visualization Checklist

by Stephanie Evergreen & Ann K. Emery

This checklist is meant to be used as a guide for the development of high impact data visualizations. Rate each aspect of the data visualization by circling the most appropriate number, where 2 points means the guideline was fully met, 1 means it was partially met, and 0 means it was not met at all. n/a should not be used frequently, but reserved for when the guideline truly does not apply. For example, a pie chart has no axes lines or tick marks to rate. If the guideline has been broken intentionally to make a point, rate it n/a and deduct those points from the total possible. Refer to the Data Visualization Anatomy Chart on the last page for guidance on vocabulary and the Resources at the end for more details.

	Guideline	Rating
Text Graphs don't contain much text, so existing text must encapsulate your message and pack a punch.	**6-12 word descriptive title is left-justified in upper left corner** Short titles enable readers to comprehend takeaway messages even while quickly skimming the graph. Rather than a generic phrase, use a descriptive sentence that encapsulates the graph's finding or "so what?" Western cultures start reading in the upper left, so locate the title there.	2 1 0 n/a
	Subtitle and/or annotations provide additional information Subtitles and annotations (call-out text within the graph) can add explanatory and interpretive power to a graph. Use them to answer questions a viewer might have or to highlight specific data points.	2 1 0 n/a
	Text size is hierarchical and readable Titles are in a larger size than subtitles or annotations, which are larger than labels, which are larger than axis labels, which are larger than source information. The smallest text - axis labels - are at least 9 point font size on paper, at least 20 on screen.	2 1 0 n/a
	Text is horizontal Titles, subtitles, annotations, and data labels are horizontal (not vertical or diagonal). Line labels and axis labels can deviate from this rule and still receive full points. Consider switching graph orientation (e.g., from column to bar chart) to make text horizontal.	2 1 0 n/a
	Data are labeled directly Position data labels near the data rather than in a separate legend (e.g., on top of or next to bars and next to lines). Eliminate/embed legends when possible because eye movement back and forth between the legend and the data can interrupt the brain's attempts to interpret the graph.	2 1 0 n/a
	Labels are used sparingly Focus attention by removing the redundancy. For example, in line charts, label every other year on an axis. Do not add numeric labels *and* use a y-axis scale, since this is redundant.	2 1 0 n/a

Arrangement

Improper arrangement of graph elements can confuse readers at best and mislead viewer at worst. Thoughtful arrangement makes a data visualization easier for a viewer to interpret.

Proportions are accurate A viewer should be able measure the length or area of the graph with a ruler and find that it matches the relationship in the underlying data. Y-axis scales should be appropriate. Bar charts start axes at 0. Other graphs can have a minimum and maximum scale that reflects what should be an accurate interpretation of the data (e.g., the stock market ticker should not start at 0 or we won't see a meaningful pattern).	2	1	0	n/a
Data are intentionally ordered Data should be displayed in an order that makes logical sense to the viewer. Data may be ordered by frequency counts (e.g., from greatest to least for nominal categories), by groupings or bins (e.g., histograms), by time period (e.g., line charts), alphabetically, etc. Use an order that supports interpretation of the data.	2	1	0	n/a
Axis intervals are equidistant The spaces between axis intervals should be the same unit, even if every axis interval isn't labeled. Irregular data collection periods can be noted with markers on a line graph, for example.	2	1	0	n/a
Graph is two-dimensional Avoid three-dimensional displays, bevels, and other distortions.	2	1	0	n/a
Display is free from decoration Graph is free from clipart or other illustrations used solely for decoration. Some graphics, like icons, can support interpretation.	2	1	0	n/a

Color

Keep culture-based color connotations in mind. For example, pink is associated with feminine qualities in the USA.

Use ColorBrewer to find palettes suitable for reprinting in black-and-white and for colorblindness.

Color scheme is intentional Colors should represent brand or other intentional choice, not default color schemes. Use your organization's colors or your client's colors. Work with online tools to identify brand colors and others that are compatible.	2	1	0	n/a
Color is used to highlight key patterns Action colors should guide the viewer to key parts of the display. Less important, supporting, or comparison data should be a muted color, like gray.	2	1	0	n/a
Color is legible when printed in black and white When printed or photocopied in black and white, the viewer should still be able to see patterns in the data.	2	1	0	n/a
Color is legible for people with colorblindness Avoid red-green and yellow-blue combinations when those colors touch one another. Avoid using red to mean bad and green to mean good in the same chart.	2	1	0	n/a
Text sufficiently contrasts background Black/very dark text against a white/transparent background is easiest to read.	2	1	0	n/a

Lines

Excessive lines—gridlines, borders, tick marks, and axes—can add clutter or noise to a graph, so eliminate them whenever they aren't useful for interpreting the data.

Gridlines, if present, are muted Color should be faint gray, not black. Full points if no gridlines are used. Gridlines, even muted, should not be used when the graph includes numeric labels on each data point.	2	1	0	n/a
Graph does not have border line Graph should bleed into the surrounding page or slide rather than being contained by a border.	2	1	0	n/a
Axes do not have unnecessary tick marks or axis lines Tick marks can be useful in line graphs (to demarcate each point in time along the y-axis) but are unnecessary in most other graph types. Remove axes lines whenever possible.	2	1	0	n/a
Graph has one horizontal and one vertical axis Viewers can best interpret one x- and one y-axis. Don't add a second y-axis. Try a connected scatter plot or two graphs, side by side, instead. (A secondary axis used to hack new graph types is ok, so long as viewers aren't being asked to interpret a second y-axis.)	2	1	0	n/a

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Graphs will catch a viewer's attention so only visualize the data that needs attention. Too many graphics of unimportant information dilute the power of visualization.

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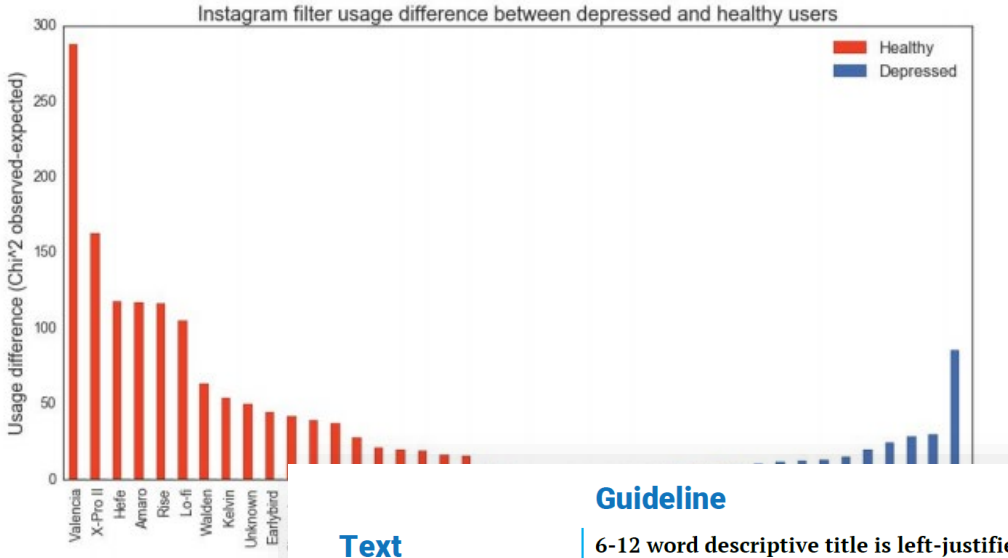

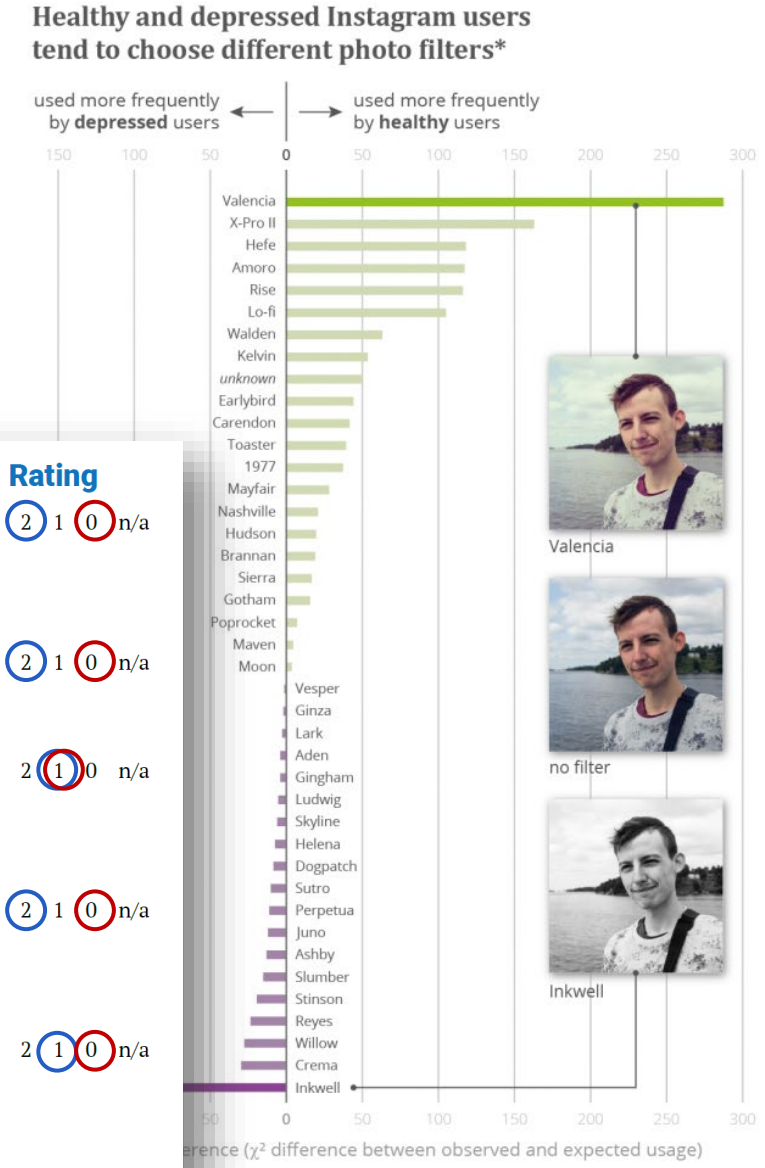

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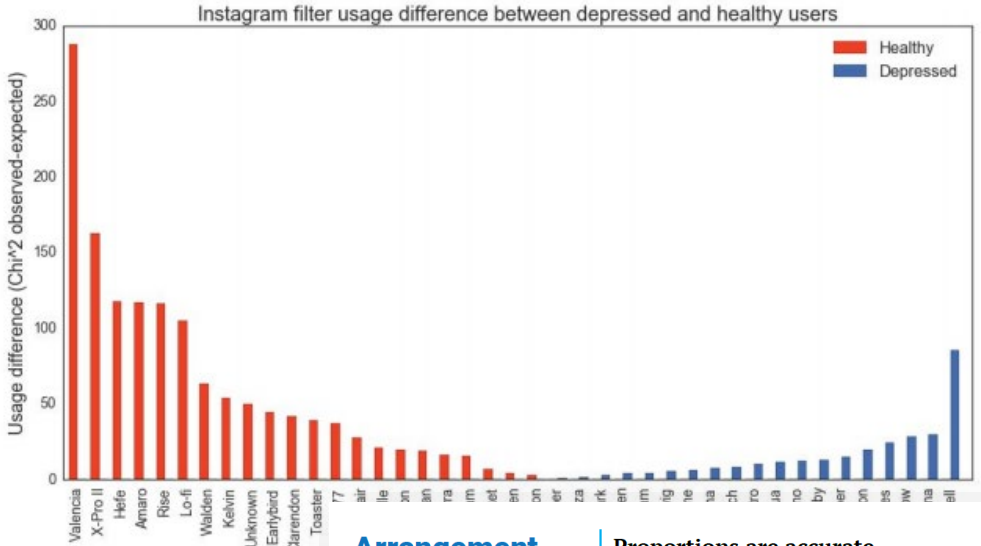

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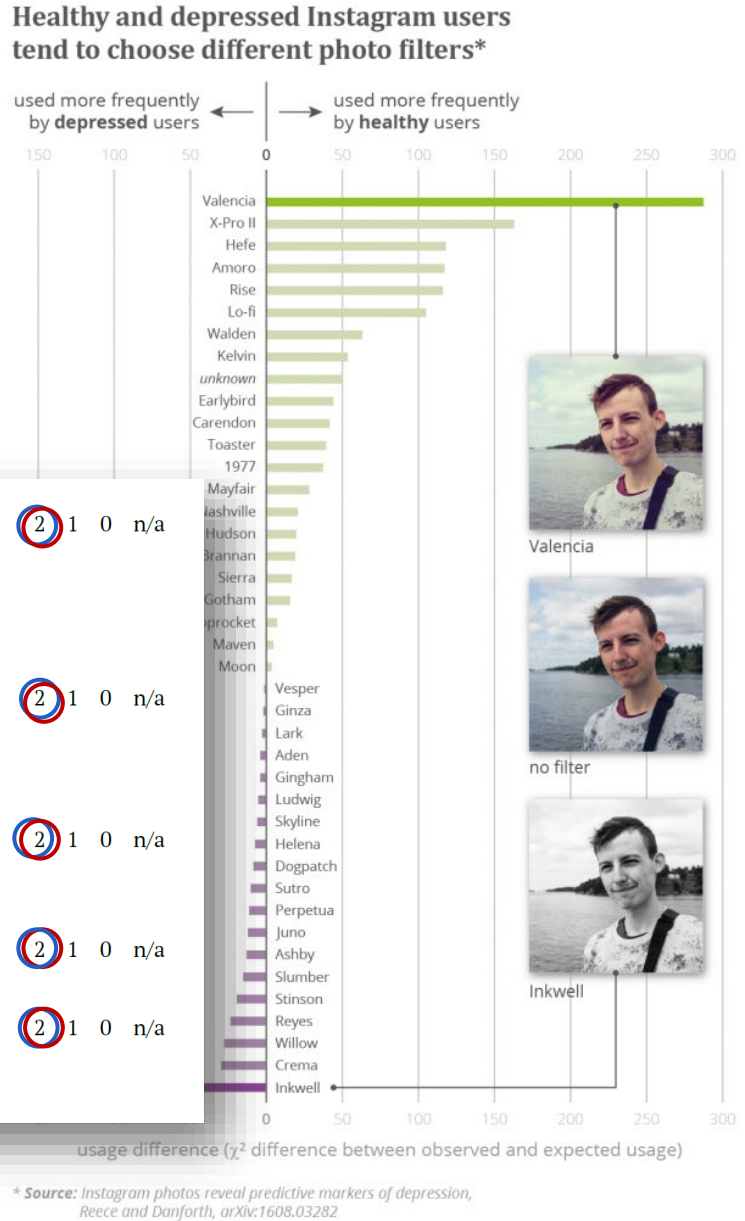
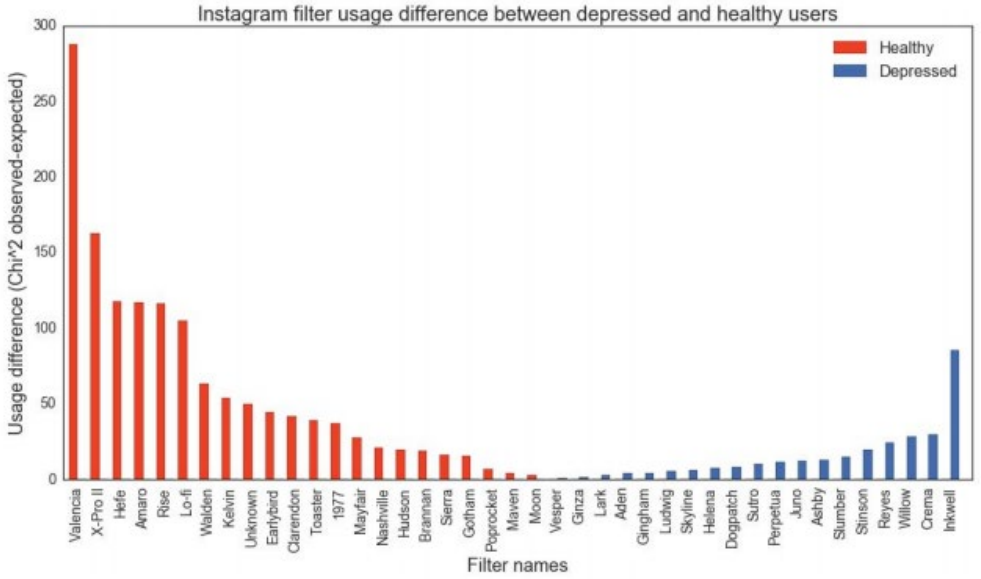
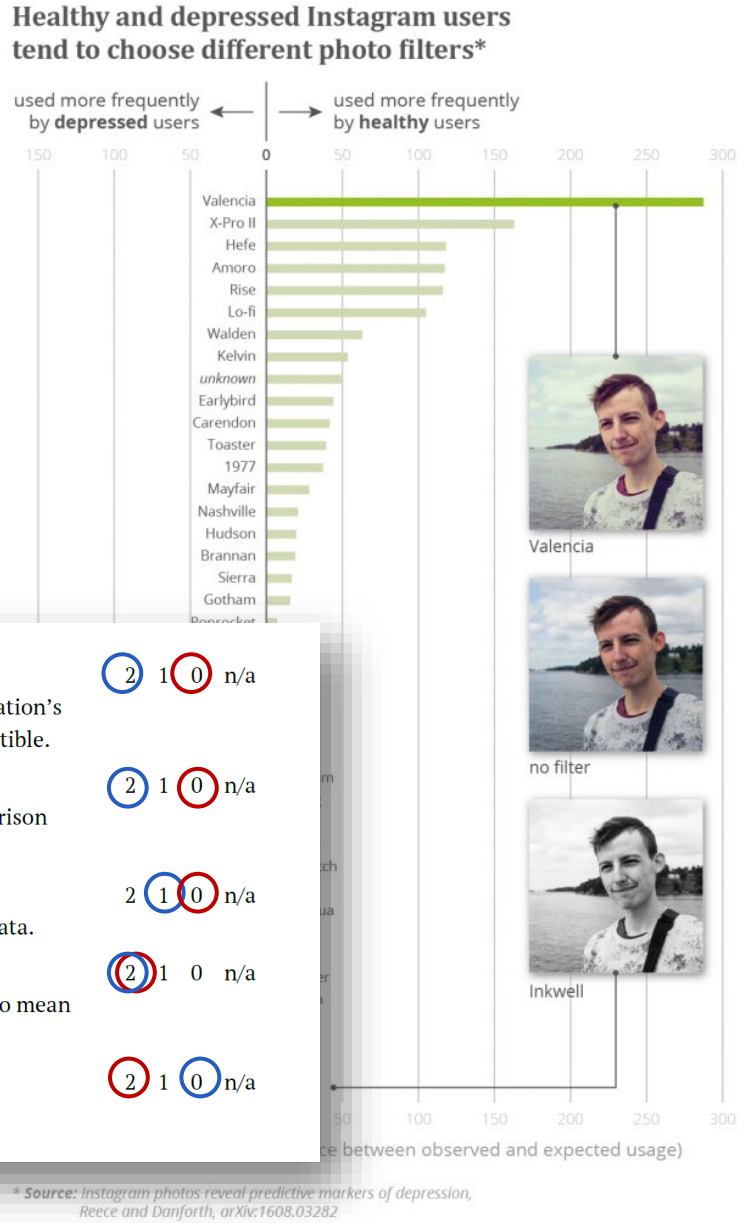


* **Source:** *Instagram photos reveal predictive markers of depression, Reece and Danforth, arXiv:1608.03282*

10/10





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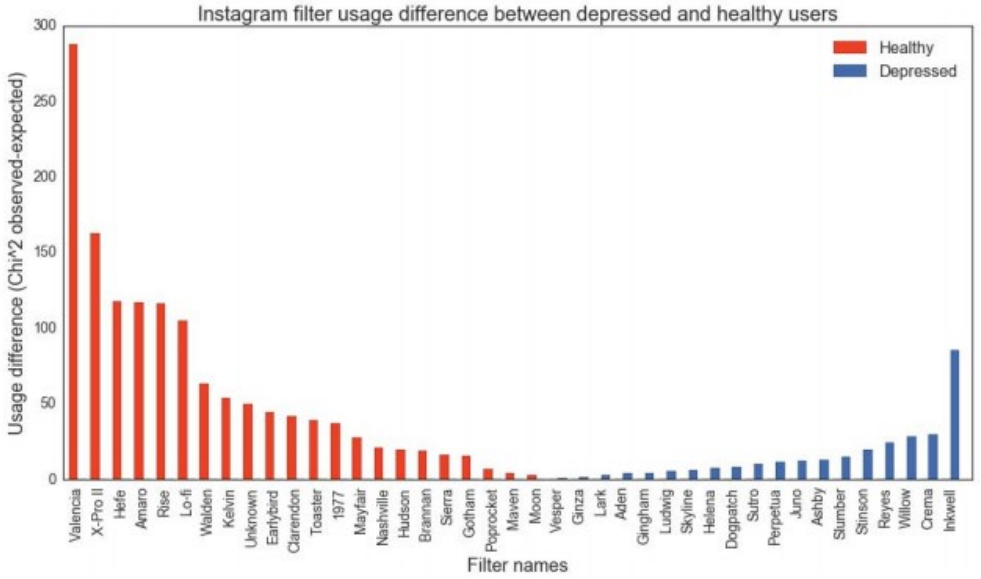

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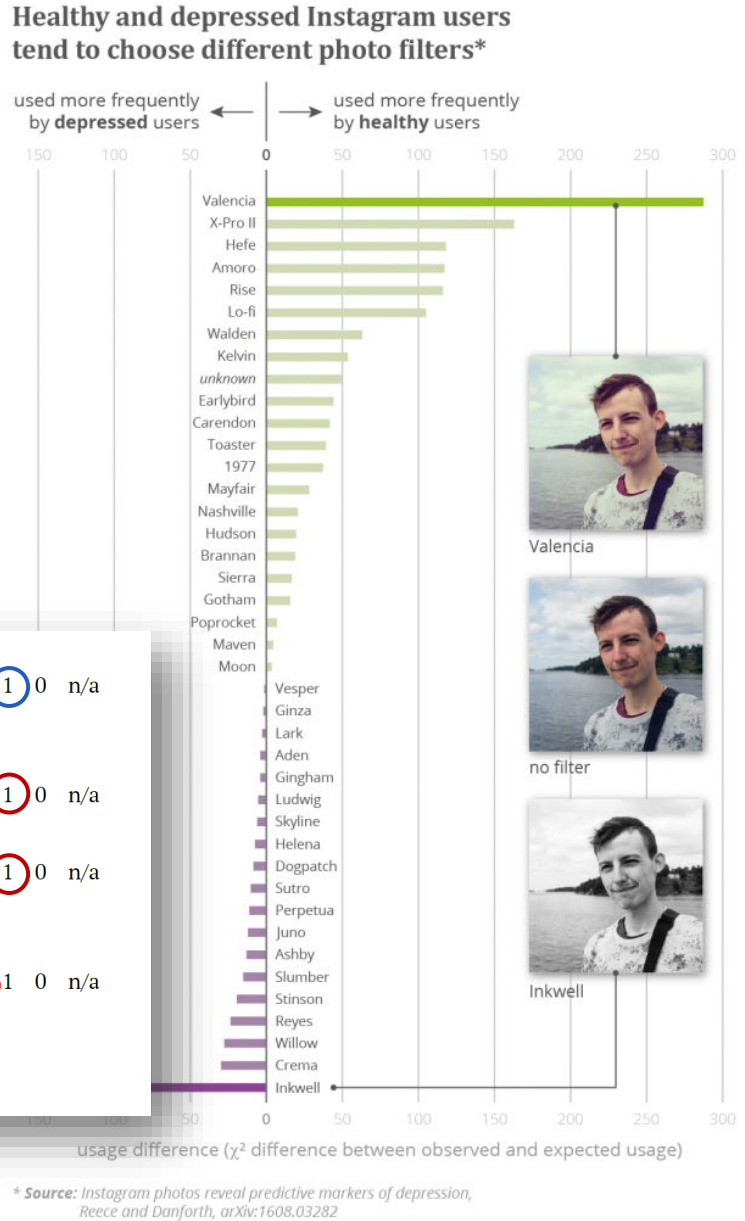

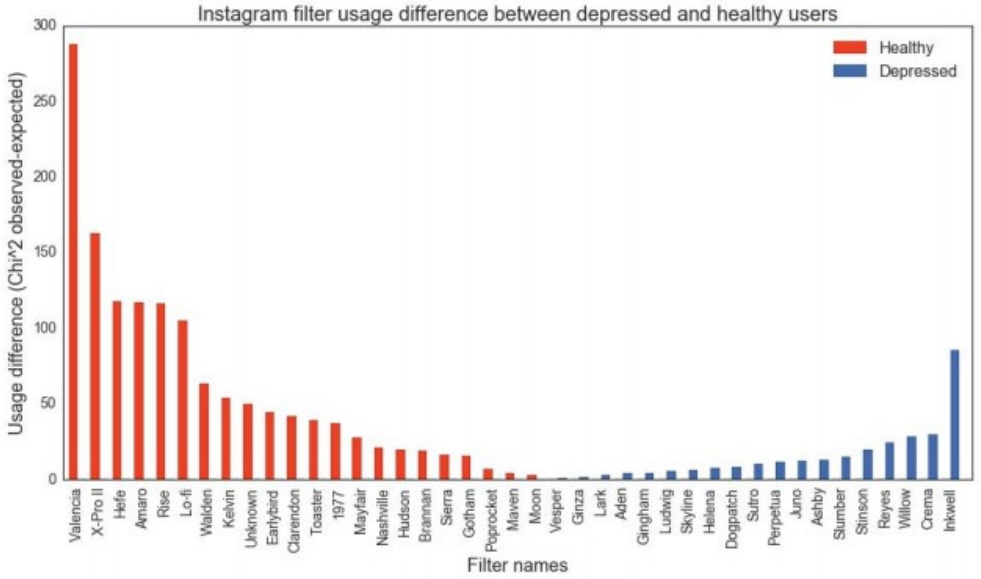

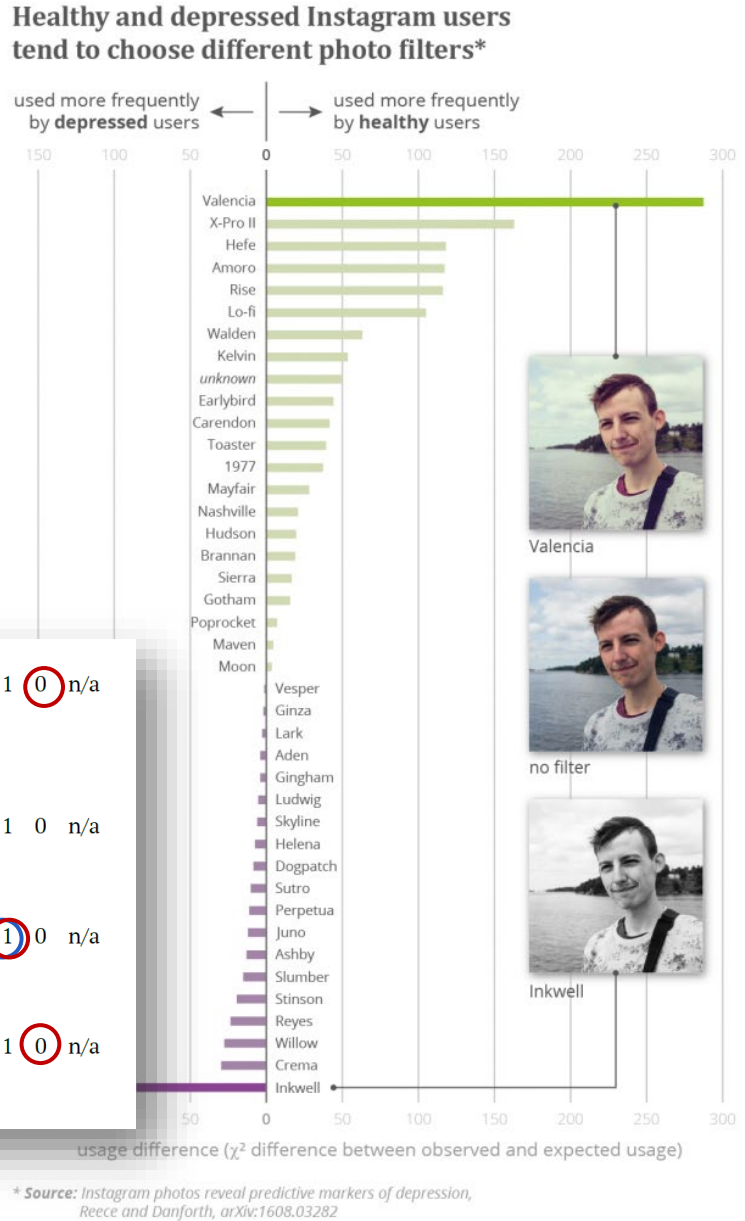

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Choices about graph type, text, arrangement, color, and lines should reinforce the same takeaway message.

3/8 **Total:** 26/48 (54%)

7/8 **Total:** 40/48 (83%)

Break

All the slides and all the links:

baryon.be/dataviz-resources

Feedback

Feedback on homework assignment part 2

15’ break

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Dealing with outliers

Qualitative charts

Creating better tables

Projections and missing data

Visuals for posters and presentations

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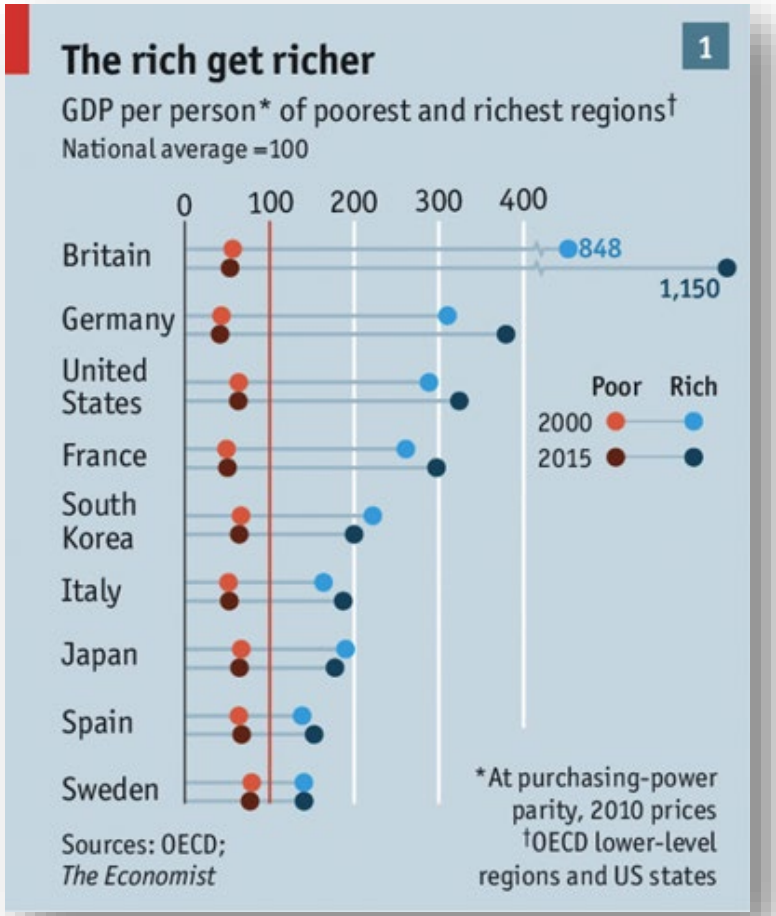
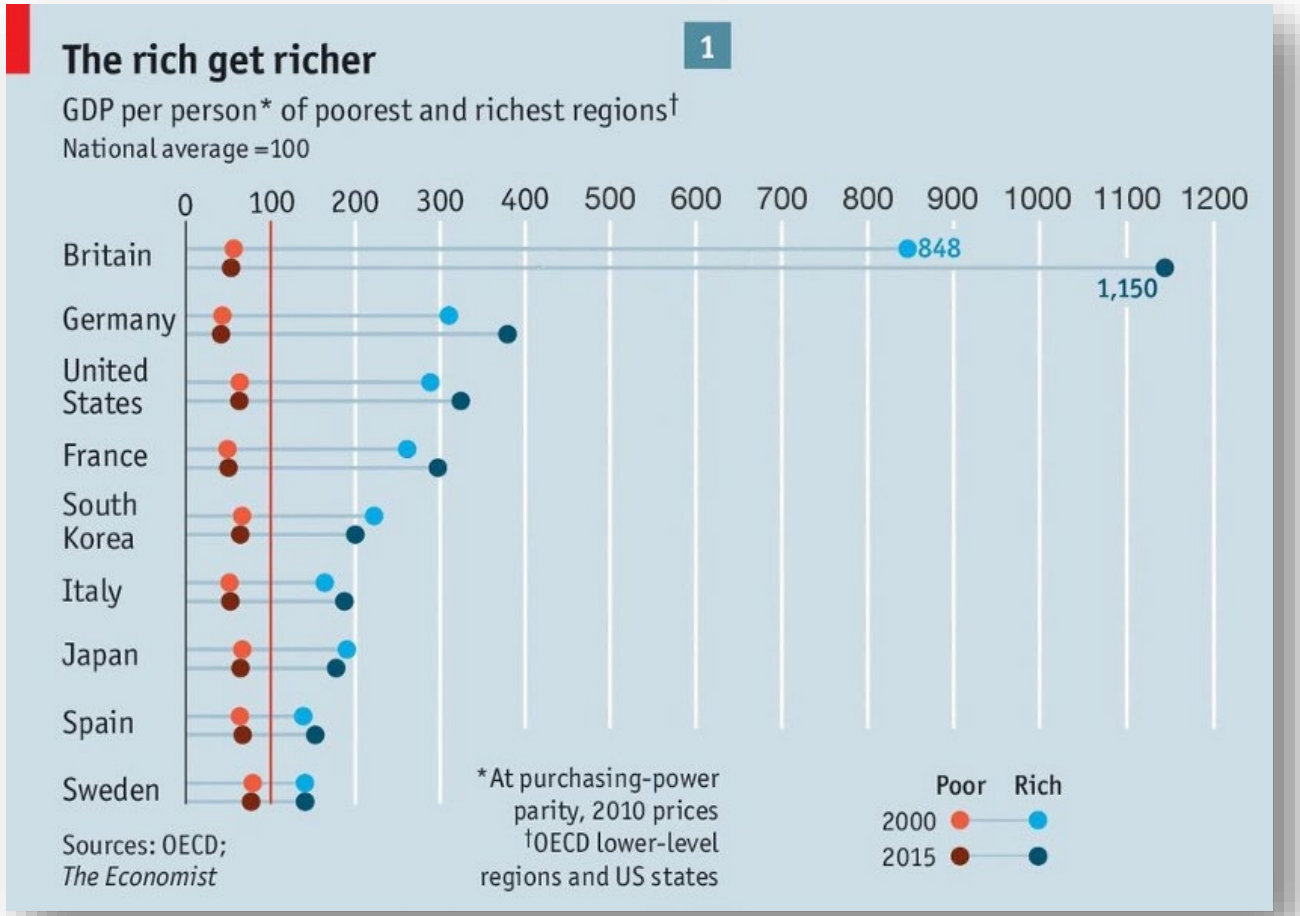
Dealing with outliers

flowingdata.com/2018/03/07/visualizing-outliers/


The rich get richer
1
GDP per person* of poorest and richest regions†
National average =100
0
100
200
300
400
Britain
848
1,150
Germany
United States
France
South Korea
Italy
Japan
Spain
Sweden
Poor
Rich
2000
2015
*At purchasing-power parity, 2010 prices
†OECD lower-level regions and US states
Sources: OECD;
The Economist


The rich get richer
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GDP per person* of poorest and richest regions†
National average =100
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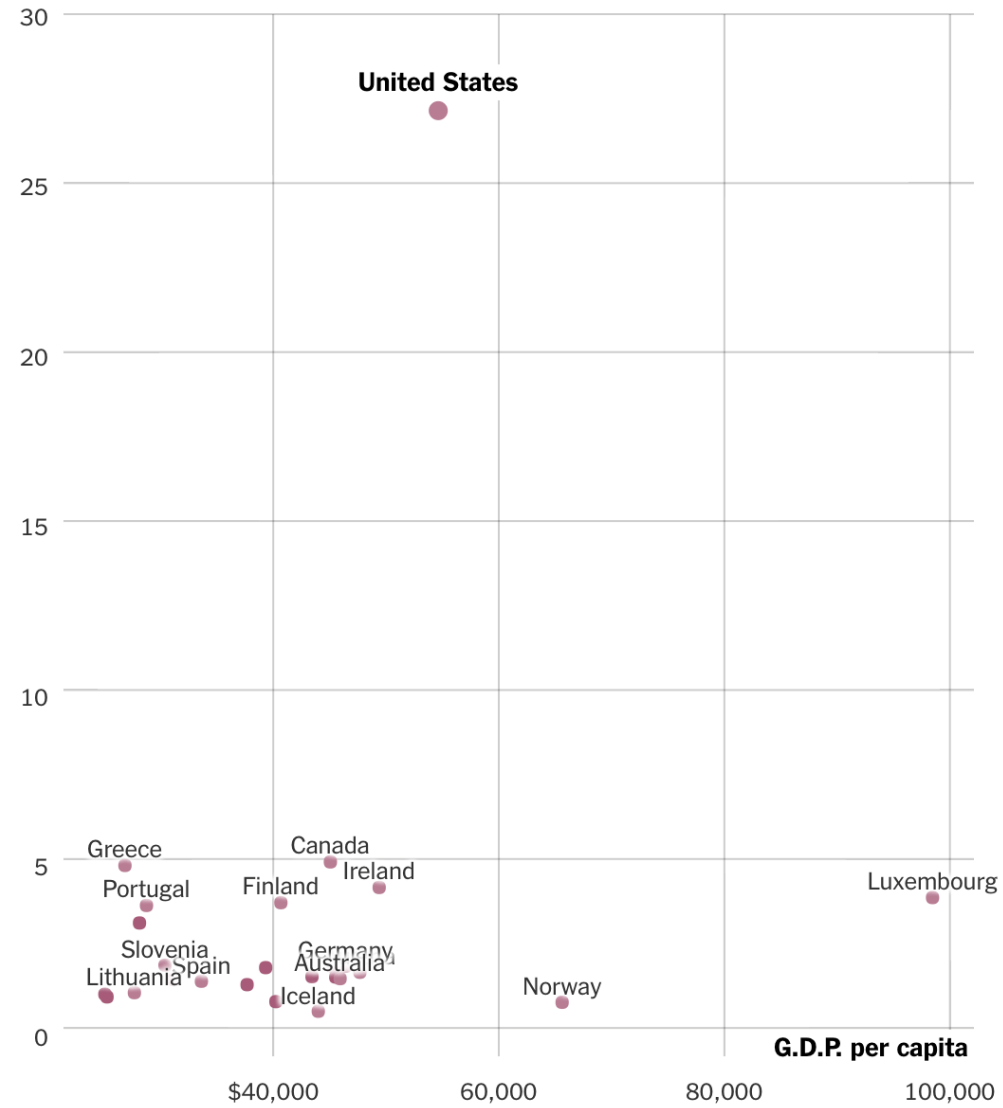
Sources: OECD;
The Economist
Poor
Rich
2000
2015

Approaches

the outlier is of **crucial importance**: make it the focal point

No Other Rich Western Country Comes Close

Gun homicides per day if each country had the same population as the U.S.

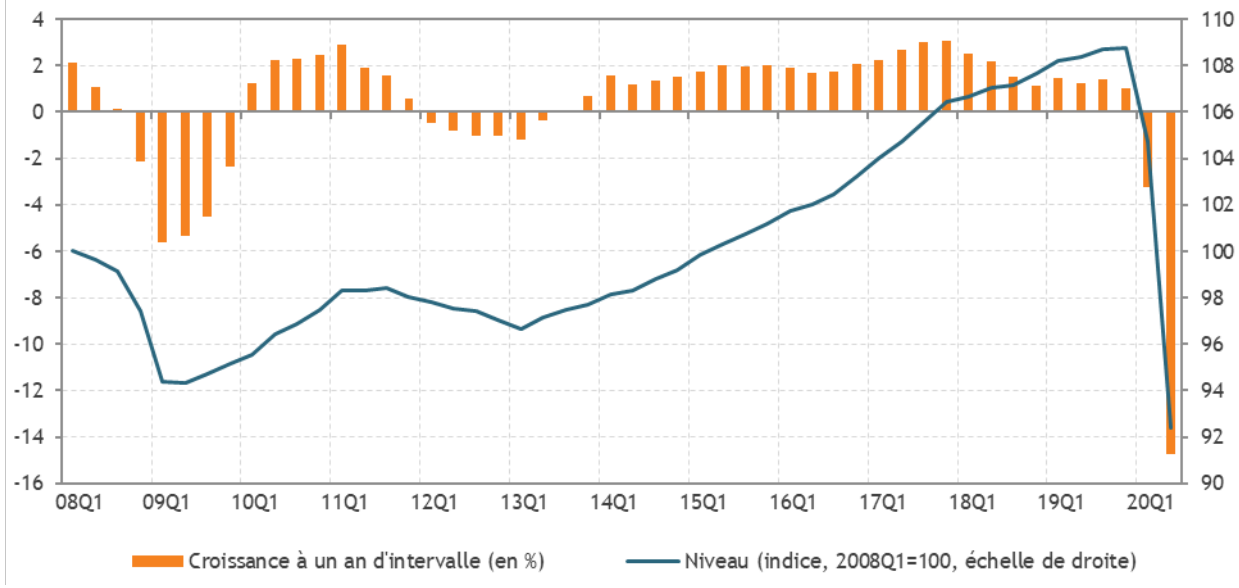


Shown are Western countries that have G.D.P. per capita over $25,000 and that make statistics on gun homicides available.

Sources: Small Arms Survey (2007–12 average); World Bank

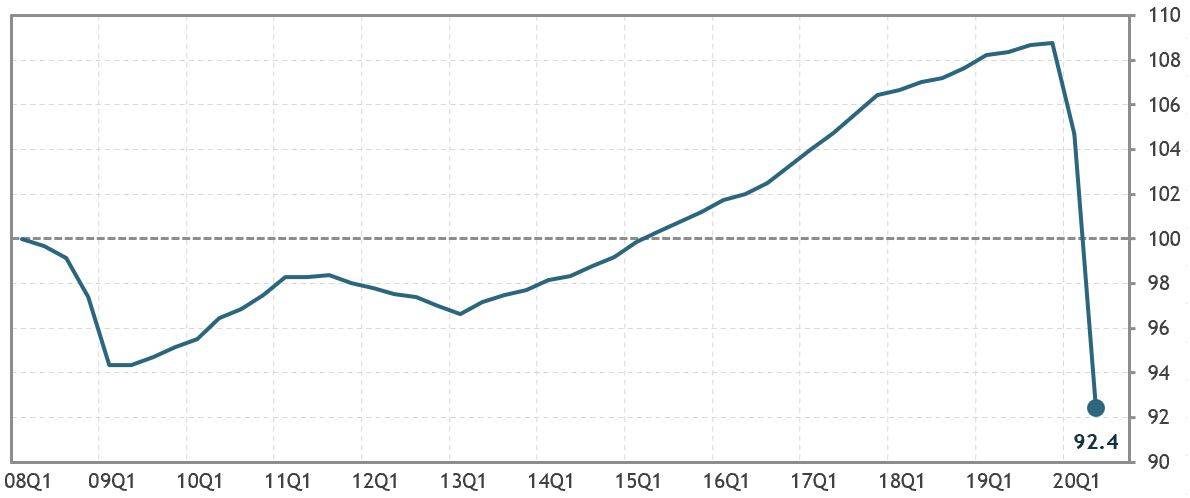
Graphique 1. Évolution trimestrielle du PIB de la zone euro en volume

Données corrigées des variations saisonnières et des effets calendaires

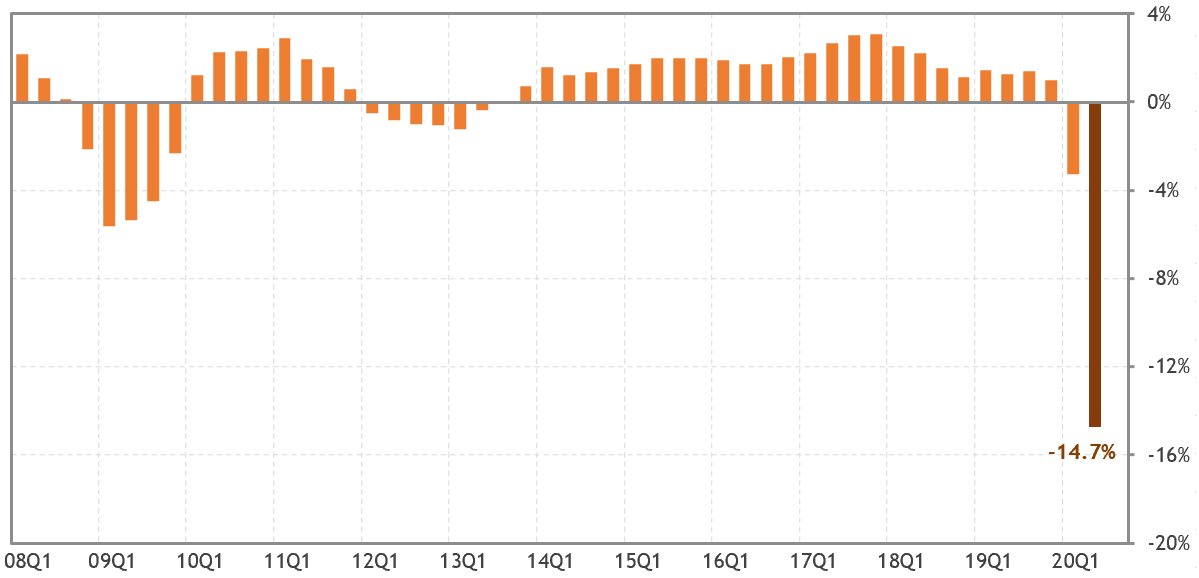


Produit Intérieur Brut de la zone euro en volume
Corrigé des variations saisonnières et des effets calendaires

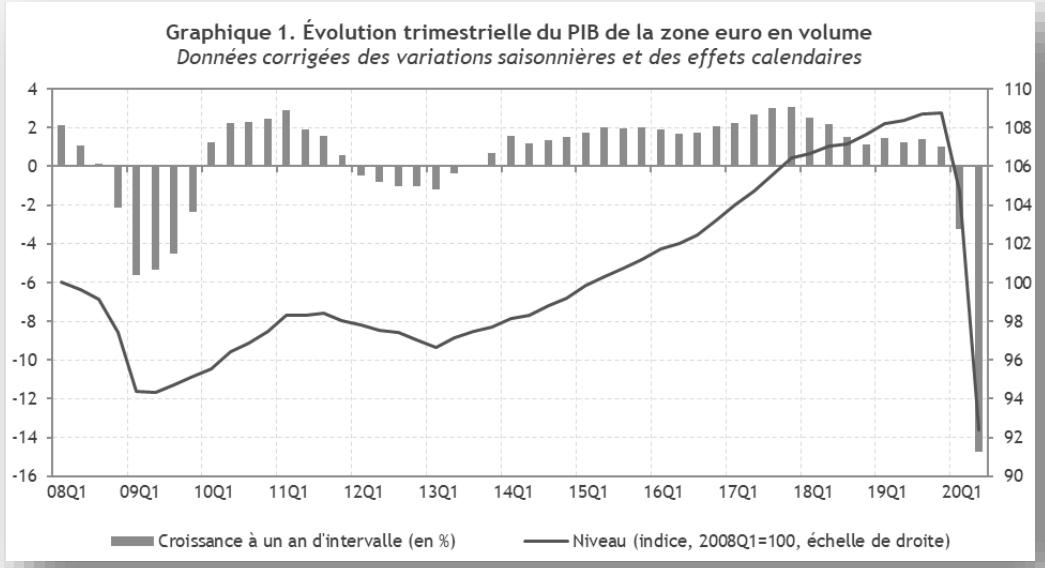
Indice (2008Q1=100)



Croissance à un an d'intervalle

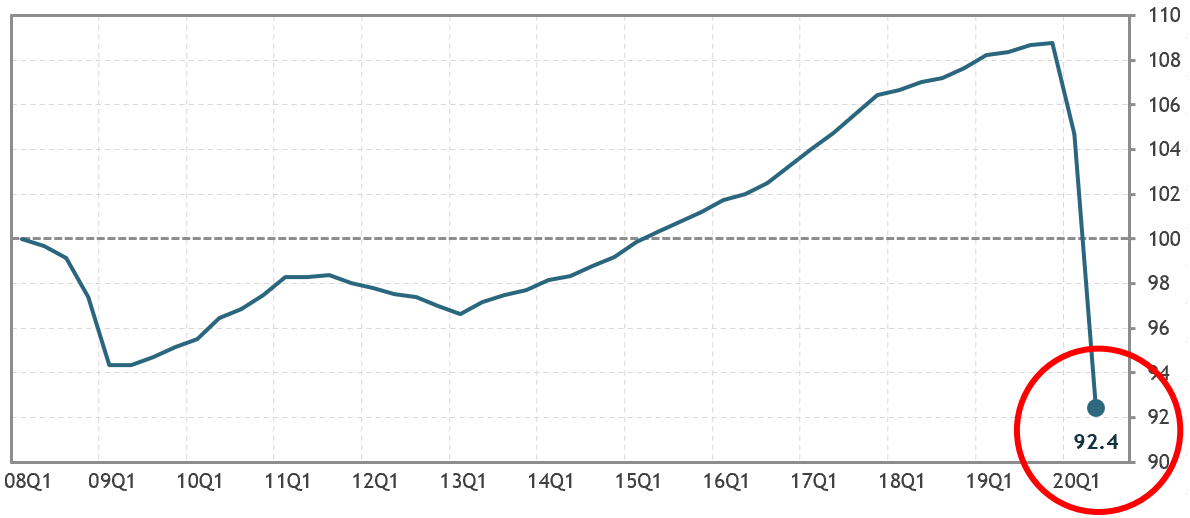


separate the two graphs
to reduce deciphering



Produit Intérieur Brut de la zone euro en volume
Corrigé des variations saisonnières et des effets calendaires

Indice (2008Q1=100)



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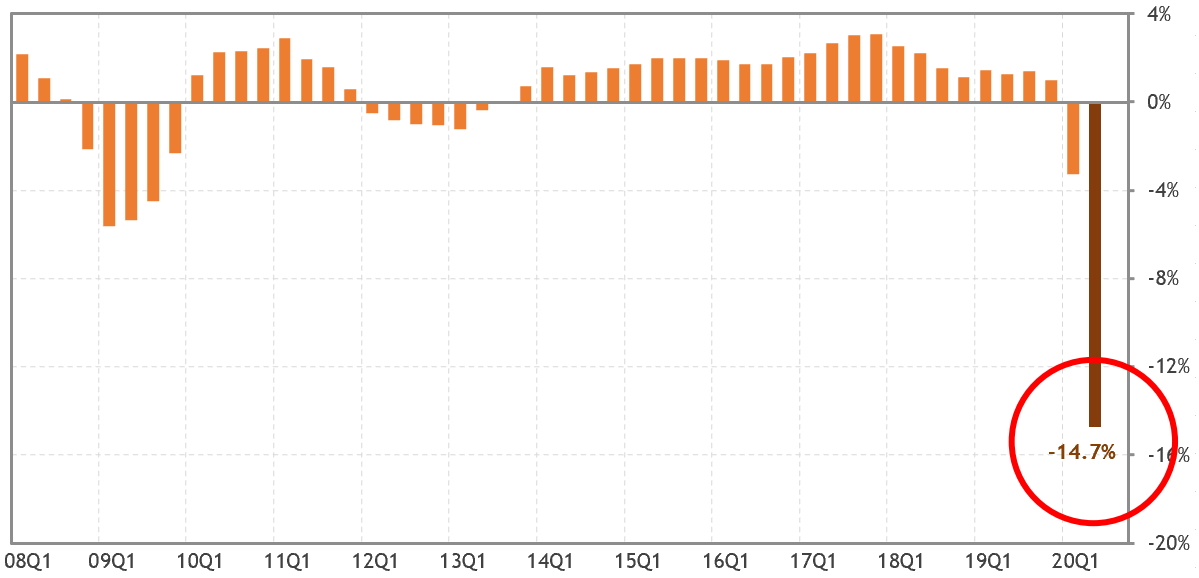
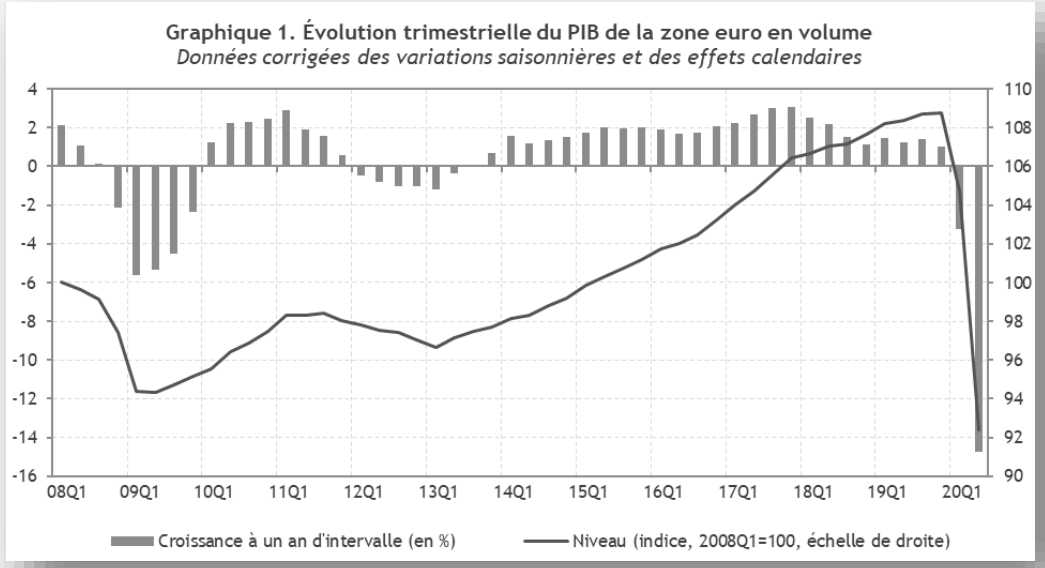
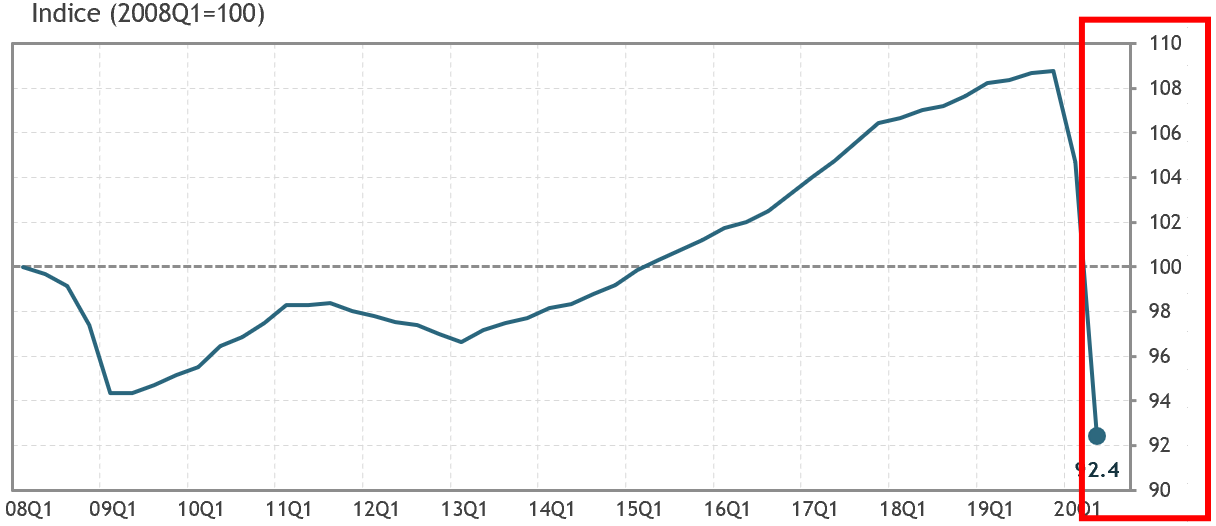


highlight the outlier datapoint (color + data label)

