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Basic Data Visualisation Principles



University of
St Andrews

School of Geography and
Sustainable Development



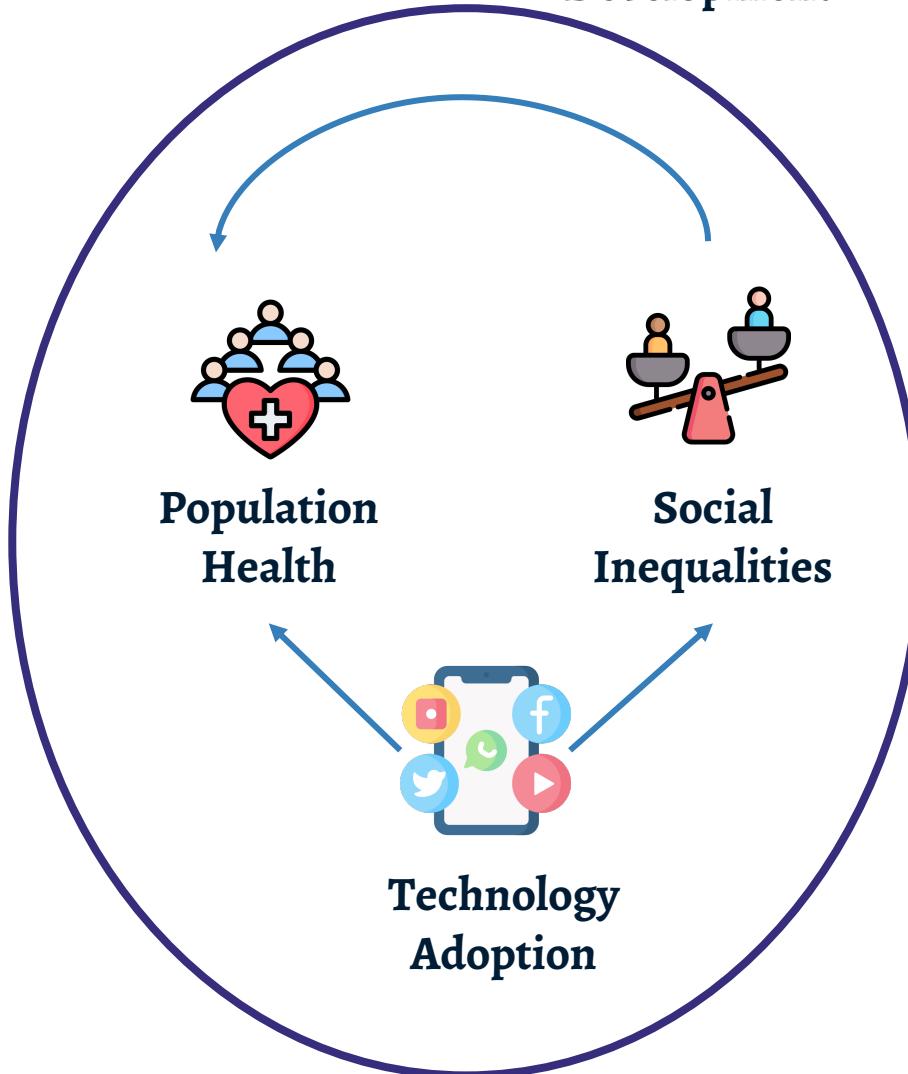
Dr Emmanuel OLAMIJUWON

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Data Science (Literacy)