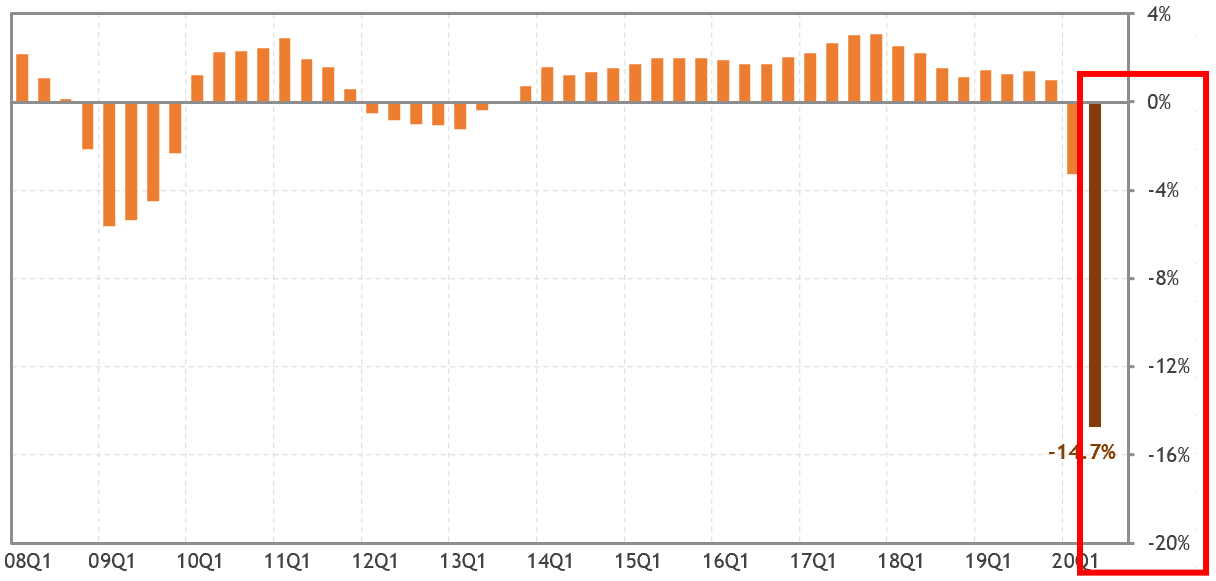


Produit Intérieur Brut de la zone euro en volume
Corrigé des variations saisonnières et des effets calendaires

Indice (2008Q1=100)

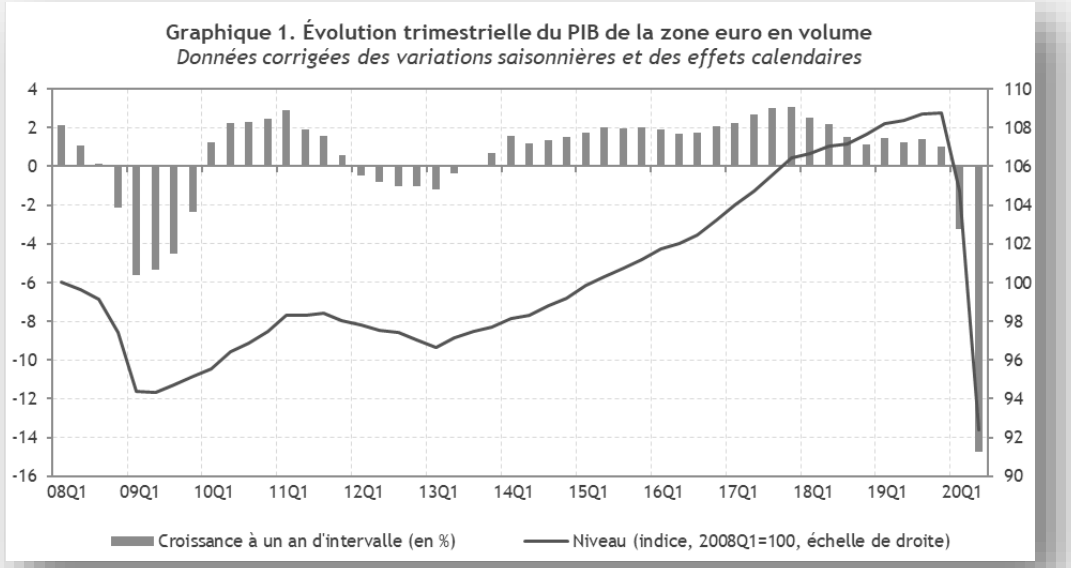


Croissance à un an d'intervalle



remove noise by

- providing whitespace to the right
- moving both axes to the right
- removing the legend



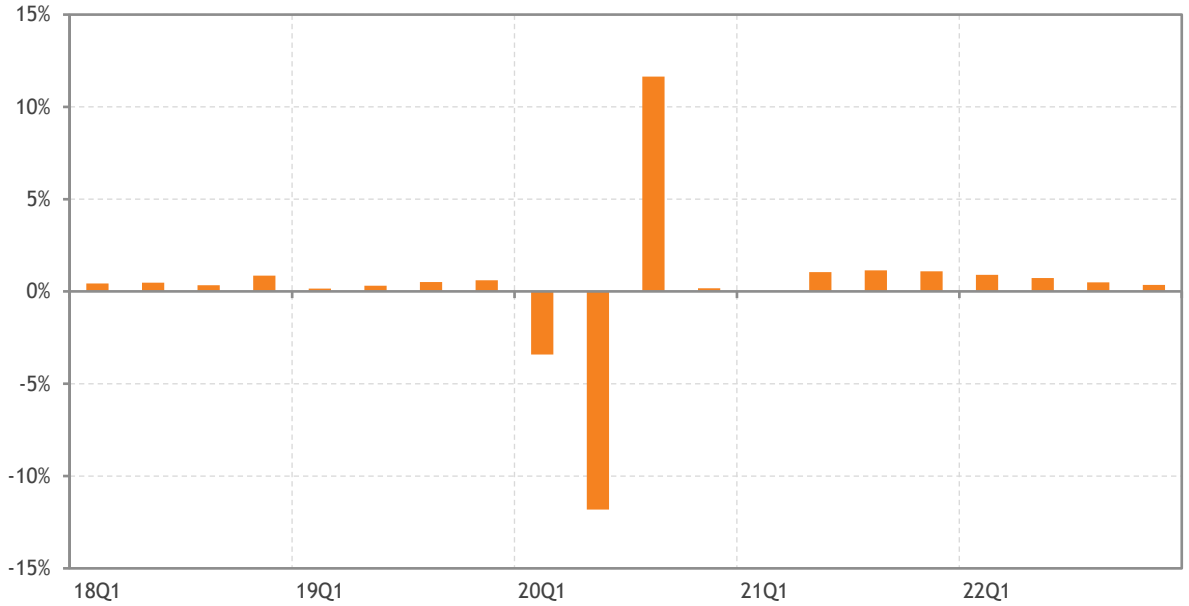
Approaches

the outlier is of **crucial importance**: make it the focal point

the outlier is **less important**: send it to the background

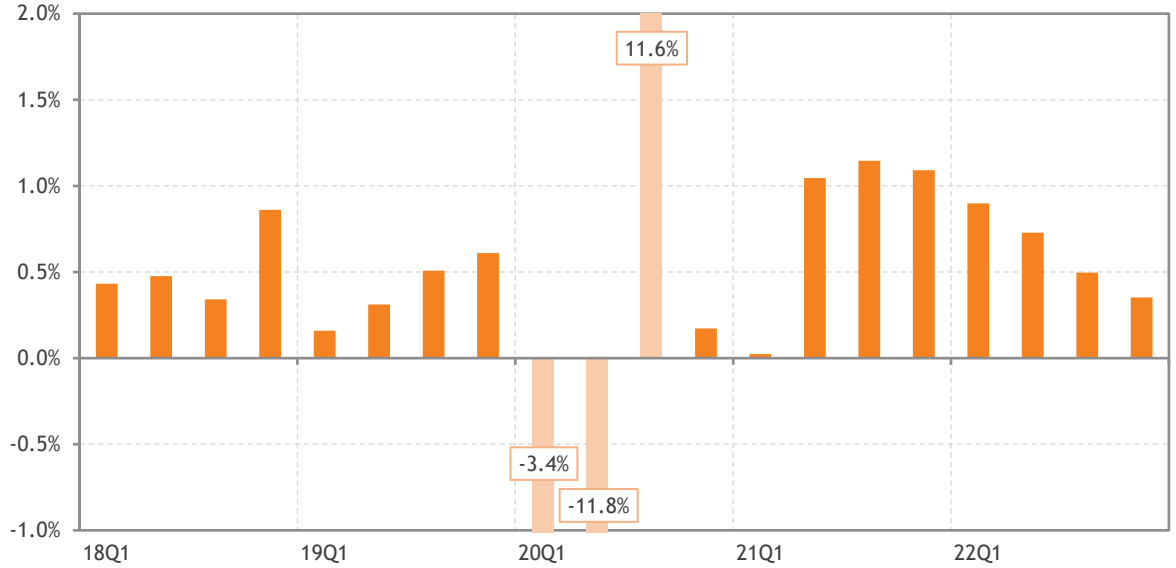
Bruto binnenlands product

Kwartaal-op-kwartaalgroei



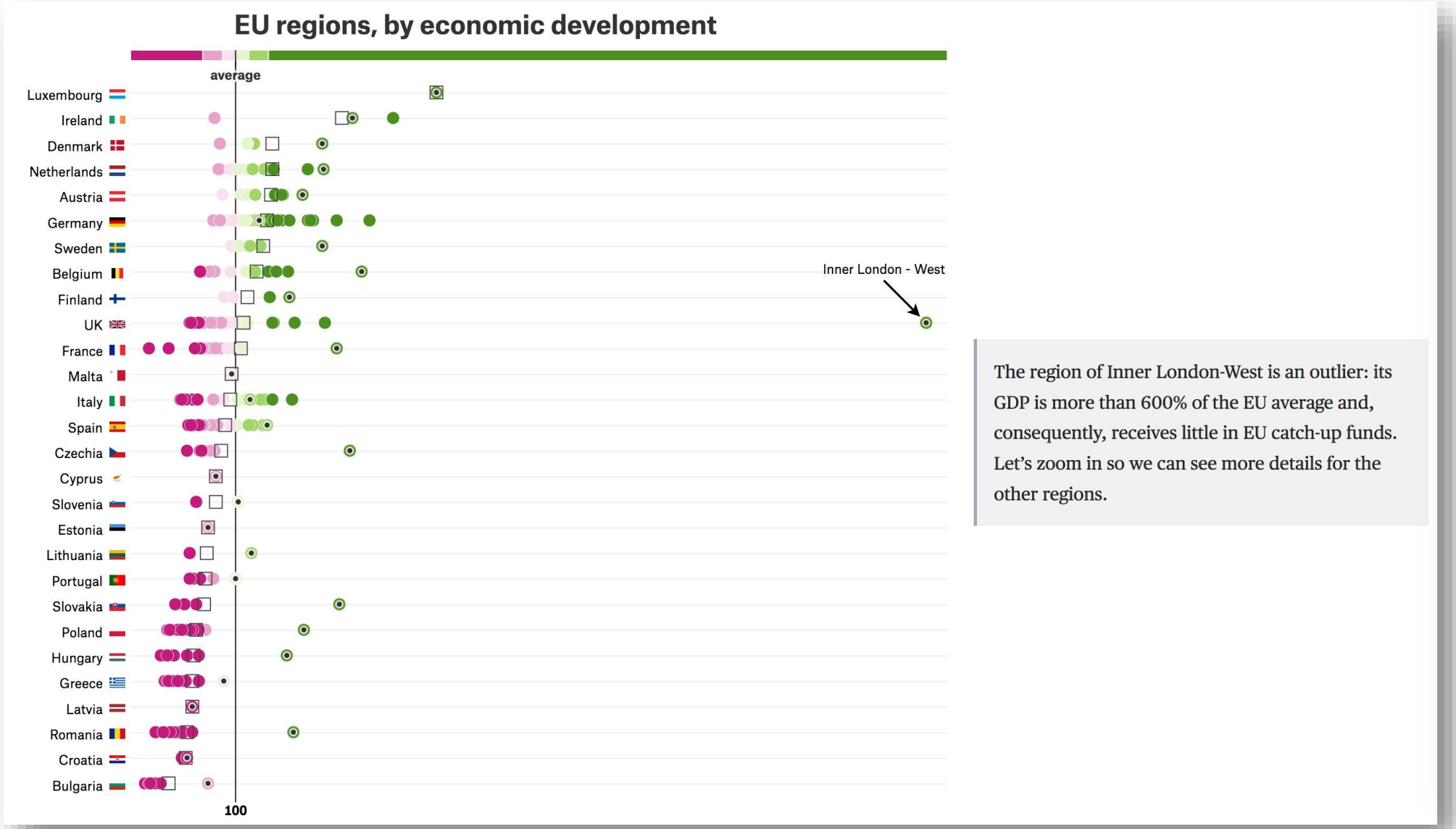
Bruto binnenlands product

Kwartaal-op-kwartaalgroei



Approaches

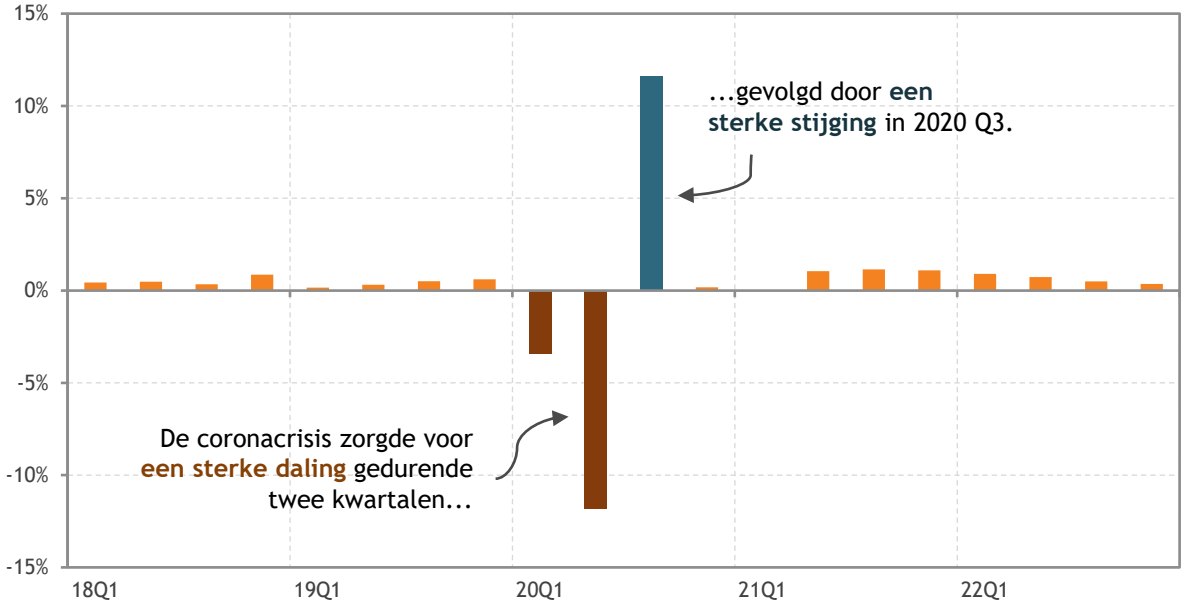
the outlier is of **crucial importance**:	make it the focal point
the outlier is **less important**:	send it to the background
hybrid approach:	create a breakout view



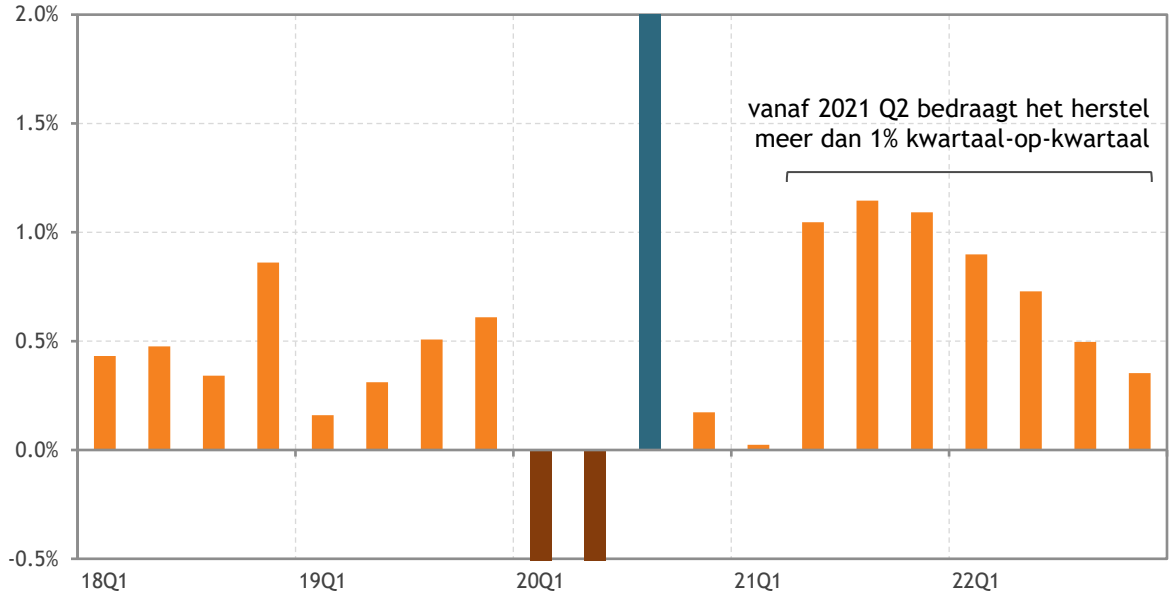
The region of Inner London-West is an outlier: its GDP is more than 600% of the EU average and, consequently, receives little in EU catch-up funds. Let's zoom in so we can see more details for the other regions.

pudding.cool/2019/04/eu-regions/

Bruto binnenlands product
Kwartaal-op-kwartaalgroei



Bruto binnenlands product
Kwartaal-op-kwartaalgroei



Approaches

the outlier is of **crucial importance**:	make it the focal point
the outlier is **less important**:	send it to the background
hybrid approach:	create a breakout view
showing it all:	switch scales

flowingdata.com/2016/02/09/why-people-visit-the-emergency-room/

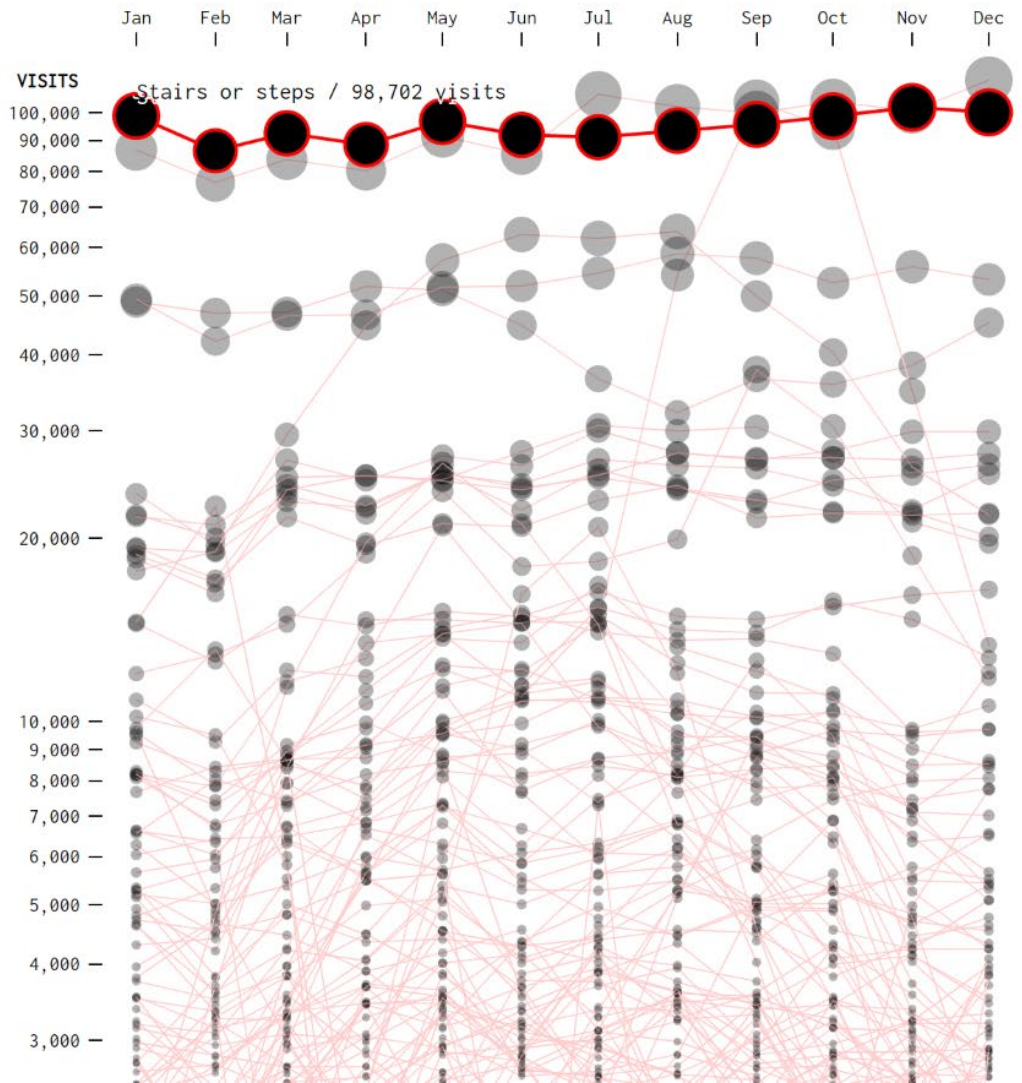
Why People Visit the Emergency Room

These are the top 250 products that people injure themselves on or with in a year.

When you think about what it's like to work in a hospital's emergency room, what comes to mind? For me, I used to imagine something that resembles *ER*, the medical drama series from the late 1990s full of actual emergencies. However, being married to an ER doctor, I've learned that the workplace is much more routine (for most hospitals, at least).

While there are certainly life-or-death situations that I can only imagine as high-stress for everyone involved, the bulk of patients injure themselves in minor ways while doing everyday things. You can see this in injury data collected by the Consumer Product Safety Commission. They sample US hospitals and cull product-related injuries each year, which, from the CPSC documentation, includes the following:

- All poisonings and chemical burns to children under 5 years of age.
- All injuries where a consumer product, sport, or recreational activity is associated with the reason for the visit or related to a condition

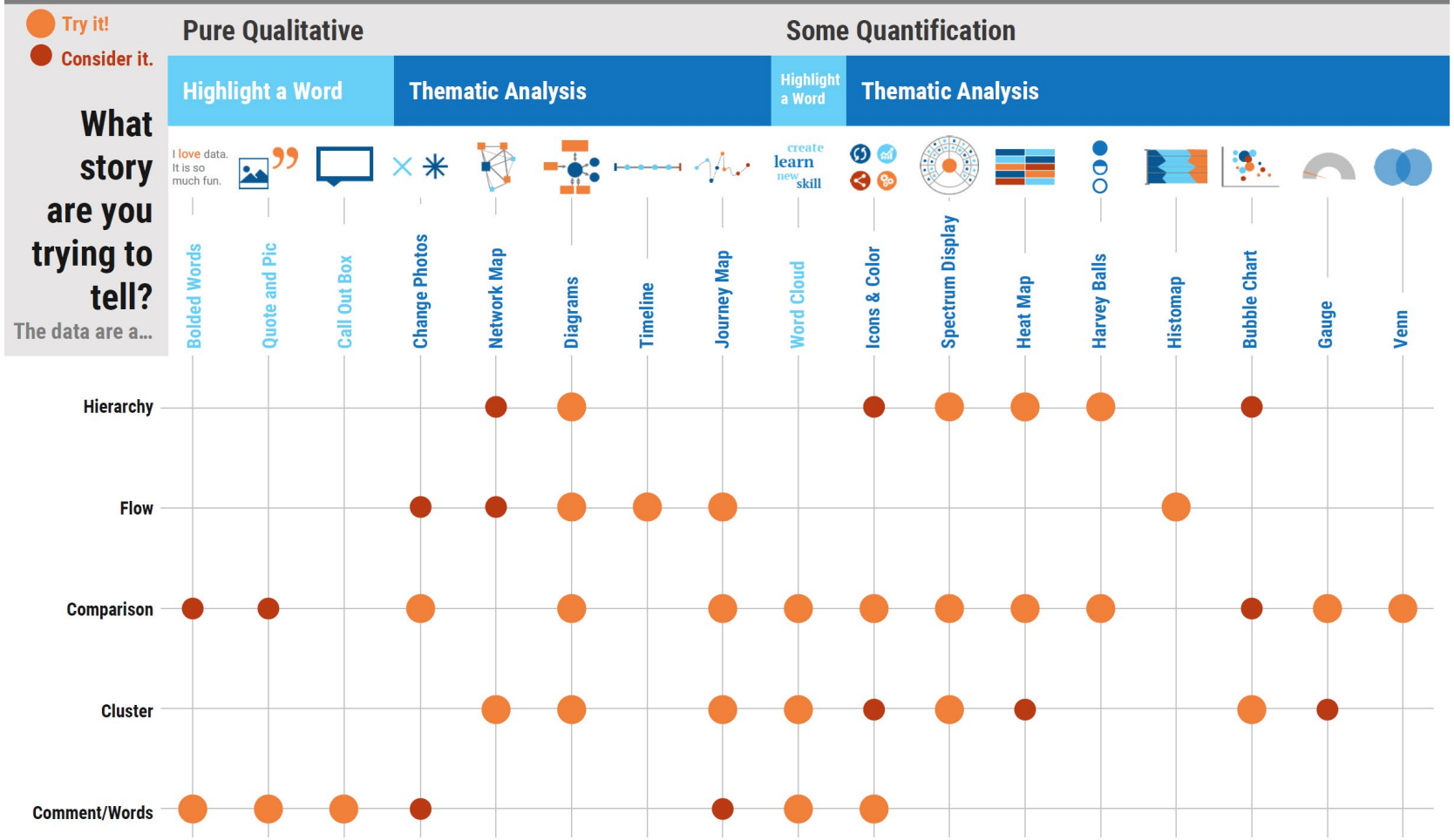


Qualitative charts

stephanieevergreen.com/must-know-qualitative-charts

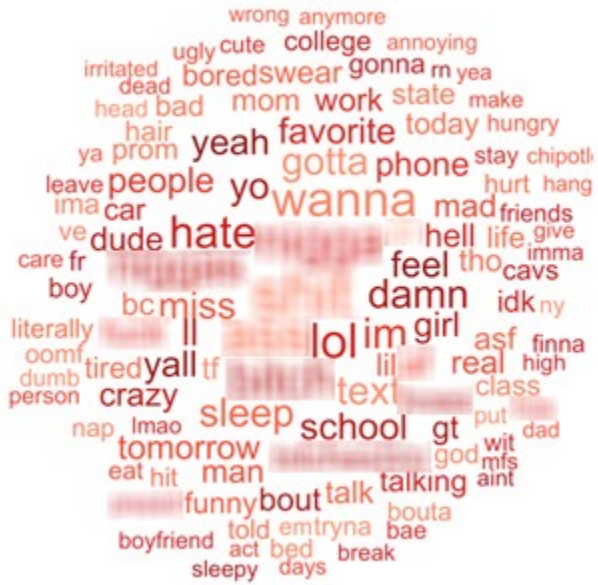
Qualitative Chart Chooser

By Jennifer Lyons & Stephanie Evergreen



For more see StephanieEvergreen.com/qualitative-viz [Presenting Data Effectively]() [Effective Data Visualization]()

stephanieevergreen.com/qualitative-chart-chooser-3


wrong anymore
ugly cute college annoying
irritated dead boredswear gonna rn yea
head bad mom work state make
hair favorite today hungry
ya prom yeah gotta phone stay chipotl
leave people yo wanna hurt hang
ima car mad friends
ve dude hate hell life give
care fr feel tho cavs imma
boy damn idk ny
bc miss
literally ll lol im girl asf finna
oomf tired yall tf lil real high
dumb class
person crazy text
nap lmao sleep school gt put dad
tomorrow god wit mfs
eat hit man talking aint
funny bout talk bouta
told emtryna bae
boyfriend act bed break
sleepy days


meeting
buddy sunday blue international raps
strike meet part excited
album bus good dm april
sens praise lool live season game
adam enjoy gorgeous congrats kind
colour fan team raptors video book bless
ppl photo nice favourite pls lots street
goal ily set tour 1st
exams wow rtz thx leafs amazing niall beer
busy series
square awesome great world march dear
iz fans guys show amp wine
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boys sweet ur tn beautiful nhl party
hockey sexy follow jays city fun xx pleasure
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fashion place win morning holy tbh dreams
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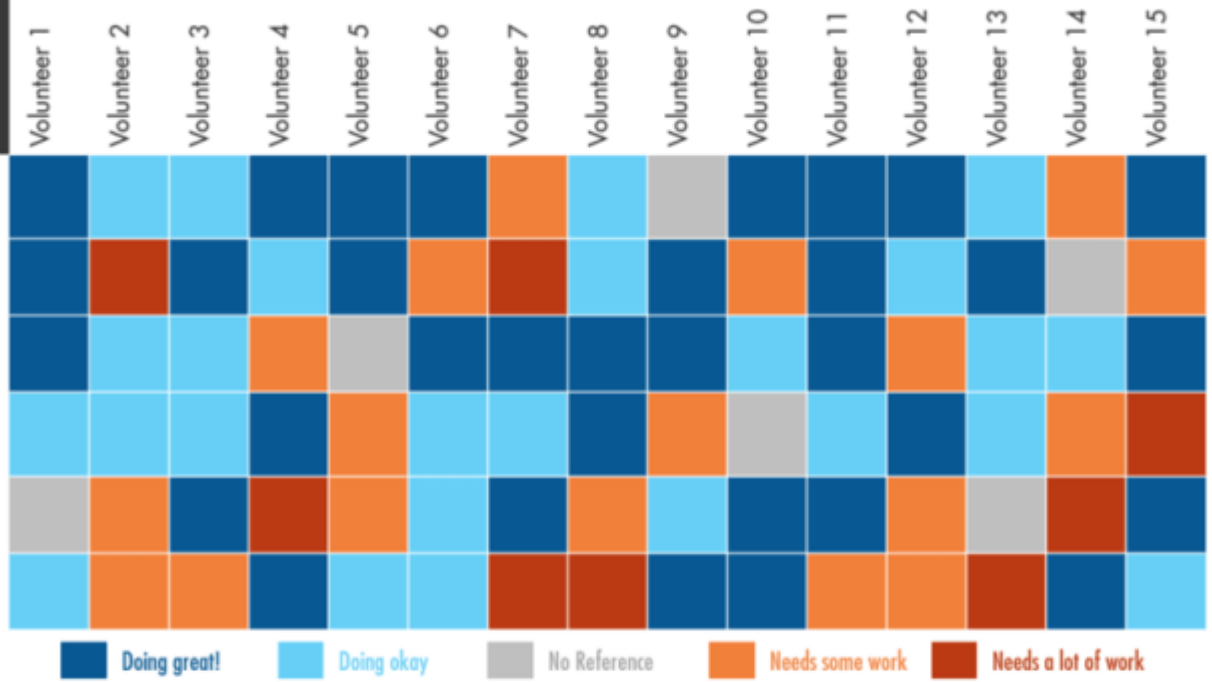
word clouds

FINDINGS
FROM VOLUNTEER INTERVIEWS



OVERALL FINDING

Most of the volunteers felt that the program was very clearly described and that they had a good sense of their role.

The majority of the volunteers had very positive feedback about the volunteer training.

The volunteers had extremely positive feedback on the formal and informal meetings.

The greatest impact of volunteering with the program was increased knowledge of the criminal court system.

Volunteers had widely varying perceptions of the amount of impact of the program.

The volunteers reported different levels of engagement over their tenure as volunteers.

EXAMPLE QUOTES

"I like being informed and seeing a different part of the world that on my daily basis I don't see and I hope I never have to see. You get a better appreciation of how things happen."

One volunteer shared how they felt more engaged in the program over time, as they've become more involved, and that "I have a real sense of being part of my community's efforts to maintain justice for all."

One student thought that the program director spent too much time reviewing what they saw in the courtroom; "we were outside the courtroom for 30 minutes. It was overkill, could have been 2 minutes."

One volunteer reflected how they "weren't prepared for hostility some of the judges feel, and how you're treated by the court like the enemy." They thought the court was not very not user-friendly.

heat table

spectrum display

The drug and alcohol program is unstructured, and the GED program is not fostering independence.

Drug and Alcohol

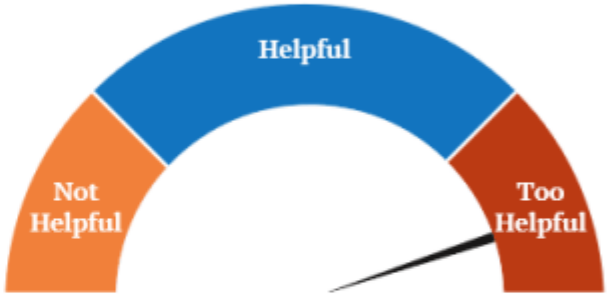
"Most of the time in class, we all mess around and talk."

- *Inmate Respondent*

Domestic Violence

"There is a strong bond of friendship and support from others in the program."

- *Inmate Respondent*



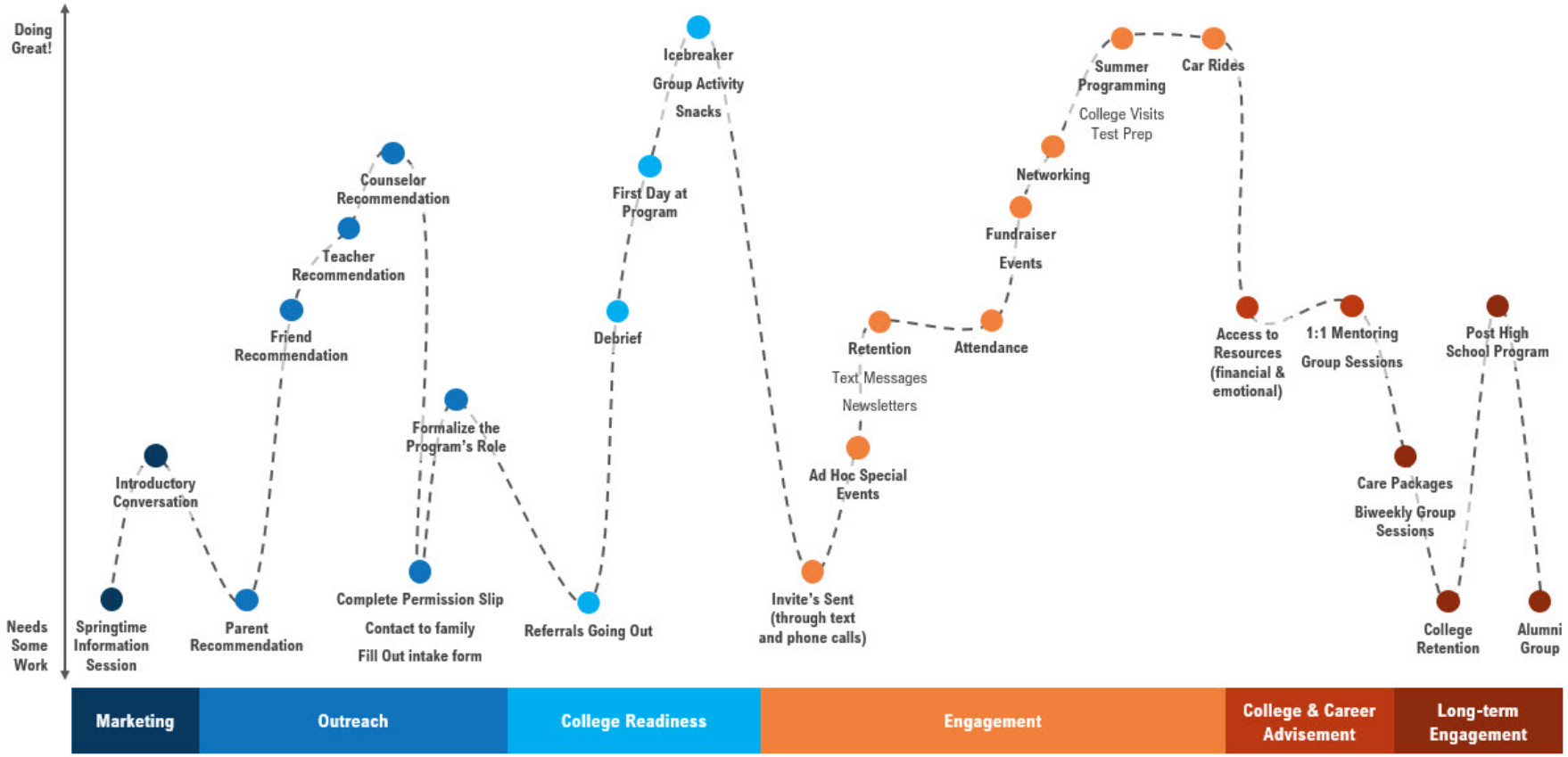
GED

"I felt like I learned a lot, but some of the material was very hard. The teacher gave us strong hints about some answers."

- *Inmate Respondent*

gauge chart

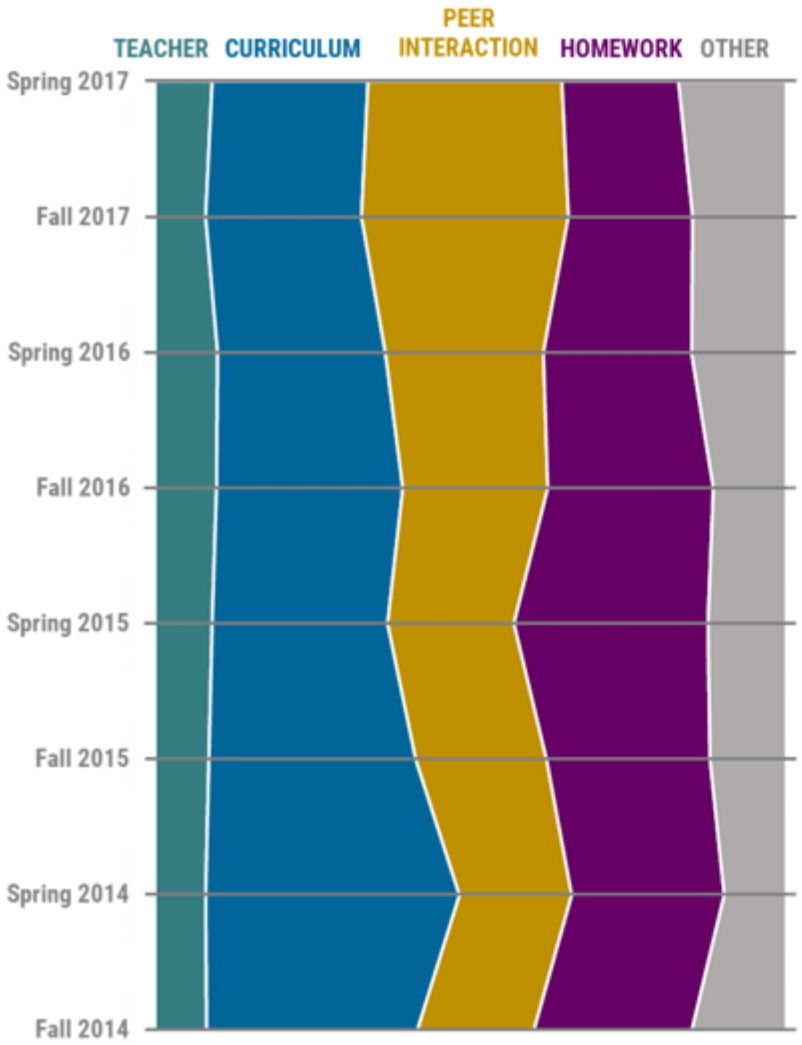
CLIENT JOURNEY MAP



journey map

When examining focus groups data since 2014, students want to see less change with the curriculum and more change regarding peer interaction.

Sample quotes from the Spring 2017 focus group



TEACHER

"The teacher can be kind of critical of certain questions asked by students, but overall they are great and I learned a lot."

CURRICULUM

"I wish we didn't have to move so quickly through the course topics. I feel like we are always rushing."

PEER INTERACTION

"Without a lot of group work, I feel kind of disconnected from my peers. I wish we had more of a chance to get to know one another."

HOMEWORK

"There is so much homework in this class. I can never catch a break!"

OTHER

"I was always late for class because of a transportation conflict and the program wasn't very helpful with the situation."

histomap

Creating better tables

medium.com/design-with-figma/the-ultimate-guide-to-designing-data-tables-7db29713a85a

Tableau1 - Parts dans le total des passagers-kilomètres

Pourcentages par mode (colonnes) et motif de déplacement (lignes)

Motif	Total par motif	Bus	Covoiturage	Voiture-solo	Métro	Moto	Marche et vélo	Train	Tram
Affaires	7,1	0,1	0,9	5,9	0,0	0,2	0,1	0,0	0,0
Autres	60,8	2,3	29,8	21,8	0,4	0,4	3,3	2	0,8
École et étudiants	5,5	1,3	1,5	0,3	0	0	0,4	1,7	0,1
Travail	26,6	0,7	2,1	20,0	0,1	0,3	0,4	2,9	0,1
Total par mode	100,0	4,4	34,3	48,0	0,5	0,9	4,1	6,6	1,1

Source : PLANET

Tableau 1 - Parts dans le total des passagers-kilomètres

Pourcentages par mode (colonnes) et motif de déplacement (lignes)

	Bus	Co-voiturage	Voiture-solo	Métro	Moto	Marche et vélo	Train	Tram	Total par motif
Affaires	0.1	0.9	5.9	0.0	0.2	0.1	0.0	0.0	7.1
École et étudiants	1.3	1.5	0.3	0.0	0.0	0.4	1.7	0.1	5.5
Travail	0.7	2.1	20.0	0.1	0.3	0.4	2.9	0.1	26.6
Autres	2.3	29.8	21.8	0.4	0.4	3.3	2.0	0.8	60.8
Total par mode	4.4	34.3	48.0	0.5	0.9	4.1	6.6	1.1	100.0

Source: PLANET

Guidelines

add visual cues to show hierarchy

Day	Fat	Carbs	Protein
Monday	70g	94g	81g
Tuesday	65g	85g	95g
Wednesday	88g	71g	105g
Thursday	57g	102g	78g
Friday	73g	96g	84g
Average	74g	85g	88g

Tableau1 - Parts dans le total des passagers-kilomètres

Pourcentages par mode (colonnes) et motif de déplacement (lignes)

Motif	Total par motif	Bus	Covoiturage	Voiture-solo	Métro	Moto	Marche et vélo	Train	Tram
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Autres	60,8	2,3	29,8	21,8	0,4	0,4	3,3	2	0,8
École et étudiants	5,5	1,3	1,5	0,3	0	0	0,4	1,7	0,1
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Source : PLANET

Tableau 1 - Parts dans le total des passagers-kilomètres

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Affaires	0.1	0.9	5.9	0	0.2	0.1	0	0	7.1
École et étudiants	1.3	1.5	0.3	0	0	0.4	1.7	0.1	5.5
Travail	0.7	2.1	20	0.1	0.3	0.4	2.9	0.1	26.6
Autres	2.3	29.8	21.8	0.4	0.4	3.3	2	0.8	60.8
Total par mode	4.4	34.3	48	0.5	0.9	4.1	6.6	1.1	100

Source: PLANET

Tabel 1 **Baseline projectie uitgaven geneeskundige verzorging 2021-2026, gealigneerd op T**

Uitgaven, in duizend euro, in prijzen 2021

Omschrijving	2021	2022	2023	2024	2025	2026
Honoraria artsen						
a) Klinische biologie	1 431 546	1 417 618	1 407 049	1 395 811	1 384 139	1 370 922
b) Medische beeldvorming	1 384 179	1 385 163	1 388 486	1 390 928	1 393 189	1 394 509
c) Raadplegingen en bezoeken	2 663 768	2 660 860	2 702 712	2 741 148	2 780 834	2 820 629
d) Speciale verstrekkingen + e) Heelkunde	2,702,236	2 750 174	2 801 156	2 852 386	2 905 046	2 953 250
f) Gynaecologie + g) Toezicht + h) Honoraria buiten nomenclatuur	708,776	723 643	734 725	745 919	756 079	765 722
Totaal honoraria artsen	8 890 505	8 937 458	9 034 128	9 126 192	9 219 287	9 305 032
Honoraria tandheelkundigen	1 096 936	1 109 311	1 125 018	1 142 236	1 160 783	1 181 258
Farmaceutische verstrekkingen	5 475 665	5 679 498	5 918 341	6 166 611	6 456 823	6 725 562
Honoraria verpleegkundigen	1 827 399	1 850 547	1 889 100	1 931 830	1 974 988	2 016 590
Verzorging door kinesitherapeuten	903 348	936 994	972 952	1 009 723	1 047 620	1 088 160
Implantaten	851 939	897 940	949 842	1 004 037	1 063 673	1 122 695
Ziekenhuizen: verpleegdagprijs + forfaitaire dagprijs algemene ziekenhuizen + vervoer	6 576 506	6 704 772	6 828 755	6 943 435	7 043 215	7 135 832
Overige uitgaven	4 451 262	4 868 478	5 041 393	5 236 181	5 396 990	5 548 124
Totaal	30 073 560	30 984 999	31 759 528	32 560 245	33 363 377	34 123 251

Tabel 1

Baseline projectie uitgaven geneeskundige verzorging 2021-2026, gealigneerd op T

Uitgaven, in duizend euro, in prijzen 2021

Omschrijving	2021	2022	2023	2024	2025	2026
Totaal honoraria artsen	8 890 505	8 937 458	9 034 128	9 126 192	9 219 287	9 305 032
» a) Klinische biologie	*1 431 546*	*1 417 618*	*1 407 049*	*1 395 811*	*1 384 139*	*1 370 922*
» b) Medische beeldvorming	*1 384 179*	*1 385 163*	*1 388 486*	*1 390 928*	*1 393 189*	*1 394 509*
» c) Raadplegingen en bezoeken	*2 663 768*	*2 660 860*	*2 702 712*	*2 741 148*	*2 780 834*	*2 820 629*
» d) Speciale verstrekkingen + e) Heelkunde	*2 702 236*	*2 750 174*	*2 801 156*	*2 852 386*	*2 905 046*	*2 953 250*
» f) Gynaecologie + g) Toezicht + h) Buiten nomenclatuur	*708 776*	*723 643*	*734 725*	*745 919*	*756 079*	*765 722*
Honoraria tandheelkundigen	1 096 936	1 109 311	1 125 018	1 142 236	1 160 783	1 181 258
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Honoraria verpleegkundigen	1 827 399	1 850 547	1 889 100	1 931 830	1 974 988	2 016 590
Verzorging door kinesitherapeuten	903 348	936 994	972 952	1 009 723	1 047 620	1 088 160
Implantaten	851 939	897 940	949 842	1 004 037	1 063 673	1 122 695
Ziekenhuizen: verpleegdagprijs + forfaitaire dagprijs algemene ziekenhuizen + vervoer	6 576 506	6 704 772	6 828 755	6 943 435	7 043 215	7 135 832
Overige uitgaven	4 451 262	4 868 478	5 041 393	5 236 181	5 396 990	5 548 124
Totaal	**30 073 560**	**30 984 999**	**31 759 528**	**32 560 245**	**33 363 377**	**34 123 251**

Guidelines

add visual cues to show hierarchy

choose the best row style

Name	Location	Email	Phone number
Logan Henderson	Chicago, IL	logan@company.com	938-283-9277
Susie Carlson	New York, NY	susie@company.com	394-938-9223
Markus Benes	San Francisco, CA	markus@company.com	872-993-1029
Marie Stephens	Boston, MA	marie@company.com	928-938-5523
Jacob Gibson	Denver, CO	jacob@company.com	192-617-4895
Eliza Figueroa	Burlington, VT	eliza@company.com	717-029-2273

Name	Location	Email	Phone number
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Susie Carlson	New York, NY	susie@company.com	394-938-9223
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Marie Stephens	Boston, MA	marie@company.com	928-938-5523
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Name	Location	Email	Phone number
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Tableau 6 **Évolution des coûts administratifs au cours des deux dernières années telle que perçue par les entreprises selon le domaine réglementaire et la Région**

	Emploi			Fiscalité			Environnement		
	Bruxelles	Flandre	Wallonie	Bruxelles	Flandre	Wallonie	Bruxelles	Flandre	Wallonie
Hausse sensible	4 %	10 %	18 %	14 %	9 %	15 %	17 %	11 %	22 %
Hausse	36 %	35 %	38 %	34 %	38 %	39 %	26 %	34 %	42 %
Inchangé	56 %	50 %	39 %	52 %	51 %	44 %	57 %	55 %	36 %
Diminution	4 %	4 %	2 %	0 %	1 %	1 %	0 %	0 %	0 %
Diminution sensible	0 %	0 %	2 %	0 %	0 %	0 %	0 %	0 %	0 %

Remarque : il n'a pas été tenu compte de la possibilité de réponse "sans opinion" pour le calcul des pourcentages.

Tabel 1

Baseline projectie uitgaven geneeskundige verzorging 2021-2026, gealigneerd op T

Uitgaven, in duizend euro, in prijzen 2021

Omschrijving	2021	2022	2023	2024	2025	2026
Totaal honoraria artsen	8 890 505	8 937 458	9 034 128	9 126 192	9 219 287	9 305 032
» a) Klinische biologie	*1 431 546*	*1 417 618*	*1 407 049*	*1 395 811*	*1 384 139*	*1 370 922*
» b) Medische beeldvorming	*1 384 179*	*1 385 163*	*1 388 486*	*1 390 928*	*1 393 189*	*1 394 509*
» c) Raadplegingen en bezoeken	*2 663 768*	*2 660 860*	*2 702 712*	*2 741 148*	*2 780 834*	*2 820 629*
» d) Speciale verstrekkingen + e) Heelkunde	*2 702 236*	*2 750 174*	*2 801 156*	*2 852 386*	*2 905 046*	*2 953 250*
» f) Gynaecologie + g) Toezicht + h) Buiten nomenclatuur	*708 776*	*723 643*	*734 725*	*745 919*	*756 079*	*765 722*
Honoraria tandheelkundigen	1 096 936	1 109 311	1 125 018	1 142 236	1 160 783	1 181 258
Farmaceutische verstrekkingen	5 475 665	5 679 498	5 918 341	6 166 611	6 456 823	6 725 562
Honoraria verpleegkundigen	1 827 399	1 850 547	1 889 100	1 931 830	1 974 988	2 016 590
Verzorging door kinesitherapeuten	903 348	936 994	972 952	1 009 723	1 047 620	1 088 160
Implantaten	851 939	897 940	949 842	1 004 037	1 063 673	1 122 695
Ziekenhuizen: verpleegdagprijs + forfaitaire dagprijs algemene ziekenhuizen + vervoer	6 576 506	6 704 772	6 828 755	6 943 435	7 043 215	7 135 832
Overige uitgaven	4 451 262	4 868 478	5 041 393	5 236 181	5 396 990	5 548 124
Totaal	**30 073 560**	**30 984 999**	**31 759 528**	**32 560 245**	**33 363 377**	**34 123 251**

Guidelines

add visual cues to show hierarchy

choose the best row style

add visual cues to help interpretation

Tabel 1

Baseline projectie uitgaven geneeskundige verzorging 2021-2026, gealigneerd op Technische Ramingen RIZ
Uitgaven, in duizend euro, in prijzen 2021

	2021	2022	2023	2024	2025	2026
Totaal honoraria artsen	8 890 505	8 937 458	9 034 128	9 126 192	9 219 287	9 305 032
» a) Klinische biologie	*1 431 546*	*1 417 618*	*1 407 049*	*1 395 811*	*1 384 139*	*1 370 922*
» b) Medische beeldvorming	*1 384 179*	*1 385 163*	*1 388 486*	*1 390 928*	*1 393 189*	*1 394 509*
» c) Raadplegingen en bezoeken	*2 663 768*	*2 660 860*	*2 702 712*	*2 741 148*	*2 780 834*	*2 820 629*
» d) Speciale verstrekkingen + e) Heelkunde	*2 702 236*	*2 750 174*	*2 801 156*	*2 852 386*	*2 905 046*	*2 953 250*
» f) Gynaecologie + g) Toezicht + h) Buiten nomenclatuur	*708 776*	*723 643*	*734 725*	*745 919*	*756 079*	*765 722*
Honoraria tandheelkundigen	1 096 936	1 109 311	1 125 018	1 142 236	1 160 783	1 181 258
Farmaceutische verstrekkingen	5 475 665	5 679 498	5 918 341	6 166 611	6 456 823	6 725 562
Honoraria verpleegkundigen	1 827 399	1 850 547	1 889 100	1 931 830	1 974 988	2 016 590
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Implantaten	851 939	897 940	949 842	1 004 037	1 063 673	1 122 695
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Overige uitgaven	4 451 262	4 868 478	5 041 393	5 236 181	5 396 990	5 548 124
Totaal	**30 073 560**	**30 984 999**	**31 759 528**	**32 560 245**	**33 363 377**	**34 123 251**

Tabel 1

Baseline projectie uitgaven geneeskundige verzorging 2021-2026, gealigneerd op Technische R
Uitgaven, in duizend euro, in prijzen 2021

	2021	2022	2023	2024	2025	2026
Totaal honoraria artsen	8 890 505	8 937 458	9 034 128	9 126 192	9 219 287	9 305 032
» a) Klinische biologie	*1 431 546*	*1 417 618*	*1 407 049*	*1 395 811*	*1 384 139*	*1 370 922*
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» c) Raadplegingen en bezoeken	*2 663 768*	*2 660 860*	*2 702 712*	*2 741 148*	*2 780 834*	*2 820 629*
» d) Speciale verstrekkingen + e) Heelkunde	*2 702 236*	*2 750 174*	*2 801 156*	*2 852 386*	*2 905 046*	*2 953 250*
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Honoraria tandheelkundigen	1 096 936	1 109 311	1 125 018	1 142 236	1 160 783	1 181 258
Farmaceutische verstrekkingen	5 475 665	5 679 498	5 918 341	6 166 611	6 456 823	6 725 562
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Ziekenhuizen (verpleegdagprijs + forfaitaire dagprijs algemene ziekenhuizen + vervoer)	6 576 506	6 704 772	6 828 755	6 943 435	7 043 215	7 135 832
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Totaal	**30 073 560**	**30 984 999**	**31 759 528**	**32 560 245**	**33 363 377**	**34 123 251**

Guidelines

add visual cues to show hierarchy

choose the best row style

add visual cues to help interpretation

break down into smaller tables

Projection de référence des perspectives démographiques 2020-2070 et impact des scénarios alternatifs (écart avec la projection de référence) – Belgique et les trois régions

En milliers d'unités, sauf indication contraire

	Référence (dp20)			NoCovid - référence			HMOR - référence			MIGR - référence		
	2026	2040	2070	2026	2040	2070	2026	2040	2070	2026	2040	2070
Belgique												
Population totale	11725	12215	12768	62	92	153	-8	-72	-231	32	156	114
Naissances	116	129	130	8	1	1	0	0	0	1	2	1
Population 0-2 ans	351	388	391	25	3	5	0	0	0	1	7	2
Population 3-11 ans	1120	1157	1183	14	30	25	0	0	0	0	15	3
Population 12-17 ans	828	759	799	2	45	21	0	0	0	0	4	2
Population 18-66 ans	7263	7188	7302	11	13	99	0	0	0	28	109	50
Population 67 ans et plus	2163	2723	3093	9	1	3	-8	-72	-231	3	21	57
Coefficient de dépendance des âgés (67+)/(18-66) en %	29,8%	37,9%	42,4%	0,1%	-0,1%	-0,5%	-0,1%	-1,0%	-3,2%	-0,1%	-0,3%	0,5%
Région de Bruxelles-Capitale												
Population totale	1242	1292	1344	10	13	15	-1	-5	-19	8	37	3
Naissances	16	19	19	1	0	0	0	0	0	0	1	0
Population 0-2 ans	47	54	53	4	1	1	0	0	0	0	1	-1
Population 3-11 ans	134	135	136	2	5	3	0	0	0	0	3	-2
Population 12-17 ans	90	78	83	0	5	1	0	0	0	0	0	-1
Population 18-66 ans	824	844	842	3	2	9	0	0	0	8	28	-1
Population 67 ans et plus	147	180	230	1	0	1	-1	-5	-19	0	4	8
Coefficient de dépendance des âgés (67+)/(18-66) en %	17,9%	21,3%	27,3%	0,1%	0,0%	-0,2%	-0,1%	-0,6%	-2,2%	-0,1%	-0,2%	1,0%
Région flamande												
Population totale	6790	7121	7560	33	53	92	-5	-43	-132	17	88	91
Naissances	64	71	74	4	1	1	0	0	0	0	1	1
Population 0-2 ans	194	216	225	14	2	3	0	0	0	1	4	2
Population 3-11 ans	632	657	694	8	17	15	0	0	0	0	10	6
Population 12-17 ans	471	439	475	1	26	13	0	0	0	0	3	3
Population 18-66 ans	4149	4107	4273	6	7	59	0	0	0	15	61	45
Population 67 ans et plus	1344	1701	1894	4	0	2	-5	-43	-132	2	10	34
Coefficient de dépendance des âgés (67+)/(18-66) en %	32,4%	41,4%	44,3%	0,1%	-0,1%	-0,6%	-0,1%	-1,0%	-3,1%	-0,1%	-0,4%	0,3%
Région wallonne												
Population totale	3693	3802	3865	19	26	46	-3	-24	-80	6	31	20
Naissances	36	38	37	2	0	0	0	0	0	0	0	0
Population 0-2 ans	110	117	113	8	0	1	0	0	0	0	1	0
Population 3-11 ans	354	364	354	5	7	8	0	0	0	0	2	-1
Population 12-17 ans	267	242	242	0	15	7	0	0	0	0	1	0
Population 18-66 ans	2290	2236	2187	2	3	30	0	0	0	5	20	6
Population 67 ans et plus	672	842	969	4	0	0	-3	-24	-80	1	7	15
Coefficient de dépendance des âgés (67+)/(18-66) en %	29,3%	37,6%	44,3%	0,1%	-0,1%	-0,6%	-0,1%	-1,1%	-3,7%	0,0%	0,0%	0,6%

Projection de référence des perspectives démographiques 2020-2070 et impact des scénarios alternatifs (écart avec la projection de référence) – Belgique et les trois régions

En milliers d'unités, sauf indication contraire

	Référence (dp20)			NoCovid - référence			HMOR - référence			MIGR - référence		
	2026	2040	2070	2026	2040	2070	2026	2040	2070	2026	2040	2070
Belgique												
Population totale	11725	12215	12768	62	92	153	-8	-72	-231	32	156	114
Naissances	116	129	130	8	1	1	0	0	0	1	2	1
Population 0-2 ans	351	388	391	25	3	5	0	0	0	1	7	2
Population 3-11 ans	1120	1157	1183	14	30	25	0	0	0	0	15	3
Population 12-17 ans	828	759	799	2	45	21	0	0	0	0	4	2
Population 18-66 ans	7263	7188	7302	11	13	99	0	0	0	28	109	50
Population 67 ans et plus	2163	2723	3093	9	1	3	-8	-72	-231	3	21	57
Coefficient de dépendance des âgés (67+)/(18-66) en %	29,8%	37,9%	42,4%	0,1%	-0,1%	-0,5%	-0,1%	-1,0%	-3,2%	-0,1%	-0,3%	0,5%
Région de Bruxelles-Capitale												
Population totale	1242	1292	1344	10	13	15	-1	-5	-19	8	37	3
Naissances	16	19	19	1	0	0	0	0	0	0	1	0
Population 0-2 ans	47	54	53	4	1	1	0	0	0	0	1	-1
Population 3-11 ans	134	135	136	2	5	3	0	0	0	0	3	-2
Population 12-17 ans	90	78	83	0	5	1	0	0	0	0	0	-1
Population 18-66 ans	824	844	842	3	2	9	0	0	0	8	28	-1
Population 67 ans et plus	147	180	230	1	0	1	-1	-5	-19	0	4	8
Coefficient de dépendance des âgés (67+)/(18-66) en %	17,9%	21,3%	27,3%	0,1%	0,0%	-0,2%	-0,1%	-0,6%	-2,2%	-0,1%	-0,2%	1,0%
Région flamande												
Population totale	6790	7121	7560	33	53	92	-5	-43	-132	17	88	91
Naissances	64	71	74	4	1	1	0	0	0	0	1	1
Population 0-2 ans	194	216	225	14	2	3	0	0	0	1	4	2
Population 3-11 ans	632	657	694	8	17	15	0	0	0	0	10	6
Population 12-17 ans	471	439	475	1	26	13	0	0	0	0	3	3
Population 18-66 ans	4149	4107	4273	6	7	59	0	0	0	15	61	45
Population 67 ans et plus	1344	1701	1894	4	0	2	-5	-43	-132	2	10	34
Coefficient de dépendance des âgés (67+)/(18-66) en %	32,4%	41,4%	44,3%	0,1%	-0,1%	-0,6%	-0,1%	-1,0%	-3,1%	-0,1%	-0,4%	0,3%
Région wallonne												
Population totale	3693	3802	3865	19	26	46	-3	-24	-80	6	31	20
Naissances	36	38	37	2	0	0	0	0	0	0	0	0
Population 0-2 ans	110	117	113	8	0	1	0	0	0	0	1	0
Population 3-11 ans	354	364	354	5	7	8	0	0	0	0	2	-1
Population 12-17 ans	267	242	242	0	15	7	0	0	0	0	1	0
Population 18-66 ans	2290	2236	2187	2	3	30	0	0	0	5	20	6
Population 67 ans et plus	672	842	969	4	0	0	-3	-24	-80	1	7	15
Coefficient de dépendance des âgés (67+)/(18-66) en %	29,3%	37,6%	44,3%	0,1%	-0,1%	-0,6%	-0,1%	-1,1%	-3,7%	0,0%	0,0%	0,6%

Perspectives démographiques 2020-2070 – Belgique

En milliers d'unités, sauf indication contraire

	2026	2040	2070
Naissances	116	129	130
Population 0-2 ans	351	388	391
Population 3-11 ans	1 120	1 157	1 183
Population 12-17 ans	828	759	799
Population 18-66 ans	7 263	7 188	7 302
Population 67 ans et plus	2 163	2 723	3 093
Coefficient de dépendance des âgés (67+)/(18-66)	*29,8%*	*37,9%*	*42,4%*
Population totale	**11 725**	**12 215**	**12 768**

Day	Fat	Carbs	Protein
Monday	70g	94g	81g
Tuesday	65g	85g	95g
Wednesday	88g	71g	105g
Thursday	57g	102g	78g
Friday	73g	96g	84g
Average	74g	85g	88g

Name (Symbol)	Div	Vol	Yld	P/E	Day Last	% Change
SkyHighCorp (SHC)	--	3143	--	76	21.25	+.25
LowDownInc (LDI)	2.35	2735	5.7	18	41.00	-.50
ValueNowInc (VNI)	1.00	1894	4.5	12	22.00	+.10
DoinBadlyCorp (DBC)	--	7601	--	--	33.50	-.75

Proportional	Tabular
390,209,000	390,209,000
112,371,000	112,371,000

	Invoice	Invoice date	Due date	Status	Amount
	#09293	05/10/2019	05/10/2019	Unpaid	$2,350.00
56px	#98273	05/10/2019	05/10/2019	Paid	$750.83
	#19293	05/10/2019	05/10/2019	Pending	$1,200.00
	#12839	05/11/2019	05/11/2019	Paid	$2,500.00
	81727	05/11/2019	05/11/2019	Unpaid	$3,200.00

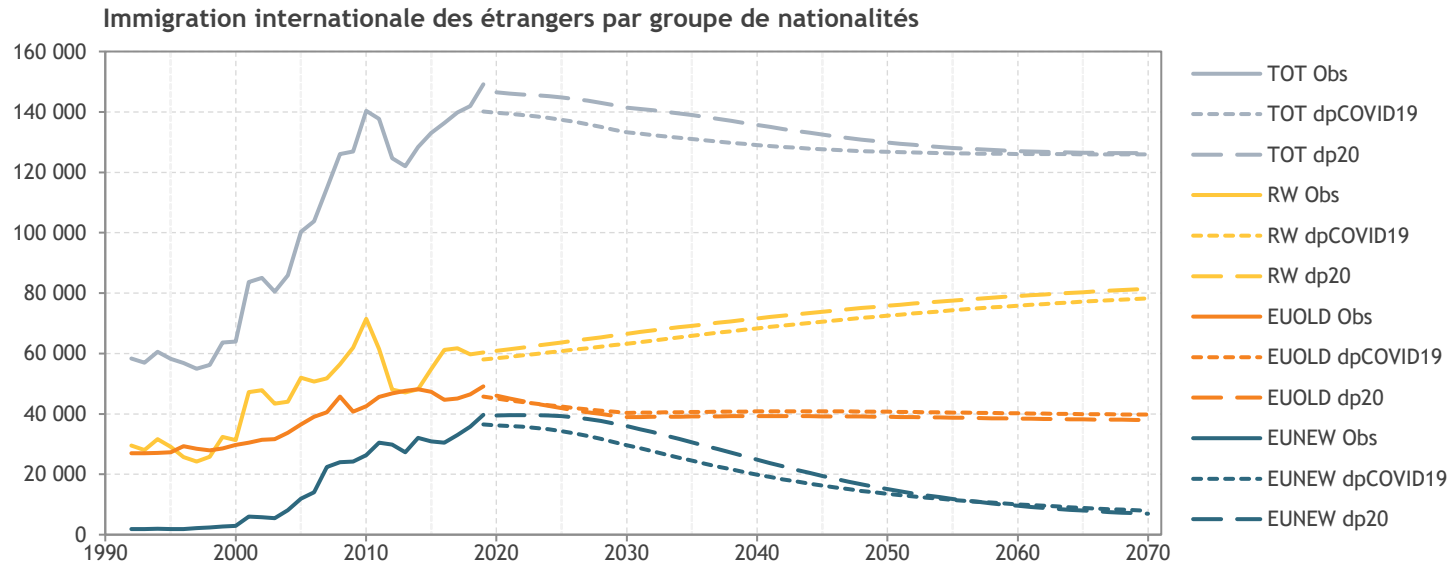
More info: [The Ultimate Guide to Designing Data Tables]

Projections and missing data

flowingdata.com/2018/01/30/visualizing-incomplete-and-missing-data/

Projections

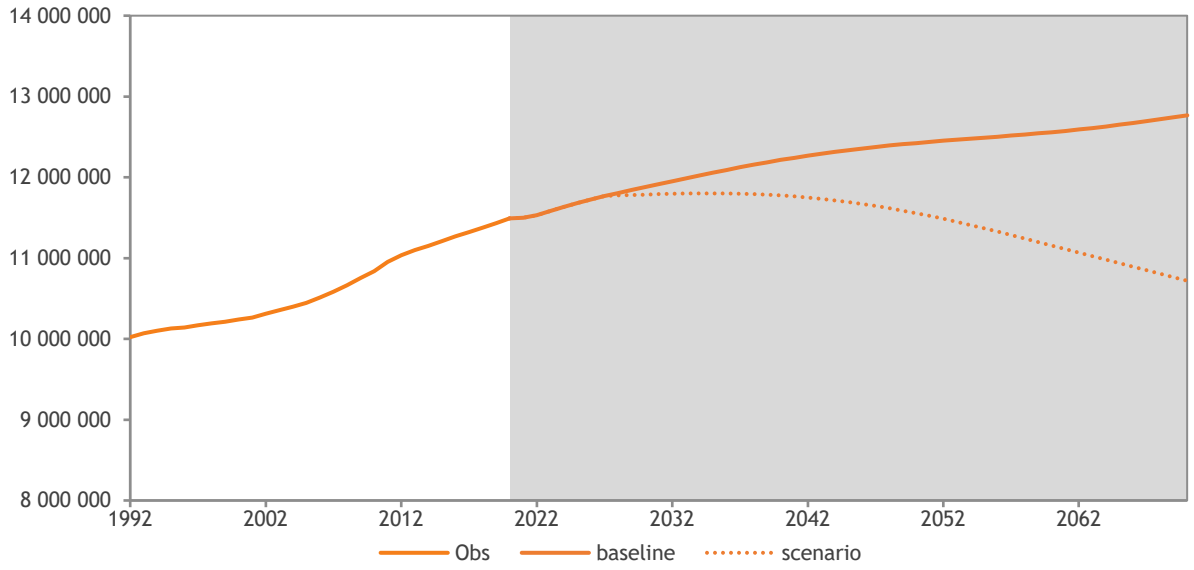
different line styles

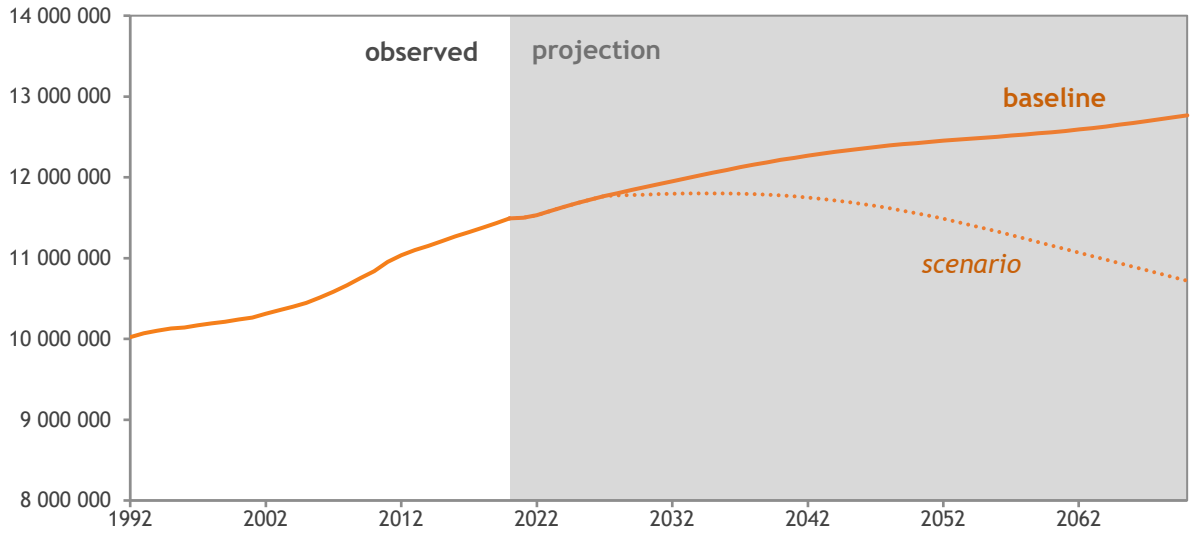

Immigration internationale des étrangers par groupe de nationalités
160 000
140 000
120 000
100 000
80 000
60 000
40 000
20 000
0
1990
2000
2010
2020
2030
2040
2050
2060
2070
TOT Obs
TOT dpCOVID19
TOT dp20
RW Obs
RW dpCOVID19
RW dp20
EUOLD Obs
EUOLD dpCOVID19
EUOLD dp20
EUNEW Obs
EUNEW dpCOVID19
EUNEW dp20

Projections

different line styles

shaded background


14 000 000
13 000 000
12 000 000
11 000 000
10 000 000
9 000 000
8 000 000
1992
2002
2012
2022
2032
2042
2052
2062
Obs
baseline
scenario


14 000 000
13 000 000
12 000 000
11 000 000
10 000 000
9 000 000
8 000 000
1992
2002
2012
2022
2032
2042
2052
2062
observed
projection
baseline
scenario

Projections

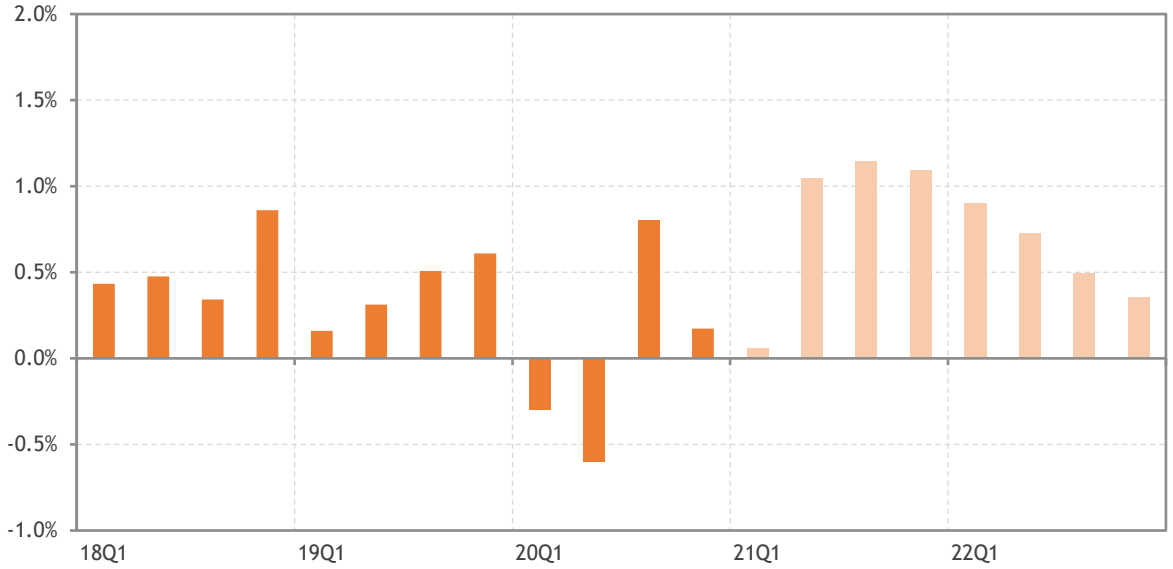
different line styles

shaded background

higher color values

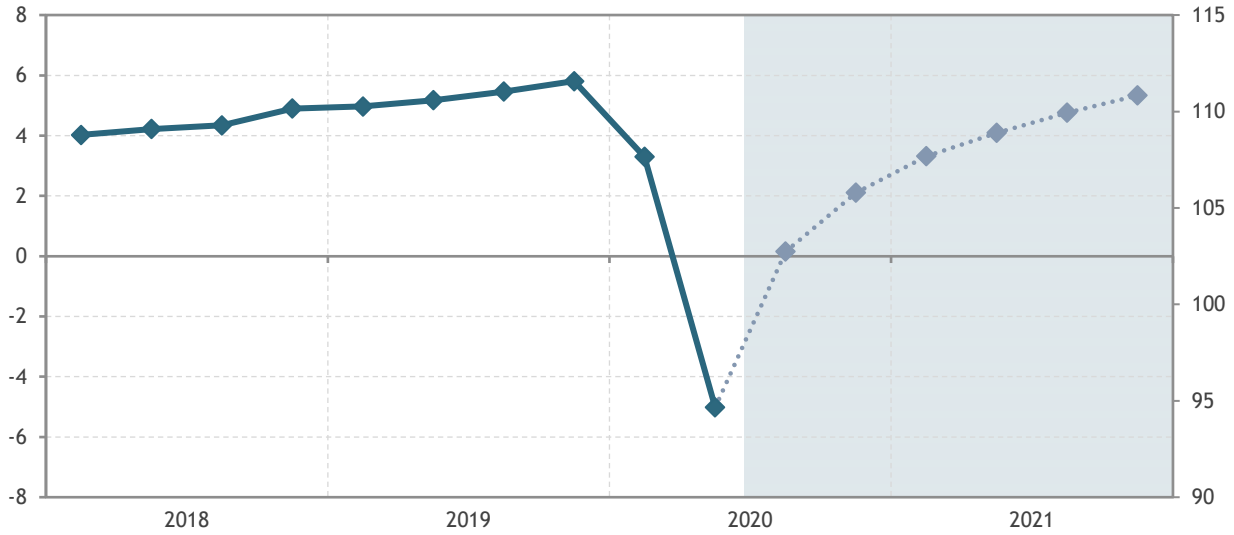
Bruto binnenlands product

Kwartaal-op-kwartaalgroei



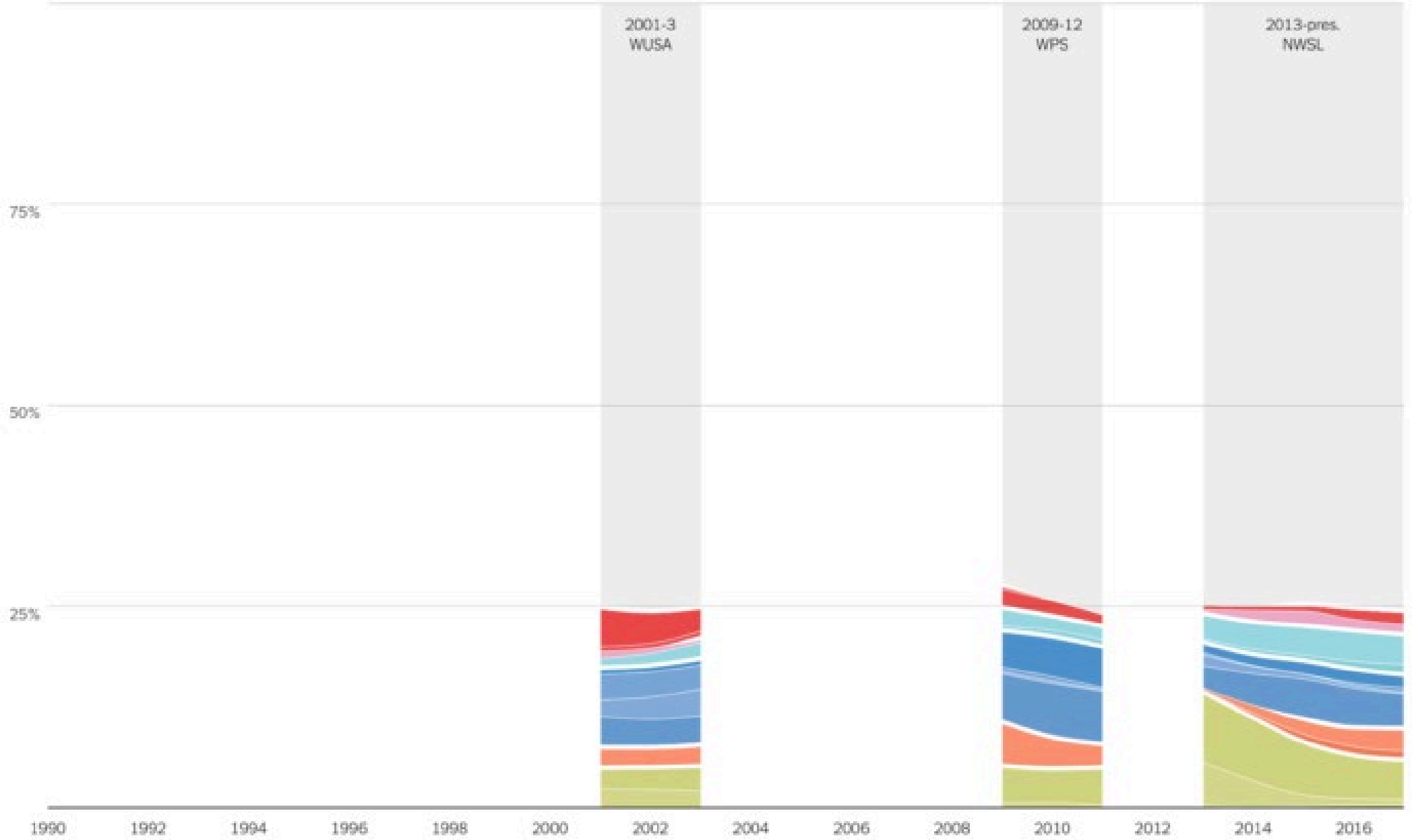
Évolution du PIB Belge

trimestrielle, en milliards d'euros de 2015



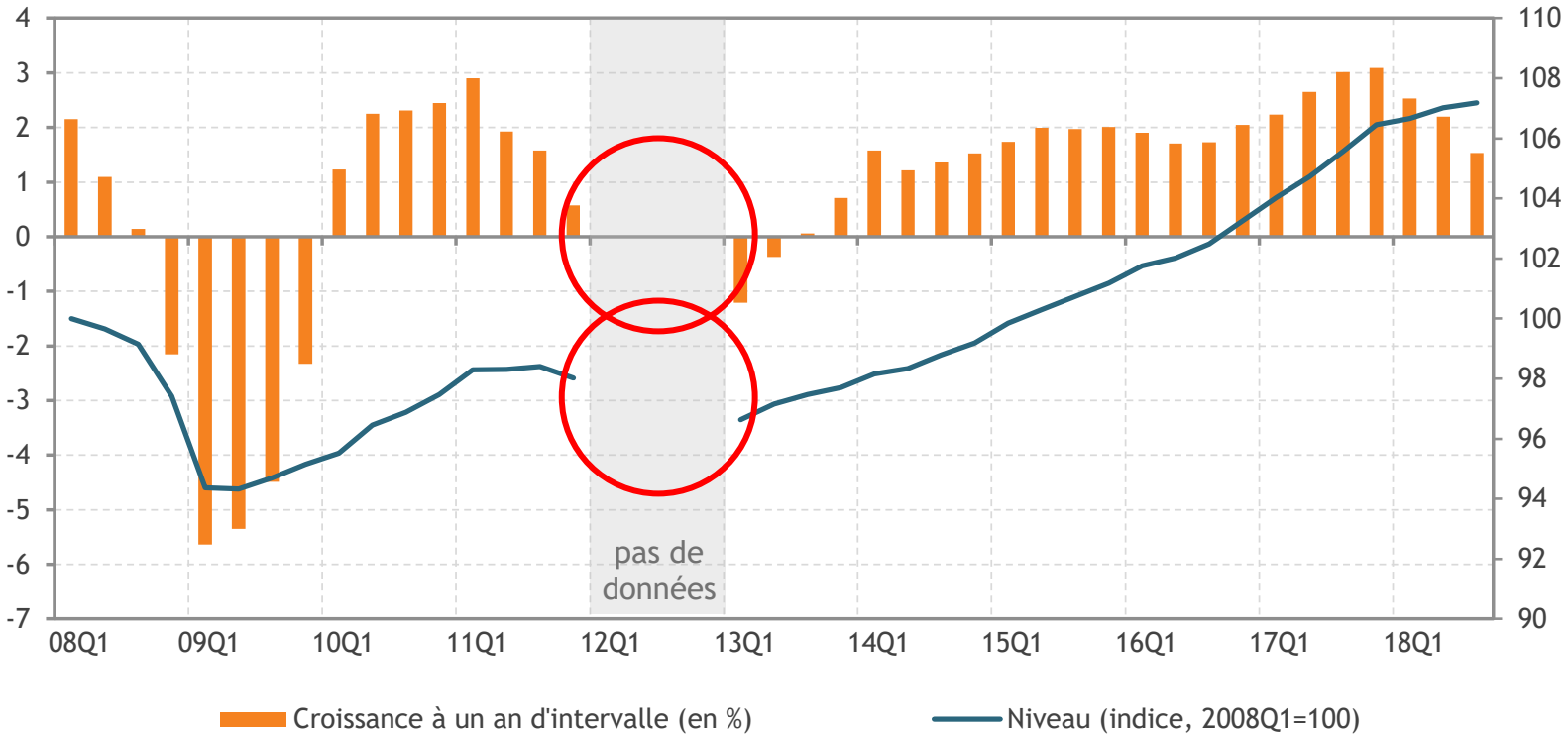
Missing data

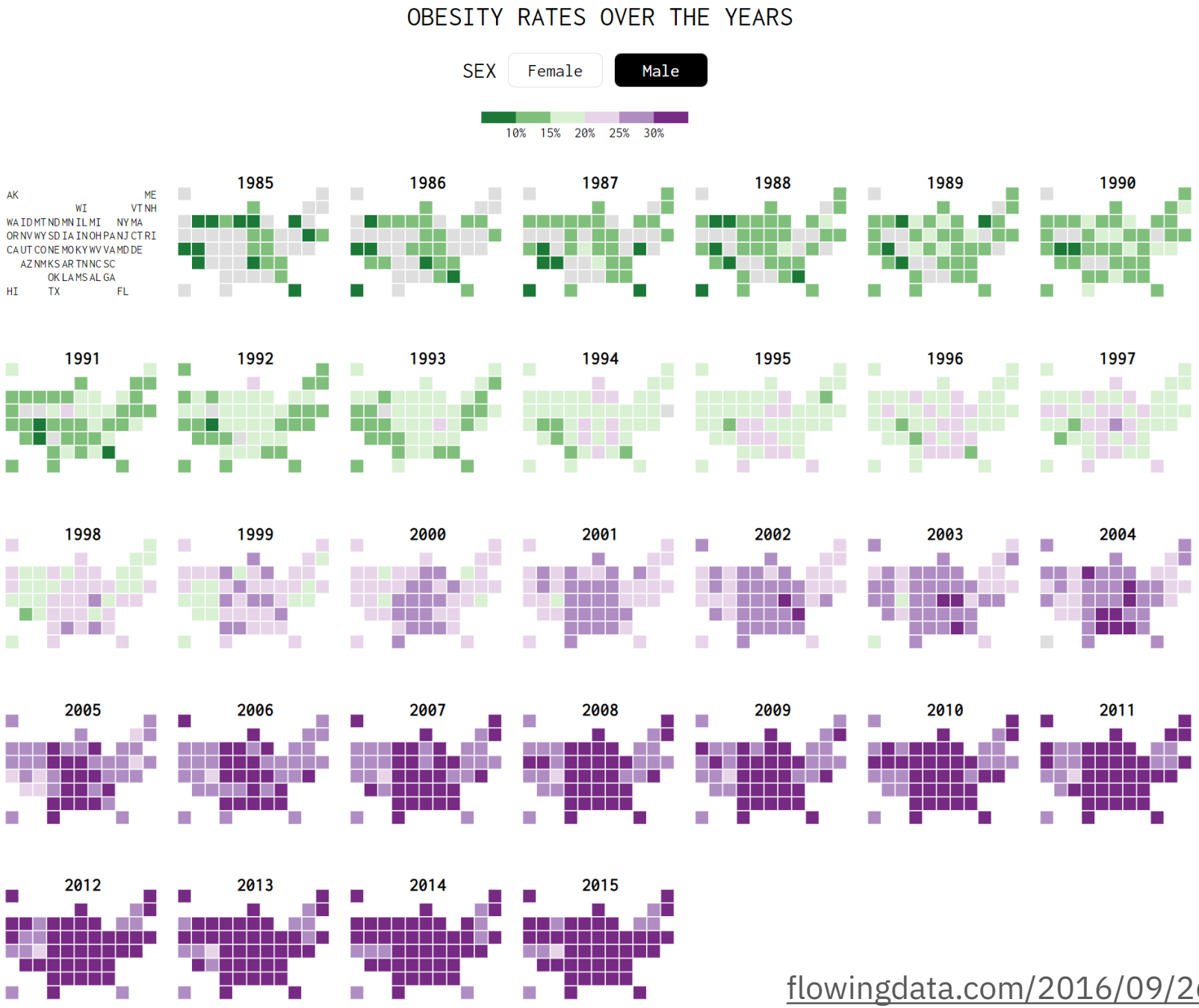
show the gaps


2001-3
WUSA
2009-12
WPS
2013-pres.
NWSL
75%
50%
25%
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016

Graphique 1. Évolution trimestrielle du PIB de la zone euro en volume

Données corrigées des variations saisonnières et des effets calendaires





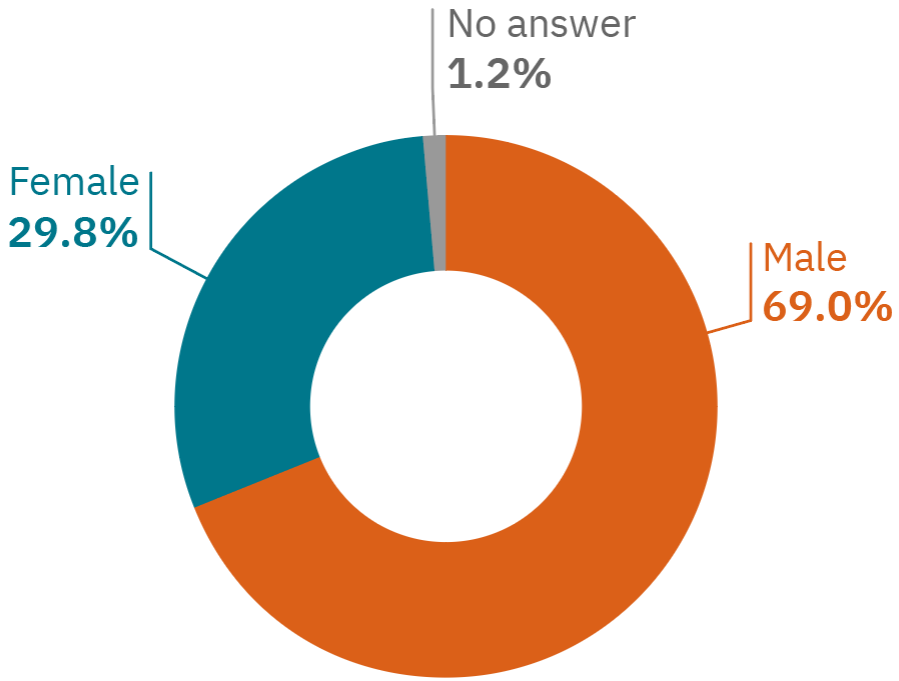
flowingdata.com/2016/09/26/the-spread-of-obesity

Missing data

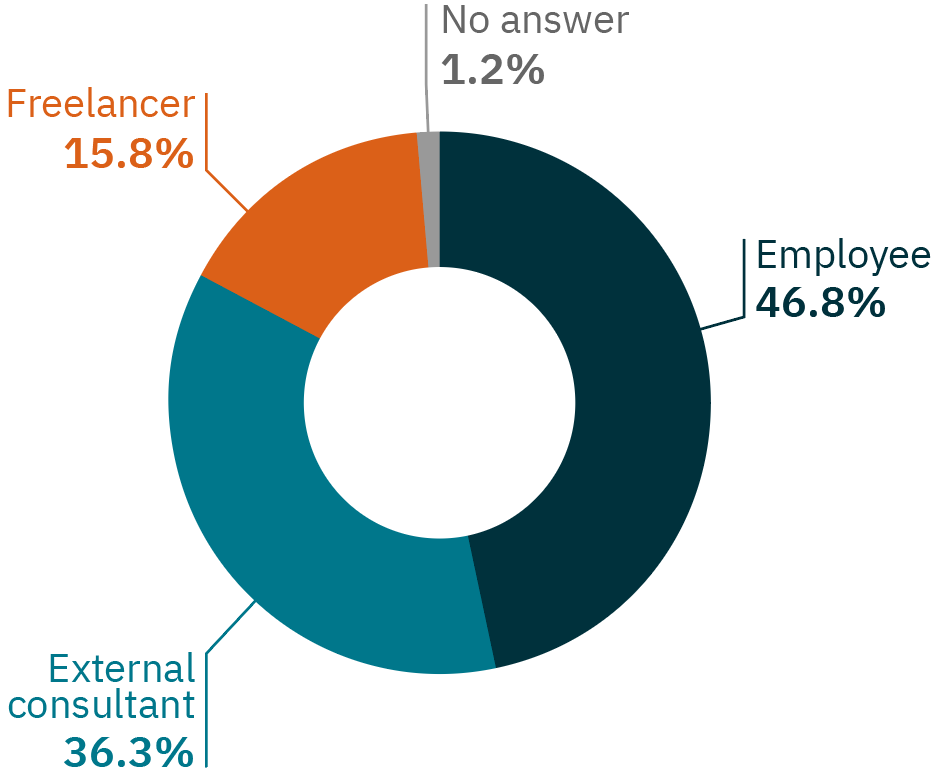
show the gaps

treat as a separate category

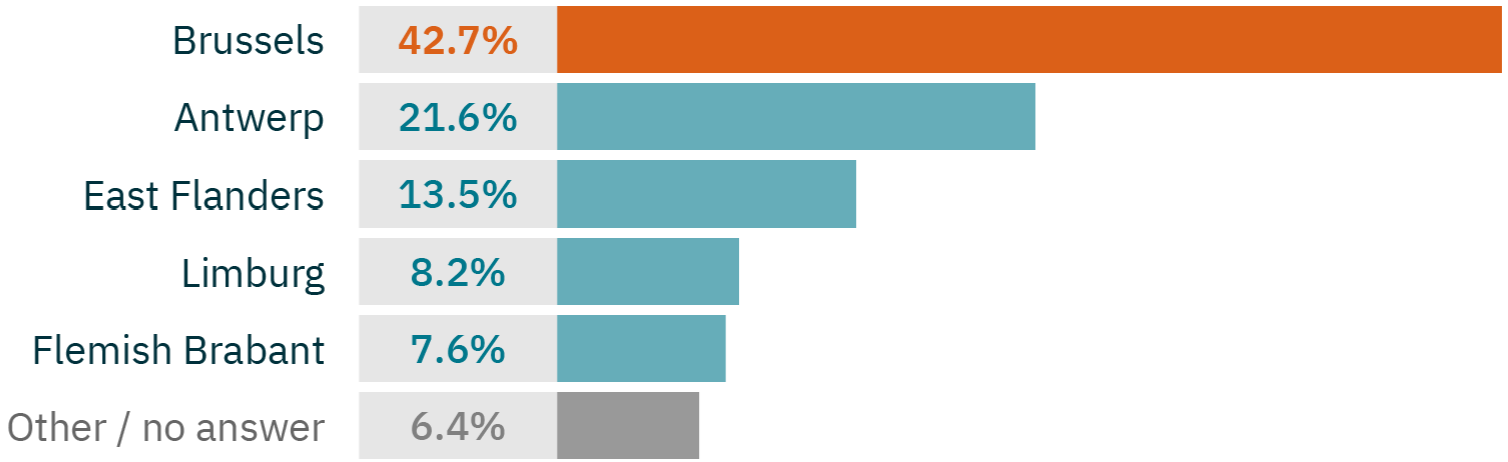
Gender



Type of employment



Location of the organisation



Missing data

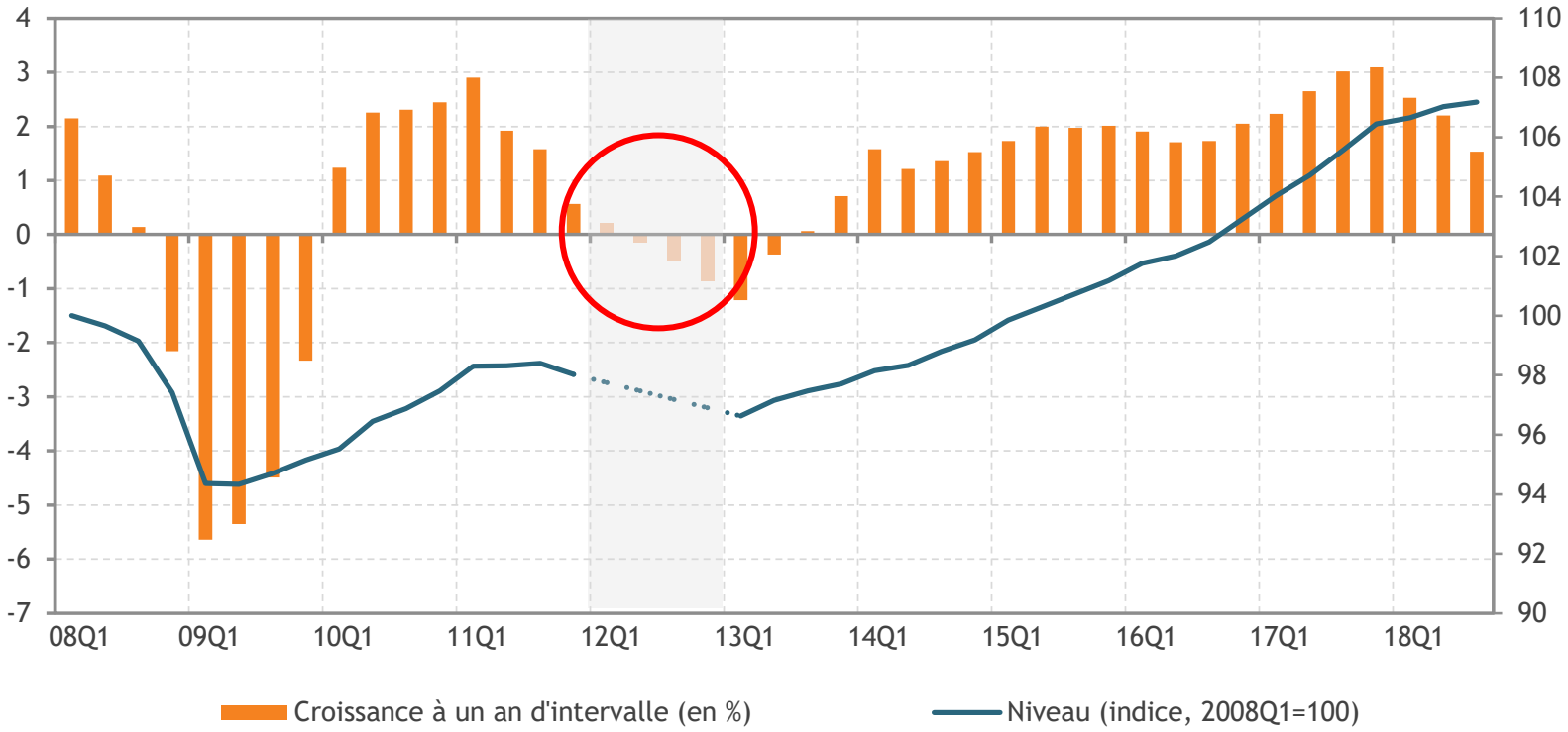
show the gaps

treat as a separate category

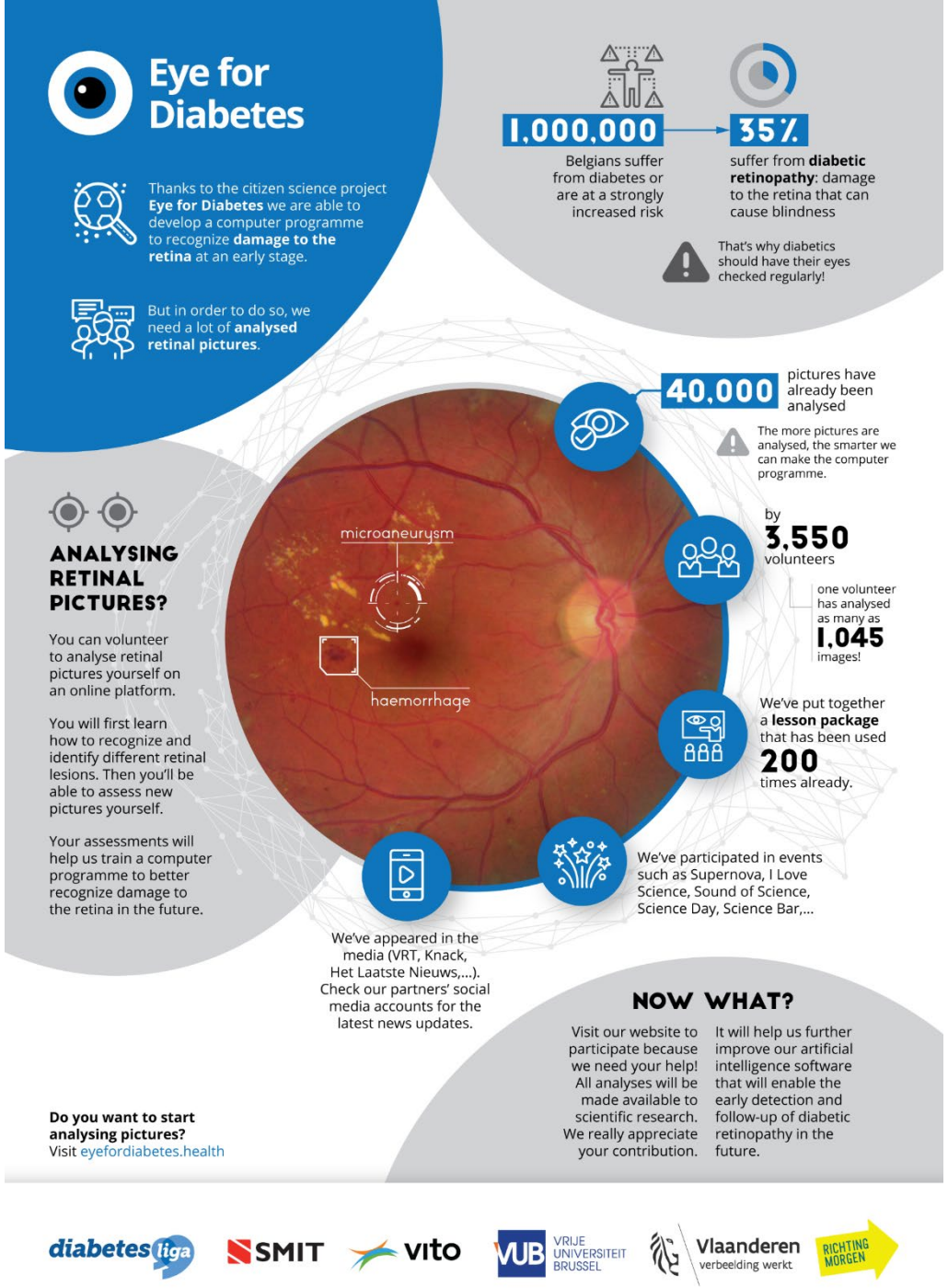
interpolate (carefully)

Graphique 1. Évolution trimestrielle du PIB de la zone euro en volume

Données corrigées des variations saisonnières et des effets calendaires



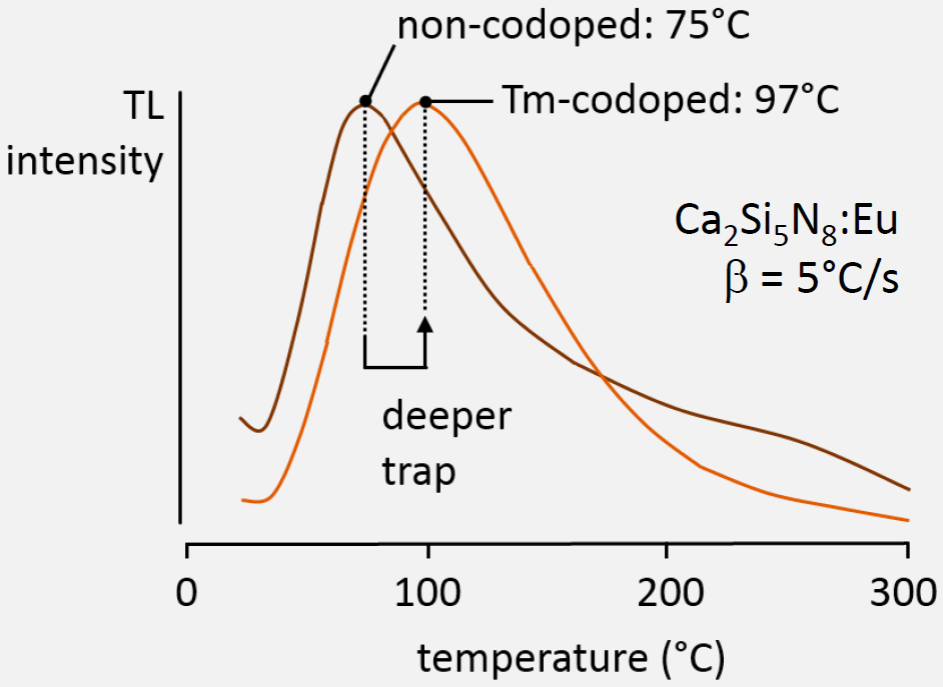
Visuals for posters and presentations



use design principles to your advantage!

create a structured layout

Deep traps – slow decay
= glow peaks at higher temperature
Shallow traps – fast decay
= glow peaks at lower temperature



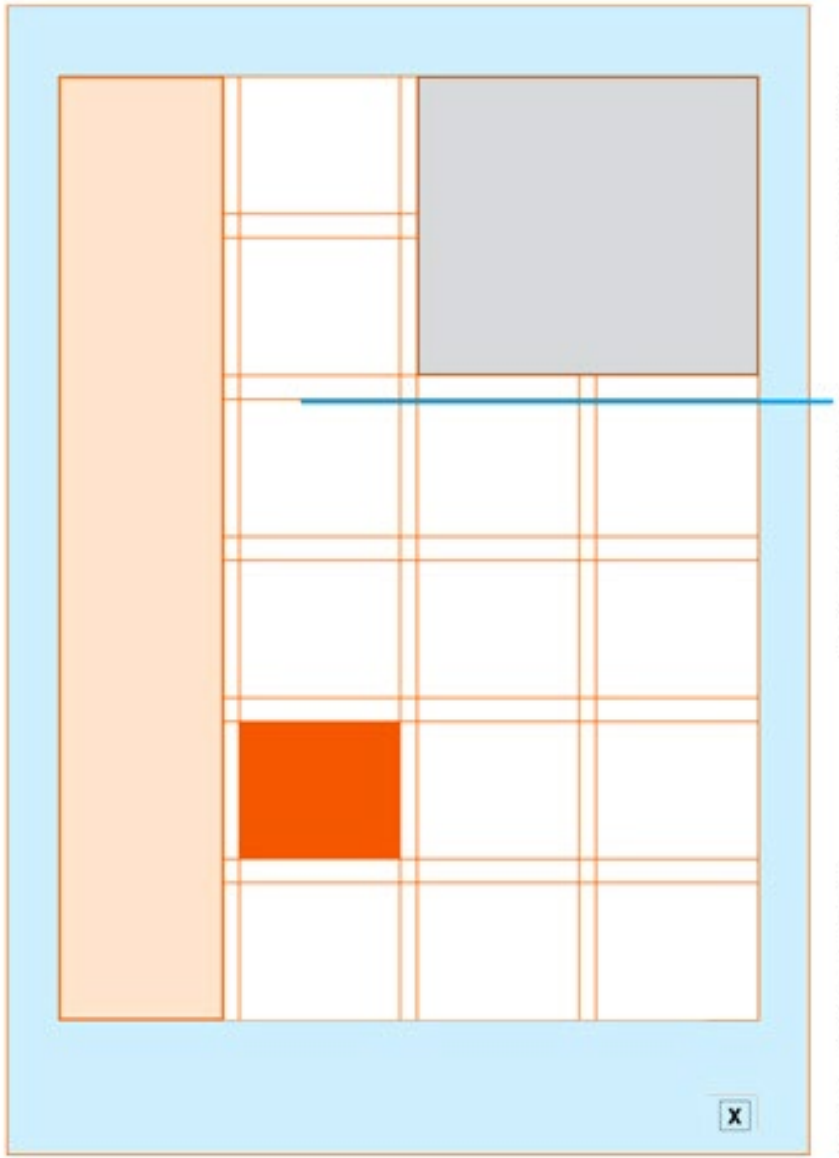
Make it readable:
few details,
sufficiently large font size

when in doubt,
start from
a grid

COLUMNS
are vertical containers that hold type or images. The width and number of columns on a page or screen can vary, depending on the content.

MODULES
are individual divisions separated by consistent space, providing a repeating, ordered grid. Combining modules can create columns and rows of varying sizes.

MARGINS
are buffer zones. They represent the amount of space between the trim size, including gutter, and the page content. Margins can also house secondary information, such as notes and captions.



SPATIAL ZONES
are groups of modules or columns that can form specific areas for type, ads, images, or other information.

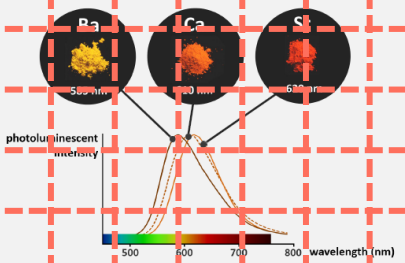
FLOWLINES
are alignments that break space into horizontal bands. Not actual lines, flowlines are a method for using space and elements to guide a reader across a page.

MARKERS
help a reader navigate a document. Indicating placement for material that appears in the same location, markers include page numbers, running heads and feet (headers and footers), and icons.

Persistent luminescence in rare-earth doped nitrido-silicates

Koen Van den Eeckhout, Philippe F. Smet, Dirk Poelman

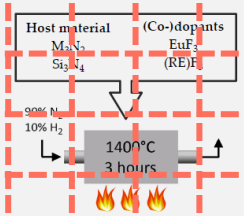
LumiLab — UNIVERSITEIT GENT



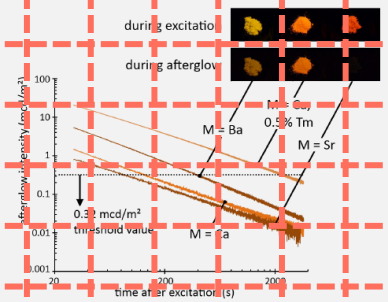
The nitrido-silicates $M_2Si_5N_8$:Eu

- Very broad excitation spectrum
  → excitable with both UV and visible light
- Resistant to heat and moisture
  → ideally suited for applications
- High quantum efficiency
  → efficient excitation and emission processes
- tunable emission color

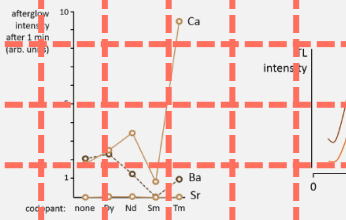
Preparation



Afterglow

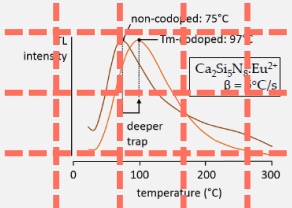


Influence of codoping



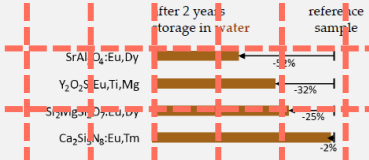
codoping can increase or decrease the afterglow intensity

$Ca_2Si_5N_8$:Eu,Tm shows the brightest afterglow, nearly 6 times brighter than in $Ca_2Si_5N_8$:Eu



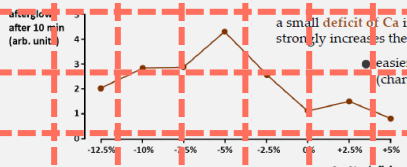
thermoluminescence measurements reveal a shift in depth of the main trap level upon codoping

Stability



the nitrido-silicates are extremely stable compared to other common host materials and hence well suited for outdoor or in-vivo applications

Starting materials



a small deficit of Ca in the starting mixture strongly increases the afterglow intensity

- easier incorporation (charge compensation)

using fluorides strongly increases afterglow intensity

- easier incorporation
- higher crystallinity

Challenges

- Enhance the afterglow brightness
  → Are there better choices for codopants?
  → Is there an optimal dopant or codopant concentration?
- Reduce the grain size for e.g. *in vivo* medical imaging
  → How can we optimize the preparation conditions?
- Determine the origin of the charge carrier traps
  → Are they vacancies? Or codopant ions? A combination of both?

Conclusions

- The nitrido-silicates $M_2Si_5N_8$ are promising host materials for orange-to-red Eu^{2+}-based persistent phosphors.

They can be excited with both UV and visible light.

- $Ca_2Si_5N_8:Eu^{2+},Tm^{3+}$ yields the best afterglow, lasting around 1 hour. $Ba_2Si_5N_8:Eu^{2+}$ has an afterglow of around 400s.
- Thermoluminescence curves indicate a shift in depth of the main trap levels upon codoping.
- The nitrido-silicates are stable and therefore ideal for applications.

Acknowledgement: Pieter Dorenbos, Adrie Bos and Erik van der Kolk (TU Delft) are kindly acknowledged for their assistance in TL measurements

Contact: Koen.VandenEeckhout@UGent.be

Persistent luminescence in the $M_2Si_5N_8:Eu^{2+},RE^{3+}$ family (M=Ca,Sr,Ba)

Koen Van den Eeckhout | Philippe F. Smet | Dirk Poelman

LumiLab, Department of Solid State Sciences, Ghent University

Background

Persistent phosphors = luminescent materials that continue emitting light for hours after ending the excitation ('afterglow').

Applications:
- safety and emergency signage
- dials and displays
- medical imaging

Wanted: efficient and stable persistent phosphor in the orange to red part of the visible spectrum

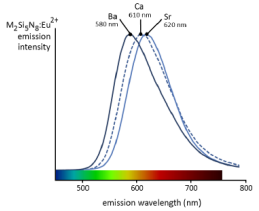
Preparation

Host material:
- M_3N_2 (M = Ca,Sr,Ba)
- Si_3N_4

(Co-)dopants:
- EuF_3, $(RE)F_3$

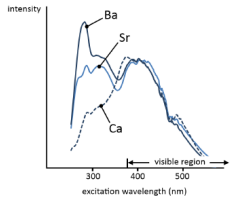
90% N_2, 10% H_2 → 1400°C, 3 hours

The alkali-earth nitrido-silicates: $M_2Si_5N_8:Eu^{2+}$



Requirements for good host materials:
- ☑ odorless
- ☑ resistant to heat
- ☑ resistant to moisture
- ☑ excitable with both UV and visible light

Ca	Sr	Ba
Cc monoclinic 610nm	$Pmn2_1$ orthorhombic 620nm	$Pmn2_1$ orthorhombic 585nm



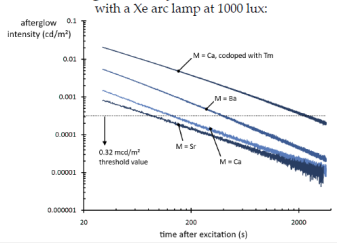
1 After excitation, all materials, even non-codoped, show some form of persistent luminescence.

2 The decay curves follow straight lines in a log-log plot, implying that they can be modelled by a power law with negative scaling exponent. In other words, the decay is initially fast, but slows down over time.

3 $Ca_2Si_5N_8:Eu^{2+},Tm^{3+}$ yields the brightest and longest afterglow, nearly 6 times brighter than the non-codoped variant. It lasts around 1 hour.

Afterglow

Afterglow intensity after 1 min excitation with a Xe arc lamp at 1000 lux:



4 The afterglow of $Ba_2Si_5N_8:Eu^{2+}$ lasts around 400s, and can be slightly increased by dysprosium codoping.

5 The emission spectra during the afterglow in $Ca_2Si_5N_8:Eu^{2+},Tm^{3+}$ and $Ba_2Si_5N_8:Eu^{2+}$ are redshifted by about 10 nm.

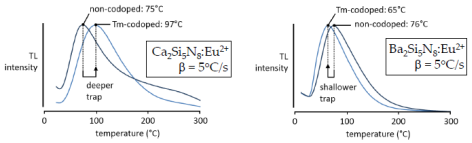
6 Codoping with samarium weakens the afterglow considerably, for all materials.