eoo1@st-andrews.ac.uk

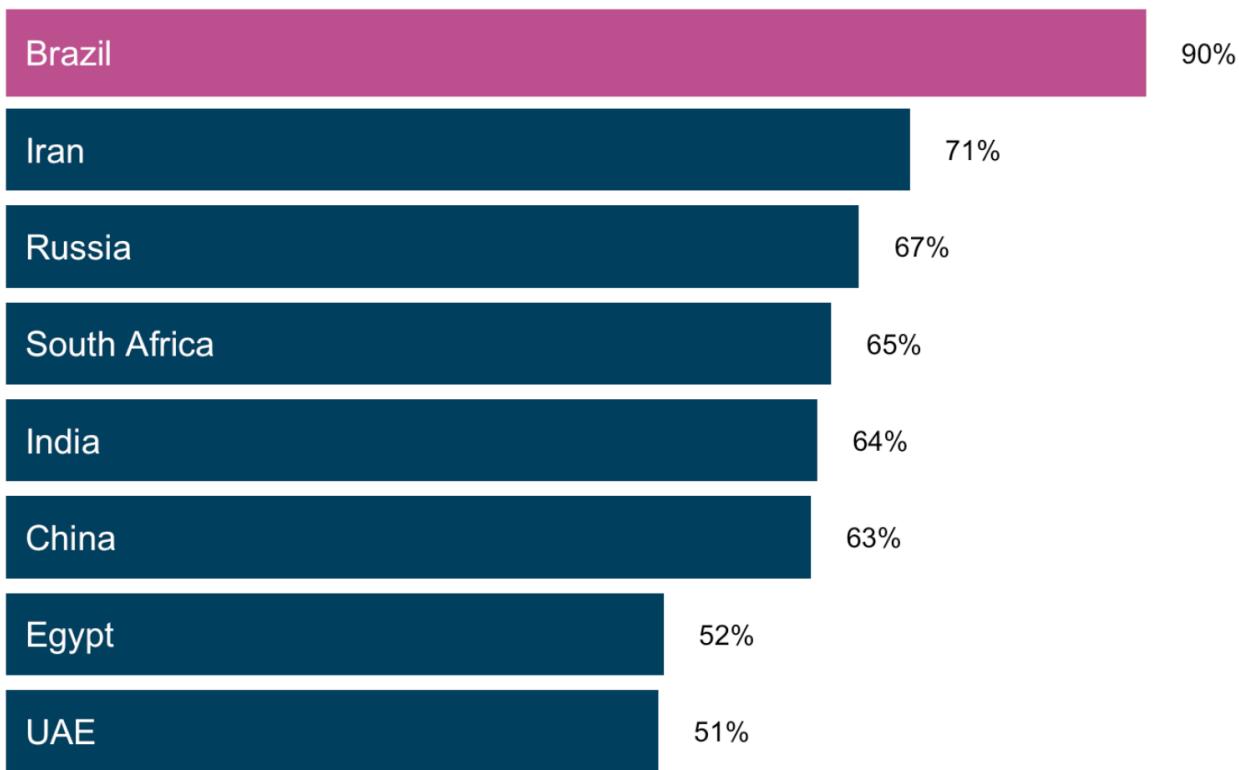
<https://e.olamijuwon.com>

Tools/Methodology Development



Expectations ::