7 For $Sr_2Si_5N_8:Eu^{2+}$ the afterglow is very weak, even upon codoping with rare earths.

Thermoluminescence

Thermoluminescence = measuring the light emission while heating a previously charged sample

Deep traps → glow peaks at **higher** temperature (±100°C for optimal afterglow)
Shallow traps → glow peaks at **lower** temperature



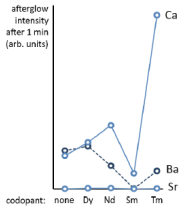
Conclusions

The $M_2Si_5N_8:Eu^{2+},RE^{3+}$ family are promising host materials for orange-to-red Eu^{2+}-based persistent phosphors.

They can be excited with both UV and visible light.

$Ca_2Si_5N_8:Eu^{2+},Tm^{3+}$ yields the best afterglow, lasting around 1 hour. $Ba_2Si_5N_8:Eu^{2+}$ has an afterglow of around 400s.

Thermoluminescence curves indicate a shift in depth of the main trap levels upon codoping.



Acknowledgement: many thanks to Pieter Dorenbos, Adrie Bos and Erik van der Kolk from Delft University of Technology for assistance in TL measurements.

Contact: Koen.VandenEeckhout@UGent.be

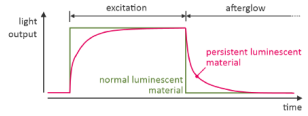
Persistent luminescent nanophosphors for *in vivo* medical imaging

Koen Van den Eeckhout | Philippe Smet | Dirk Poelman
Thomas Maldiney | Guillaume Sraiki | Cyrille Richard | Bruno Viana

Center for Nano- and Biophotonics (NB-Photonics), Ghent University
LumiLab, Department of Solid State Sciences, Ghent University
Université Paris Descartes, Chimie Paristech, Paris, France

Persistent luminescence

Persistent luminescent materials continue emitting light for minutes or hours after the excitation has ended.



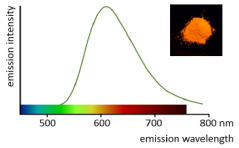
Motivation

Typical *in vivo* medical imaging requires radioactive tracer particles to follow the drug distribution throughout the body.

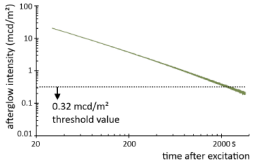
Persistent luminescent tracer particles can be excited before injection, outside of the patient's body.

Persistent luminescent nanophosphors

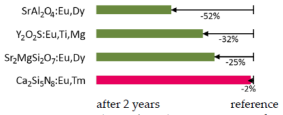
$Ca_2Si_5N_8:Eu,Tm$ shows broadband emission by divalent europium in the orange-red region of the spectrum.



The decay of the afterglow follows a power law and lasts around 45 minutes.



Compared to other common host materials, the nitrido-silicates are very stable and hence well suited for *in vivo* applications.



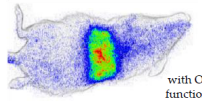
In vivo medical imaging

In vivo medical imaging using persistent luminescent particles:

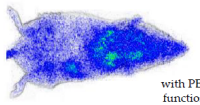
Excitation of the persistent luminescent nanoparticles
↓
Injection of the excited particles in the patient's body
↓
Detection of the radiation from outside of the body

Requirements for efficient *in vivo* imaging probes:
- ✓ long and intense persistent luminescence
- ✓ emission in the range of low tissue absorption
- ✓ good chemical stability
- ✓ ability to be functionalized
- ✗ small particle size (nanometer range)

Biodistribution of $Ca_2Si_5N_8:Eu,Tm$ 15 minutes after tail vain injection:



with OH surface functionalization



with PEG surface functionalization

Challenges

Enhance the afterglow brightness
- Are there better choices for codopants?
- Can we optimize the dopant or codopant concentration?
- Are there alternative host materials?

Reduce the particle size to nanometer range
- Can we optimize the preparation conditions?
- Are there alternative preparation routes?

Conclusions

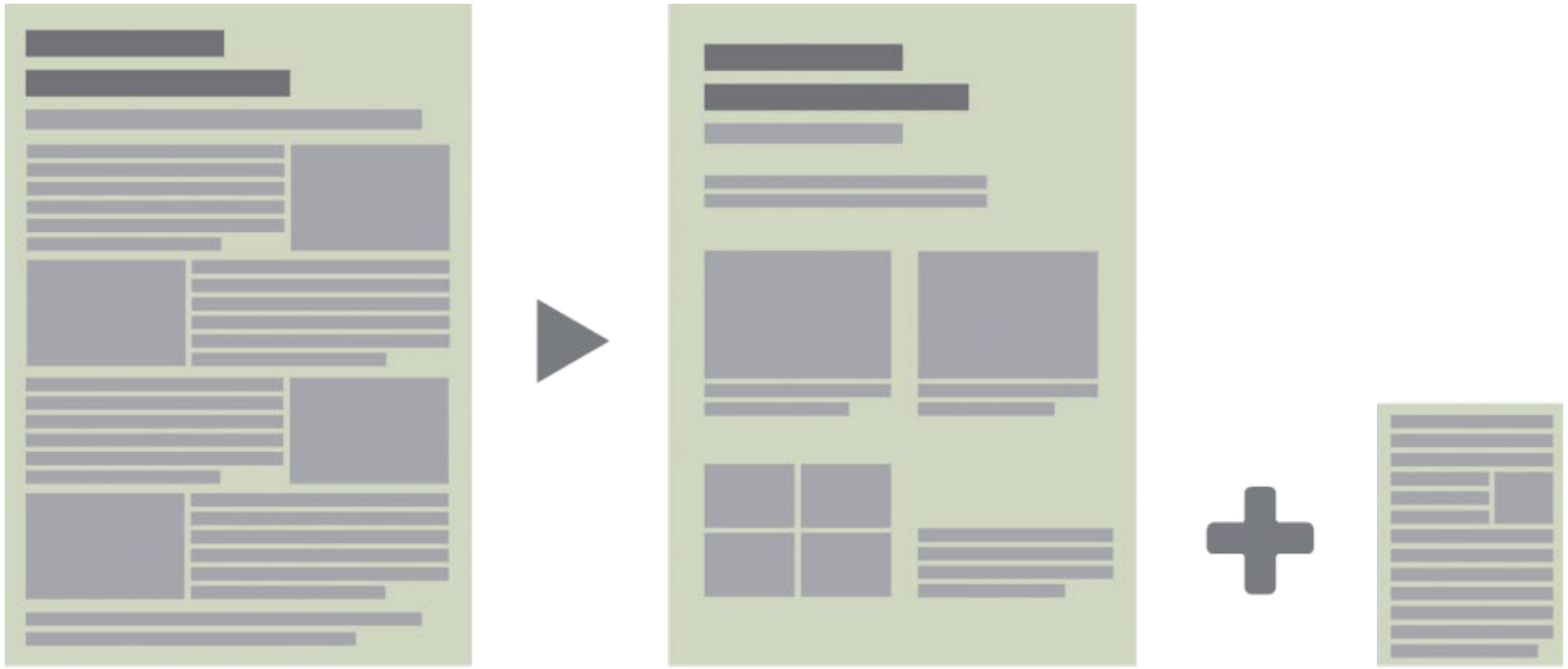
Persistent luminescent nanoparticles are a harmless alternative for radioactive tracer particles for *in vivo* medical imaging.

$Ca_2Si_5N_8:Eu,Tm$ persistent luminescent particles can be used for *in vivo* imaging:
- they have a long afterglow in the tissue transparency window,
- they are chemically stable and can be functionalized.

Better preparation conditions or alternative preparation techniques are desired to obtain a smaller particle size.

koen.vandeneeckhout@ugent.be

create a consistent theme



remove the unnecessary

Lunch break

All the slides and all the links:

baryon.be/dataviz-resources

Exercises

Practice time!

15’ break

Ethics

Poor design

Misleading stories

Dubious data

Hiding uncertainty

Exercises

Choosing the right visual

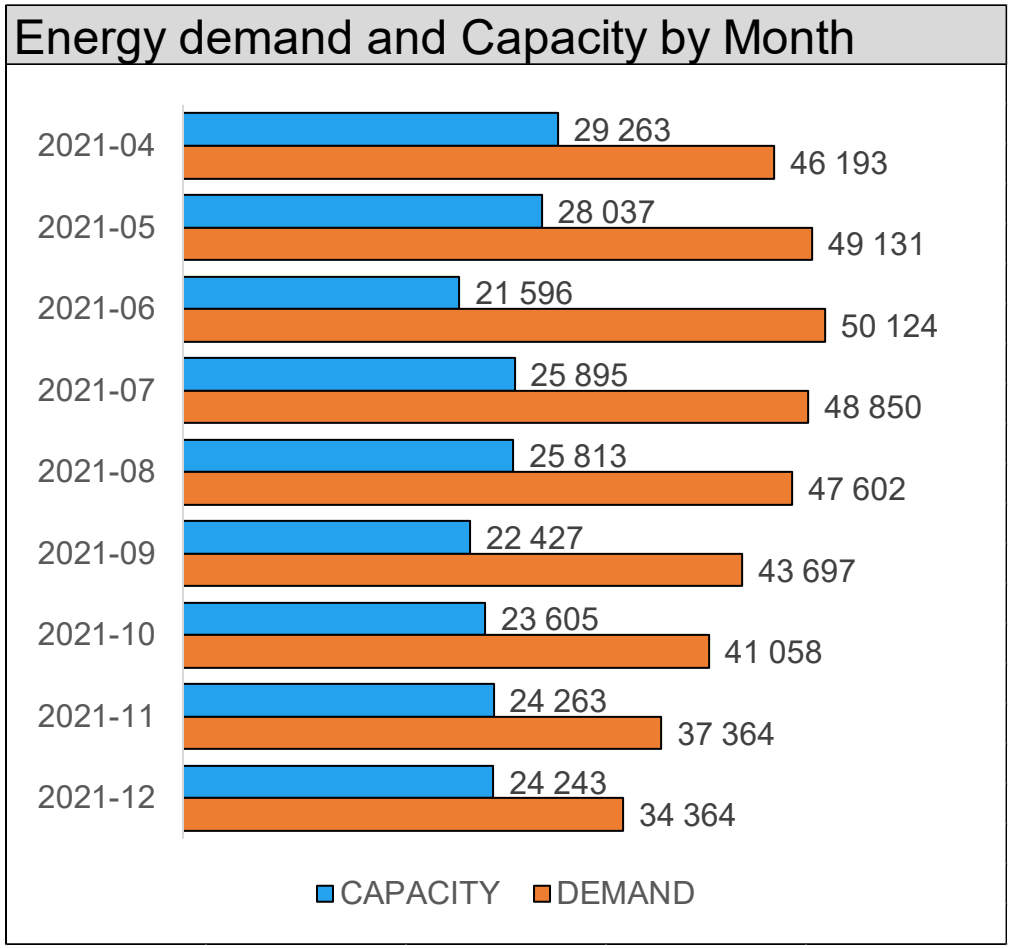
Individual exercise (10 minutes)

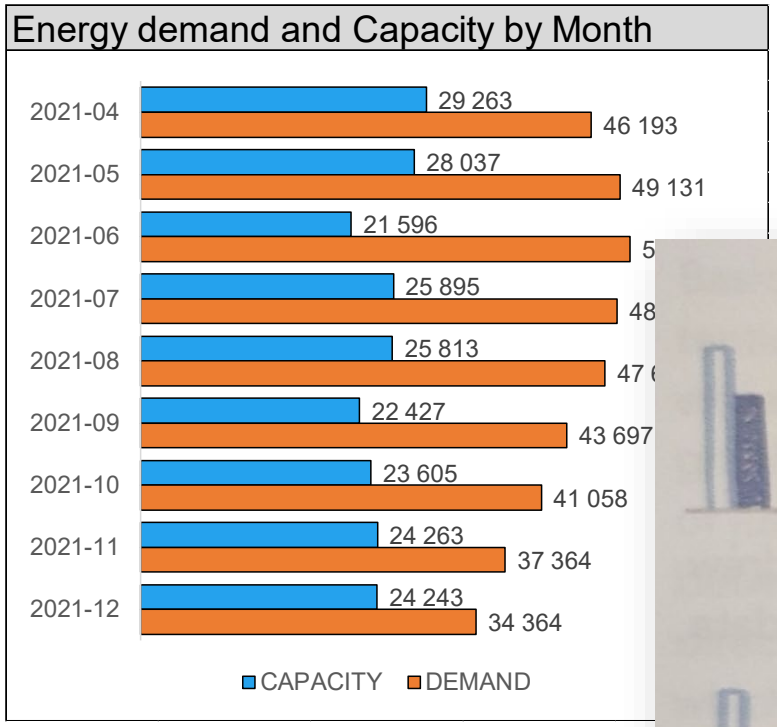
Get a blank piece of paper.

How many different ways can you come up with to potentially visualize this data?

Draw them! Don't worry about being precise, make it quick and dirty to get an overall sense of what each visual could look like.

After 10 minutes, which do you like best and why?




Energy demand and Capacity by Month
2021-04
29 263
46 193
2021-05
28 037
49 131
2021-06
21 596
2021-07
25 895
2021-08
25 813
2021-09
22 427
43 697
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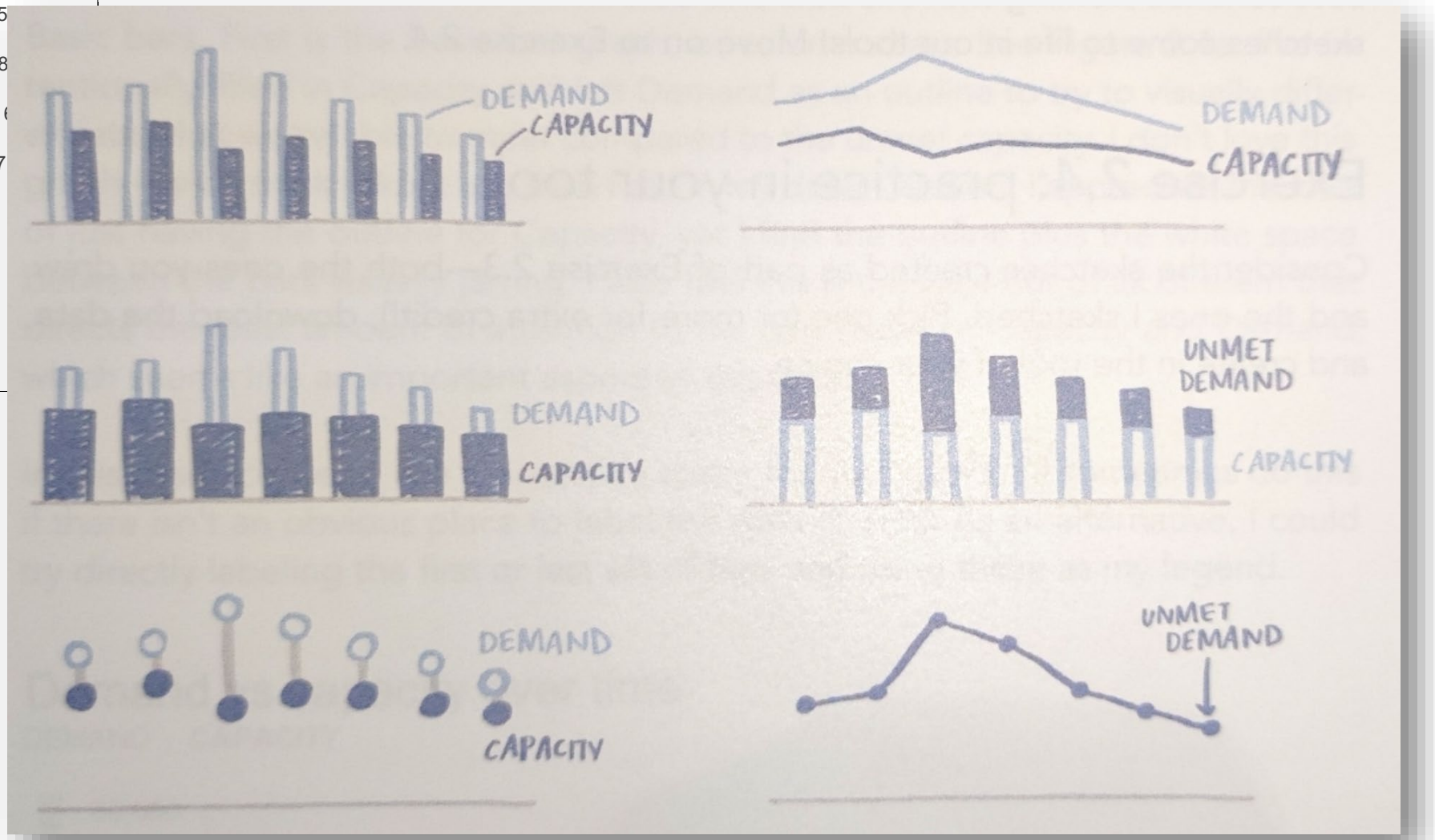
23 605
41 058
2021-11
24 263
37 364
2021-12
24 243
34 364
CAPACITY
DEMAND


DEMAND
CAPACITY
DEMAND
CAPACITY
DEMAND
CAPACITY
UNMET
DEMAND
CAPACITY
DEMAND
CAPACITY
UNMET
DEMAND

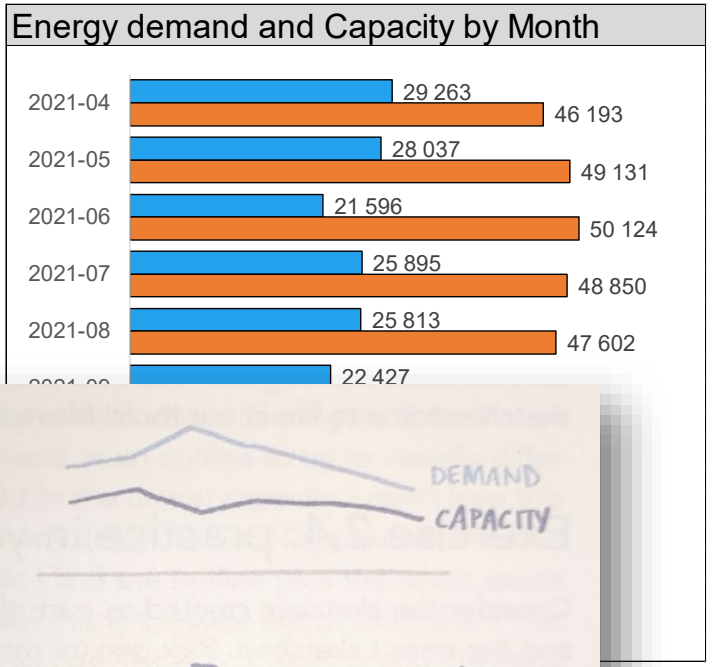
Practice in your tool

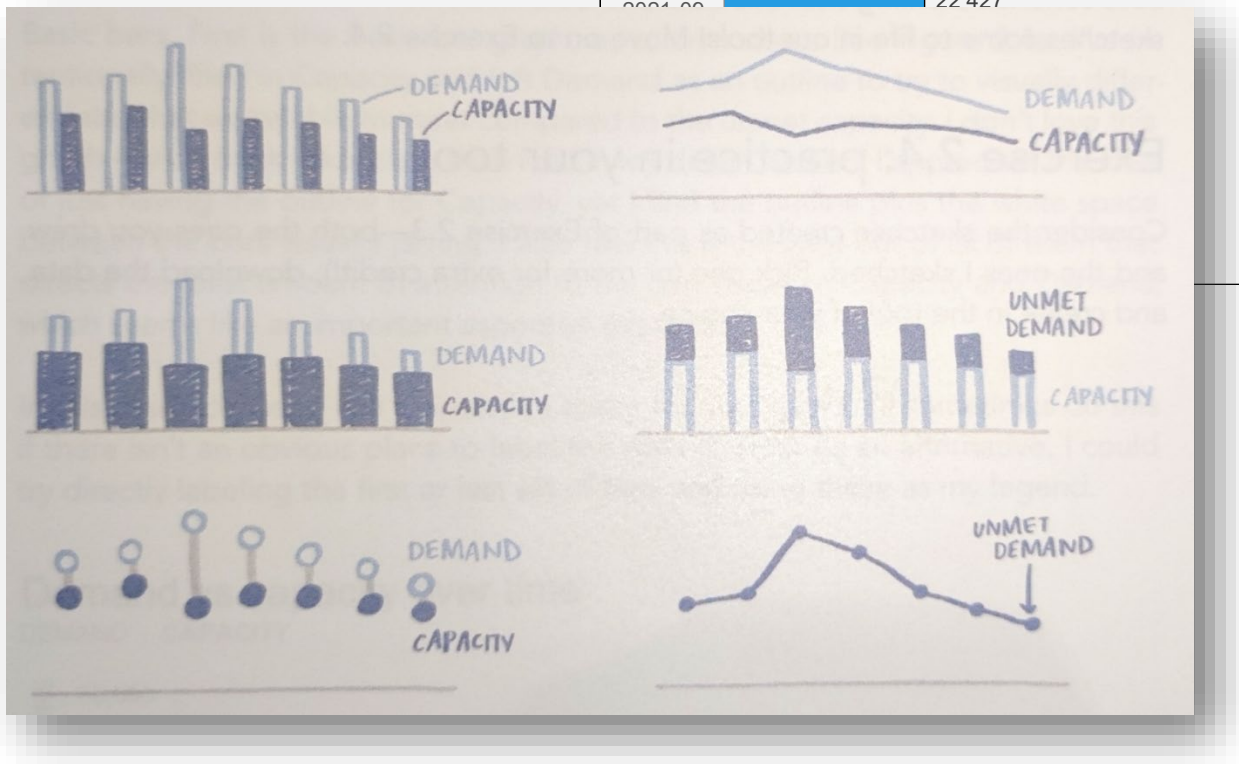
Individual exercise (15 minutes)

Consider the sketches from the previous exercise – both the ones you drew and the ones in the presentation.

Pick your favorite and **create in the tool of your choice**.

Download the data at
baryon.be/files/workshop/exercise1.xlsx





Knaflic, Cole. *Storytelling With Data: Let's Practice!* Wiley, © 2019

Which graph would you choose?

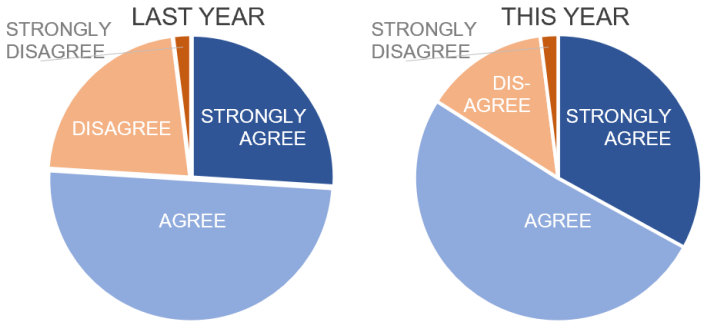
What do you like about each graph? What can you easily see or compare?

What is difficult about each view?

If you had to communicate these data, **which option would you choose** and why?

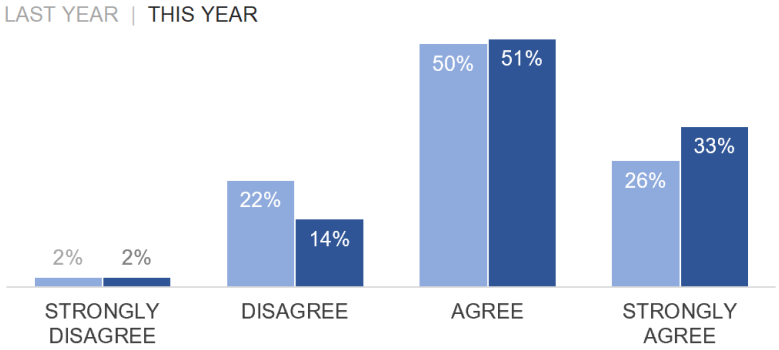
OPTION A: **pies**

"I plan to be working here in one year"



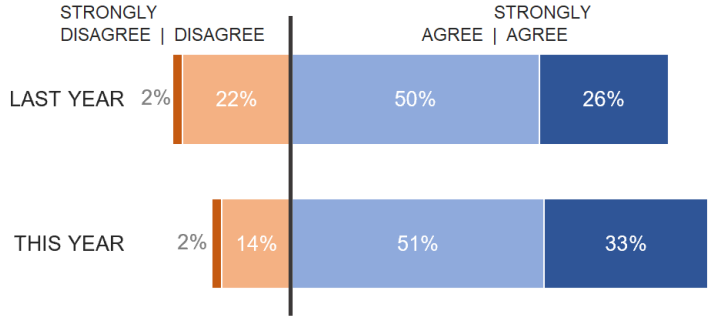
OPTION B: **bars**

"I plan to be working here in one year"



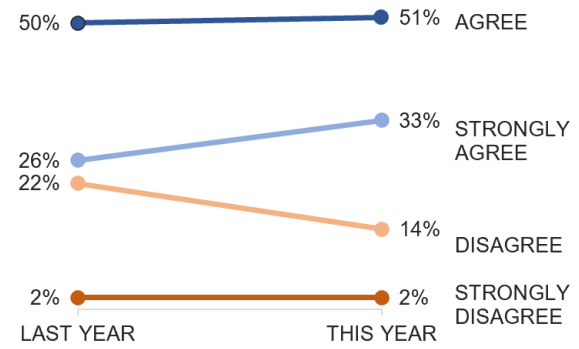
OPTION C: **divergent stacked bars**

"I plan to be working here in one year"



OPTION D: **slopegraph**

"I plan to be working here in one year"



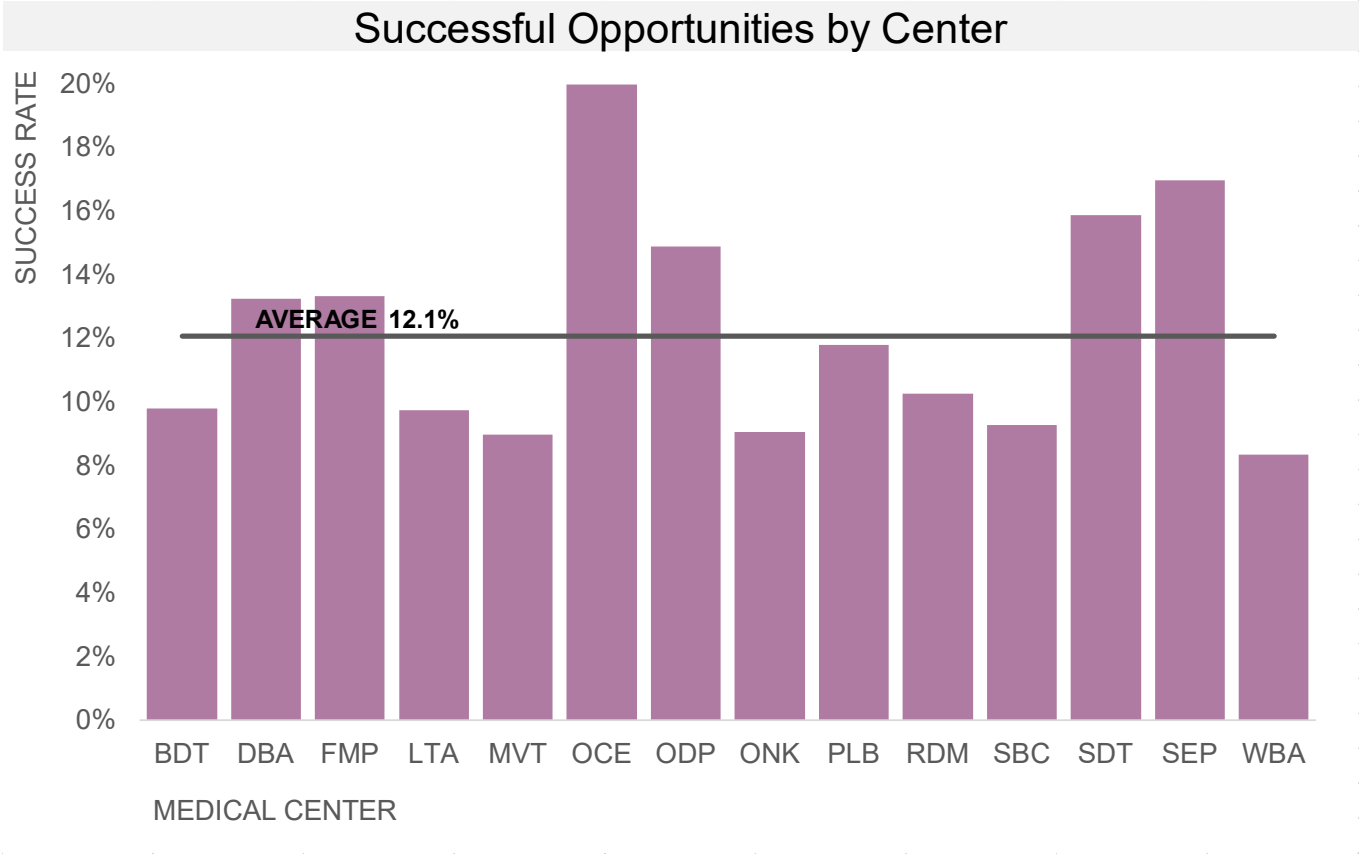
How can we focus attention?

Individual exercise (5 minutes)

This visual shows a group of medical centers, and their success rate for a specific procedure.

We want to focus our audience's attention to **those centers that are above average**.

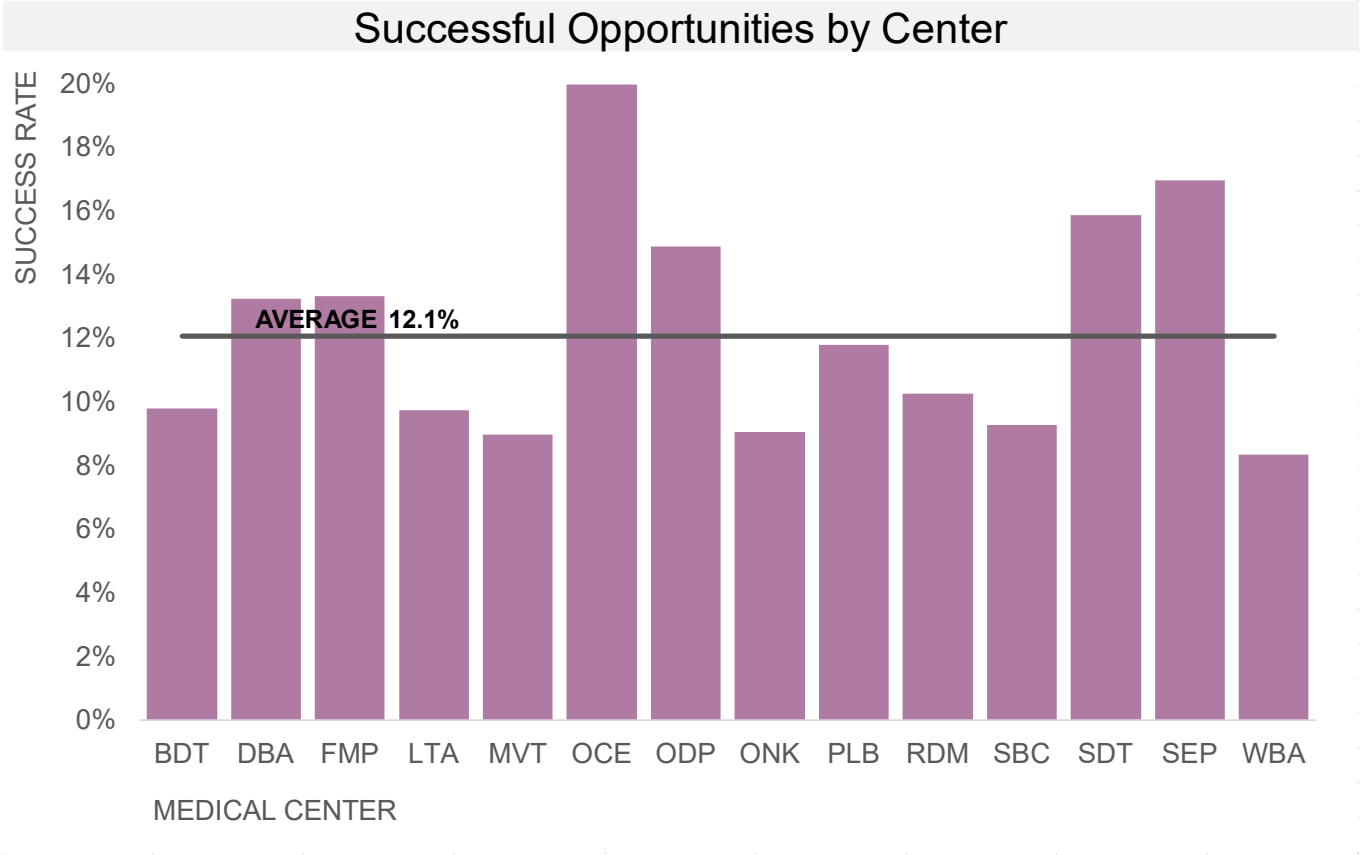
How many different ways can you come up with to focus your audience's attention?



How can we focus attention?

Individual exercise (10 minutes)

Download the data and practice applying the various ways you've listed for directing attention in your favorite tool.



Download the data at
baryon.be/files/workshop/exercise2.xlsx

A data visual from A to Z

Individual exercise (30 minutes)

Download the data at
baryon.be/files/workshop/exercise3.xlsx

This dataset contains data on the **life expectancy** and **income per capita** for the European Union, Brazil and India, between 1970 and 2016.

How would you visualize this data?
Sketch a few concepts.

Pick your favorite concept
and **create in the tool of your choice**.

Break

All the slides and all the links:

baryon.be/dataviz-resources

Ethics

Ethics of data visualization

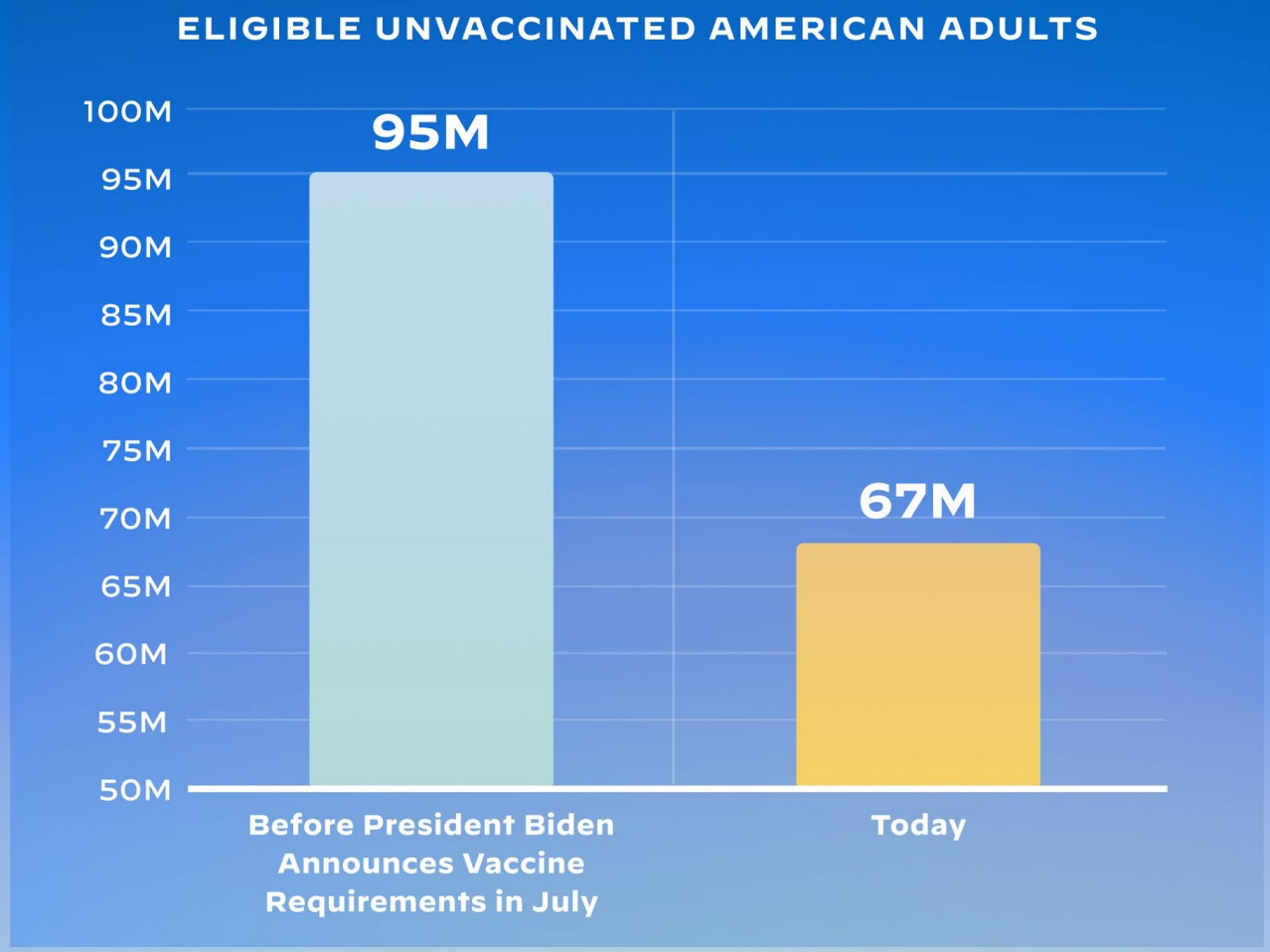
poor design

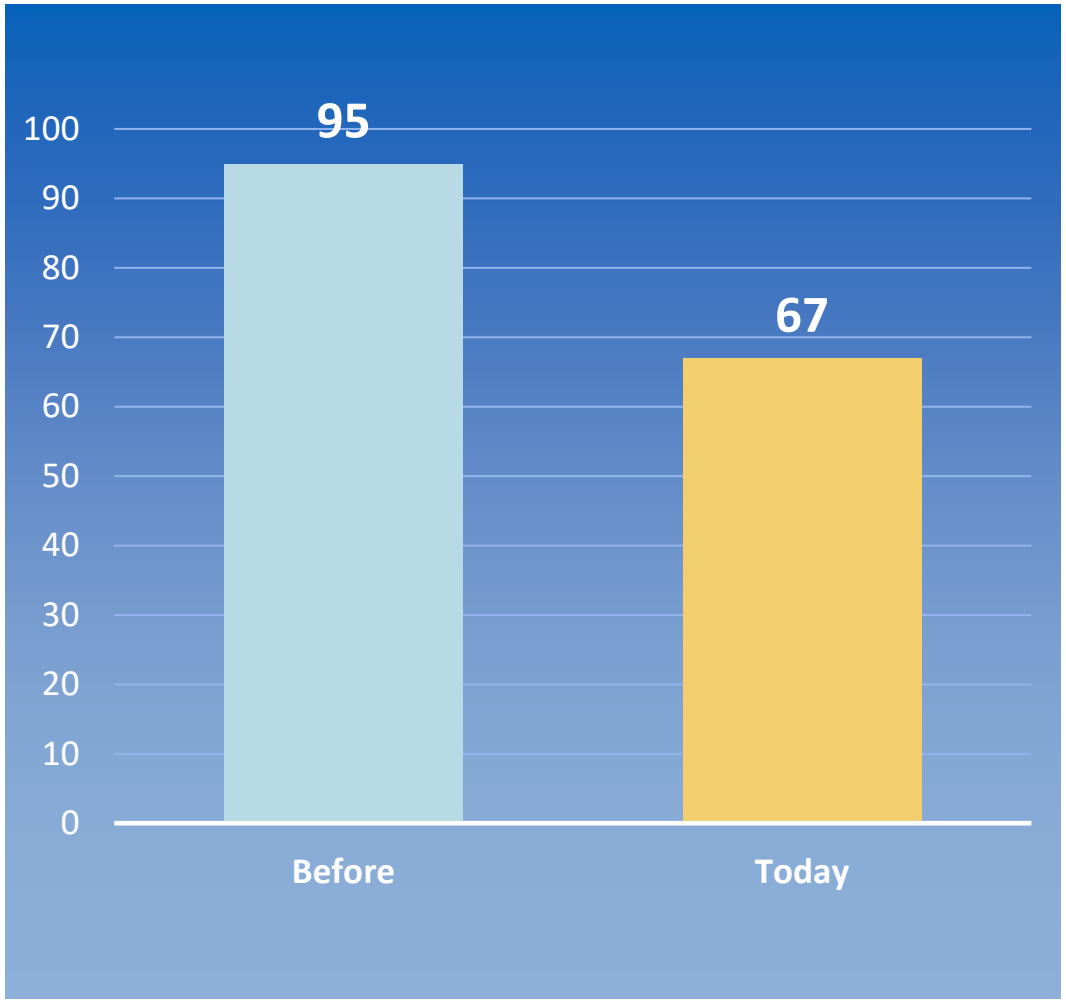
misleading stories

dubious data

hiding uncertainty

President Biden's Vaccine Requirement is Working



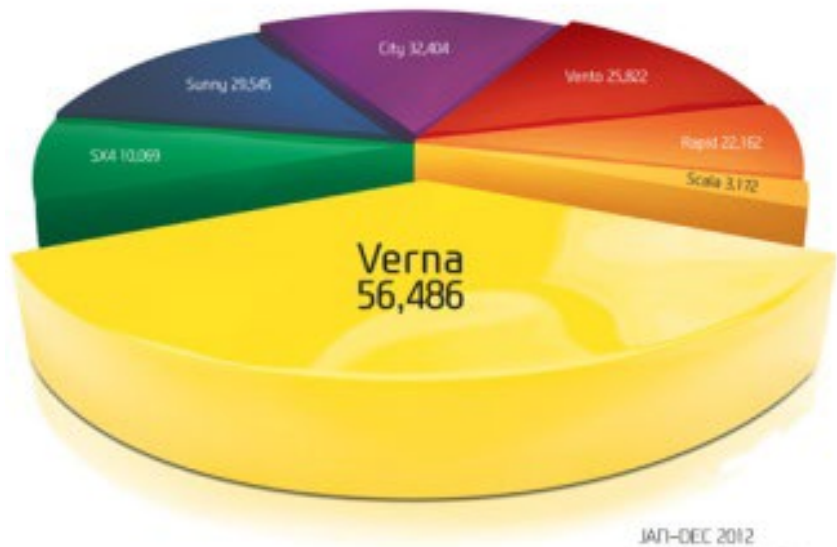


HYUNDAI NEW THINKING. NEW POSSIBILITIES.

The chartbuster rules.

The Verna stays the undisputed No. 1 in its segment.

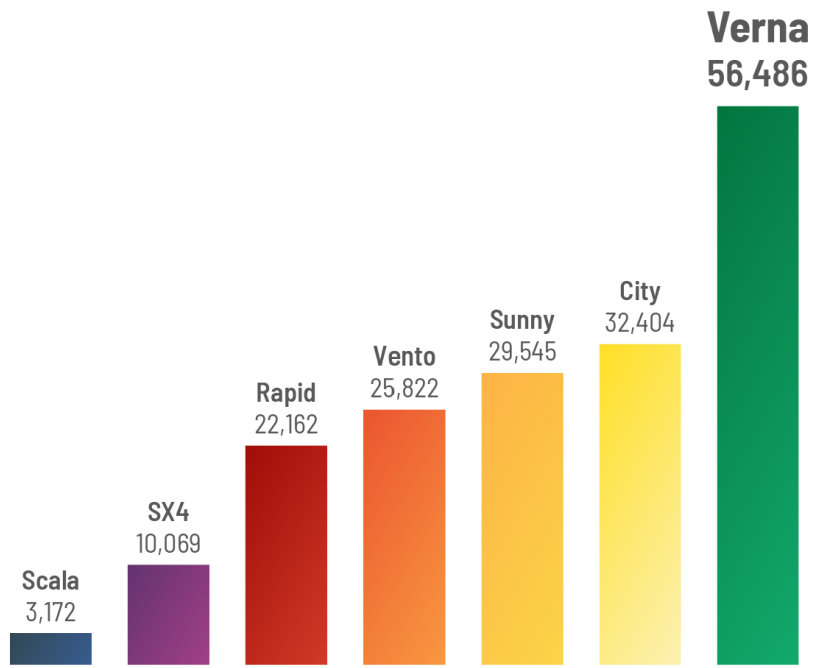
With its inimitable styling and superior design, the Verna has emerged as the largest selling car in its segment by a large margin. And it's not just the car that's made us the leader, it's also discerning people like you. No wonder the competition's been left behind. Far far behind.



JAN-DEC 2012
Cumulative Sales Figures
Source: SIAM Data

The new FLUIDIC VERNA
It sets you thinking

HYUNDAI NEW THINKING. NEW POSSIBILITIES.



JAN-DEC 2012 Cumulative Sales Figures
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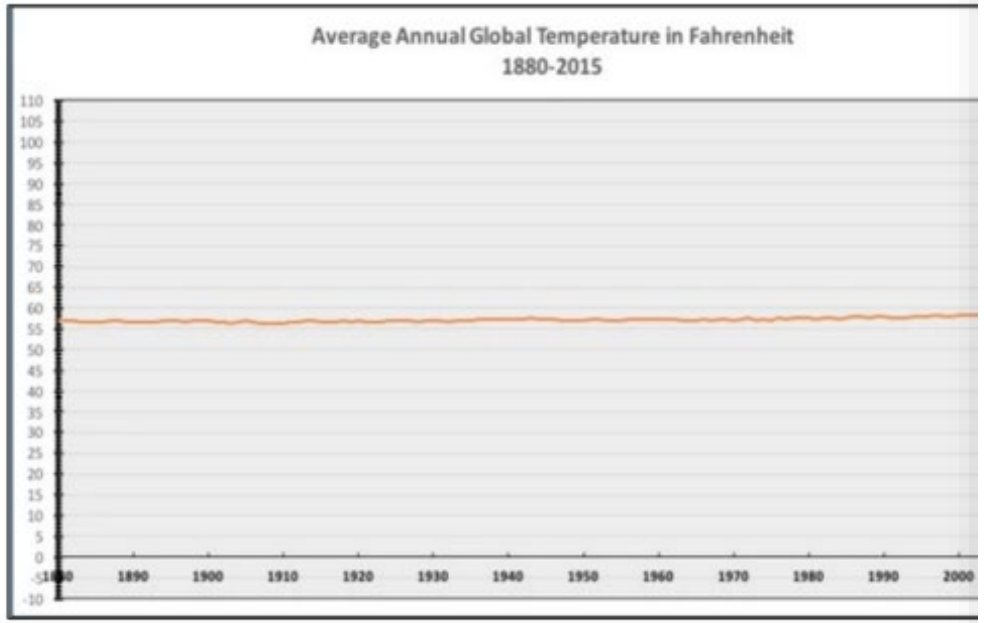
The new FLUIDIC VERNA
It sets you thinking

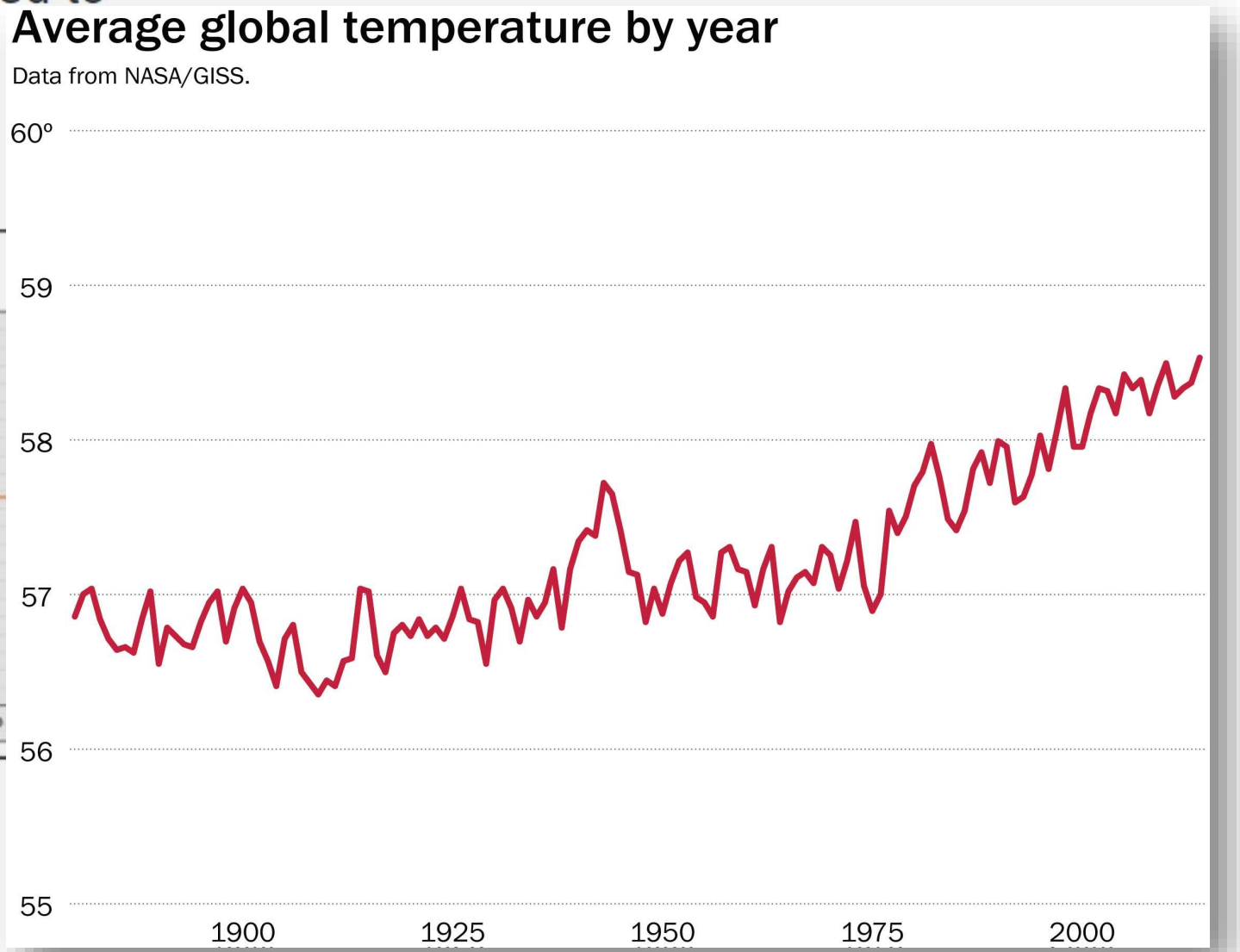
National Review
@NRO

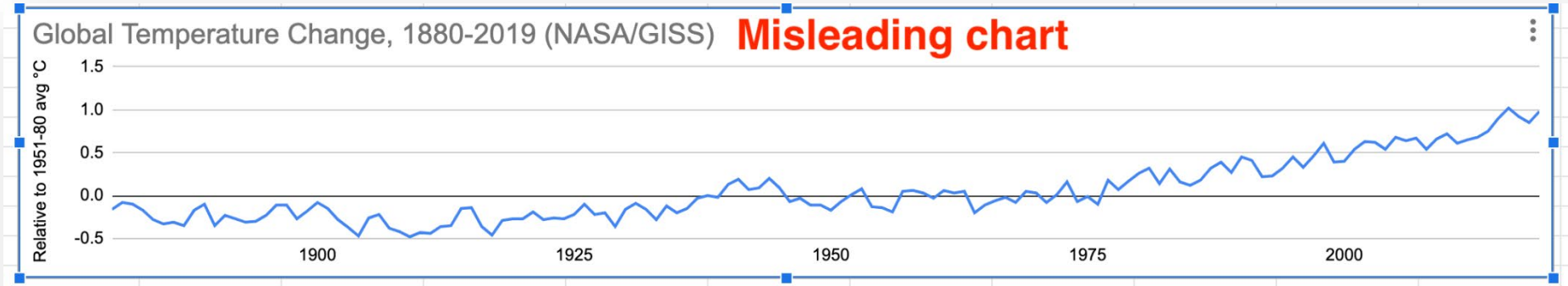
Follow

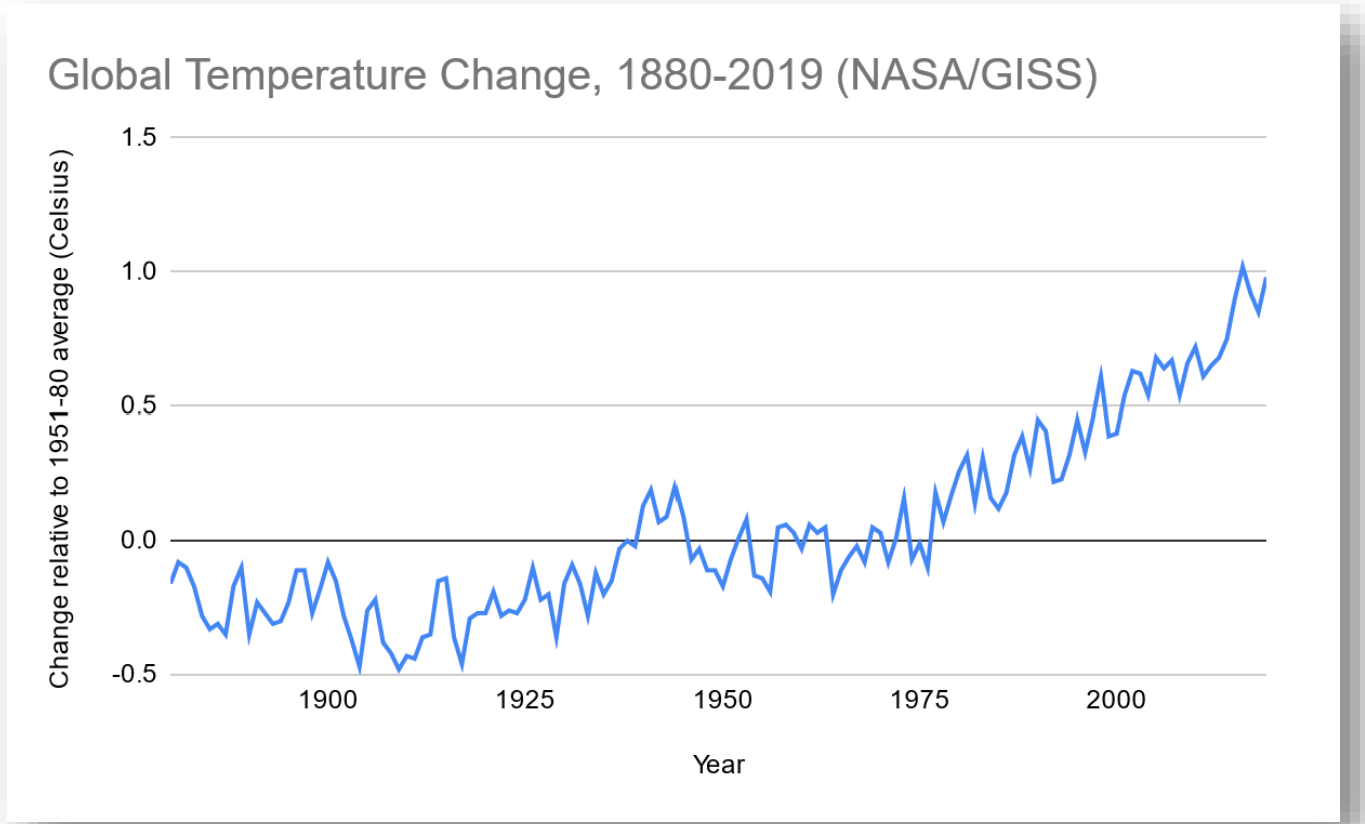
The only #climatechange chart you need to see. natl.re/wPKpro

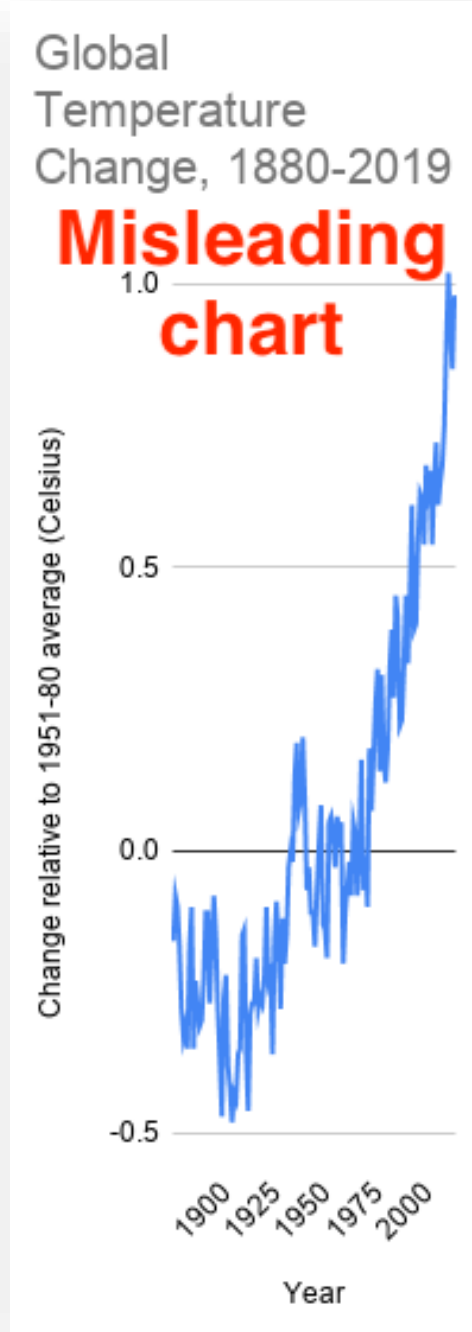
(h/t @powerlineUS)