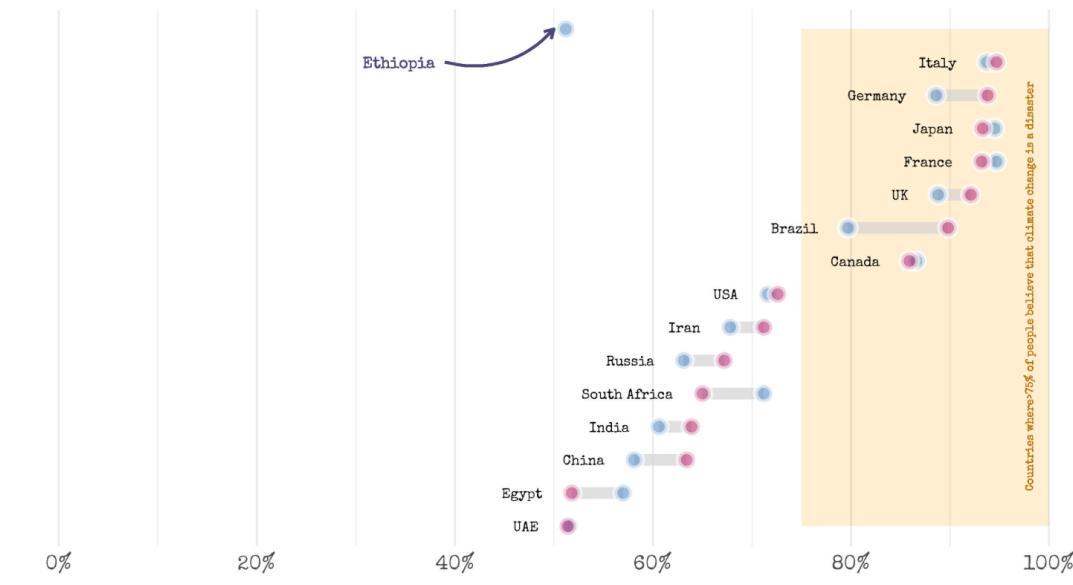
A Basic ggplot2 graphic



A tuned ggplot2 graphic

AWARENESS OF CLIMATE CHANGE THREAT IS HIGH ACROSS G8 COUNTRIES COMPARED TO BRICS COUNTRIES

Fewer people in Egypt, South Africa, France and Japan see climate change as a threat in 2021 compared to 2019



Data source: The Gapminder (gapminder.org/data/).
Climate change threat: % of people who reported that climate change is a very serious or somewhat threat to the people in their country in the next 20 years.

What is data visualization?

How many 8s can you count in the image below?

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

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

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

What is data visualization?

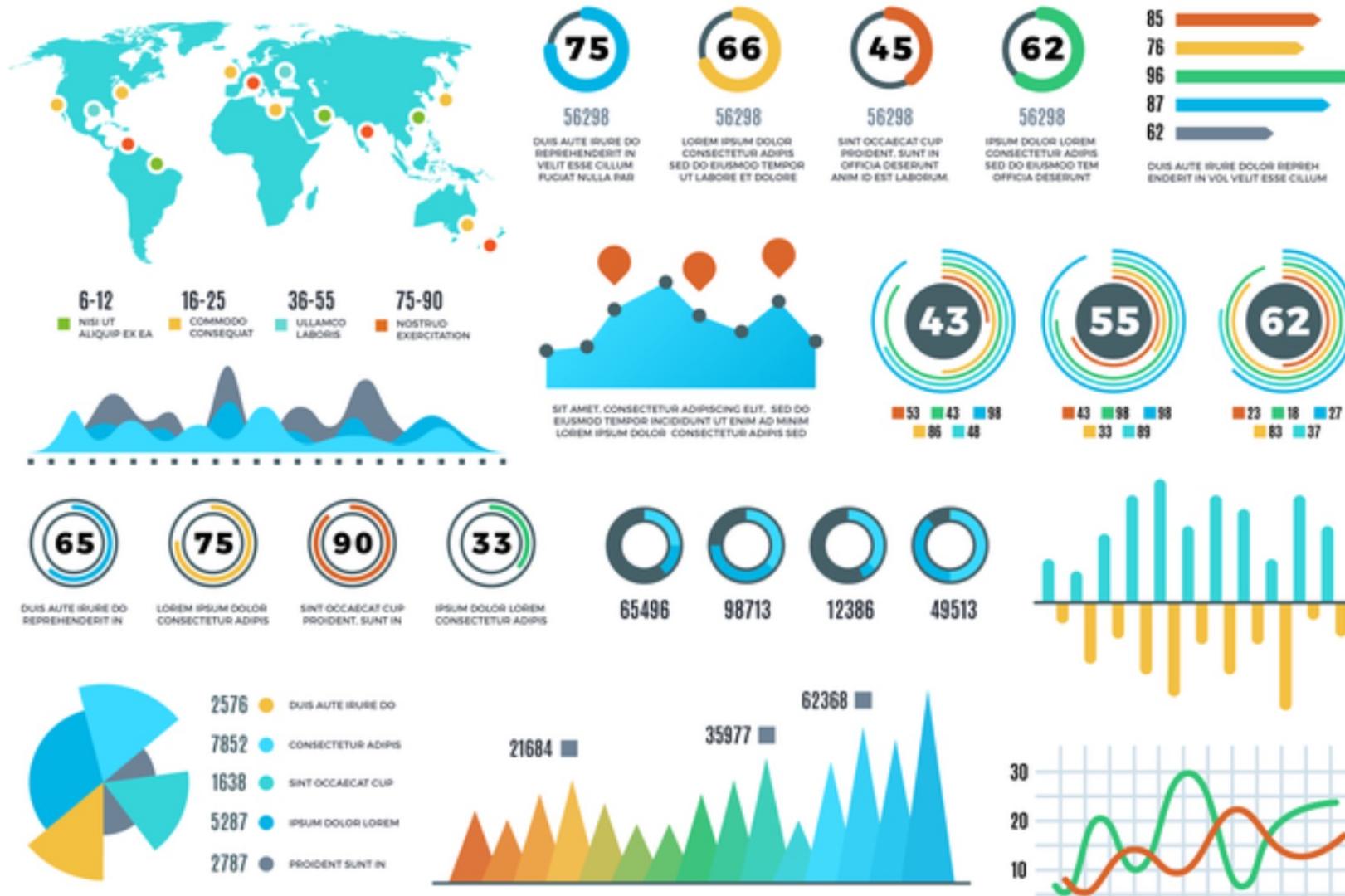
How many 8s can you count in the image below?