Global Temperature Change, 1880-2019 (NASA/GISS)
Misleading chart
Relative to 1951-80 avg °C
1.5
1.0
0.5
0.0
-0.5
1900
1925
1950
1975
2000


Global Temperature Change, 1880-2019 (NASA/GISS)
Change relative to 1951-80 average (Celsius)
1.5
1.0
0.5
0.0
-0.5
1900
1925
1950
1975
2000
Year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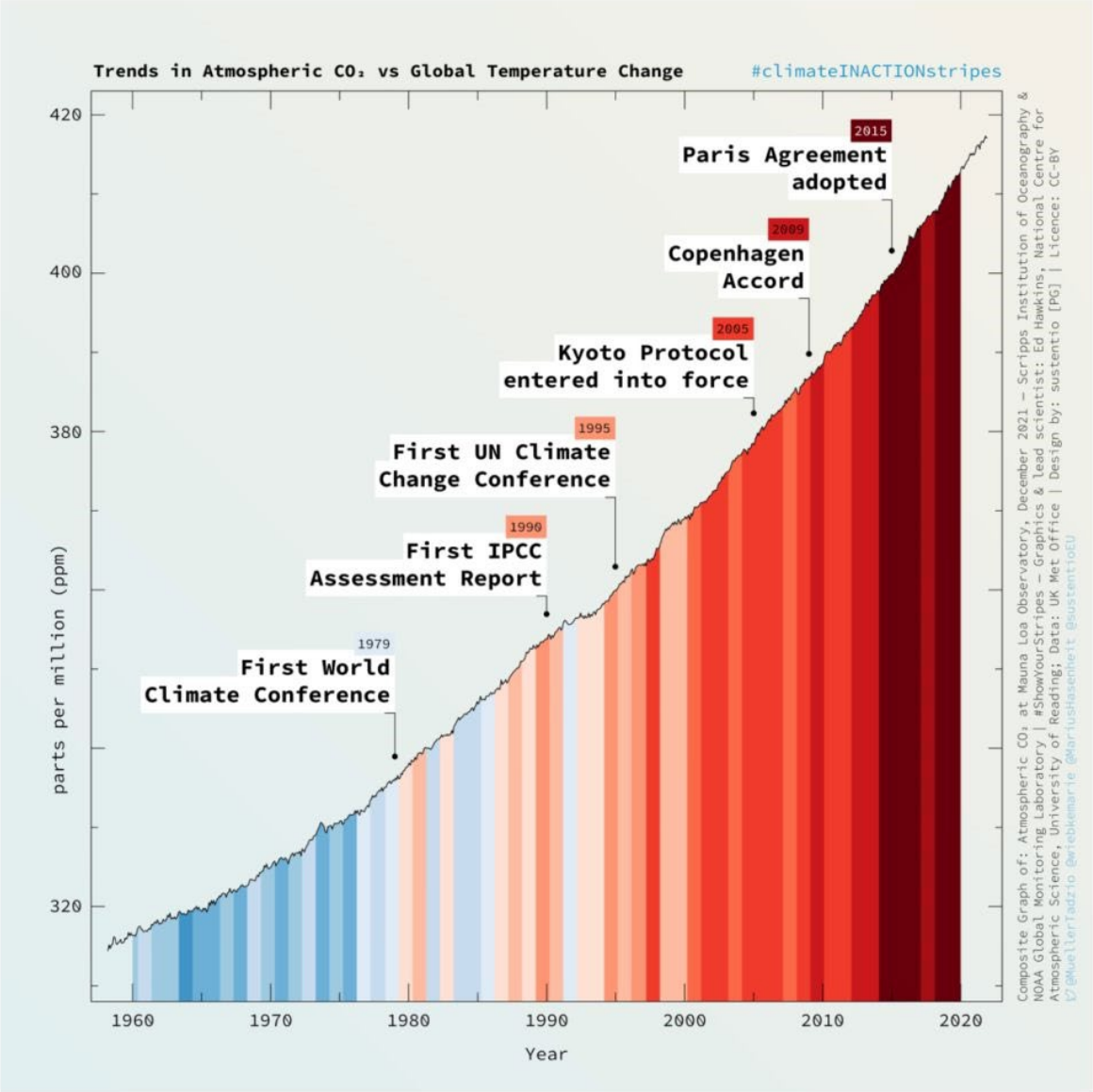
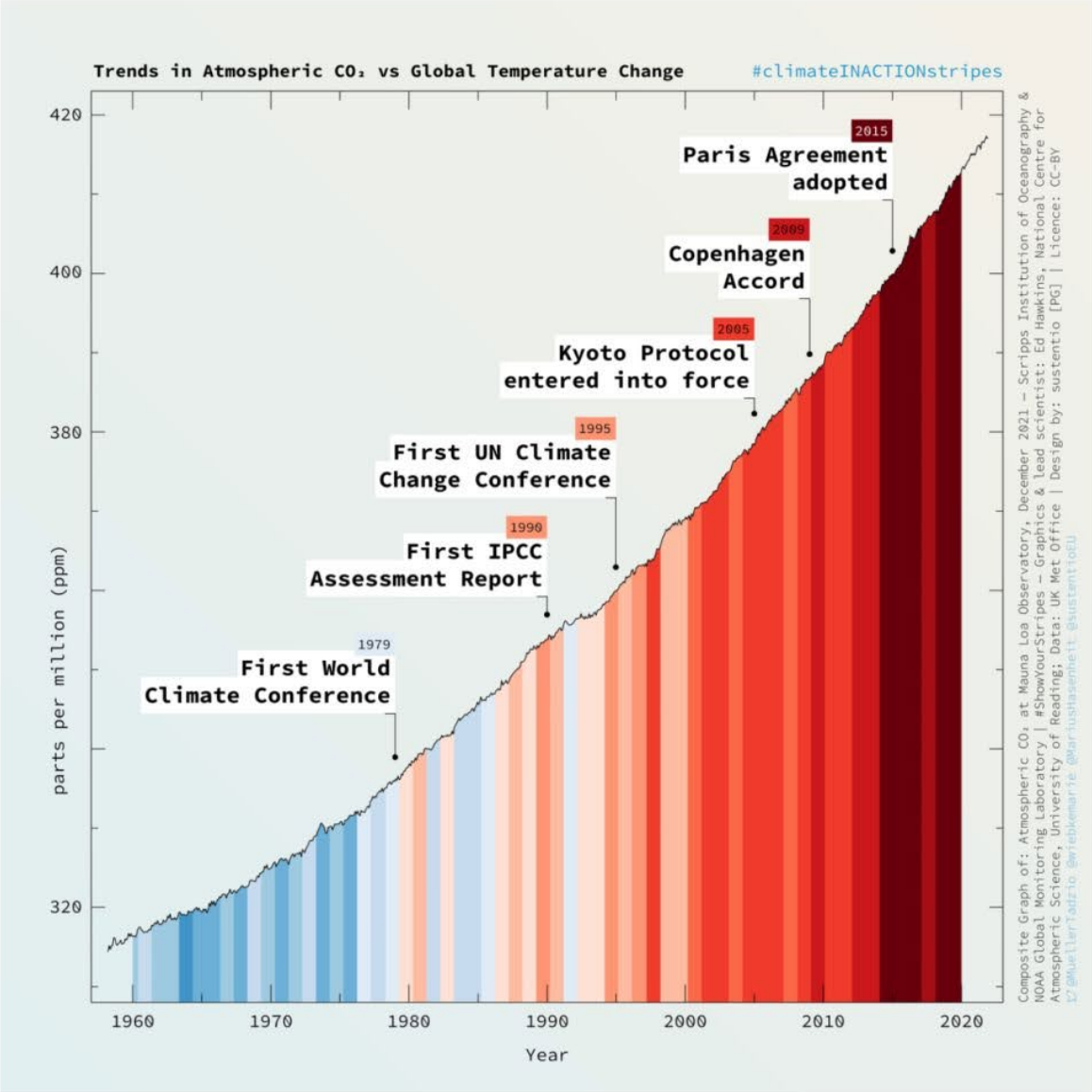
Misleading chart
Change relative to 1951-80 average (Celsius)
1.0
0.5
0.0
-0.5
1900
1925
1950
1975
2000
Year

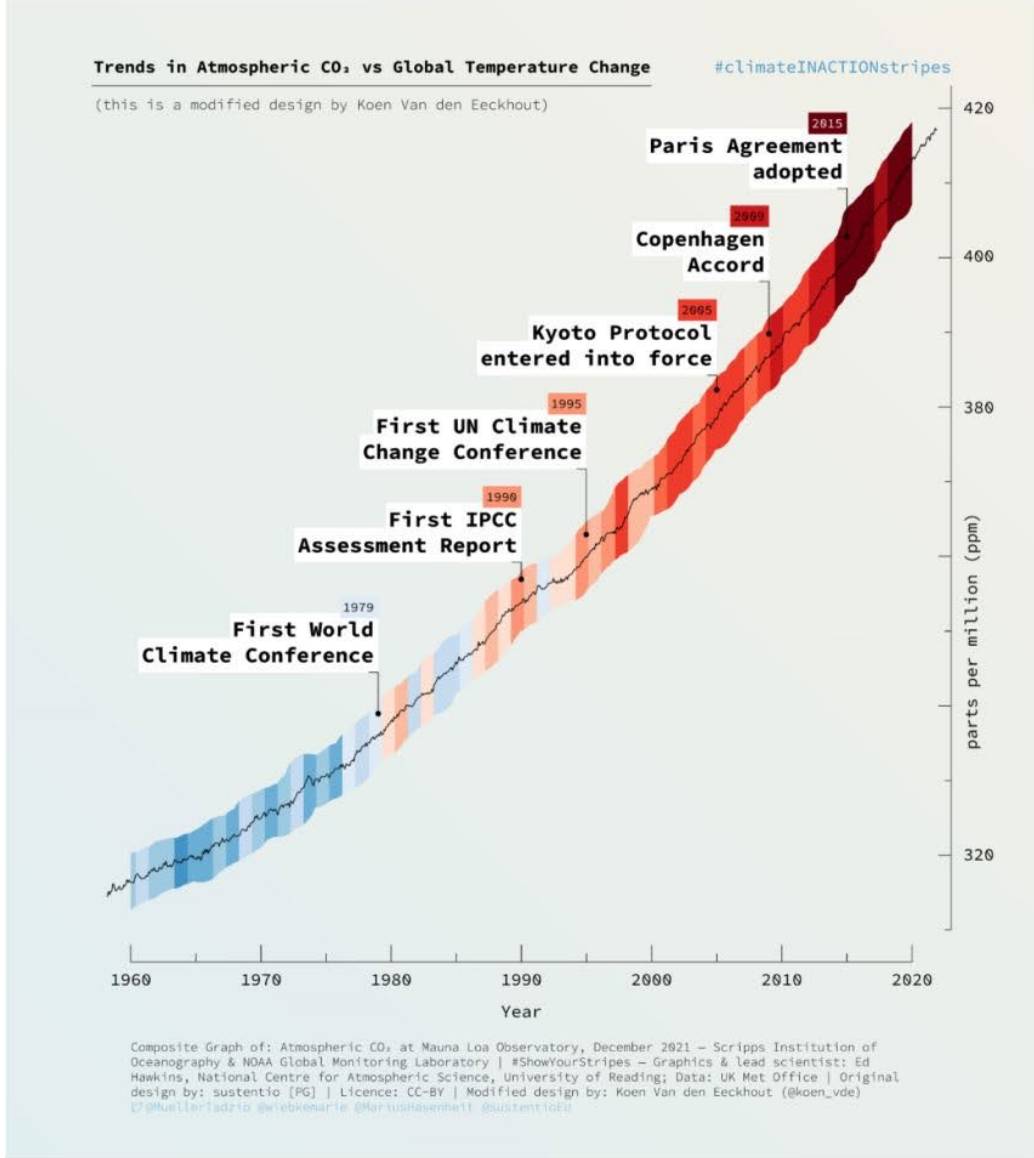
Original


Trends in Atmospheric CO₂ vs Global Temperature Change
#climateINACTIONstripes
parts per million (ppm)
420
400
380
320
1960
1970
1980
1990
2000
2010
2020
Year
1979
First World Climate Conference
1990
First IPCC Assessment Report
1995
First UN Climate Change Conference
2005
Kyoto Protocol entered into force
2009
Copenhagen Accord
2015
Paris Agreement adopted
Composite Graph of: Atmospheric CO₂ at Mauna Loa Observatory, December 2021 – Scripps Institution of Oceanography & NOAA Global Monitoring Laboratory | #ShowYourStripes – Graphics & lead scientist: Ed Hawkins, National Centre for Atmospheric Science, University of Reading; Data: UK Met Office | Design by: sustentio [PG] | Licence: CC-BY

Original



Modified



Ethics of data visualization

poor design

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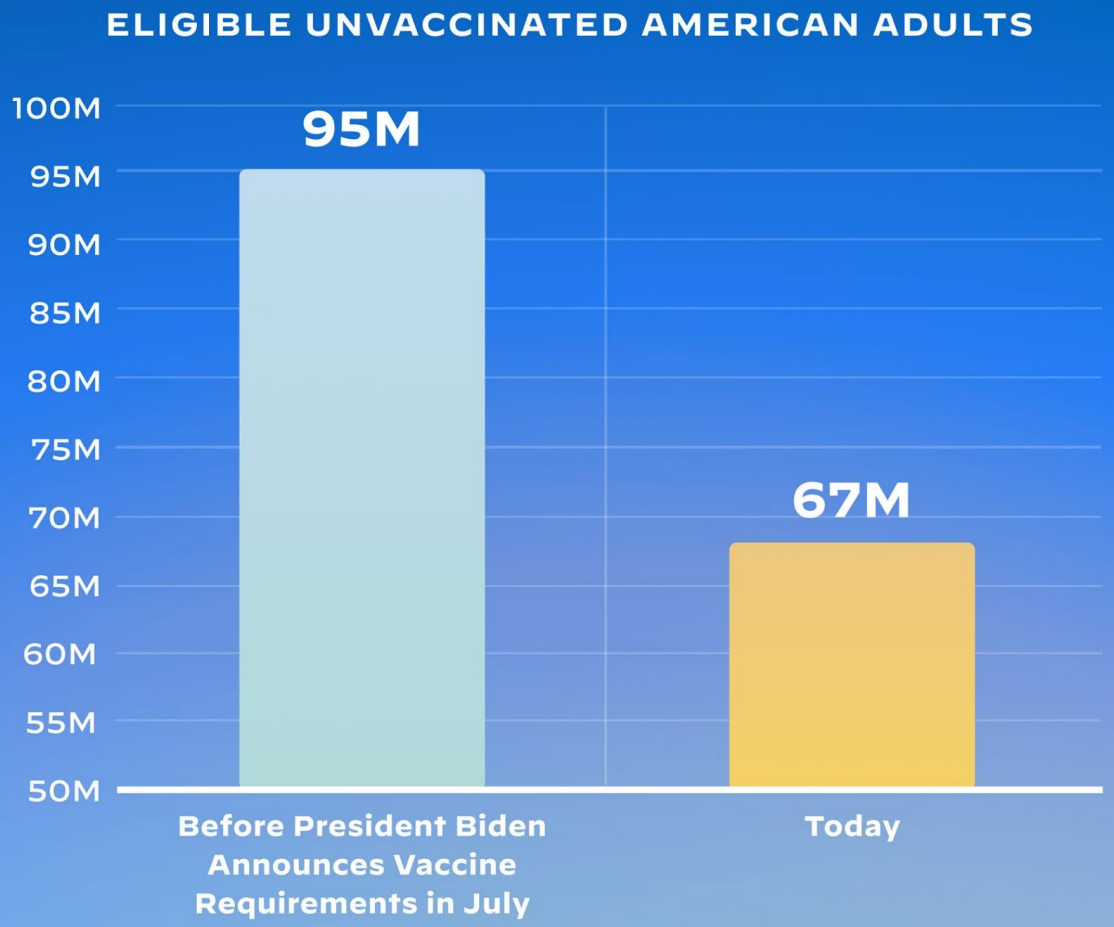
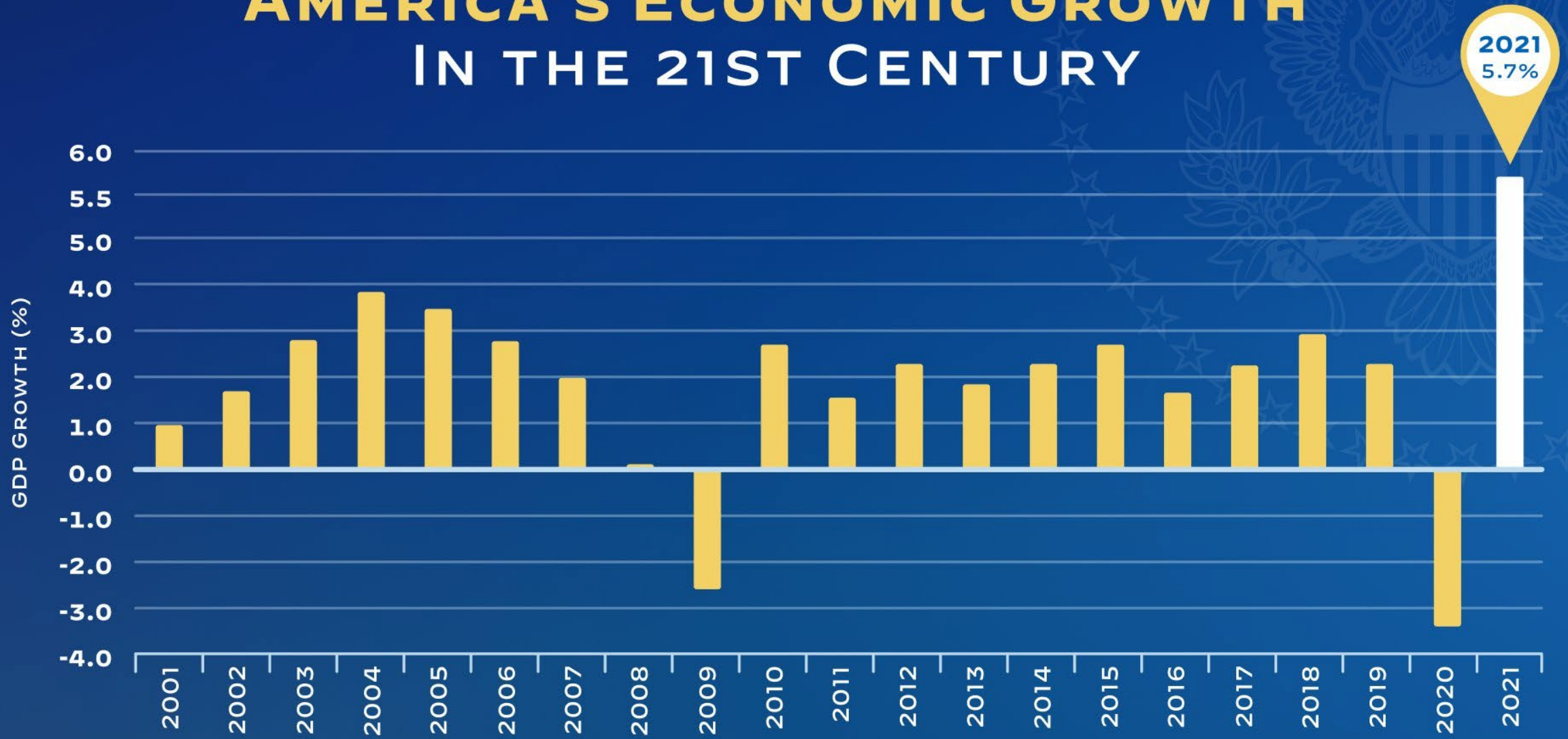
President Biden's Vaccine Requirement is Working



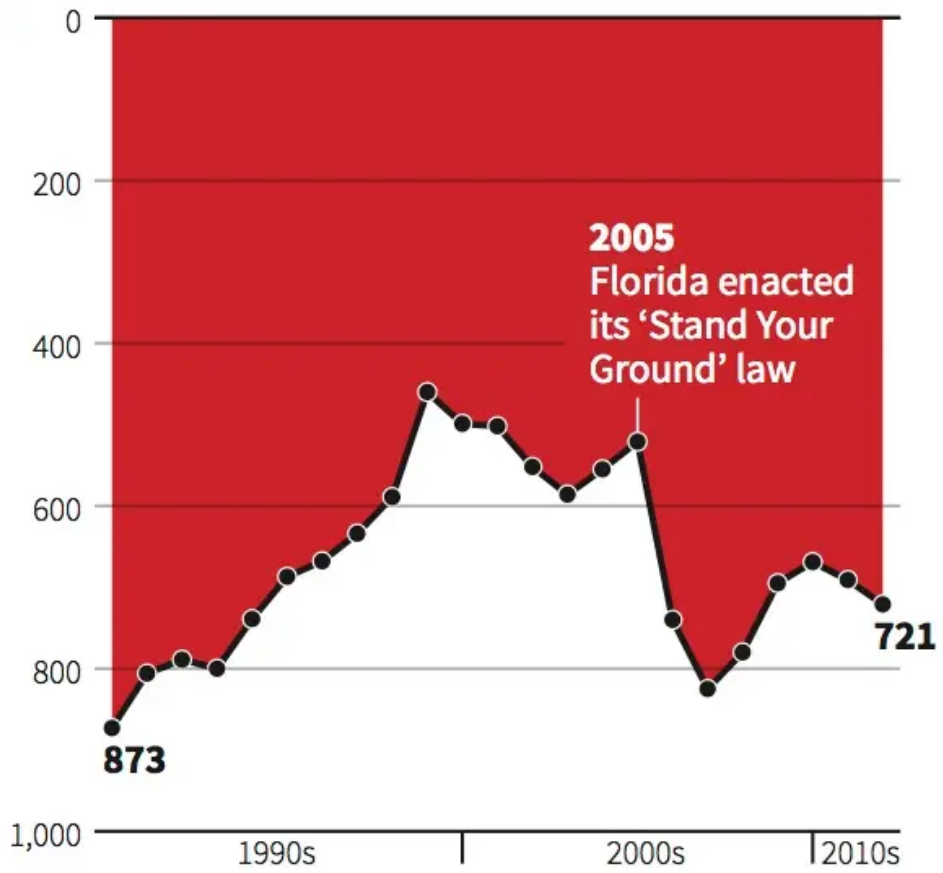
America's Economic Growth
In the 21st Century



Source: Bureau of Economic Analysis

Gun deaths in Florida

Number of murders committed using firearms

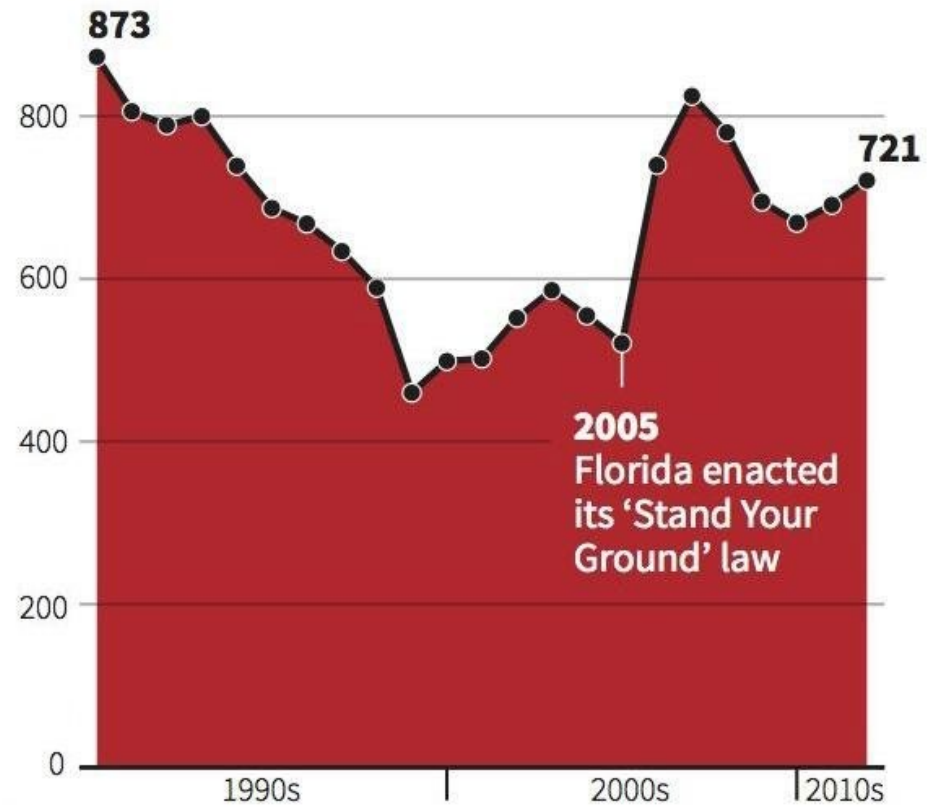


Source: Florida Department of Law Enforcement

C. Chan 16/02/2014 REUTERS

Gun deaths in Florida

Number of murders committed using firearms



Source: Florida Department of Law Enforcement

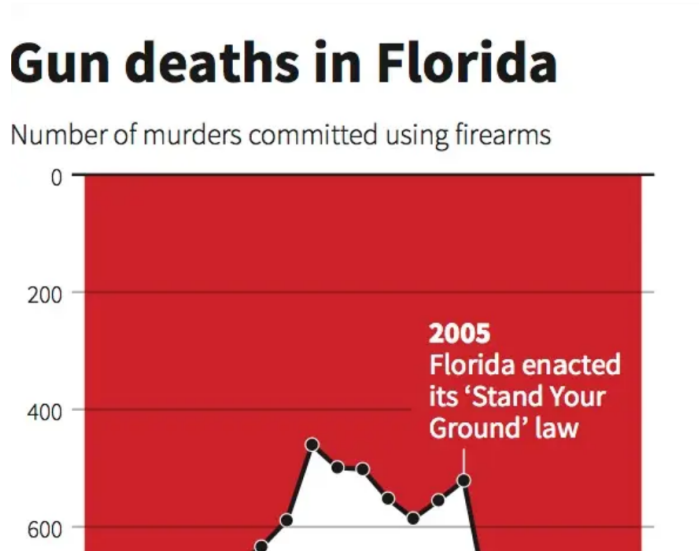
This Chart Shows An Alarming Rise In Florida Gun Deaths After 'Stand Your Ground' Was Enacted

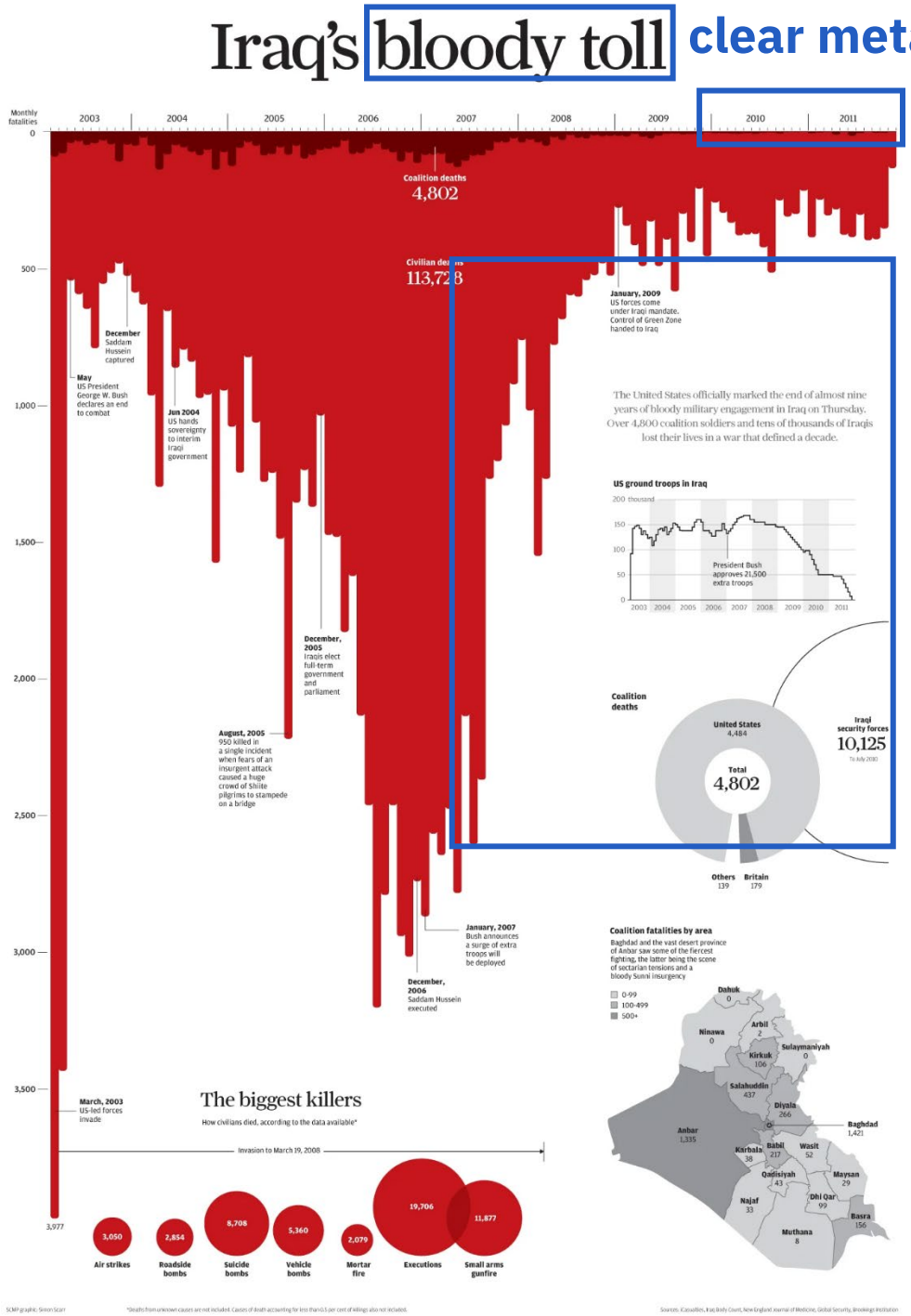
Pamela Engel Feb 18, 2014, 6:56 PM

In light of the recent trial of Michael Dunn, Reuters has published a graphic showing a dramatic spike in Florida murders by firearm after the "stand your ground" law was enacted in 2005.

Dunn is a white man who shot at a car full of black teenagers during an argument over loud music in that state.

While the law wasn't invoked specifically in his trial, critics of "stand your ground" say it increases violence in public places because it justifies "deadly force" and doesn't require people to run away if they think they're in danger.

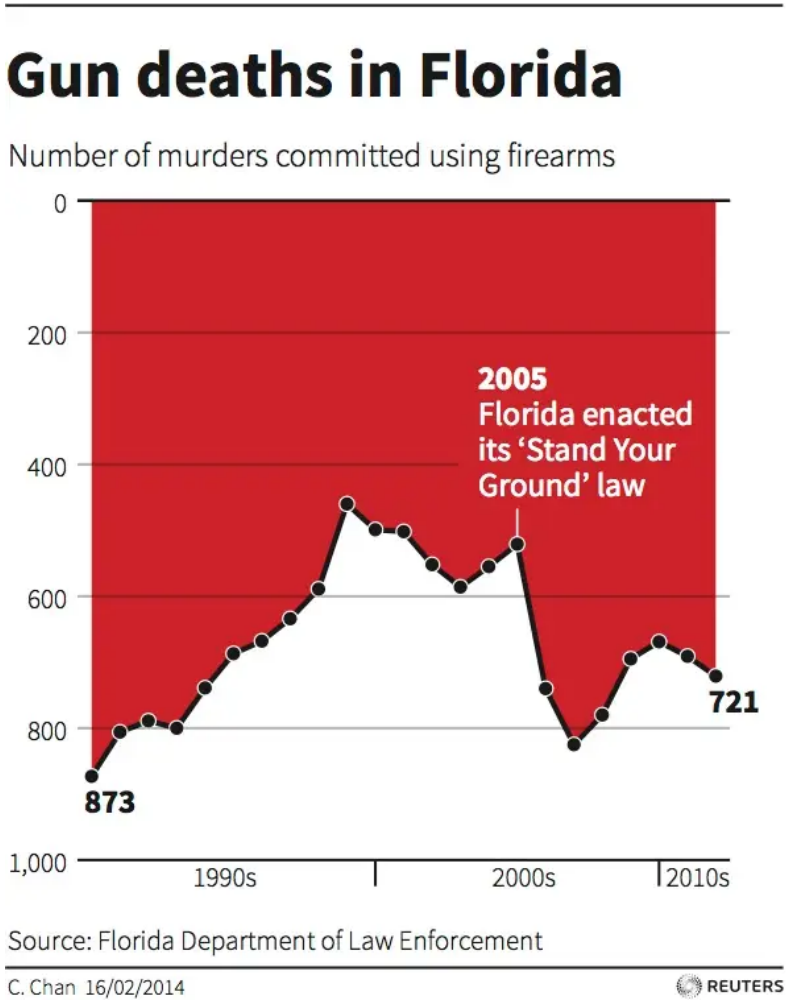


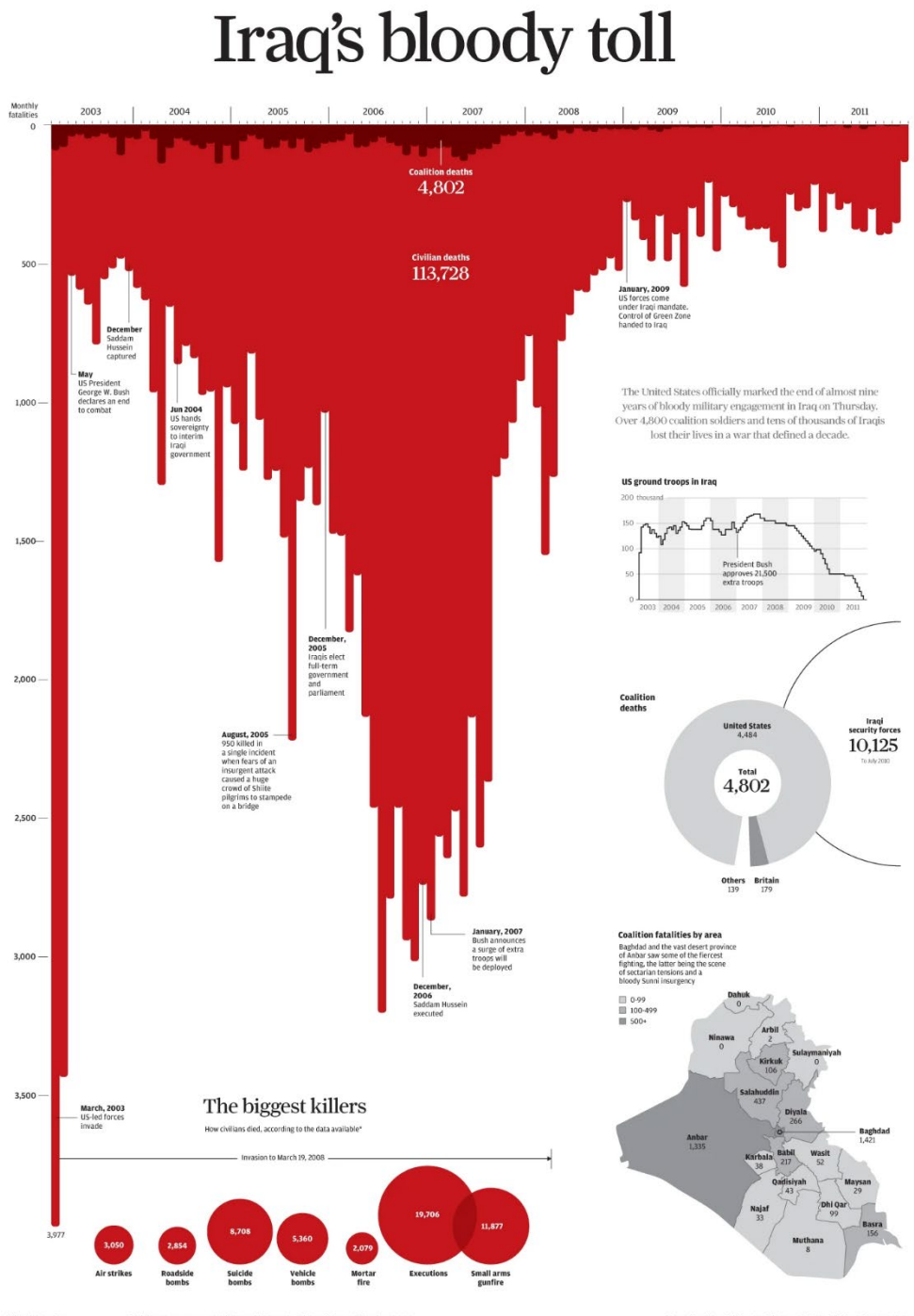


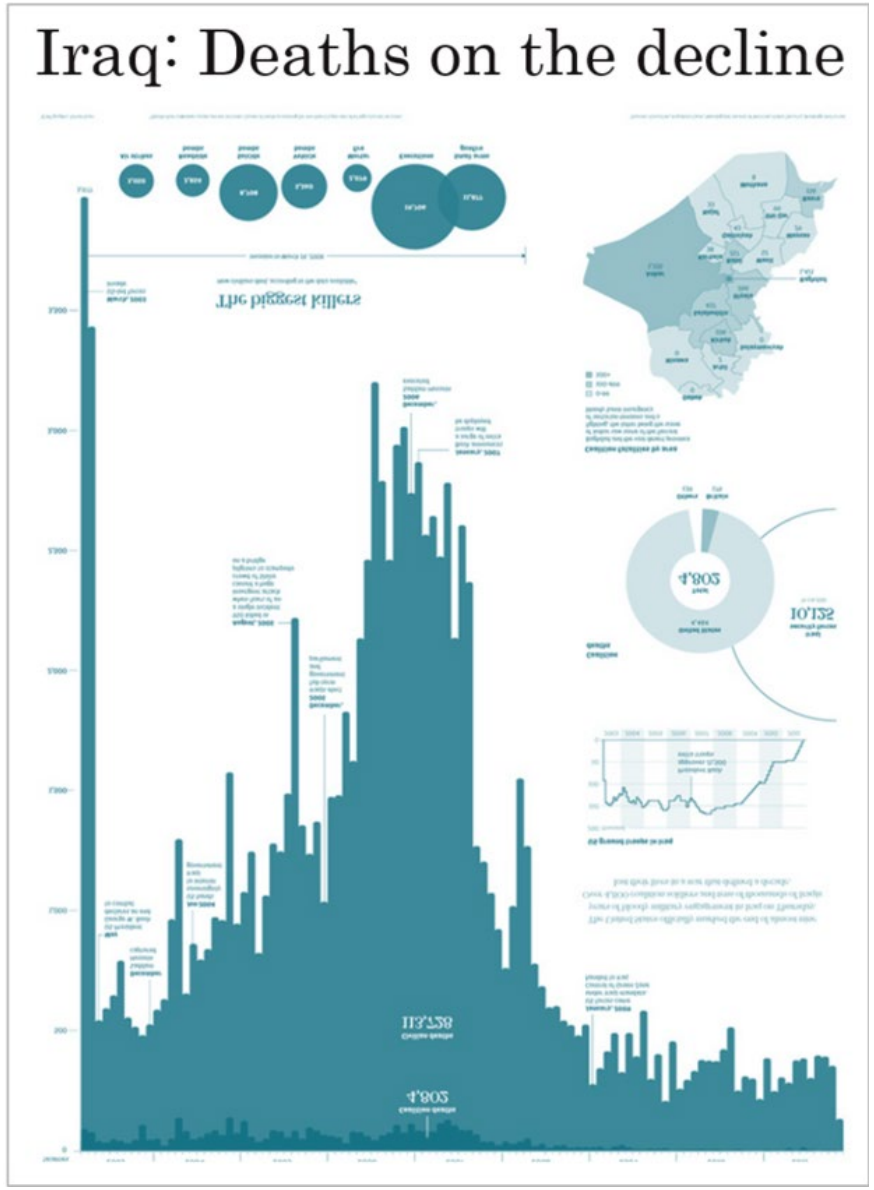
clear metaphor

clear baseline

good use of whitespace



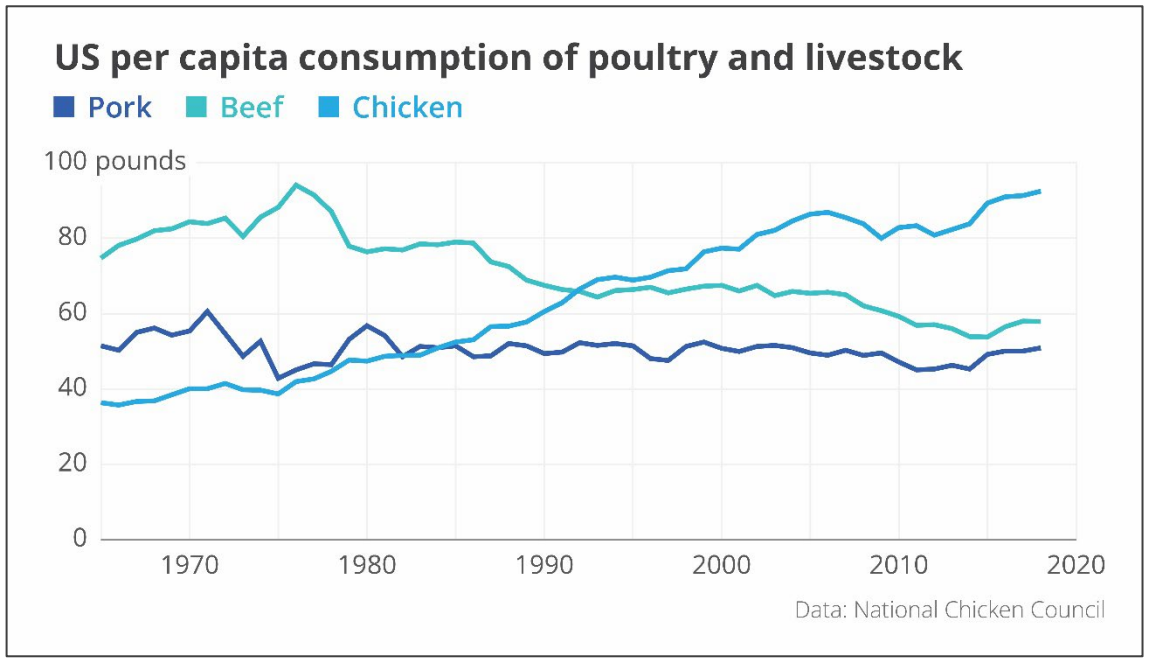


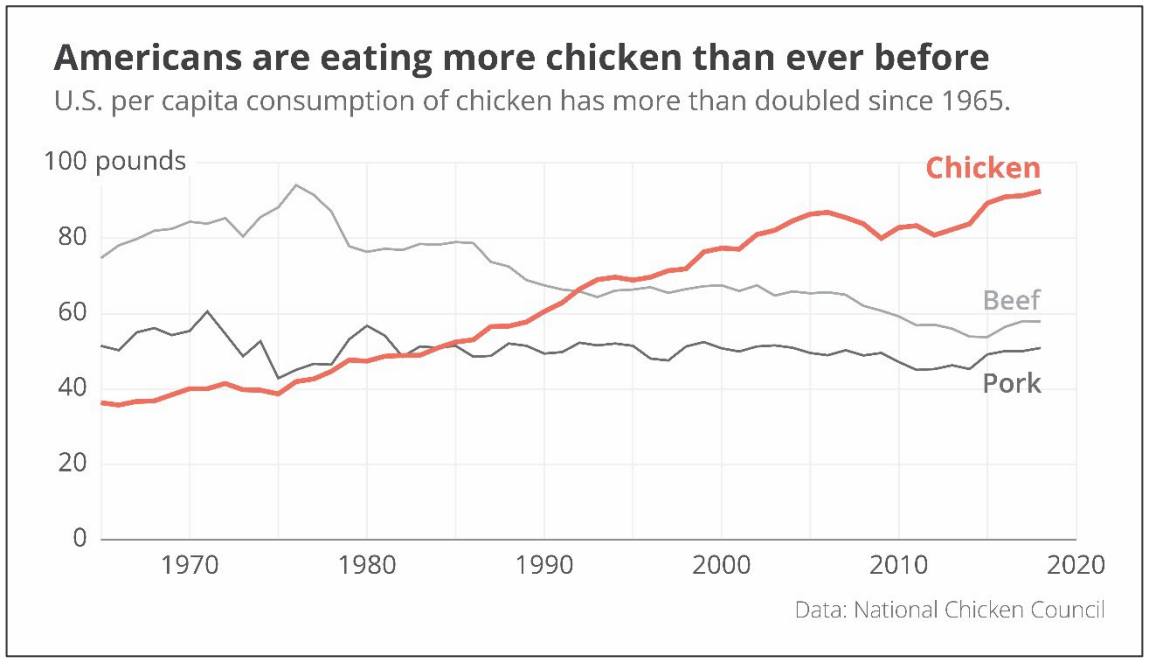


infoworld.com/article/3088166/why-how-to-lie-with-statistics-did-us-a-disservice.html

Objective versus subjective data visuals

~~data~~ → **story**


US per capita consumption of poultry and livestock
Pork
Beef
Chicken
100 pounds
80
60
40
20
0
1970
1980
1990
2000
2010
2020
Data: National Chicken Council


Americans are eating more chicken than ever before
U.S. per capita consumption of chicken has more than doubled since 1965.
100 pounds
80
60
40
20
0
Chicken
Beef
Pork
1970
1980
1990
2000
2010
2020
Data: National Chicken Council

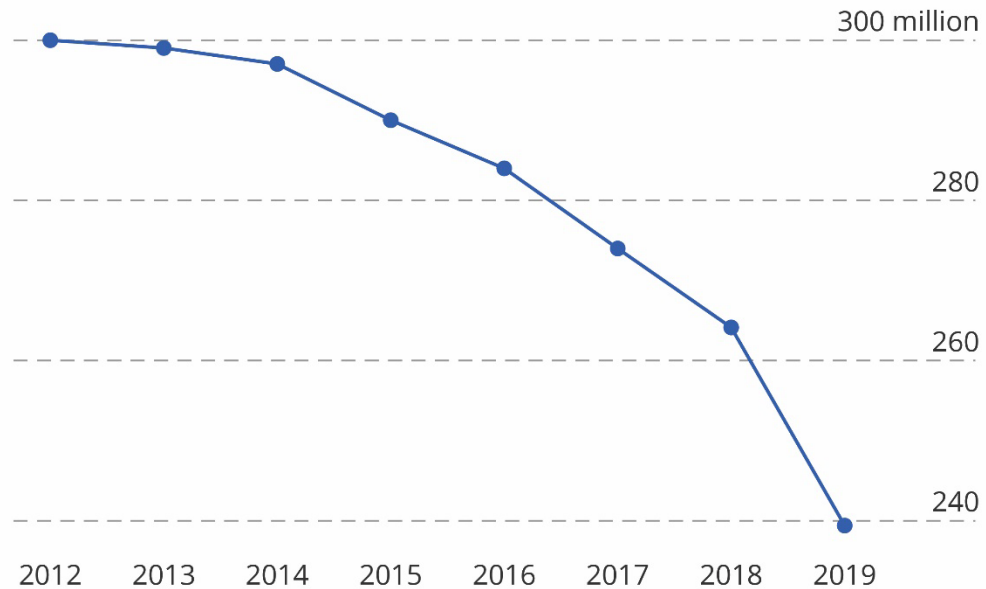
Which chart do you want?

(number of cash withdrawals from ATMs)

Source: [De Standaard](), 22 December 2020

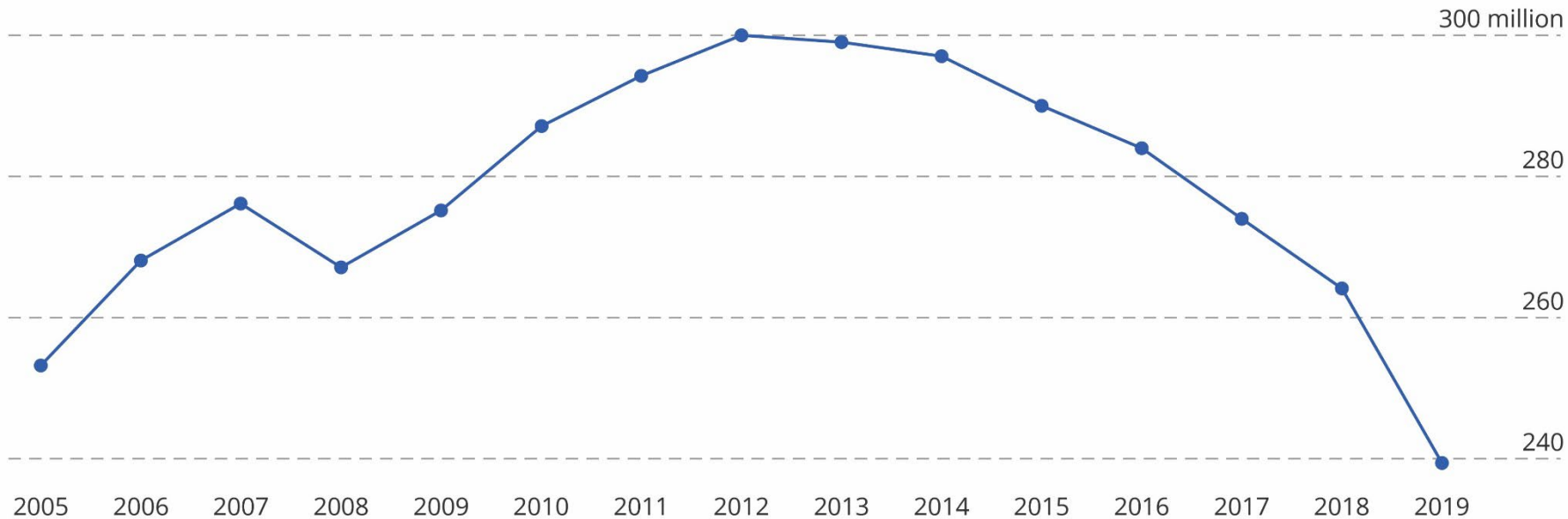
Number of cash withdrawals at Belgian ATMs

Source: Febelfin



Number of cash withdrawals at Belgian ATMs

Source: Febelfin



Number of cash withdrawals at Belgian ATMs

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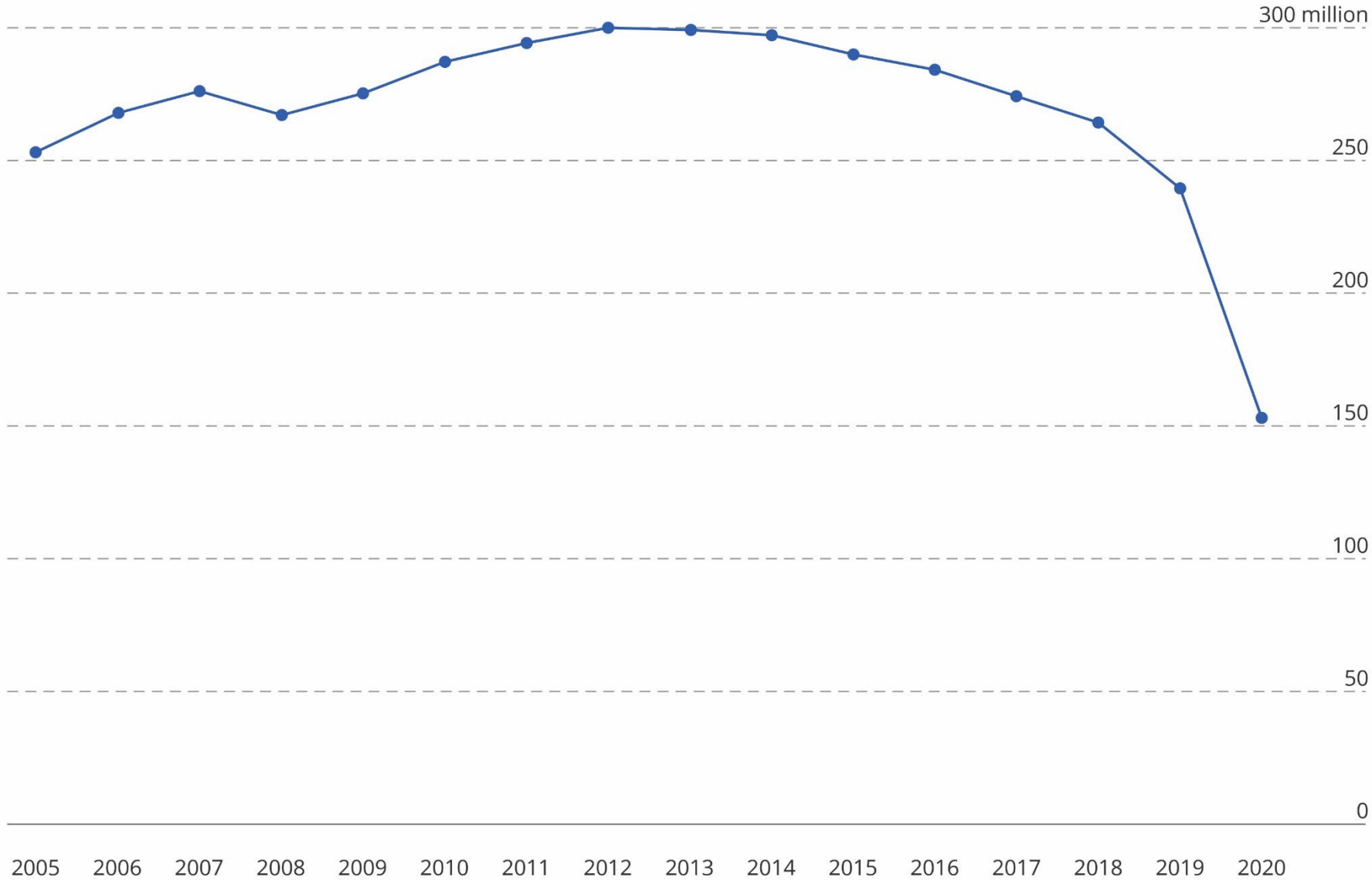
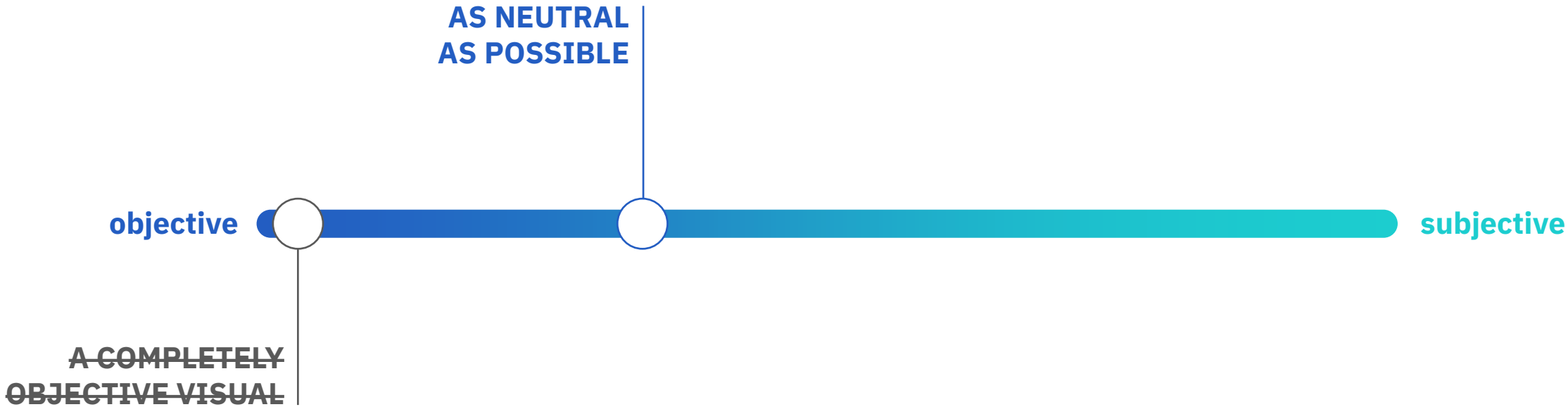
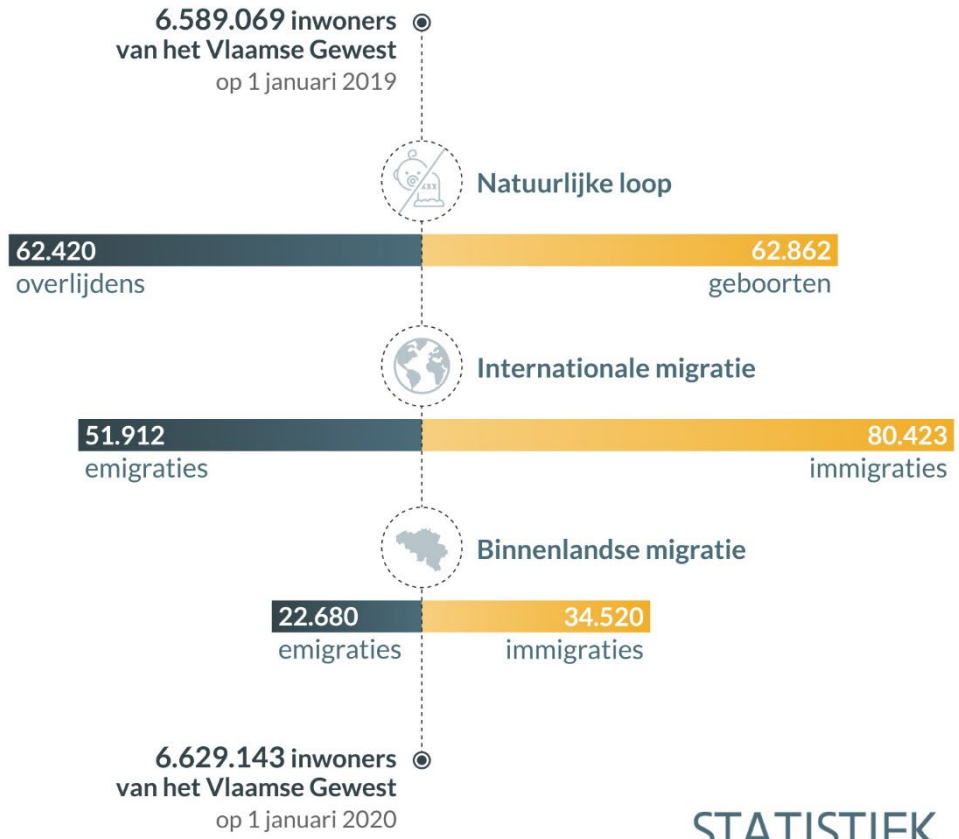


Which chart do you want?



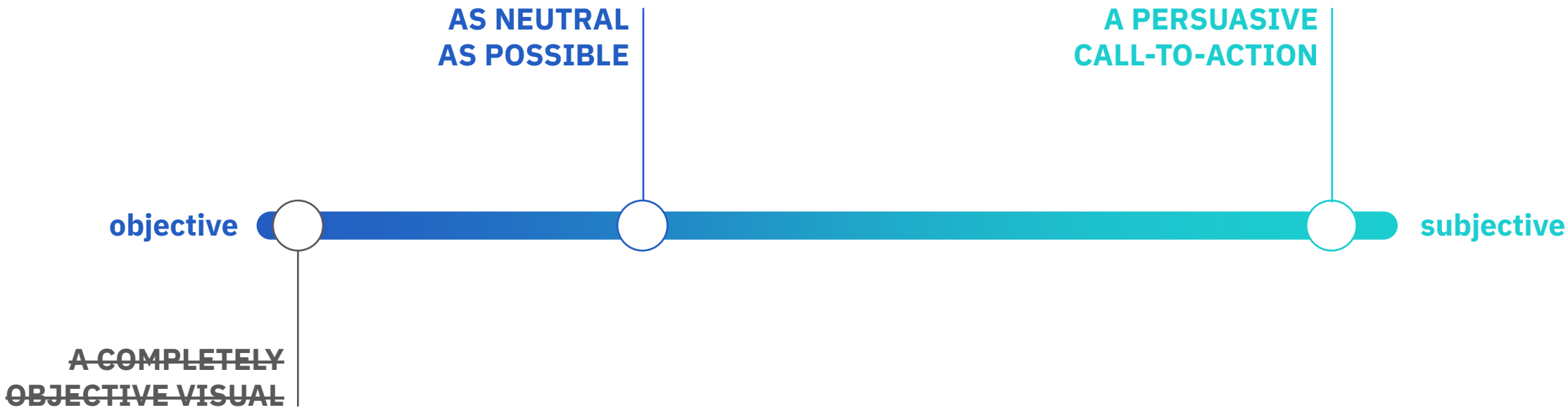
Het afgelopen jaar groeide de Vlaamse bevolking met 40.000 inwoners



Bron: Statbel, bewerking Statistiek Vlaanderen

STATISTIEK VLAANDEREN

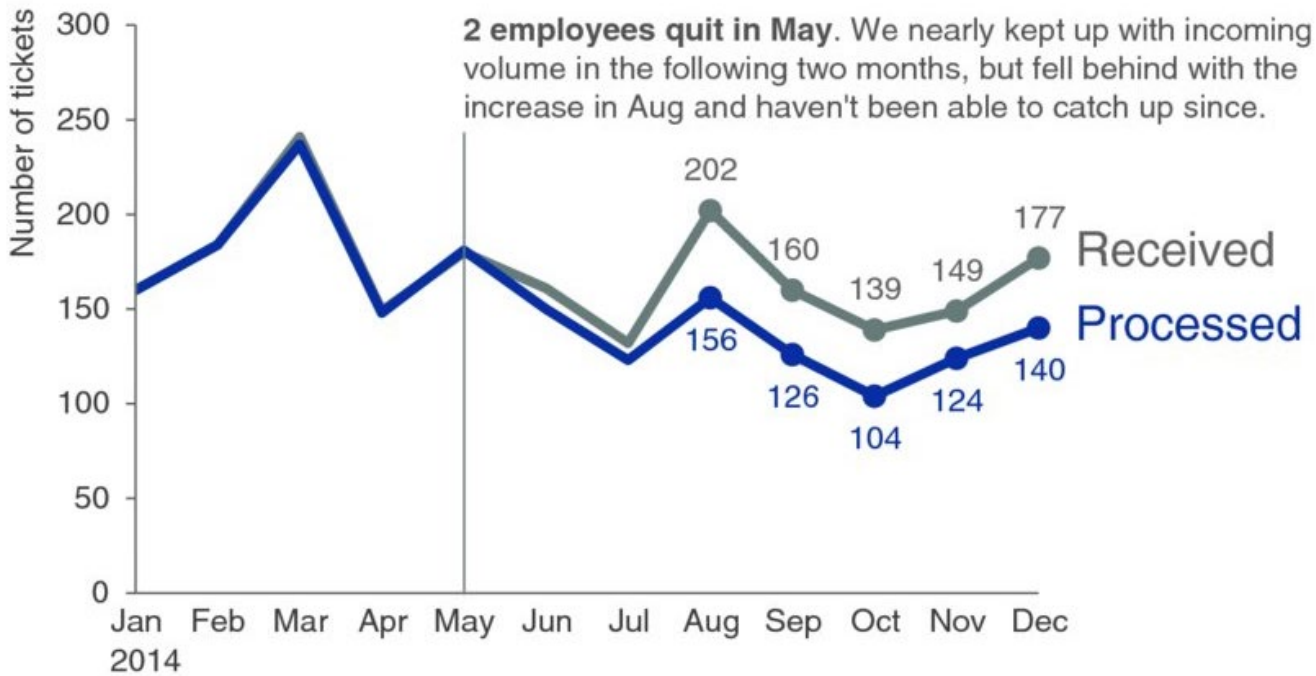
Which chart do you want?



Please approve the hire of 2 FTEs

to backfill those who quit in the past year

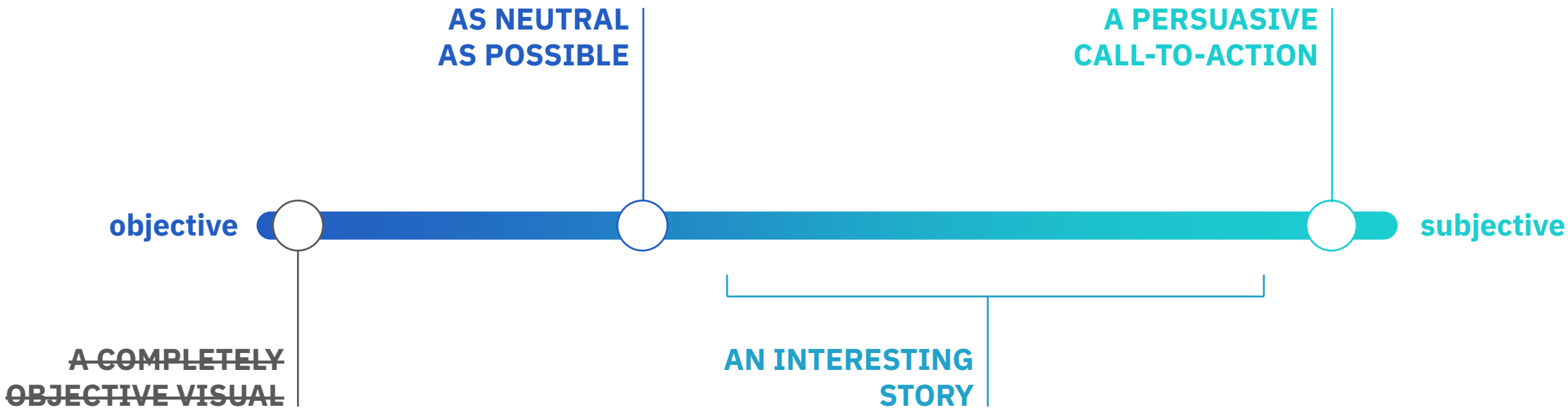
Ticket volume over time



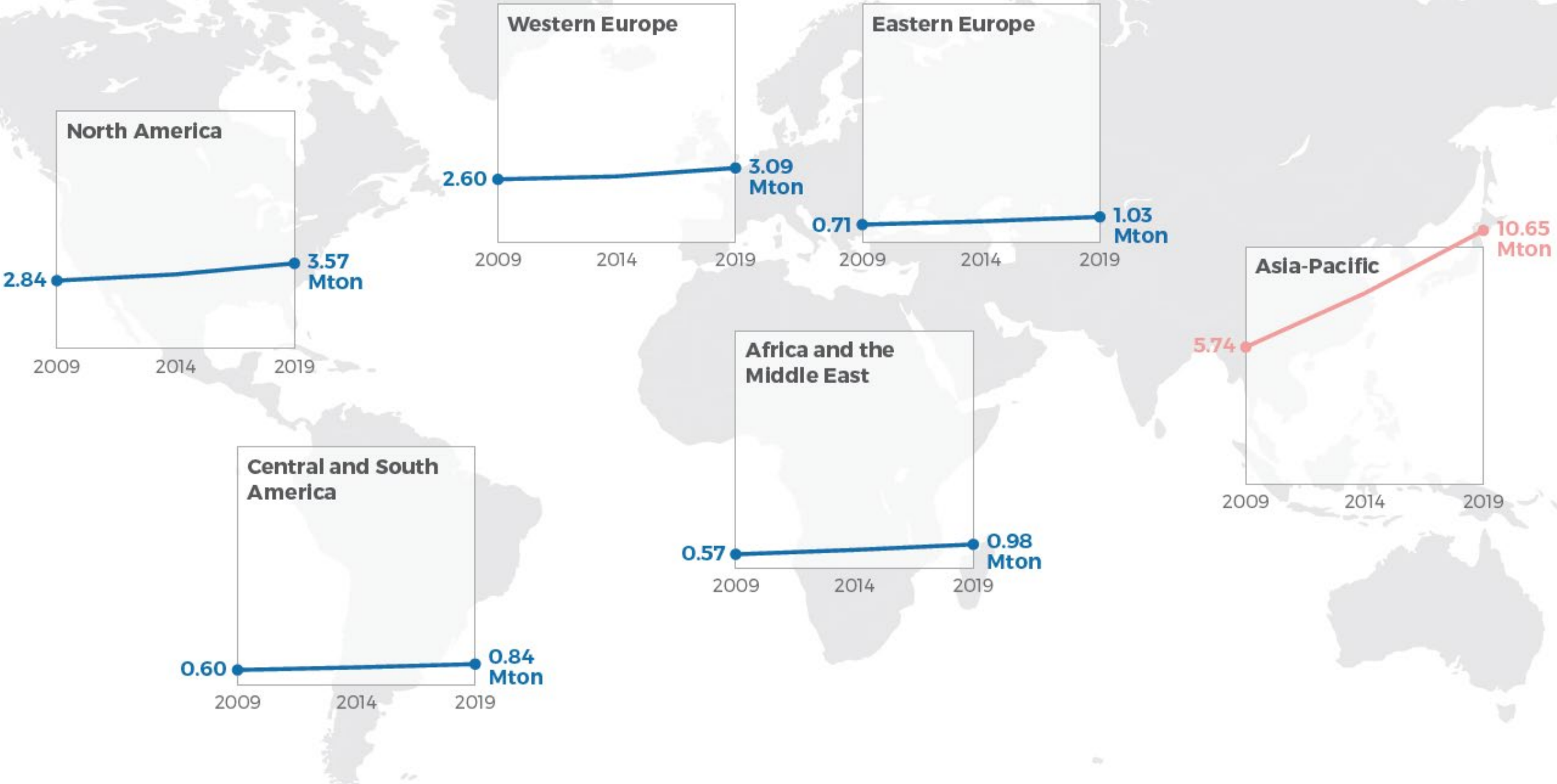
2 employees quit in May. We nearly kept up with incoming volume in the following two months, but fell behind with the increase in Aug and haven't been able to catch up since.

Data source: XYZ Dashboard, as of 12/31/2014 I A detailed analysis on tickets processed per person and time to resolve issues was undertaken to inform this request and can be provided if needed.

Which chart do you want?

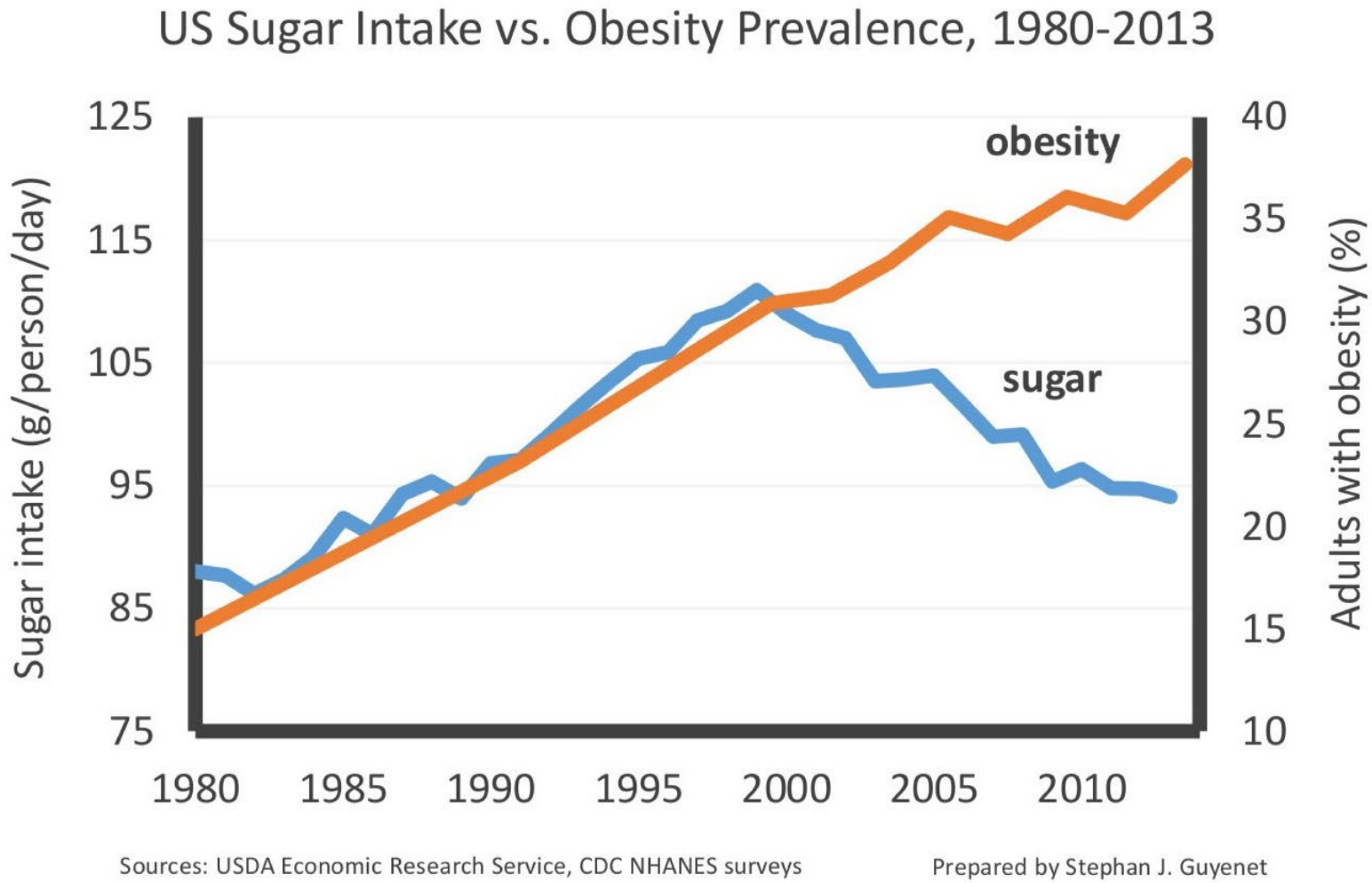


Asia-Pacific will continue to be the biggest demand region



ORIGINAL CHART

The original chart strongly suggests a correlation between sugar intake and obesity until 2000, by manipulating the vertical axis choices.

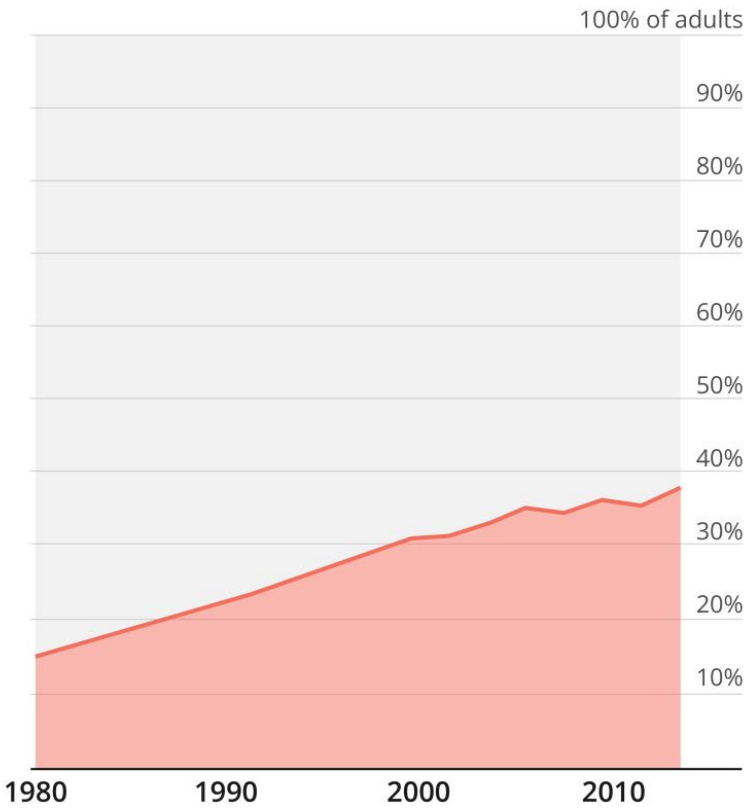


REDESIGN #1

This redesign focuses on a more truthful representation of the data, compares it with the recommended daily intake to highlight the problematic situation, and enables a good estimation of the prevalence %.

US sugar intake

US obesity prevalence



Data: USDA Economic Research Service, CDC NHANES surveys

Chart design: Koen Van den Eeckhout (@koen_vde)

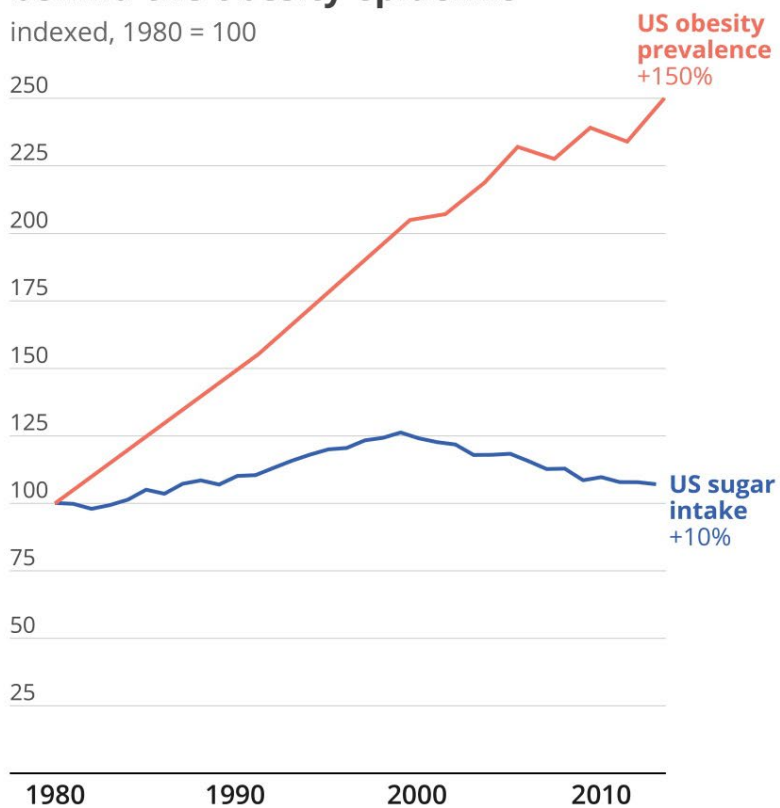
Disclaimer: charts created for educational purposes only, data found in the original chart have not been verified

REDESIGN #2

This redesign tries to show how the obesity prevalence has risen much faster than the sugar intake, suggesting both are not necessarily related.

Sugar is not the driving force behind the obesity epidemic

indexed, 1980 = 100



Data: USDA Economic Research Service, CDC NHANES surveys

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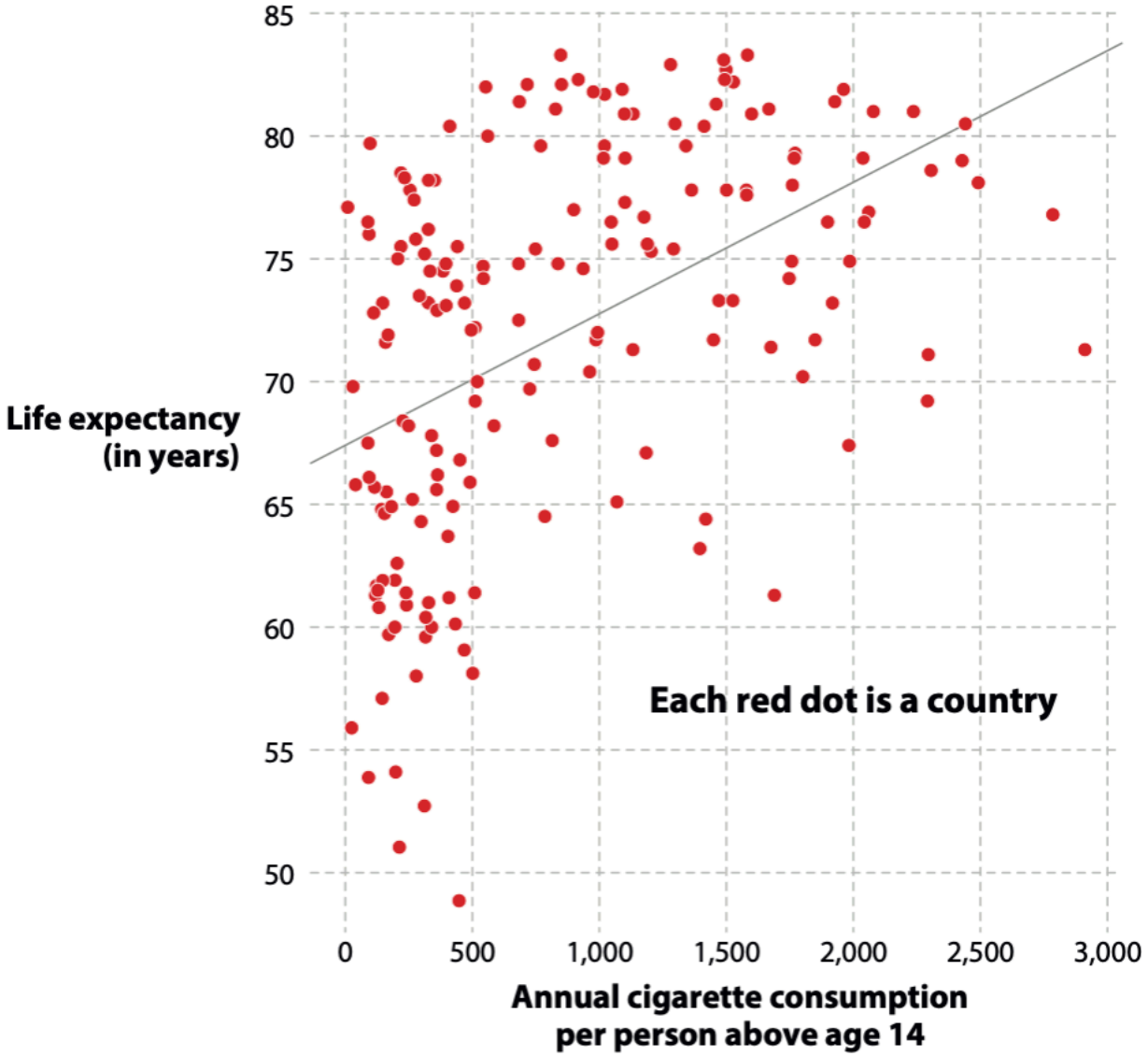
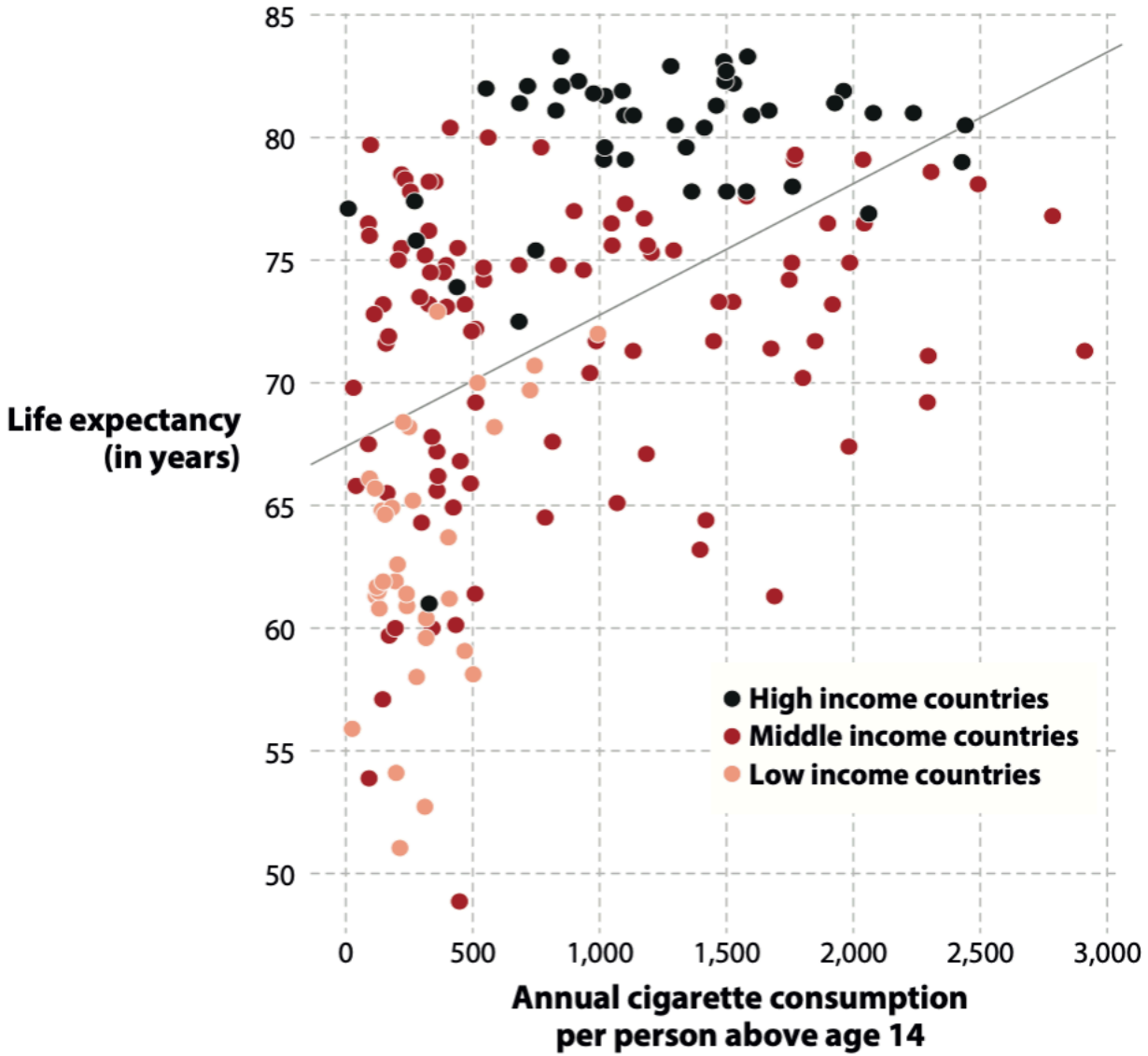


Smoking cigarettes can help you live longer!!!

Example provided by Heather Krause
https://idatassist.com

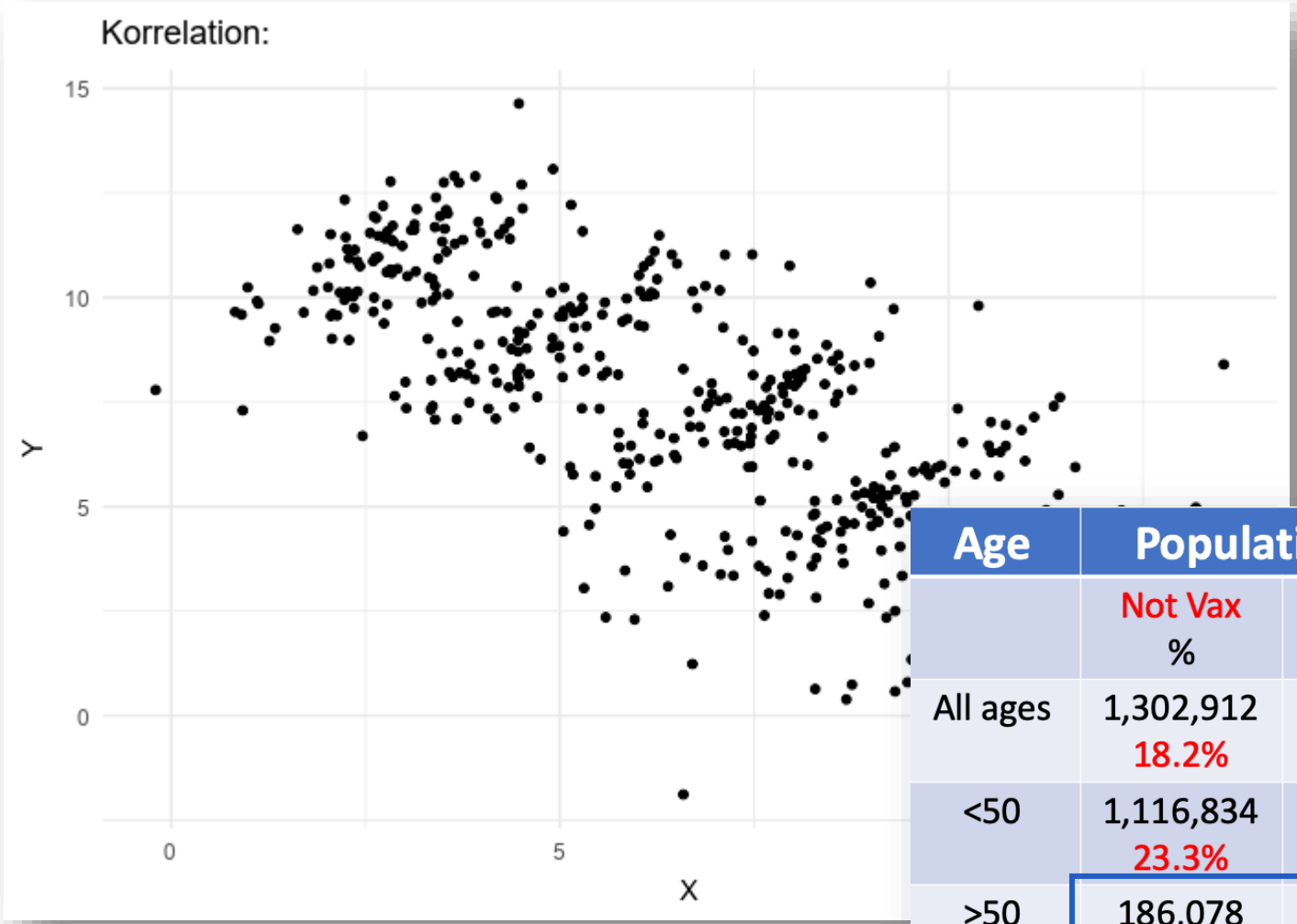


Remember:
A chart shows only what it shows *and nothing else*

Smoking cigarettes can help you live longer??

Example provided by Heather Krause
https://idatassist.com

“Simpson’s paradox”

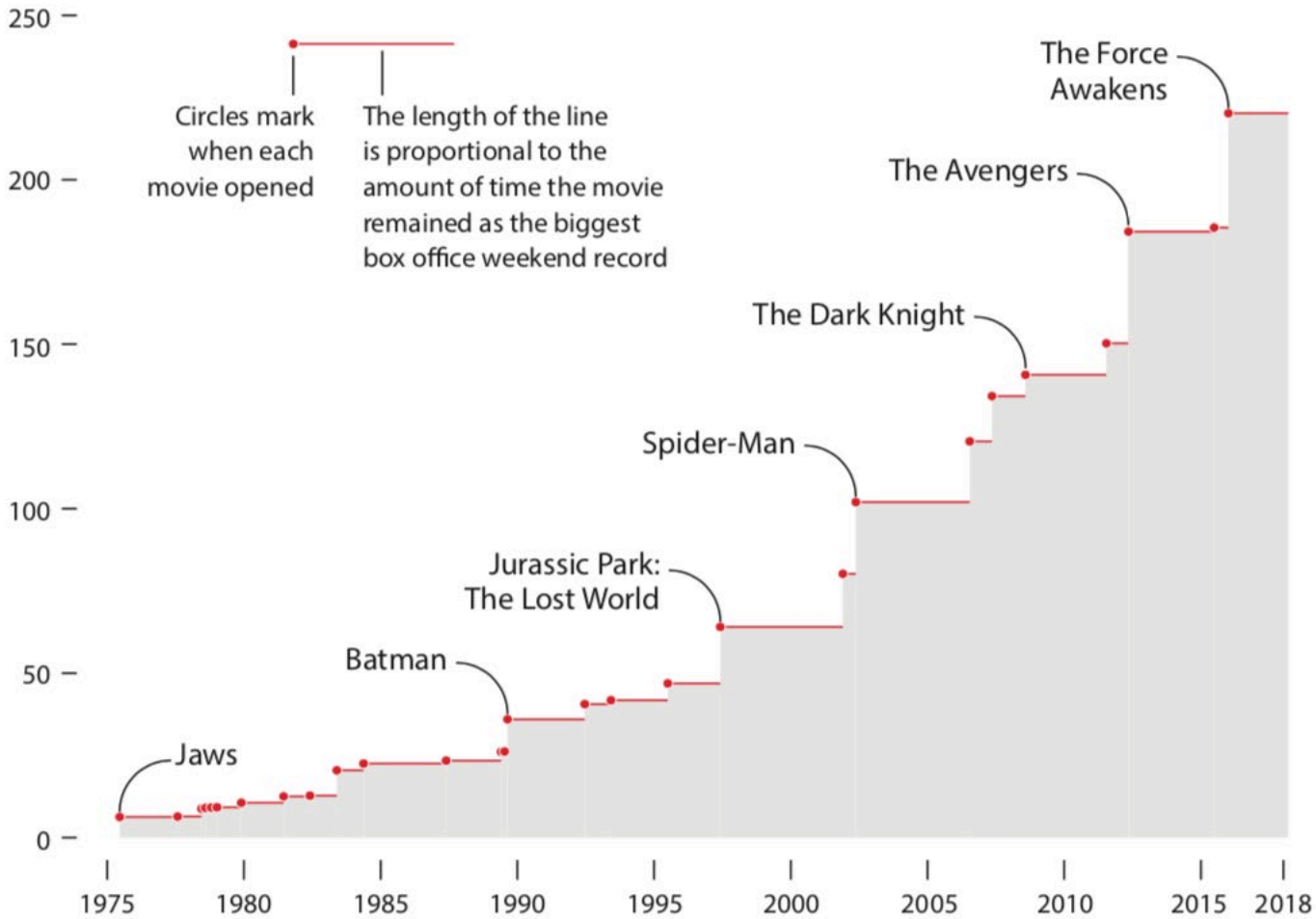


Age	Population (%)		Severe cases		Efficacy
	Not Vax %	Fully Vax %	Not Vax per 100k	Fully Vax per 100k	vs. severe disease
All ages	1,302,912 18.2%	5,634,634 78.7%	214 16.4	301 5.3	**67.5%**
<50	1,116,834 23.3%	3,501,118 73.0%	43 3.9	11 0.3	**91.8%**
>50	186,078 7.9%	2,133,516 90.4%	171 91.9	290 13.6	**85.2%**

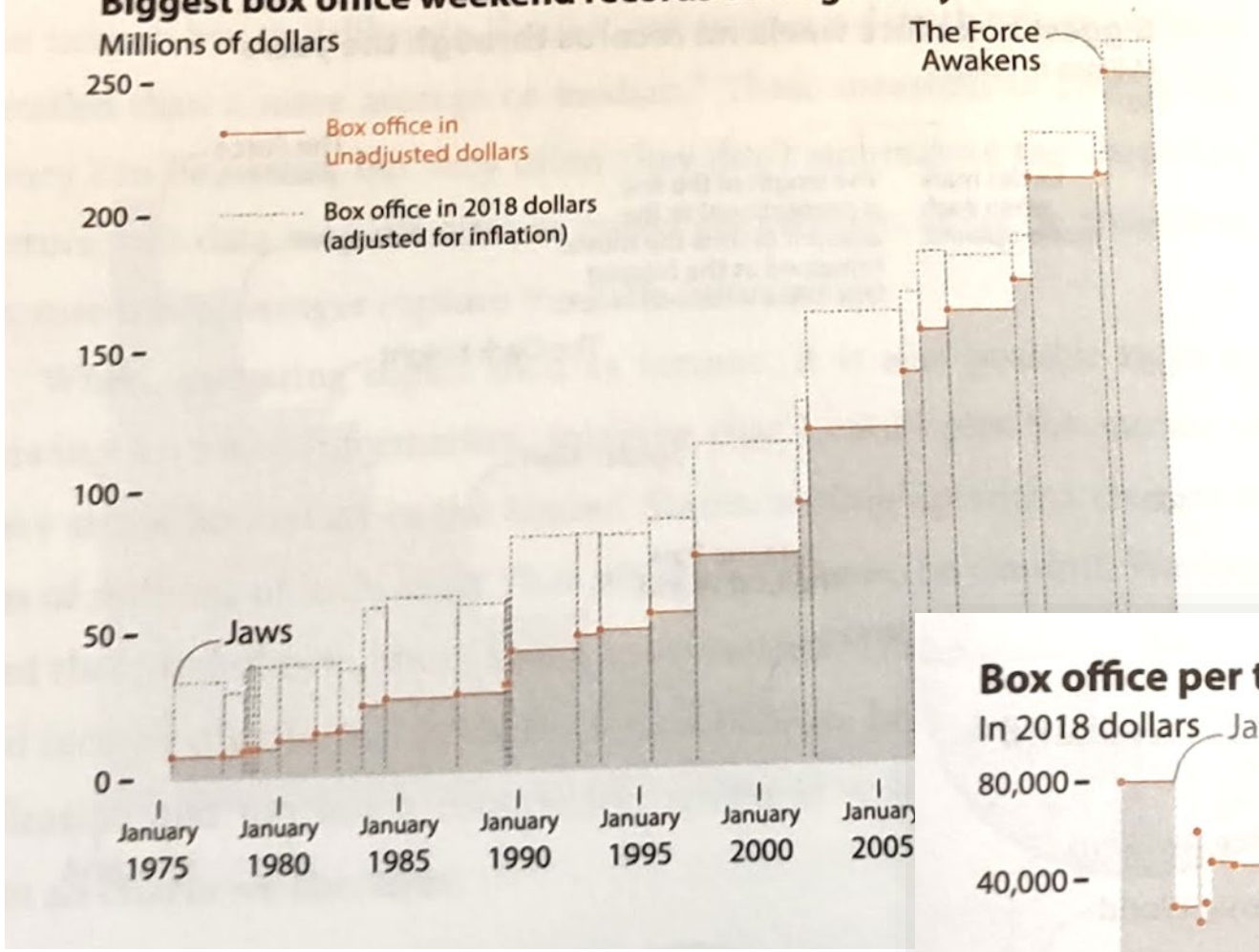
much higher level of vaccination!

BIGGEST BOX OFFICE WEEKEND RECORD THROUGH THE YEARS

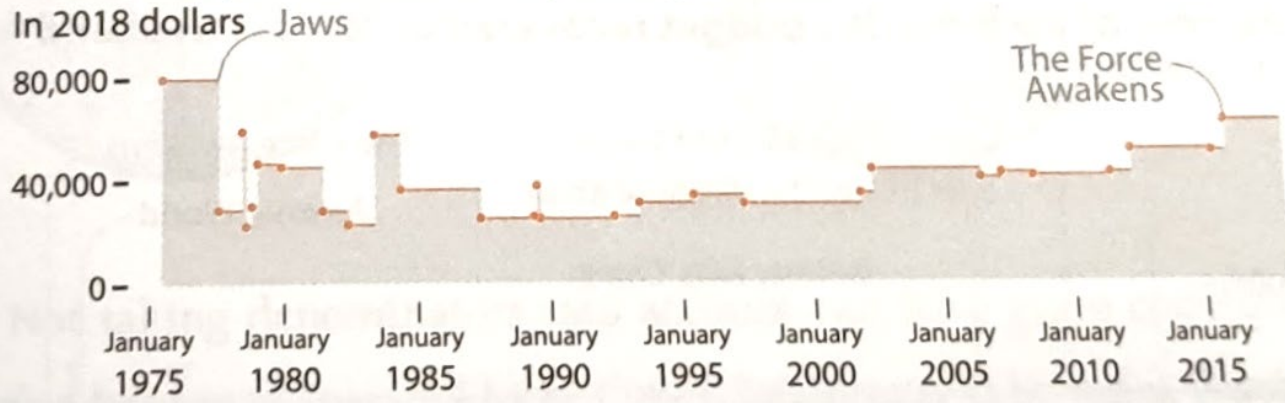
Millions of dollars



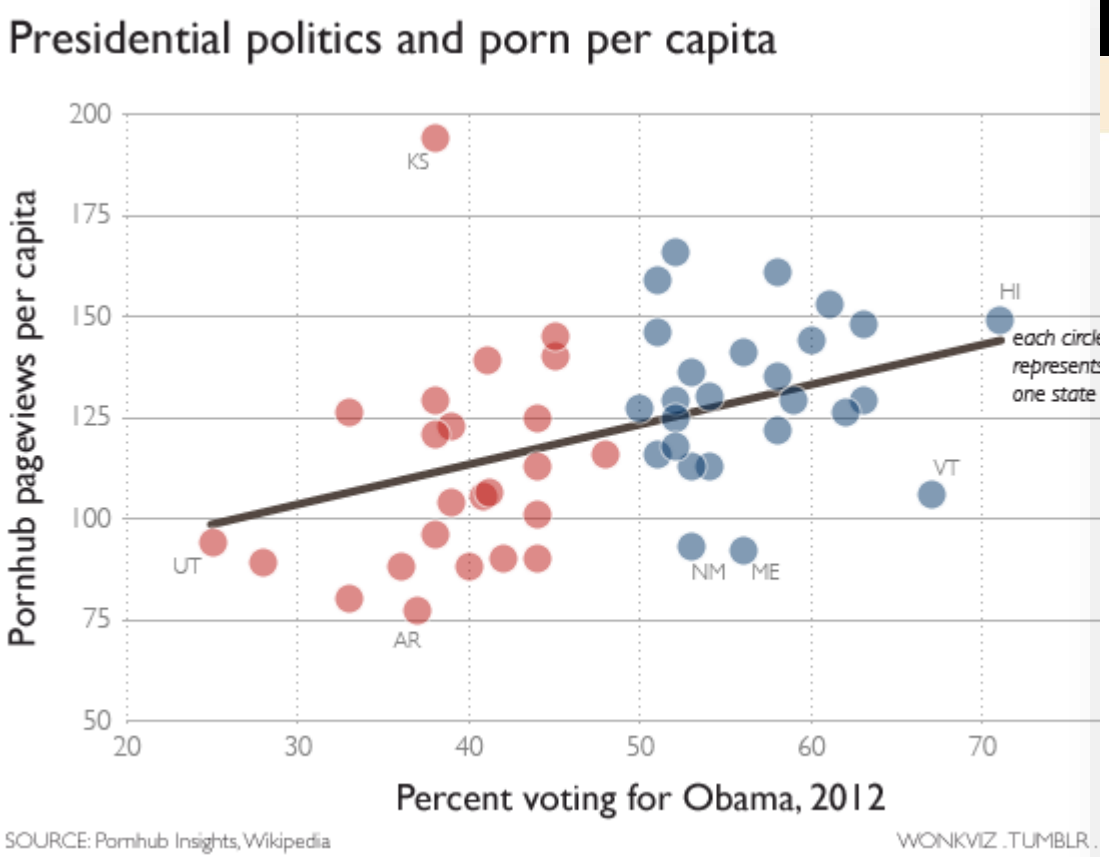
Biggest box office weekend records through the years



Box office per theater on opening weekend

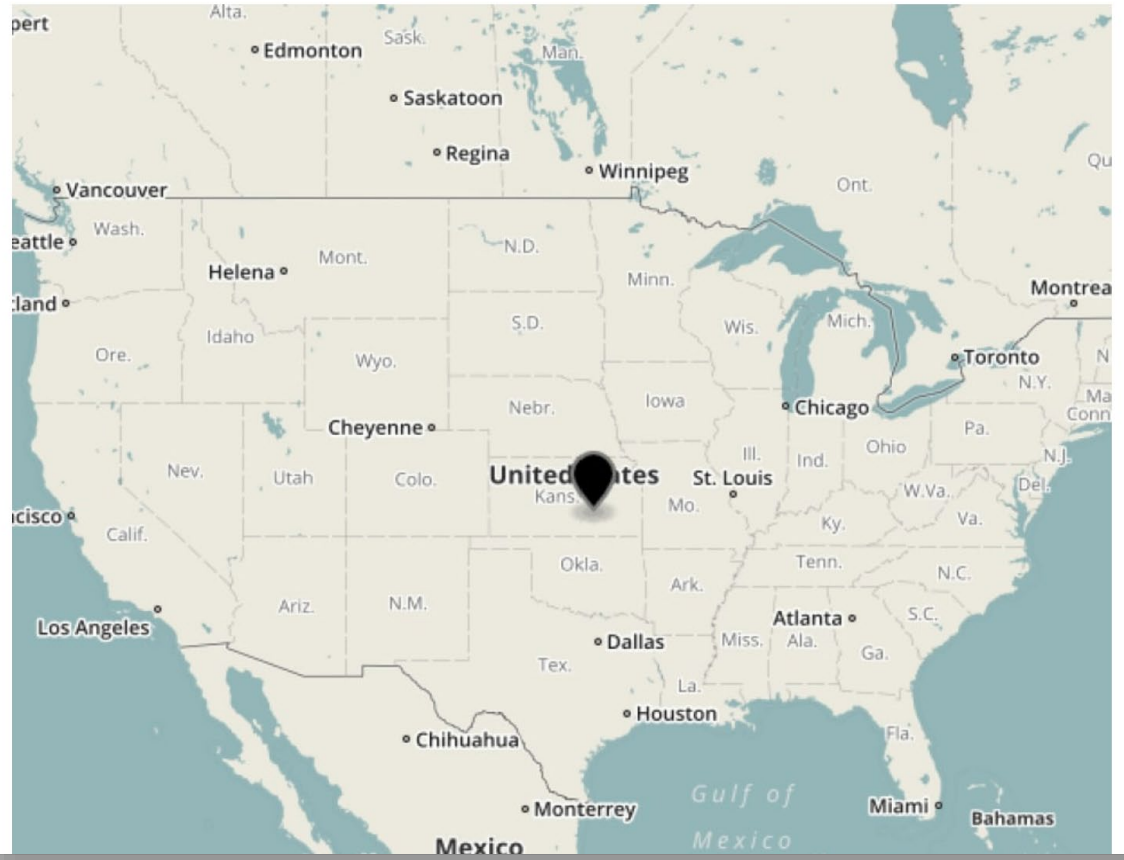


(Source for box office figures: Box Office Mojo)

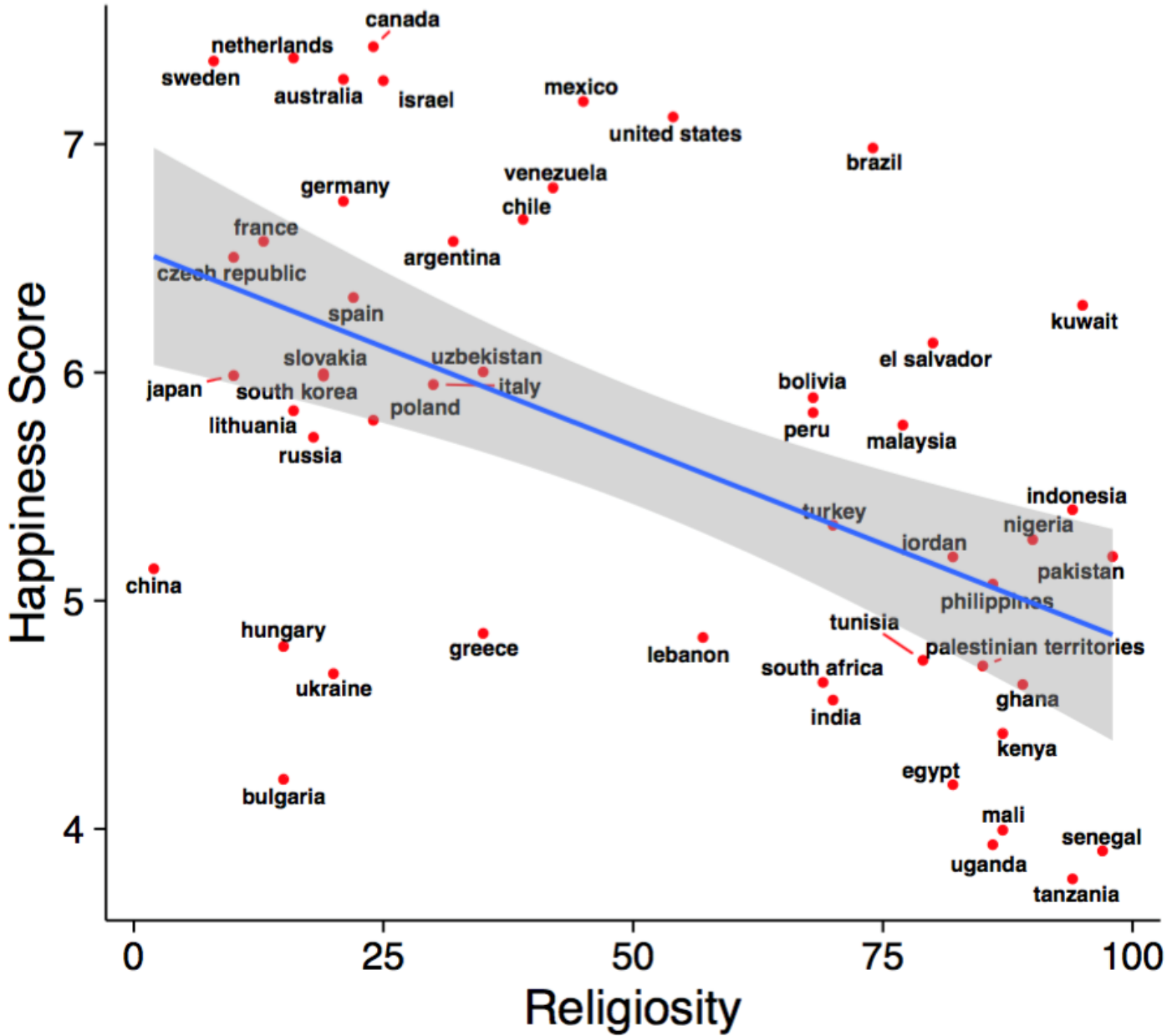


Morning Mix

Lawsuit: How a quiet Kansas home wound up with 600 million IP addresses and a world of trouble

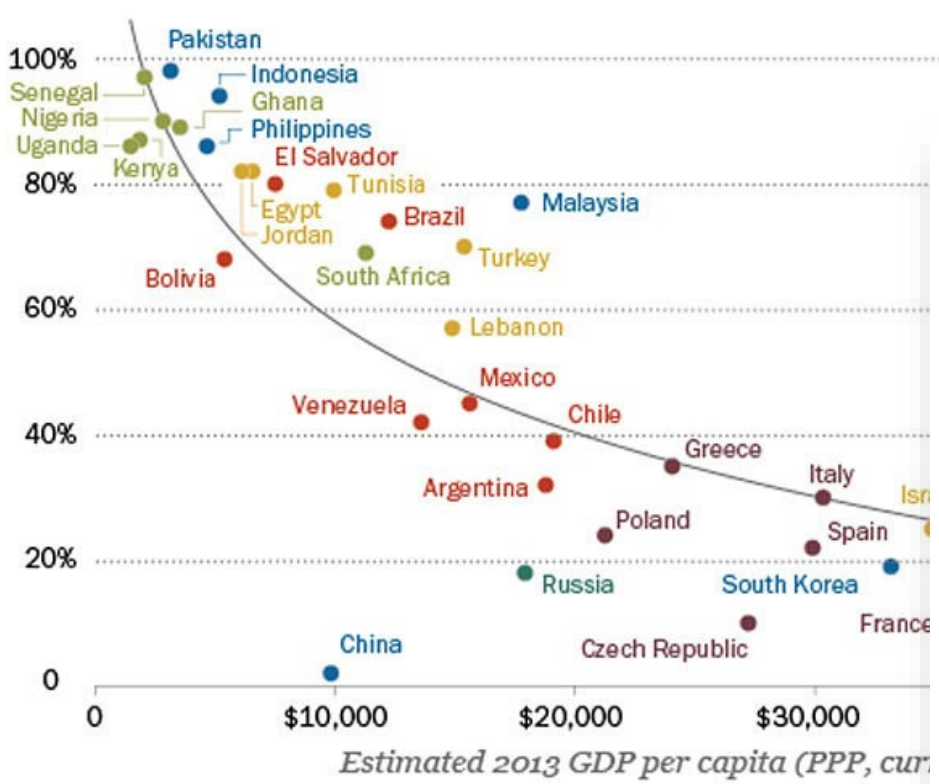


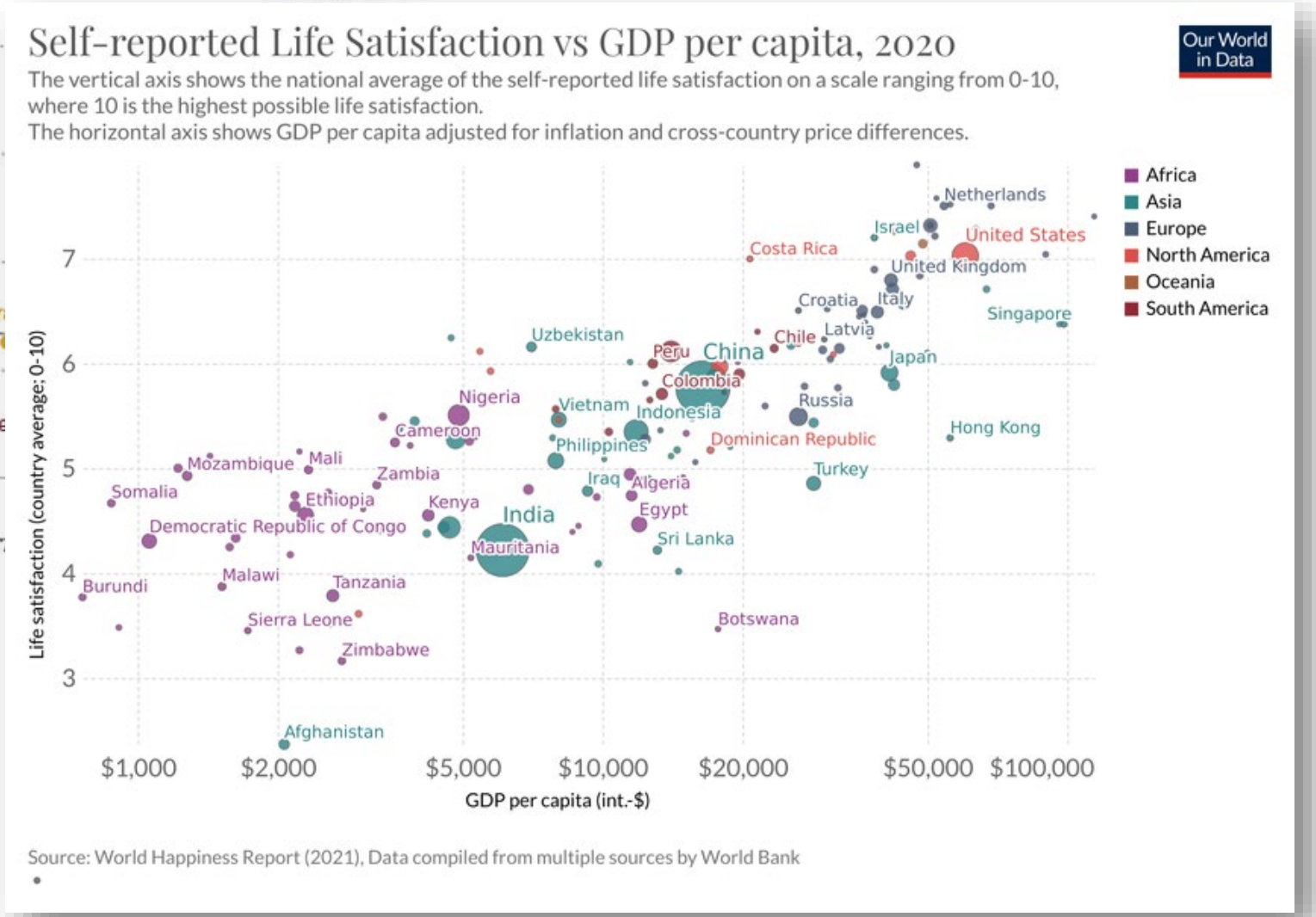
Happiness vs Religiosity
(Pearson Correlation: –0.52)

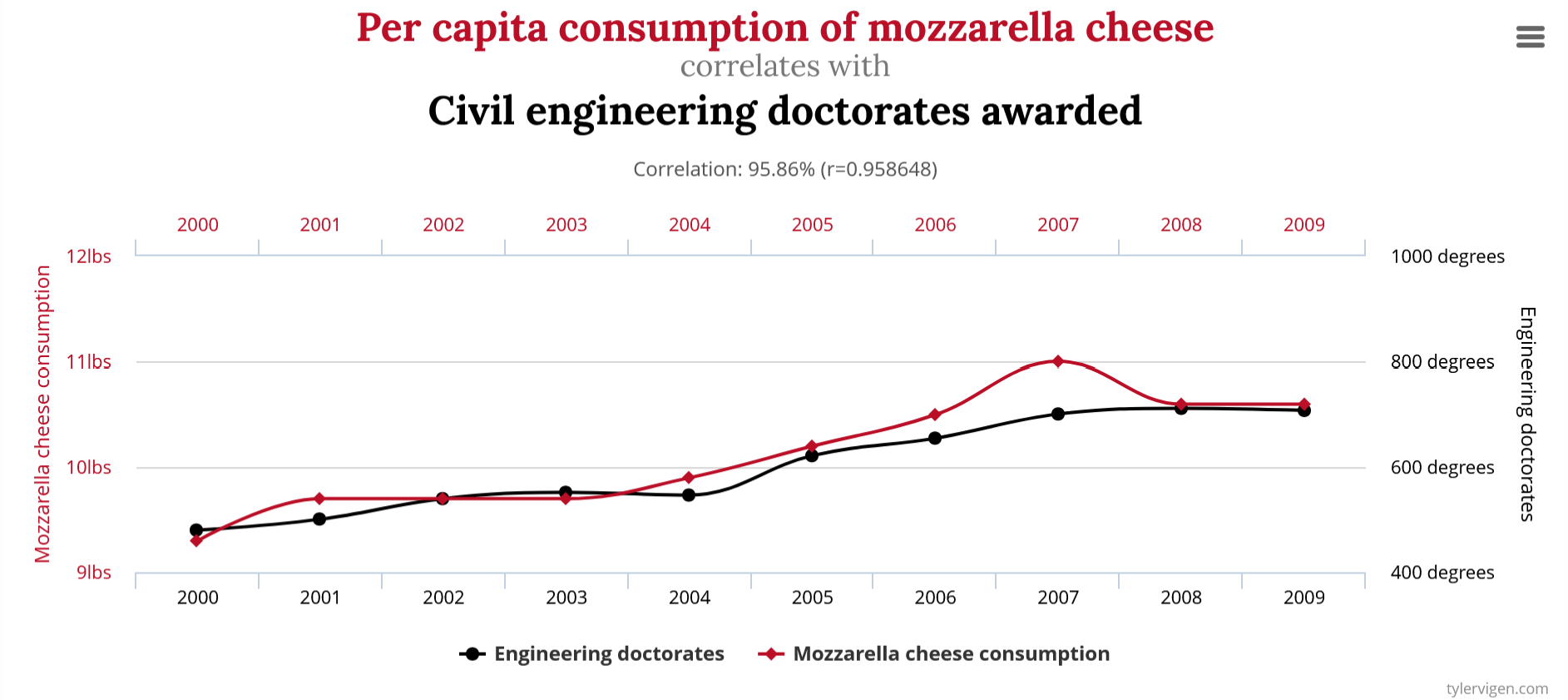


Wealthier Nations Tend to Be Less Religious, But U.S. a Prominent Exception

% saying religion plays a very important role in their lives (2011-2013)







Data sources: U.S. Department of Agriculture and National Science Foundation

tylervigen.com/spurious-correlations

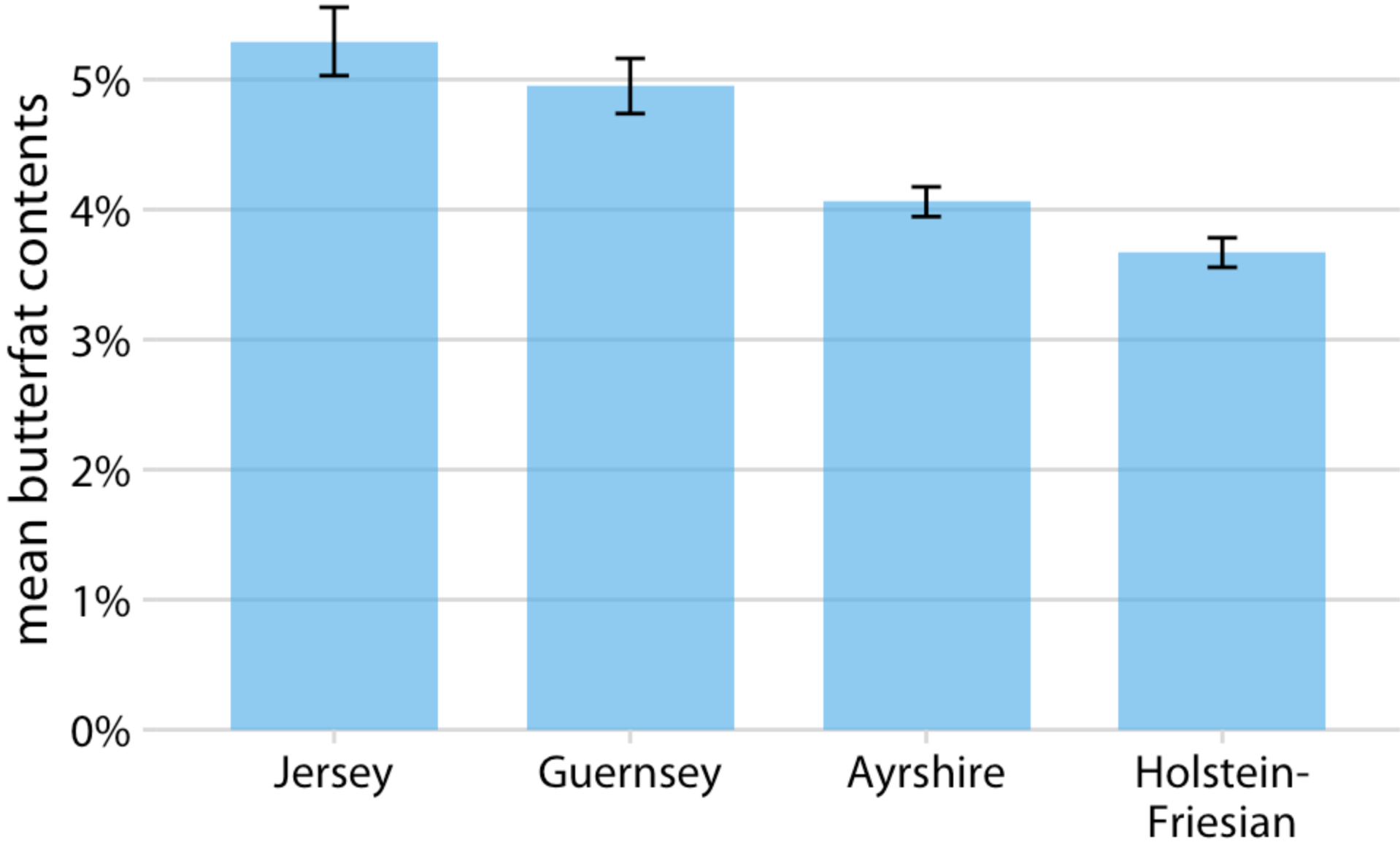
Ethics of data visualization

poor design

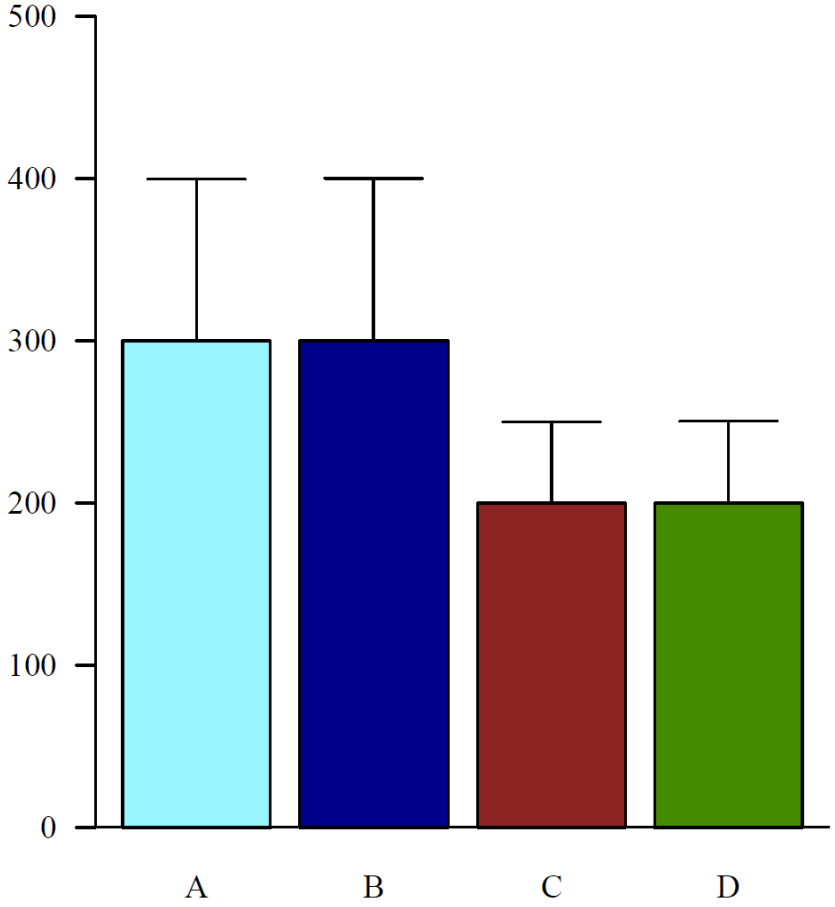
misleading stories

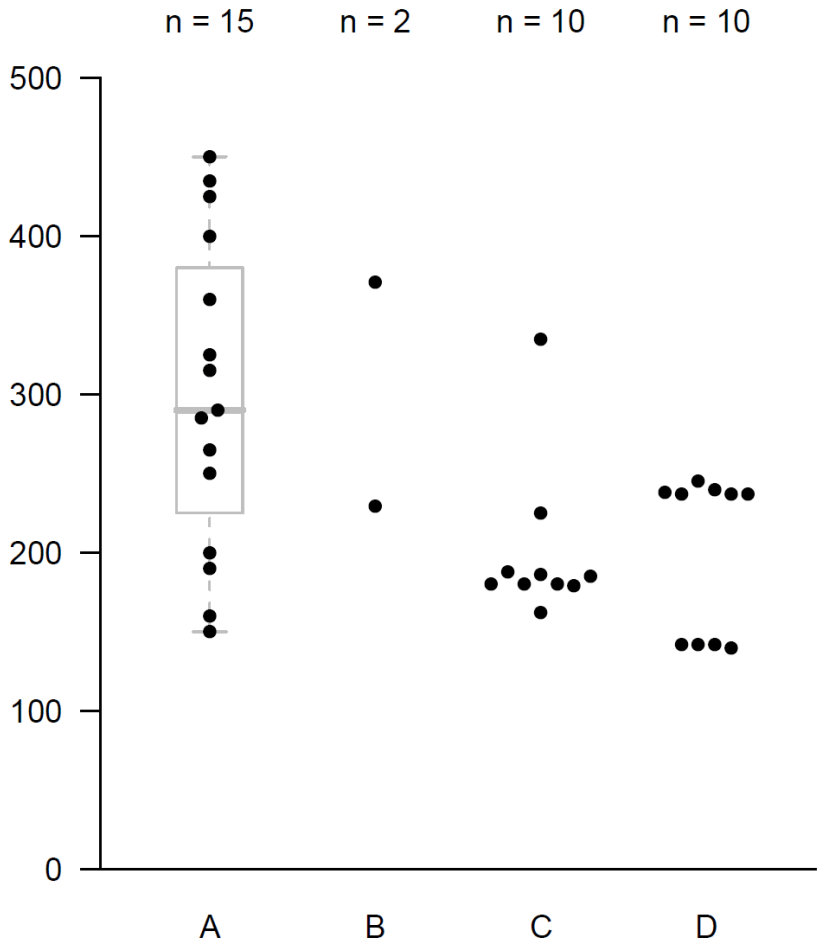
dubious data

hiding uncertainty

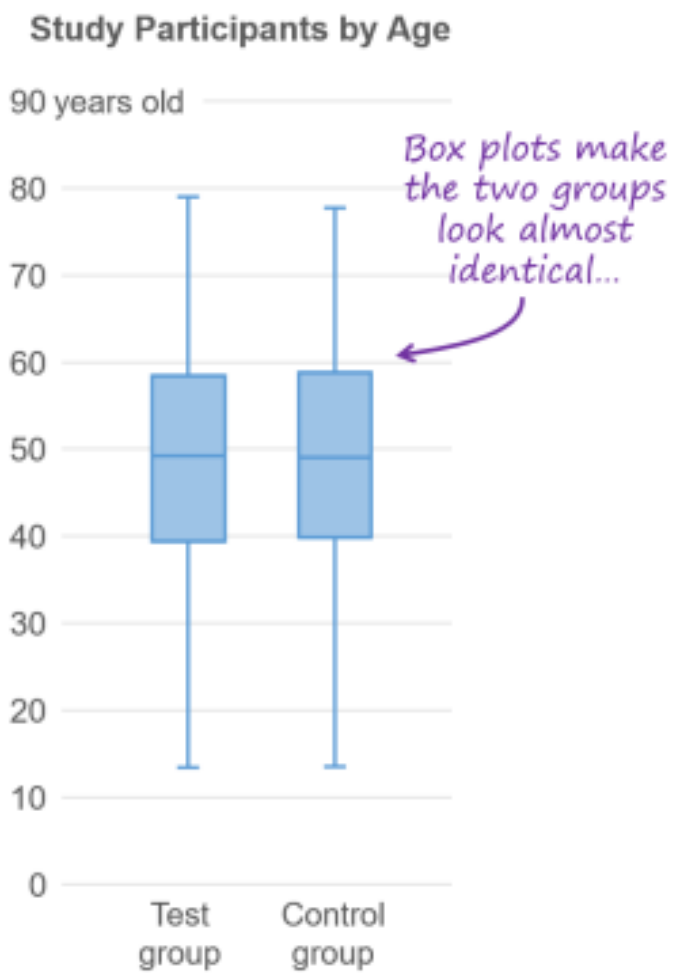

mean butterfat contents
5%
4%
3%
2%
1%
0%
Jersey
Guernsey
Ayrshire
Holstein-
Friesian

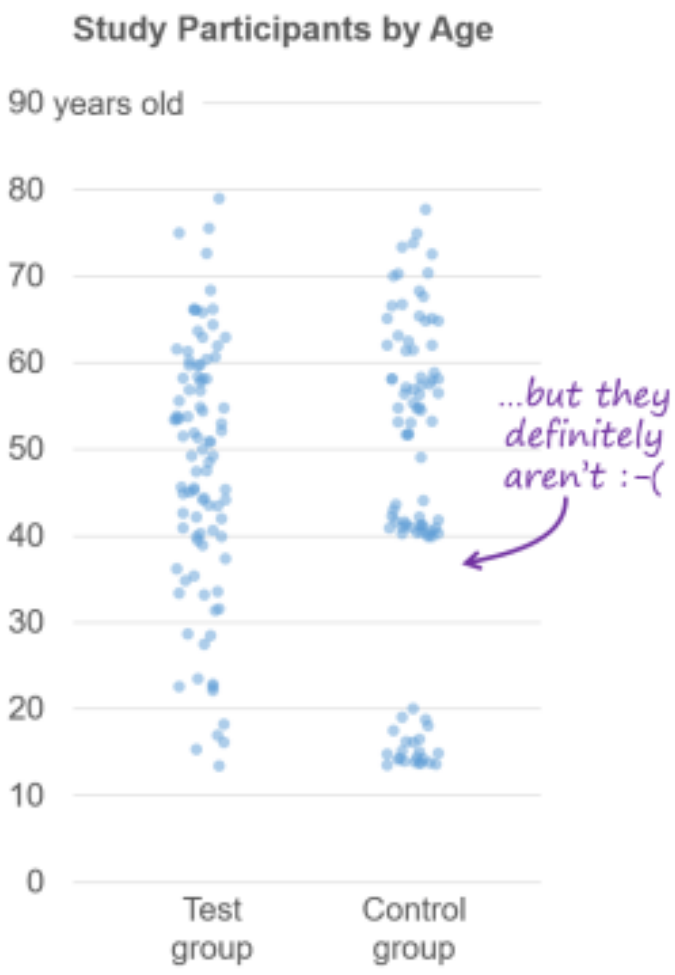
“dynamite” plot



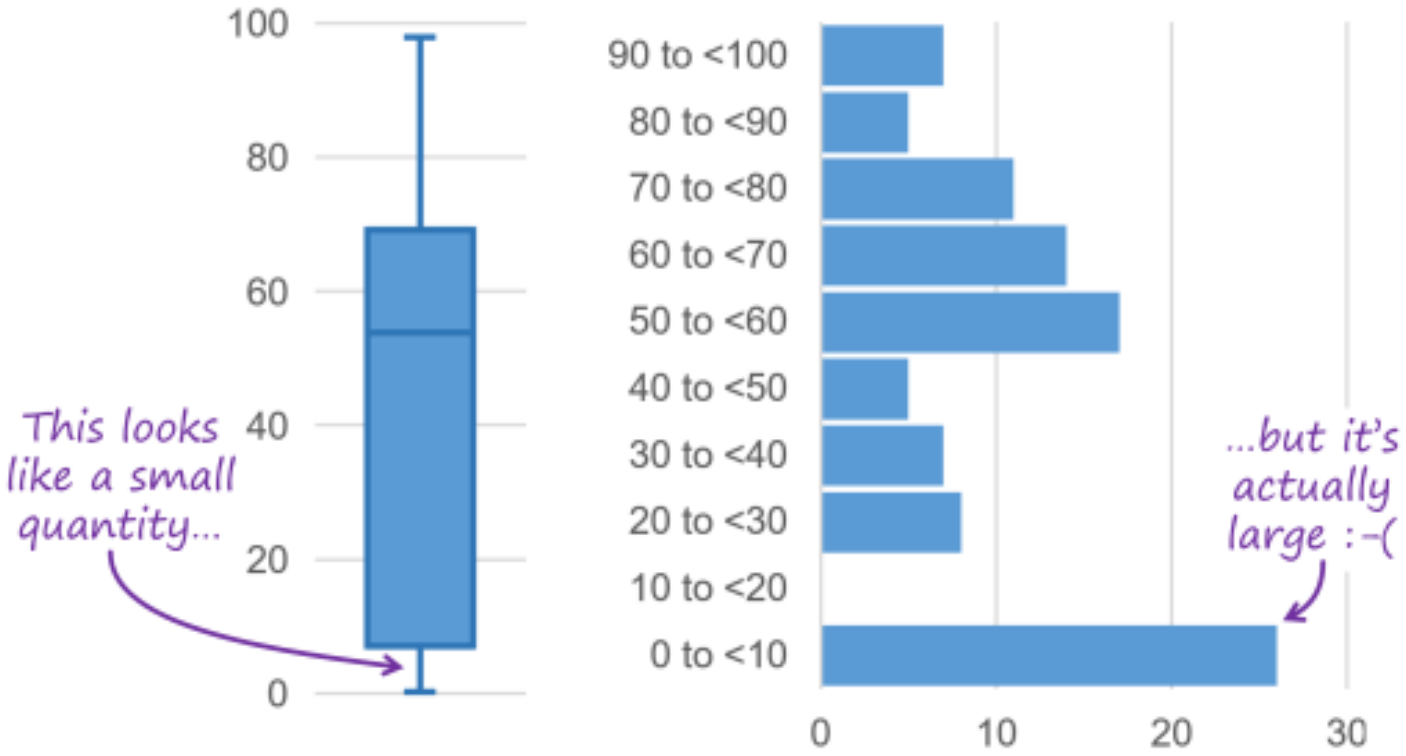


biostat.mc.vanderbilt.edu/wiki/Main/DynamitePlots





nightingaledvs.com/ive-stopped-using-box-plots-should-you



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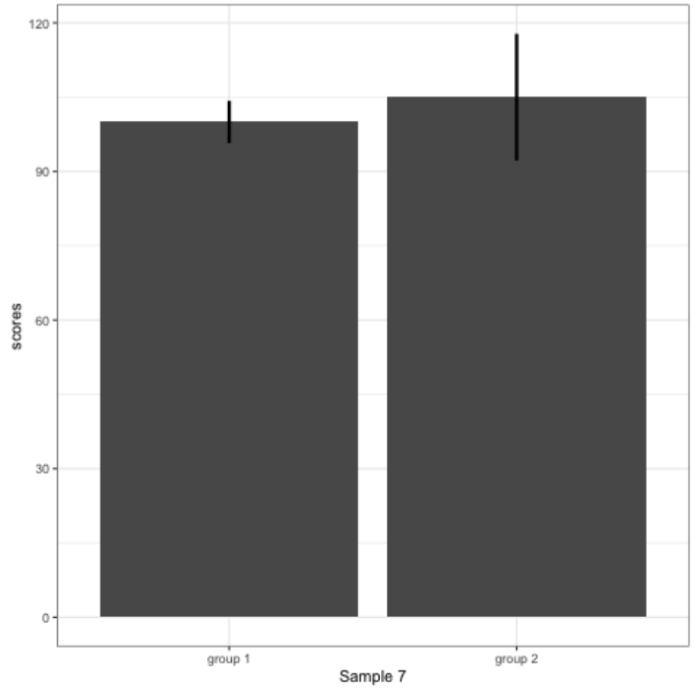
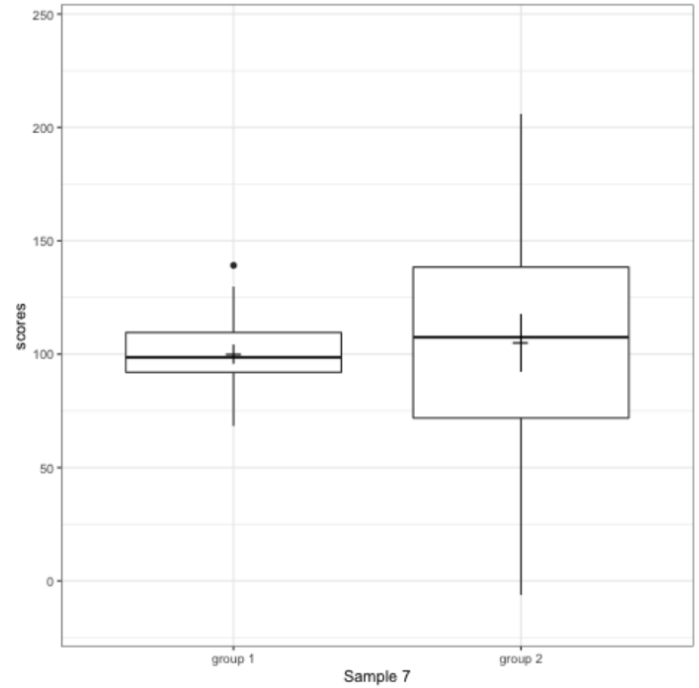
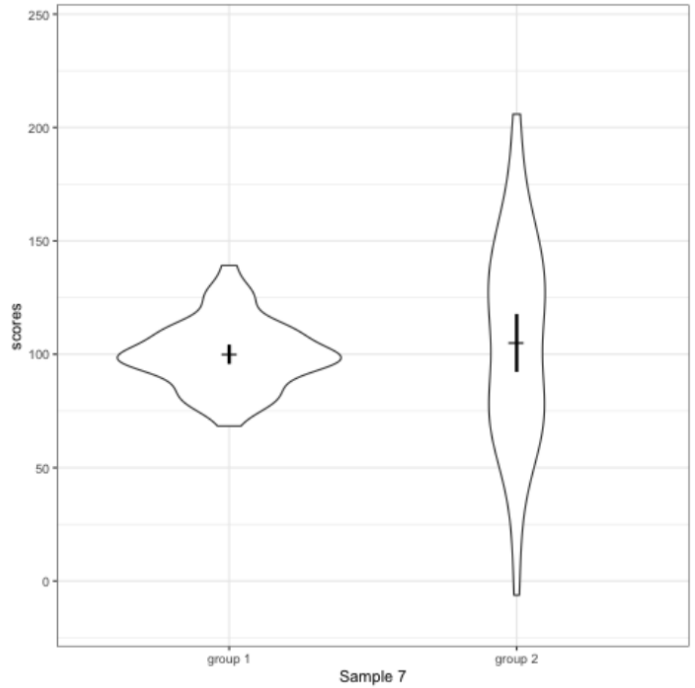
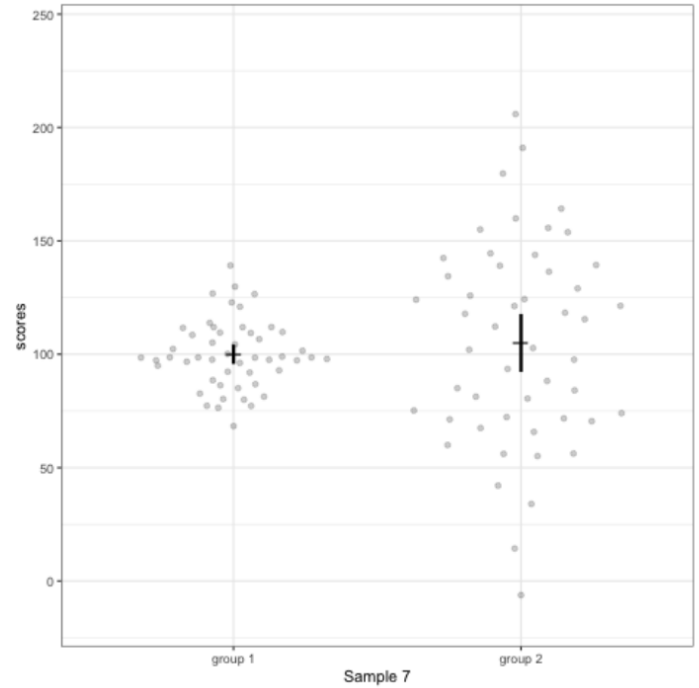
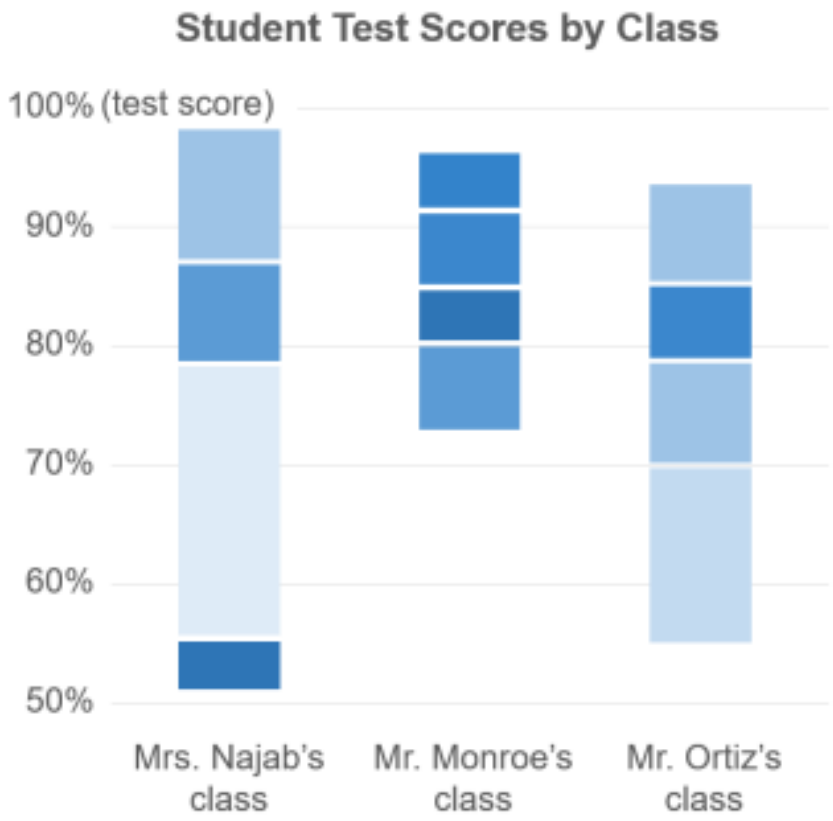
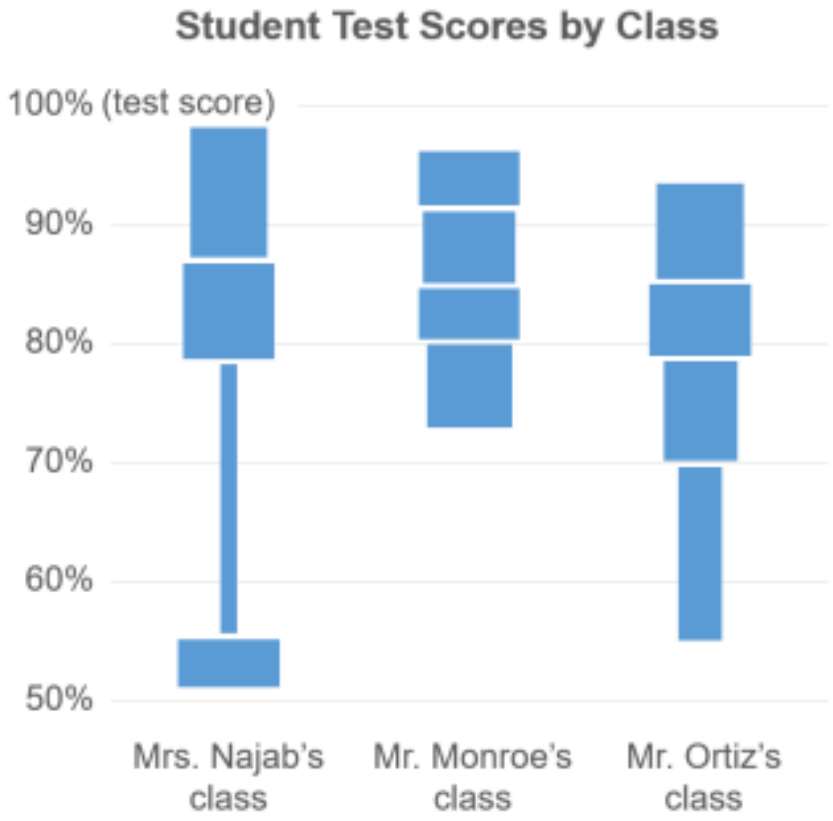

scores
120
90
60
30
0
group 1
group 2
Sample 7


scores
250
200
150
100
50
0
group 1
group 2
Sample 7

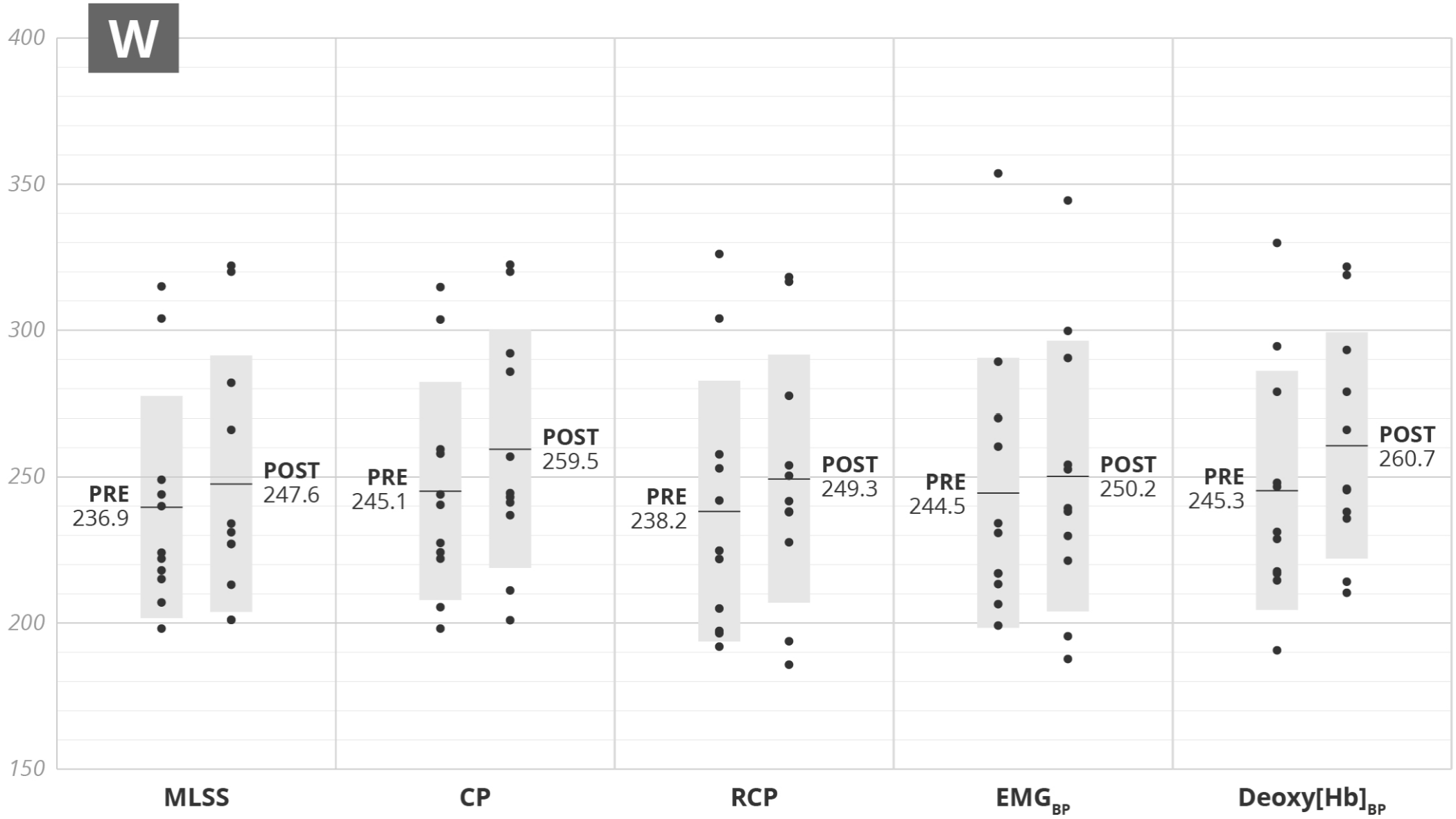

scores
250
200
150
100
50
0
group 1
group 2
Sample 7

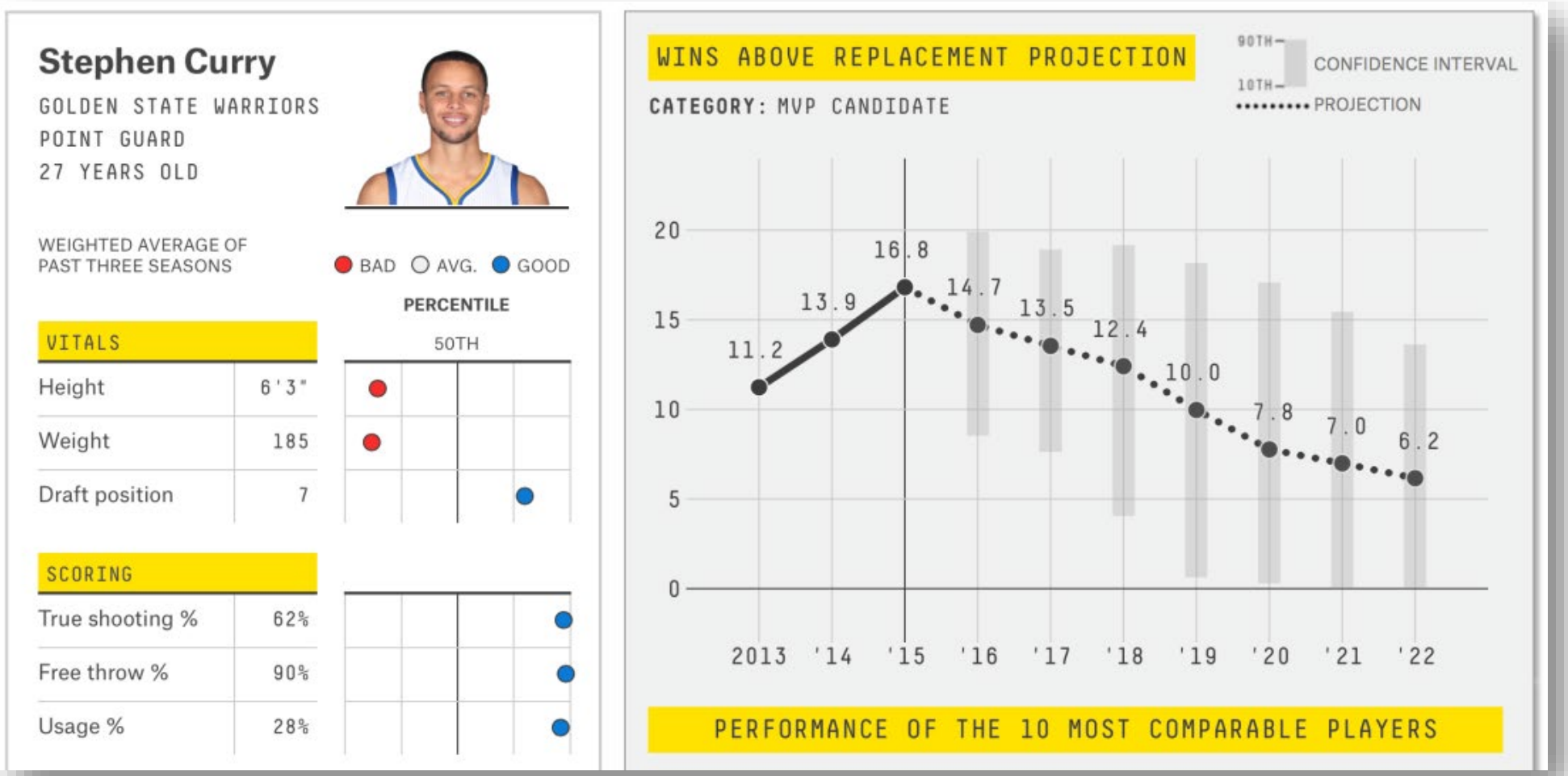

scores
250
200
150
100
50
0
group 1
group 2
Sample 7



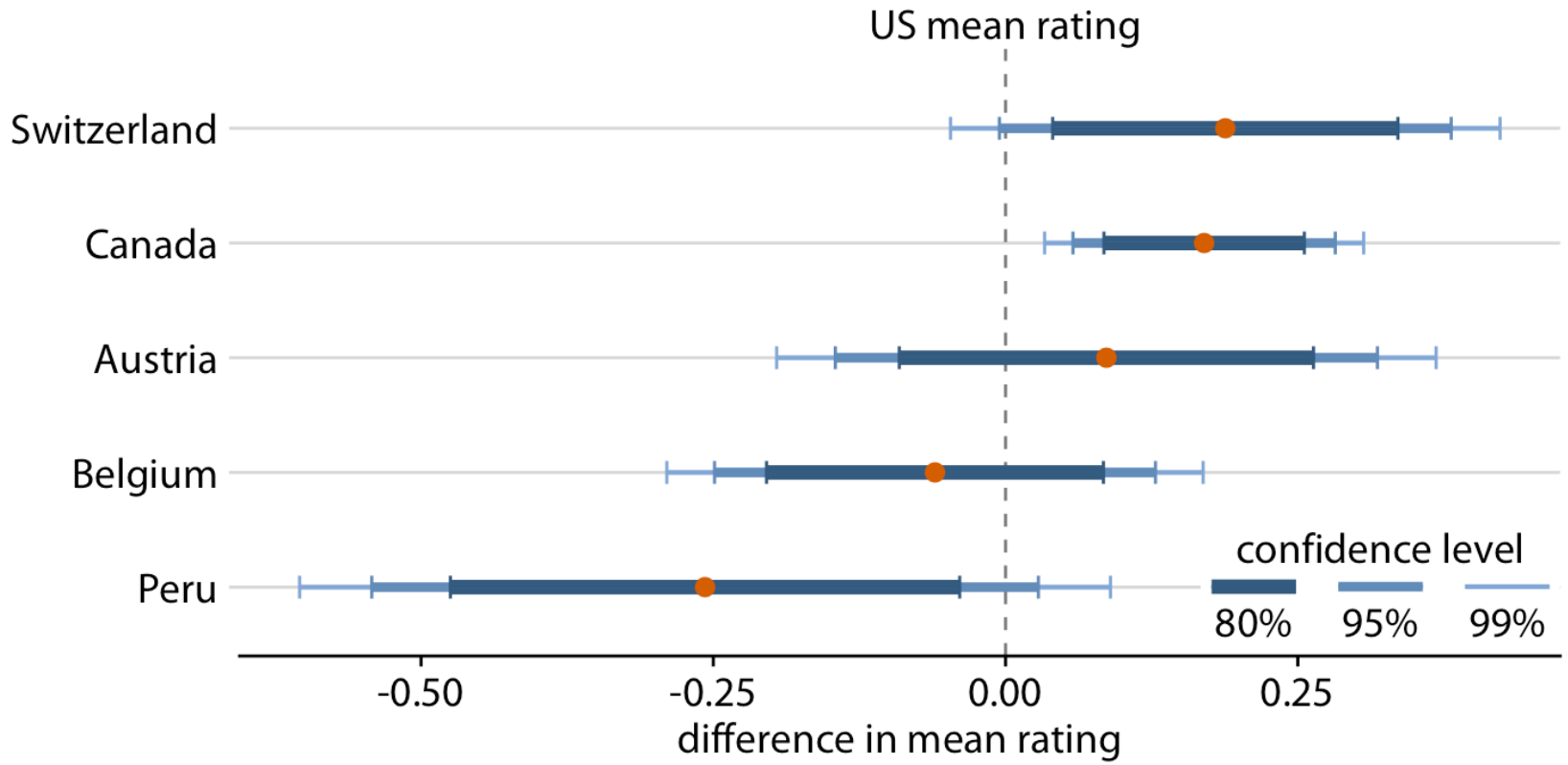


nightingaledvs.com/ive-stopped-using-box-plots-should-you

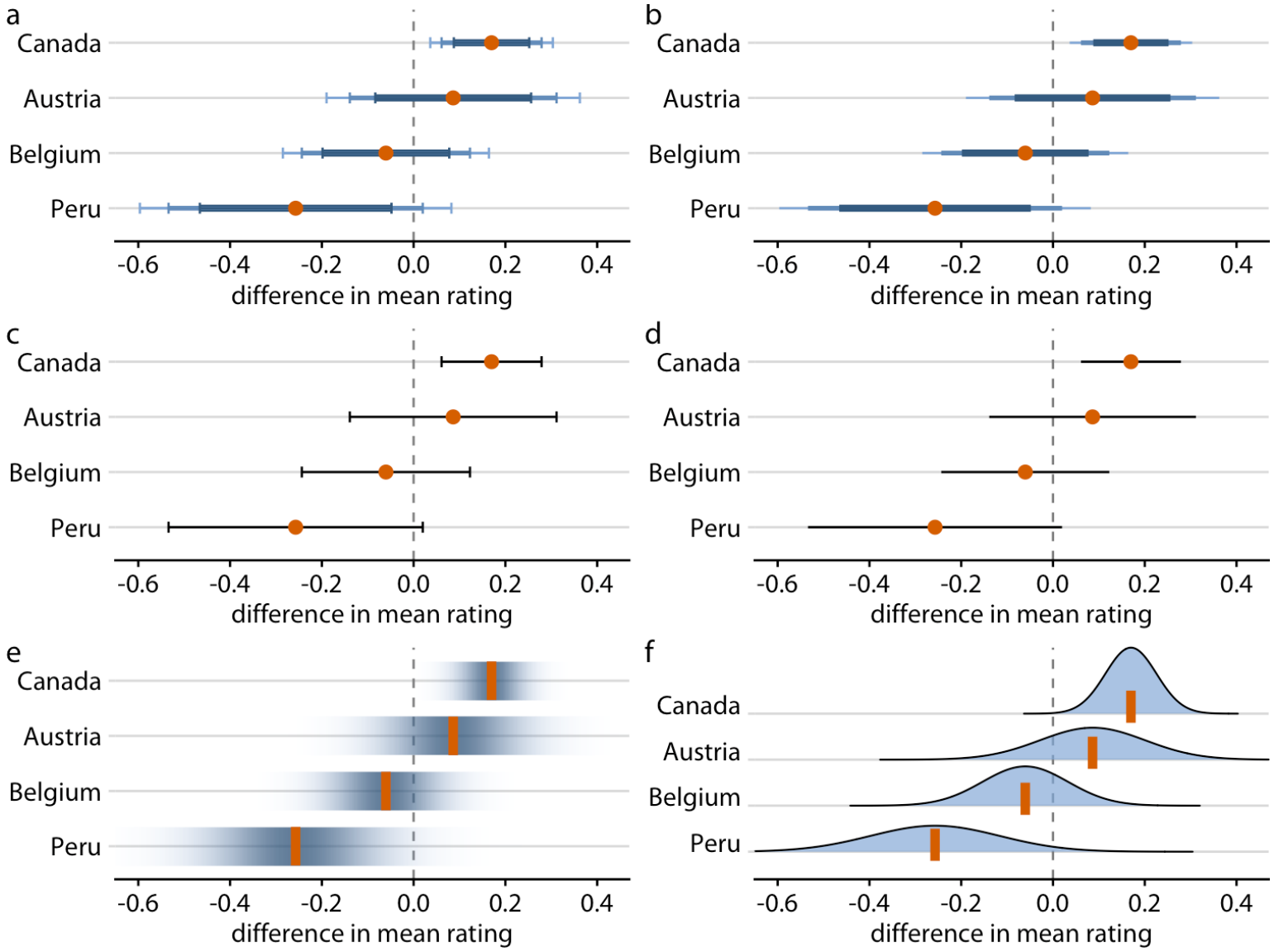

W
400
350
300
250
200
150
PRE
236.9
POST
247.6
PRE
245.1
POST
259.5
PRE
238.2
POST
249.3
PRE
244.5
POST
250.2
PRE
245.3
POST
260.7
MLSS
CP
RCP
EMG$_{BP}$
Deoxy[Hb]$_{BP}$



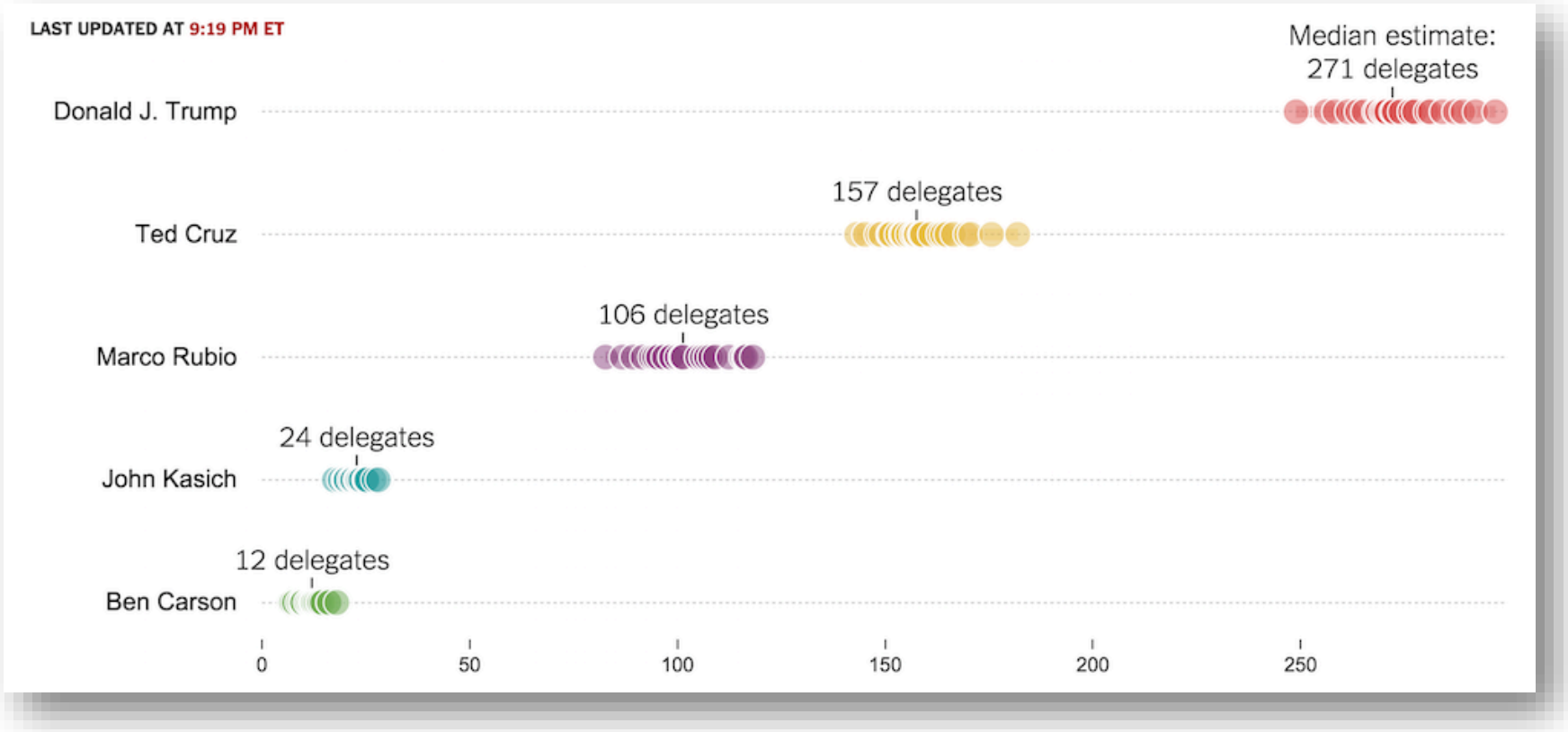
flowingdata.com/2018/01/08/visualizing-the-uncertainty-in-data



clauswilke.com/dataviz/visualizing-uncertainty.html



clauswilke.com/dataviz/visualizing-uncertainty.html

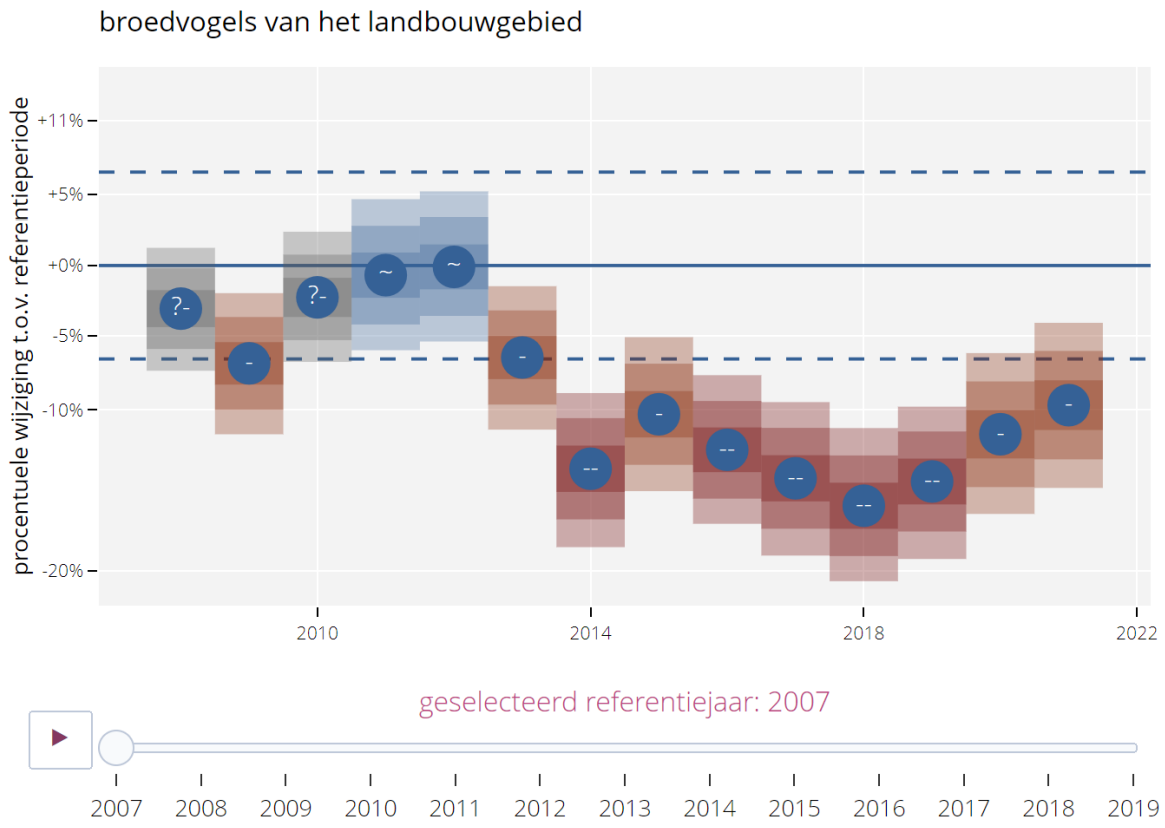


flowingdata.com/2018/01/08/visualizing-the-uncertainty-in-data

Akkervogels volgens de Algemene Broedvogelmonitoring Vlaanderen

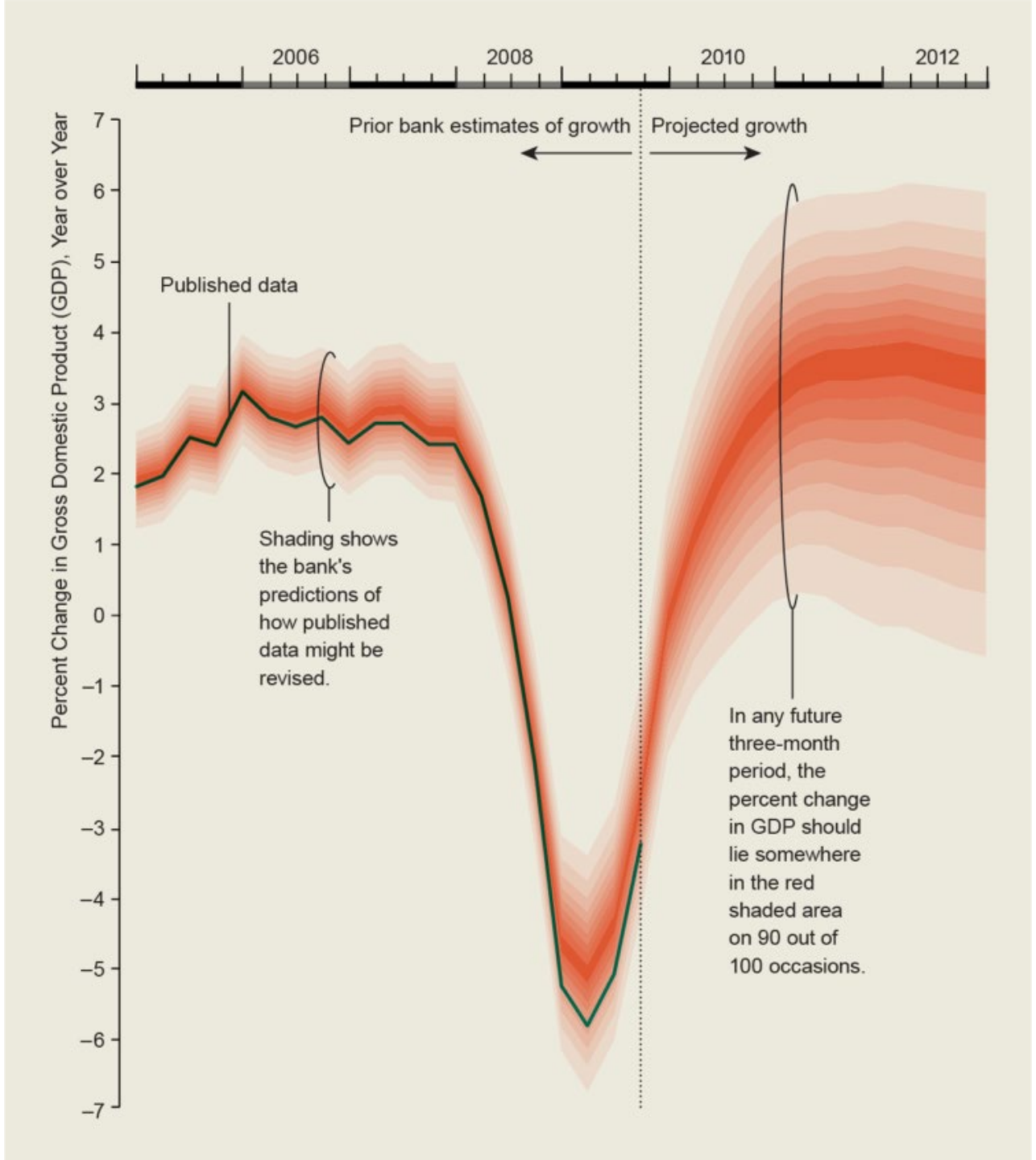
Publicatiedatum: 2022-03-24T10:00:00+01:00

De soorten van het landbouwgebied schommelden in de periode 2007-2012. Na een sterke daling in de periode 2013-2018, lijken de aantallen sinds 2019 heel langzaam wat te herstellen, maar ze bevinden zich nog ruim onder die van de start van het ABV-project in 2007.

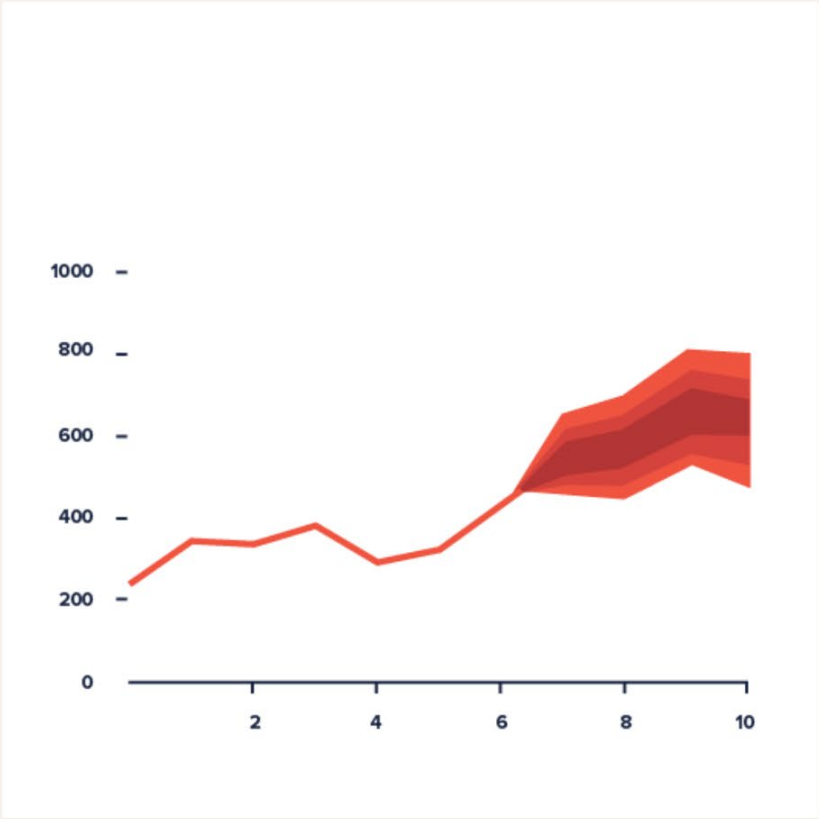


Gebruikte drempelwaarden classificatie: referentie = 0%, ondergrens = -6.6% en bovengrens = +7.0%.

vlaanderen.be/inbo/indicatoren/akkervogels-volgens-de-algemene-broedvogelmonitoring-vlaanderen


2006
2008
2010
2012
Prior bank estimates of growth
Projected growth
Percent Change in Gross Domestic Product (GDP), Year over Year
7
6
5
4
3
2
1
0
−1
−2
−3
−4
−5
−6
−7
Published data
Shading shows the bank's predictions of how published data might be revised.
In any future three-month period, the percent change in GDP should lie somewhere in the red shaded area on 90 out of 100 occasions.

Fan Chart (Time Series)



Also called: fan graph

A *fan chart* is a chart that joins a line graph for observed past data, and a range area chart for future predictions.

Predictions are shown as ranges for possible values of future data together with a line showing a central estimate or most likely value for the future outcomes. As predictions become increasingly uncertain the further into the future one goes, these forecast ranges spread out, creating distinctive wedge or "fan" shapes, hence the term. Alternative forms of the chart can also include uncertainty for past data, such as preliminary data that is subject to revision.

Read more about fan charts here

FAMILY

Plot

FUNCTION

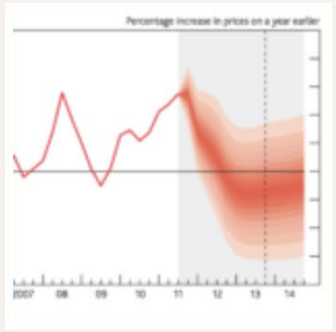
Trend over time

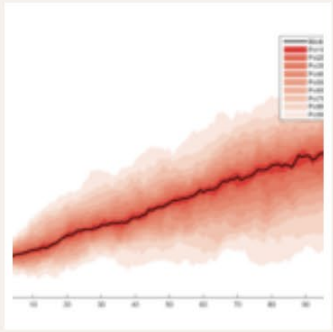
SHAPE

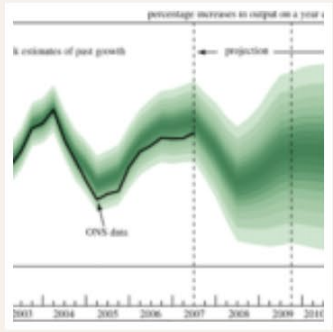
INPUT

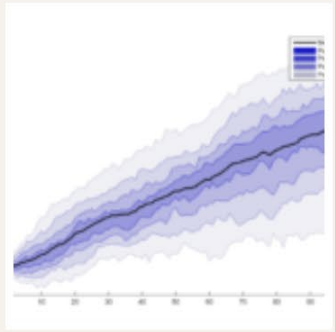
X	Y_1	Y_2
1	30	28
2	34	22
3	38	26

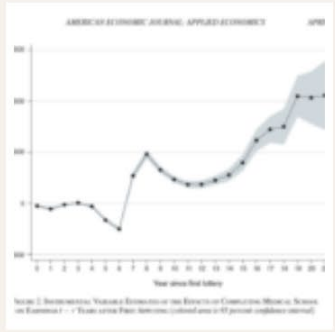
EXAMPLES











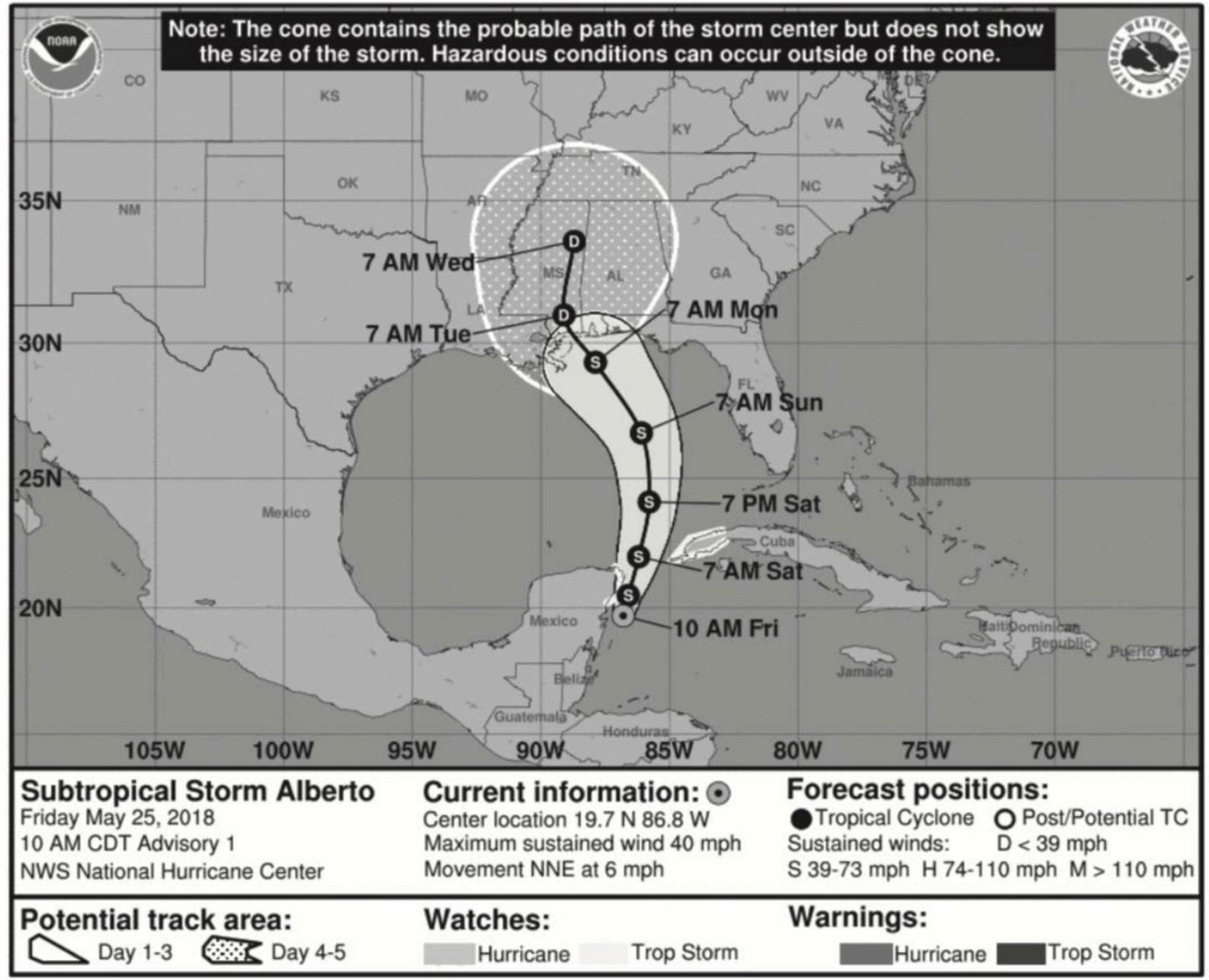

Note: The cone contains the probable path of the storm center but does not show the size of the storm. Hazardous conditions can occur outside of the cone.
7 AM Wed
7 AM Tue
7 AM Mon
7 AM Sun
7 PM Sat
7 AM Sat
10 AM Fri
35N
30N
25N
20N
105W
100W
95W
90W
85W
80W
75W
70W
CO
KS
MO
WV
KY
VA
TN
NC
OK
NM
AR
SC
MS
AL
GA
TX
LA
FL
Bahamas
Mexico
Cuba
Haiti
Dominican Republic
Puerto Rico
Jamaica
Belize
Guatemala
Honduras
Subtropical Storm Alberto
Friday May 25, 2018
10 AM CDT Advisory 1
NWS National Hurricane Center
Current information:
Center location 19.7 N 86.8 W
Maximum sustained wind 40 mph
Movement NNE at 6 mph
Forecast positions:
Tropical Cyclone
Post/Potential TC
Sustained winds:
D < 39 mph
S 39-73 mph H 74-110 mph M > 110 mph
Potential track area:
Day 1-3
Day 4-5
Watches:
Hurricane
Trop Storm
Warnings:
Hurricane
Trop Storm

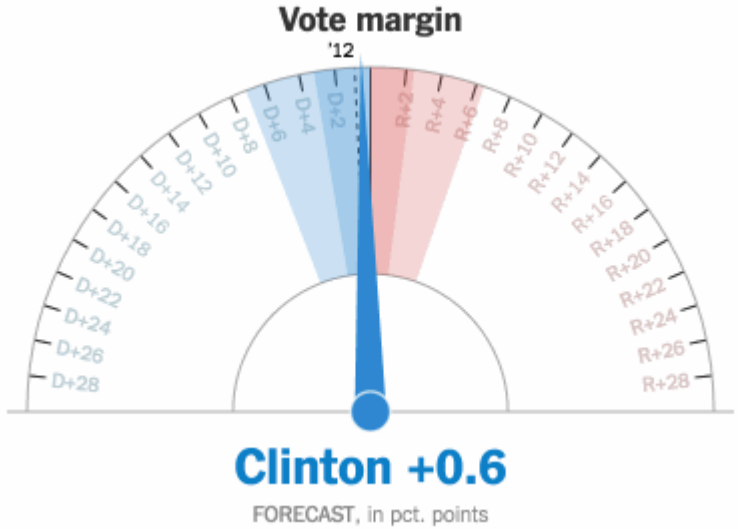
FIGURE 2

When presented with the cone of uncertainty, some readers see the boundaries of a storm.

ec.europa.eu/eurostat/cros/powerfromstatistics/OR/PfS-OutlookReport-Cairo.pdf

FIGURE 3

An alternative map of the hurricane path forecast



DEMOCRACY? | NOV. 2, 2020

Oh No, the Dreaded Needle Is Back

By Bridget Read

US & WORLD | CULTURE

The NYT's election forecast needle is stressing people out with fake jitter

By Rich McCormick | Nov 8, 2016, 11:02pm EST

HOME › INTERNATIONAAL › THE NEW YORK TIMES HAS A WILDLY SWINGING FORECAST NEEDLE THAT'S DRIVING EVERYO

The New York Times has a wildly swinging forecast needle that's driving everyone insane

HOME > POLITICS > POLITICS NEWS

FEBRUARY 3, 2020 2:32PM ET

The New York Times Needle and the Damage Done

Have we learned nothing from political journalism's failures of four years ago?

"A must-read for anyone who wants to stay informed."
—CATHY O'NEIL, best-selling author of *Weapons of Math Destruction*

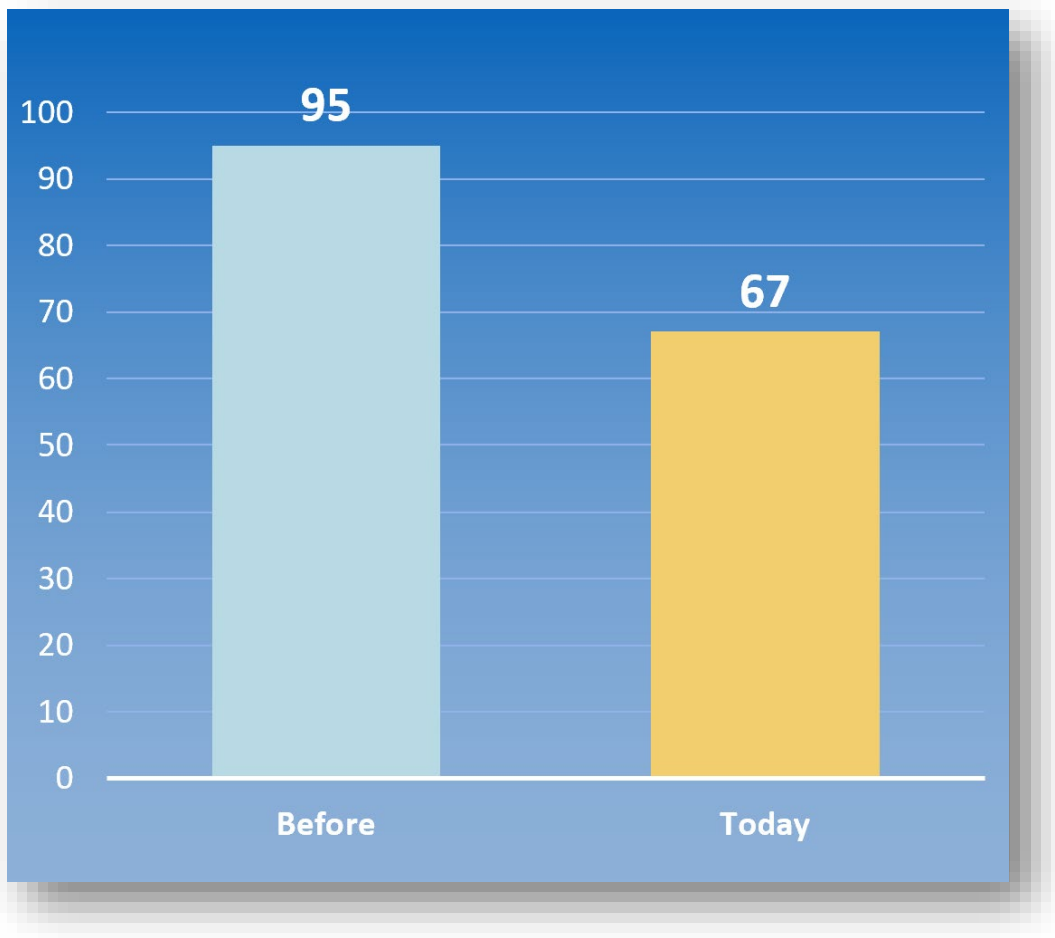
How Charts Lie

Getting Smarter about Visual Information

Alberto Cairo

Ethical data visualization

make sure your **visual variables** are showing the data as clearly as possible



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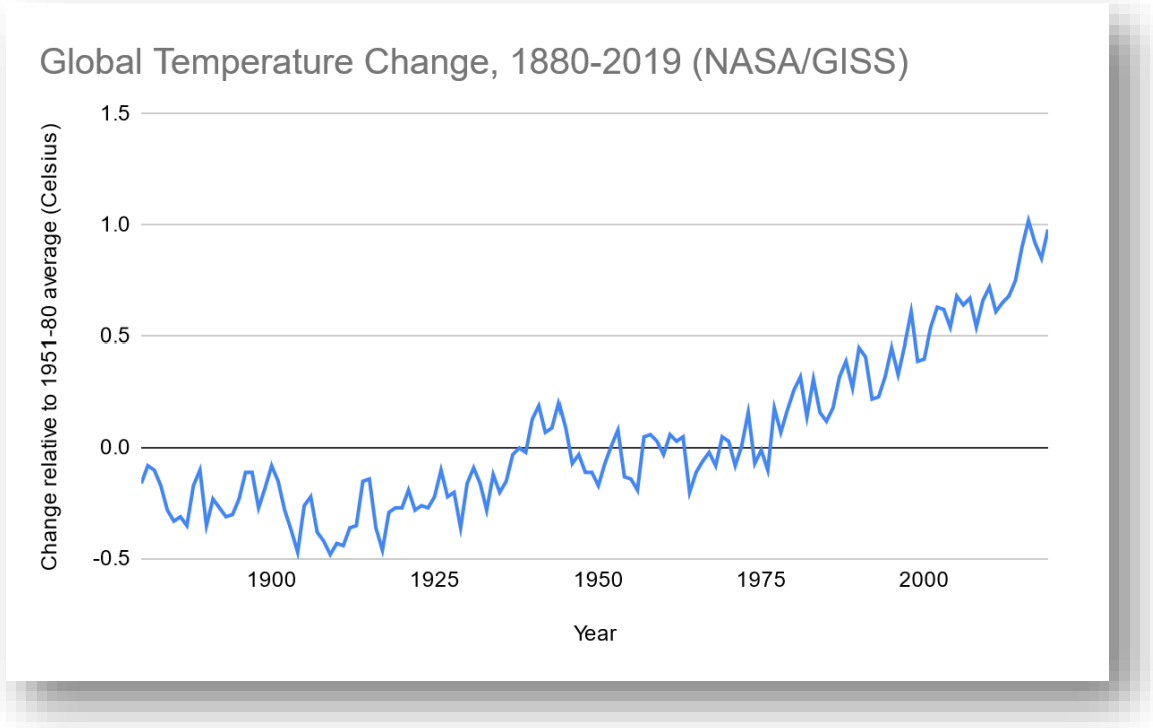

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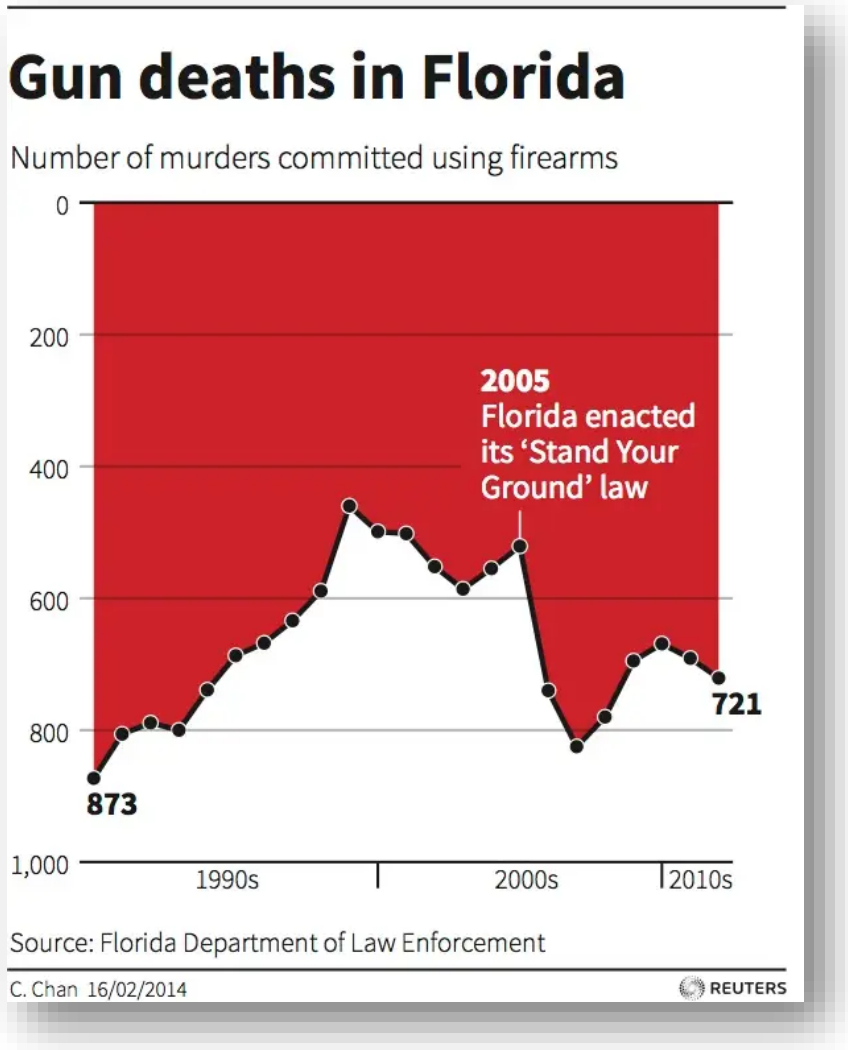

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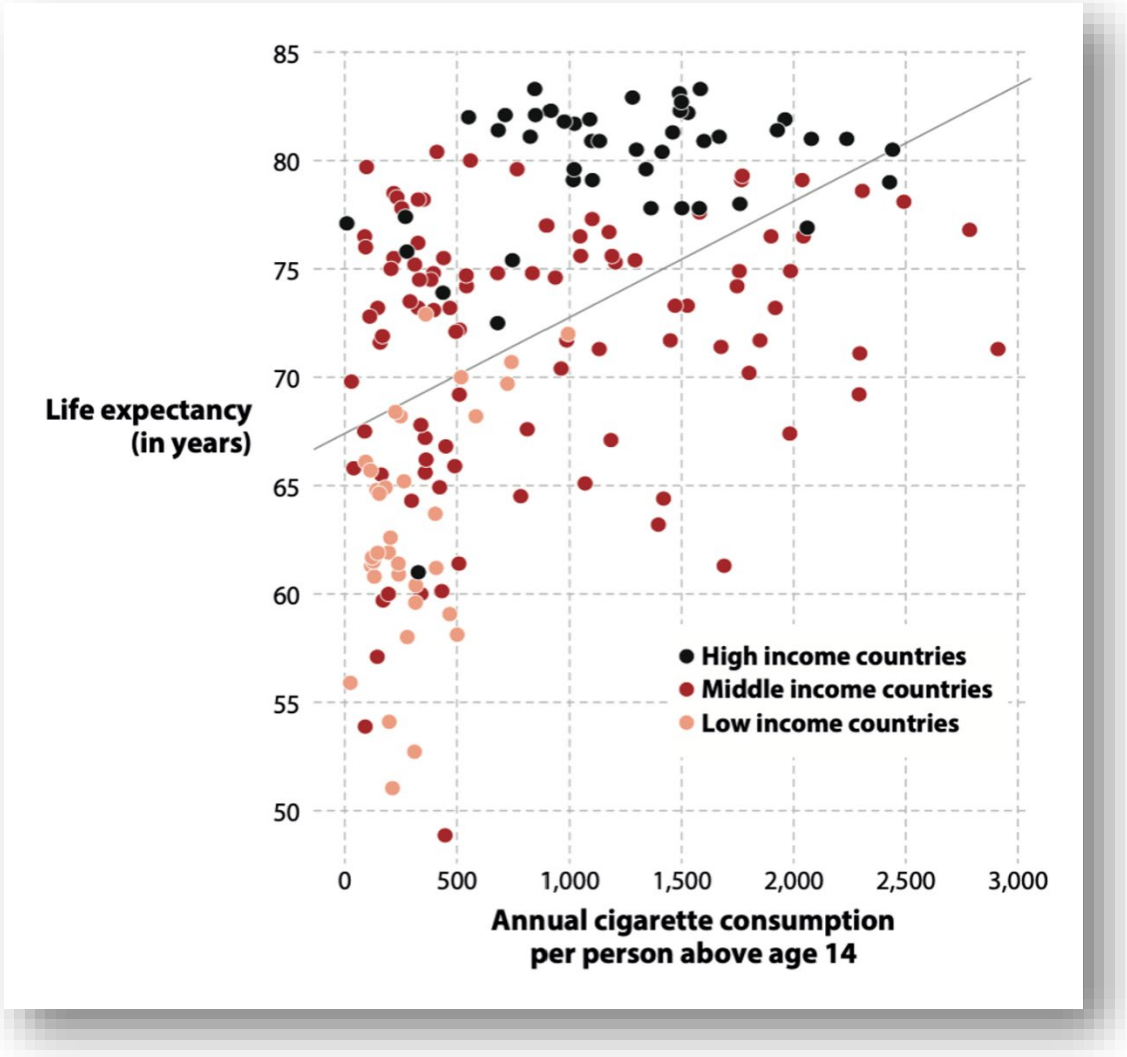

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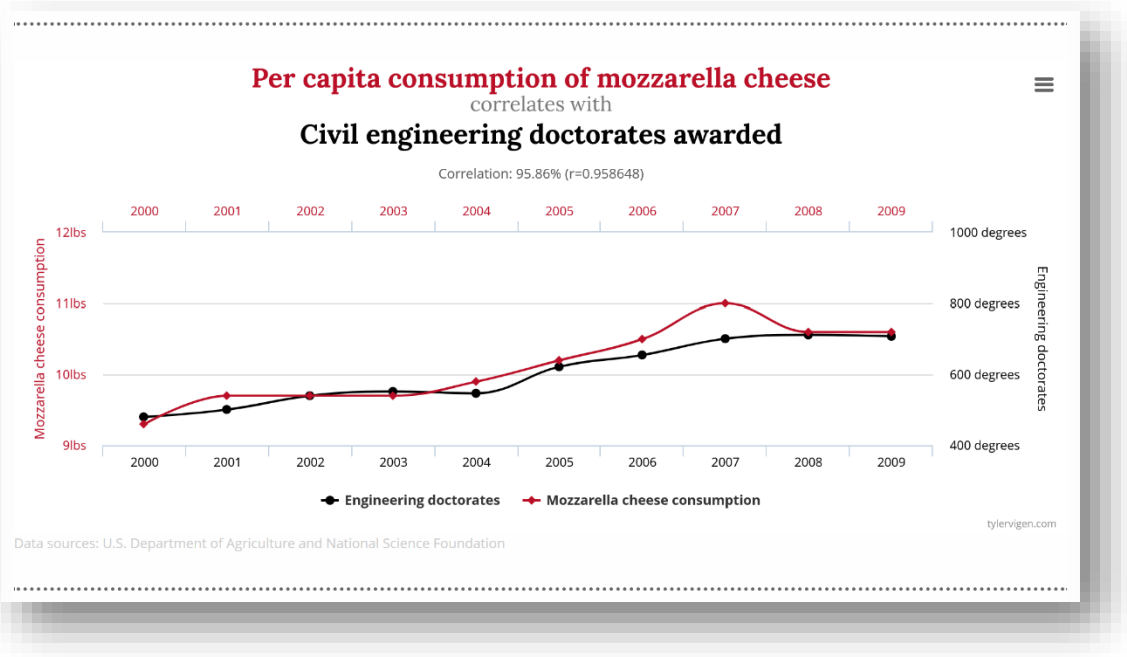

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make sure your **visual metaphors** are clear and well-executed

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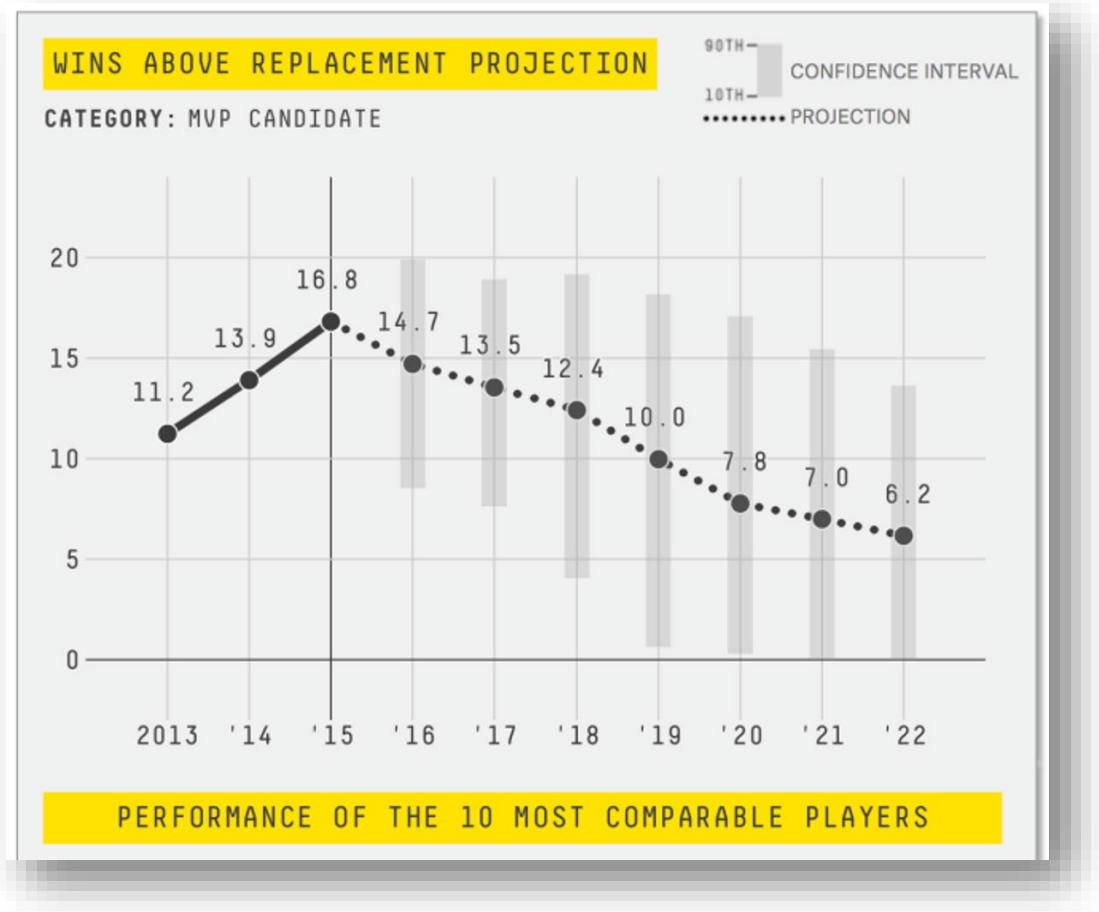
provide sufficient **context** for your data

don't confuse **correlation** with **causality**

show clearly that you're **uncertain**



What is your key learning from this course?

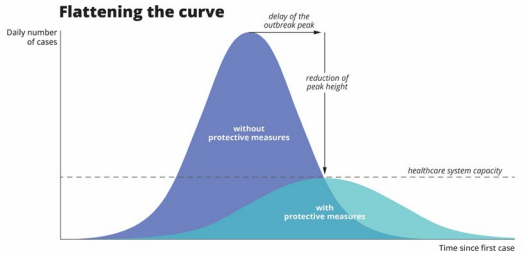
How will you change your data visuals after this course?

Course recap

Introduction

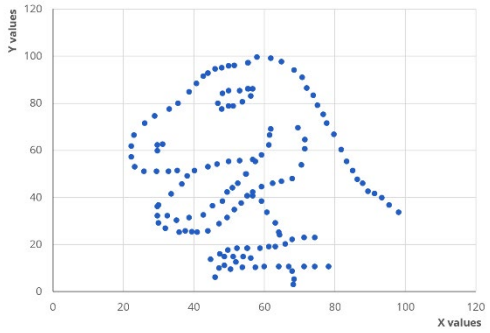
ATTRACTIVE

better at catching the reader's attention



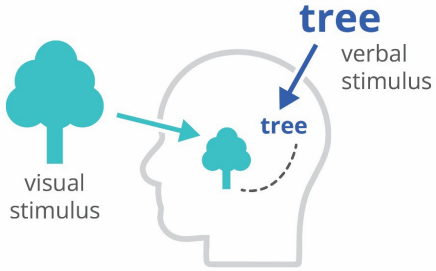
INFORMATION DENSITY

better at summarizing large amounts of information

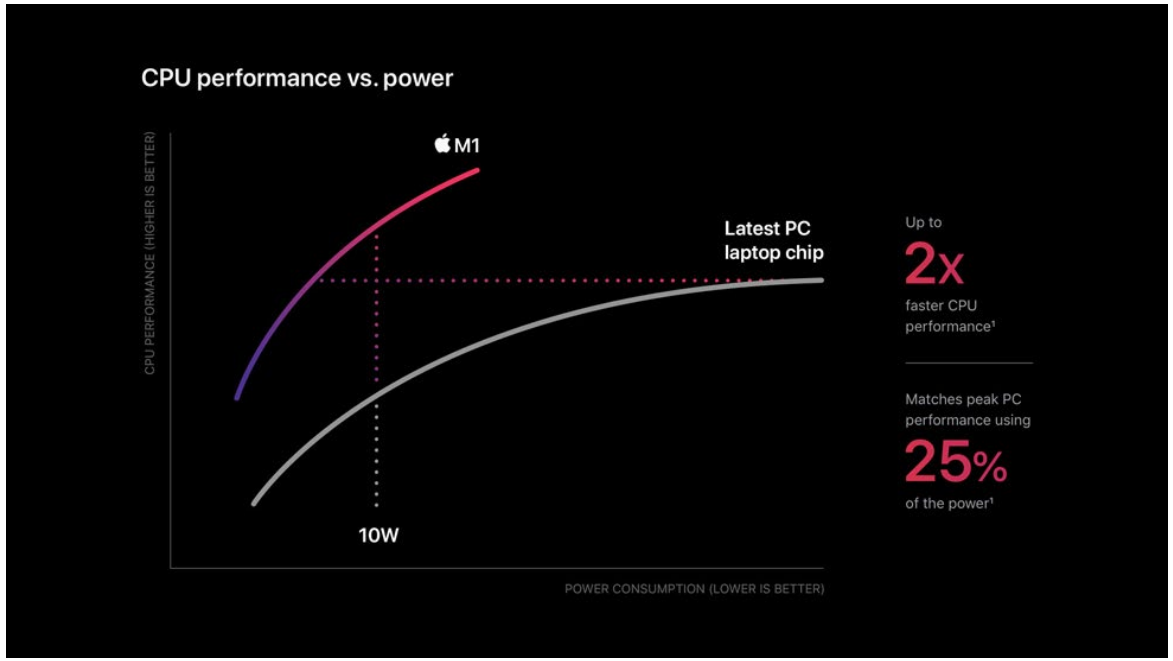


EASIER TO UNDERSTAND

thanks to dual coding and better knowledge retention



The properties of great data visuals



High signal-to-noise ratio

Telling a story

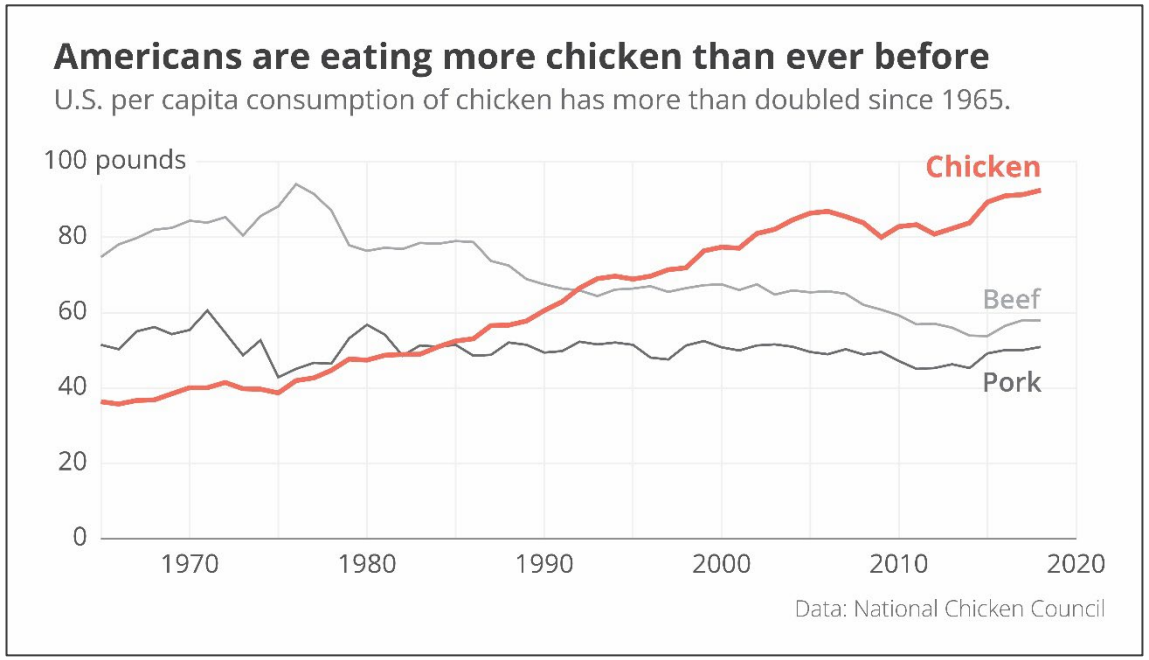
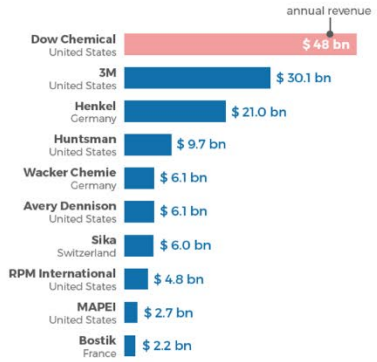


Chart types

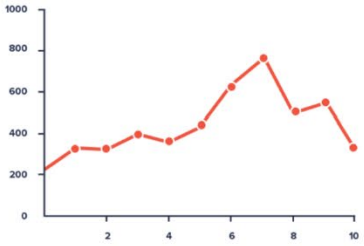
Graphical representation categories

comparison
part-to-whole comparison
distribution
spatial distribution
correlation
evolution
hierarch

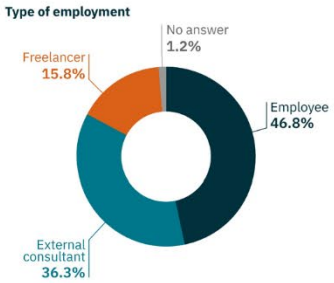
part-to-whole



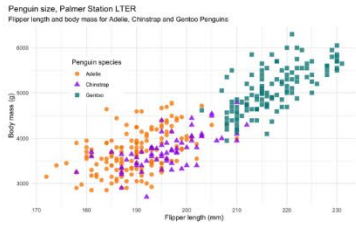
Bar charts



Line charts



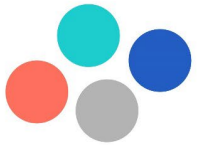
Pie charts



Scatter plots

visual variables

size

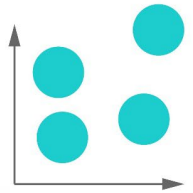


color hue

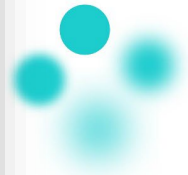
color brightness

orientation

shape

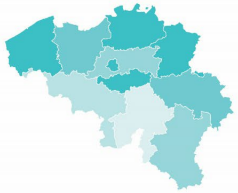


position

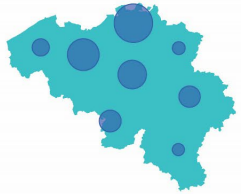


fuzziness

Beyond charts



choropleth map



bubble map

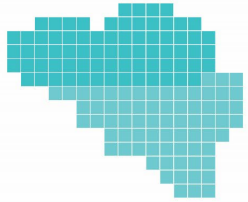
flow map

isoline map

pin map

dot density map

route map

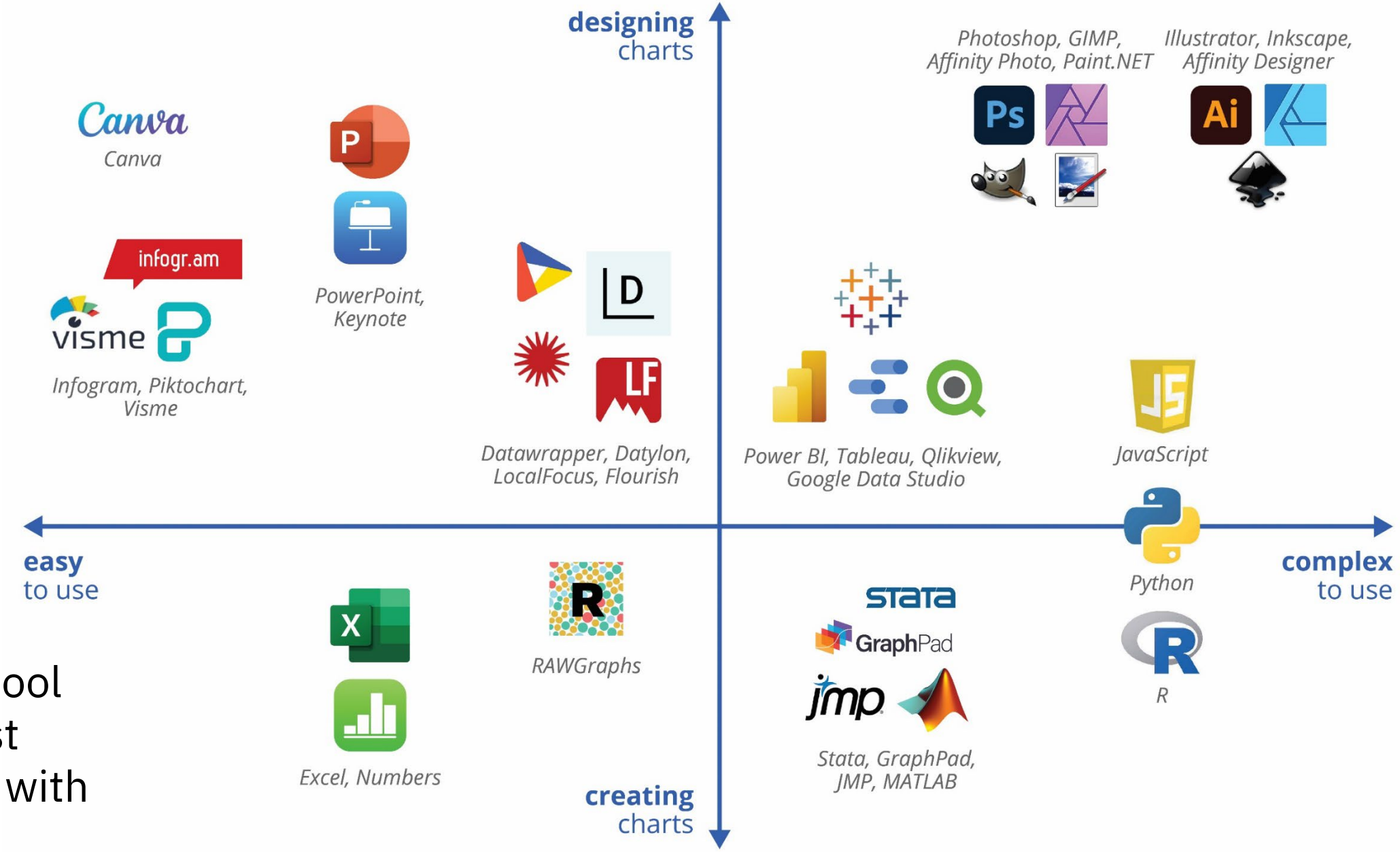


cartogram

56px

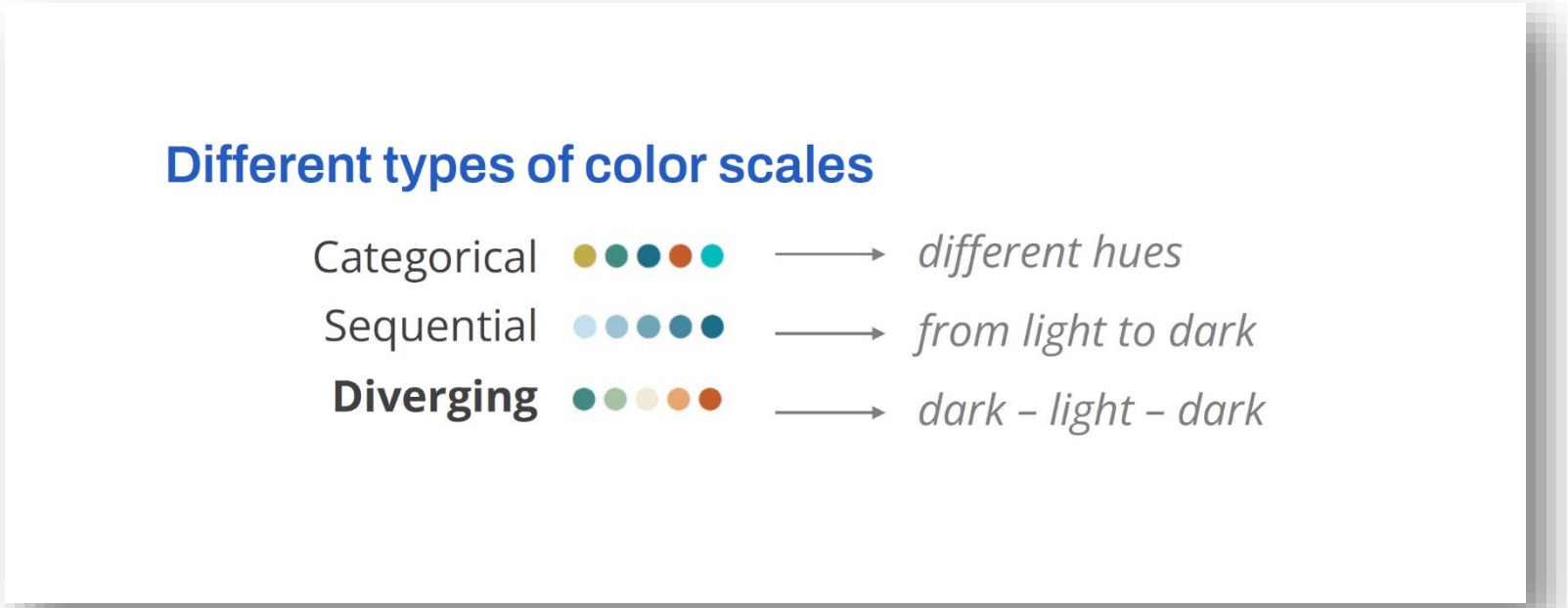
Invoice	Invoice date	Due date	Status	Amount
#09293	05/10/2019	05/10/2019	Unpaid	$2,350.00
#98273	05/10/2019	05/10/2019	Paid	$750.83
#19293	05/10/2019	05/10/2019	Pending	$1,200.00
#12839	05/11/2019	05/11/2019	Paid	$2,500.00
81727	05/11/2019	05/11/2019	Unpaid	$3,200.00

Tools to create data visuals



Choose the tool you feel most comfortable with

Colors and typography



Data visualization

counter

Readability at small font sizes!

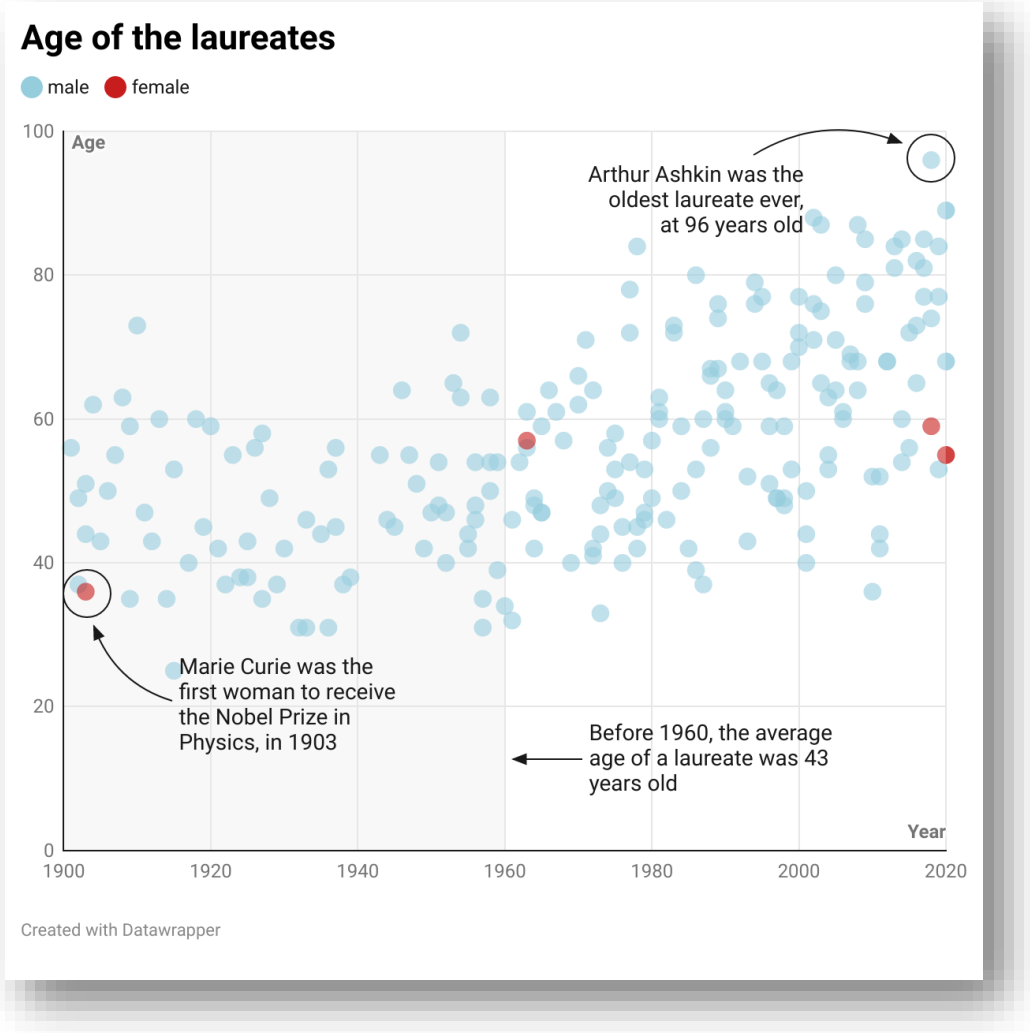
Interactive data visuals

Types of interactivity

tooltips

filtering and navigation

storytelling



Ethical data visualization

make sure your **visual variables** are showing the data as clearly as possible

make sure your **axes choices** are not downplaying or exaggerating the trend

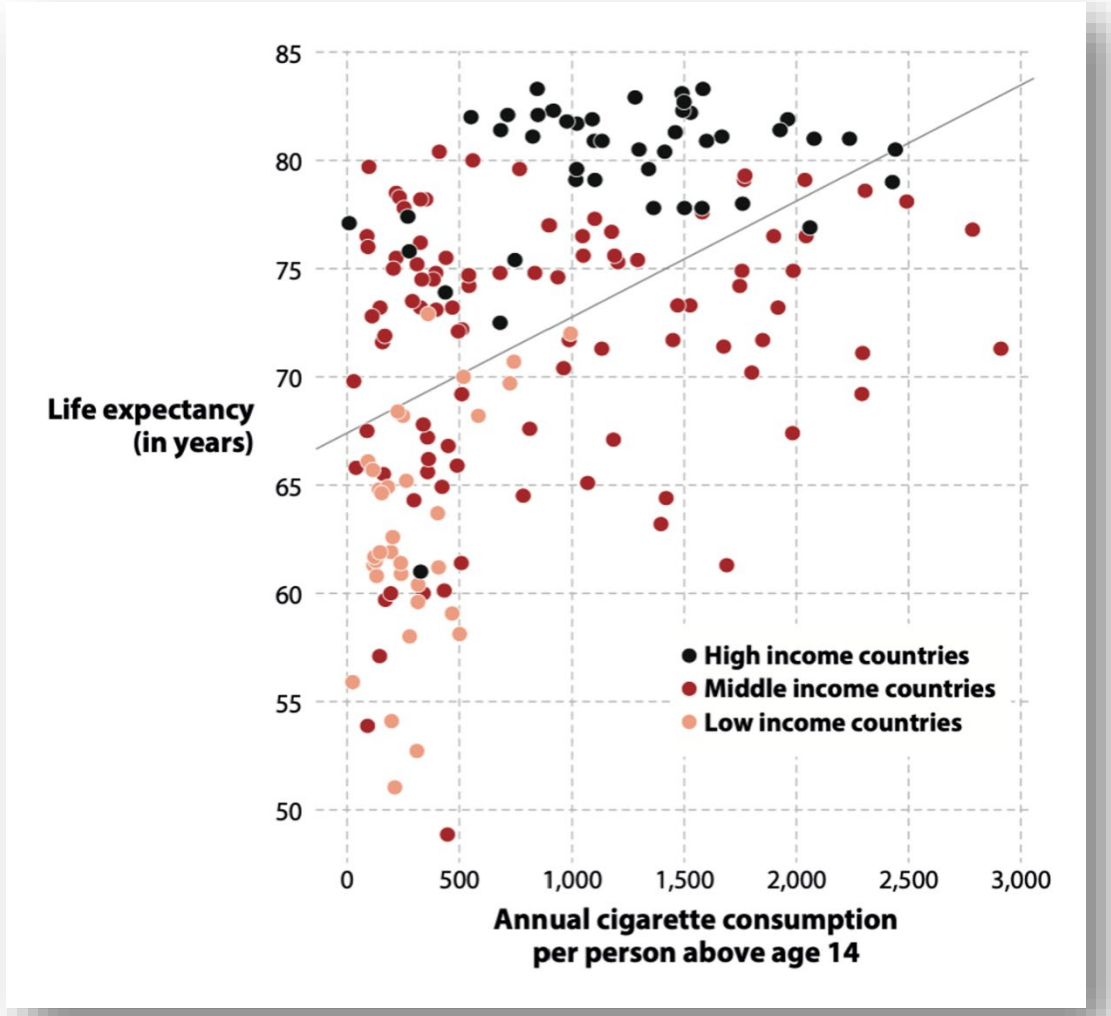
make sure your **visual metaphors** are clear and well-executed

realize that there's **no such thing as an objective chart**

provide sufficient **context** for your data

don't confuse **correlation** with **causality**

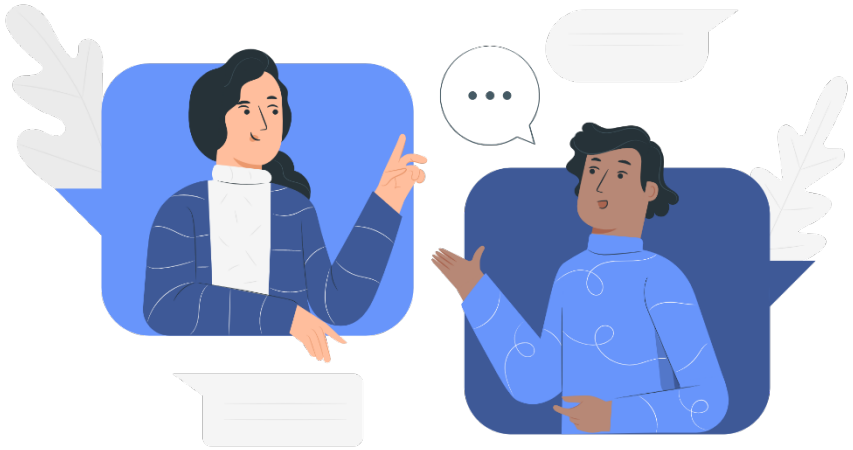
show clearly that you're **uncertain**



Thank you!

All the slides and all the links:

baryon.be/dataviz-resources



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