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

What is data visualization?



What is data visualization?



Data visualization is a graphical representation of data. It presents data as an image or graphic to make it easier to identify patterns and understand difficult concepts.

Data visualization and pre-attentive attributes



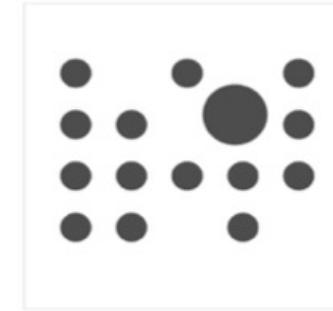
Length



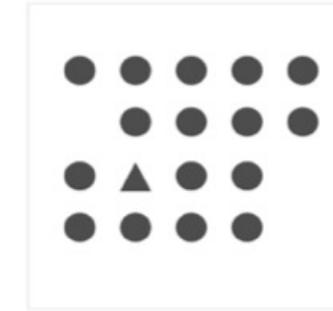
Width



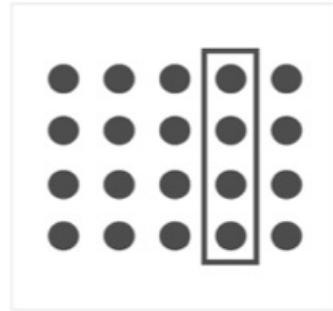
Orientation



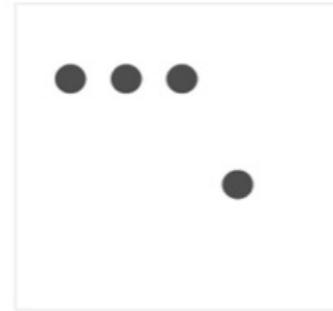
Size



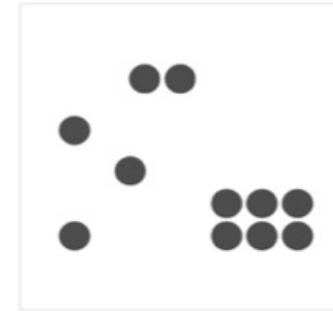
Shape



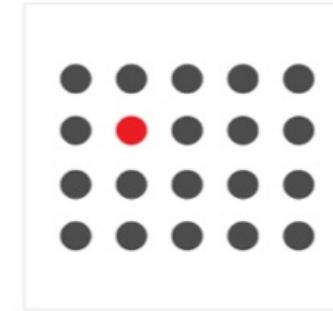
Enclosure



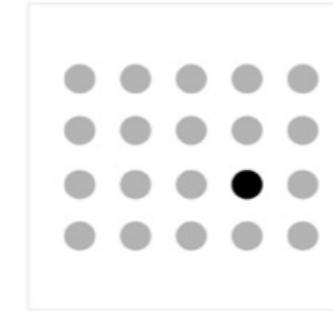
Position



Grouping



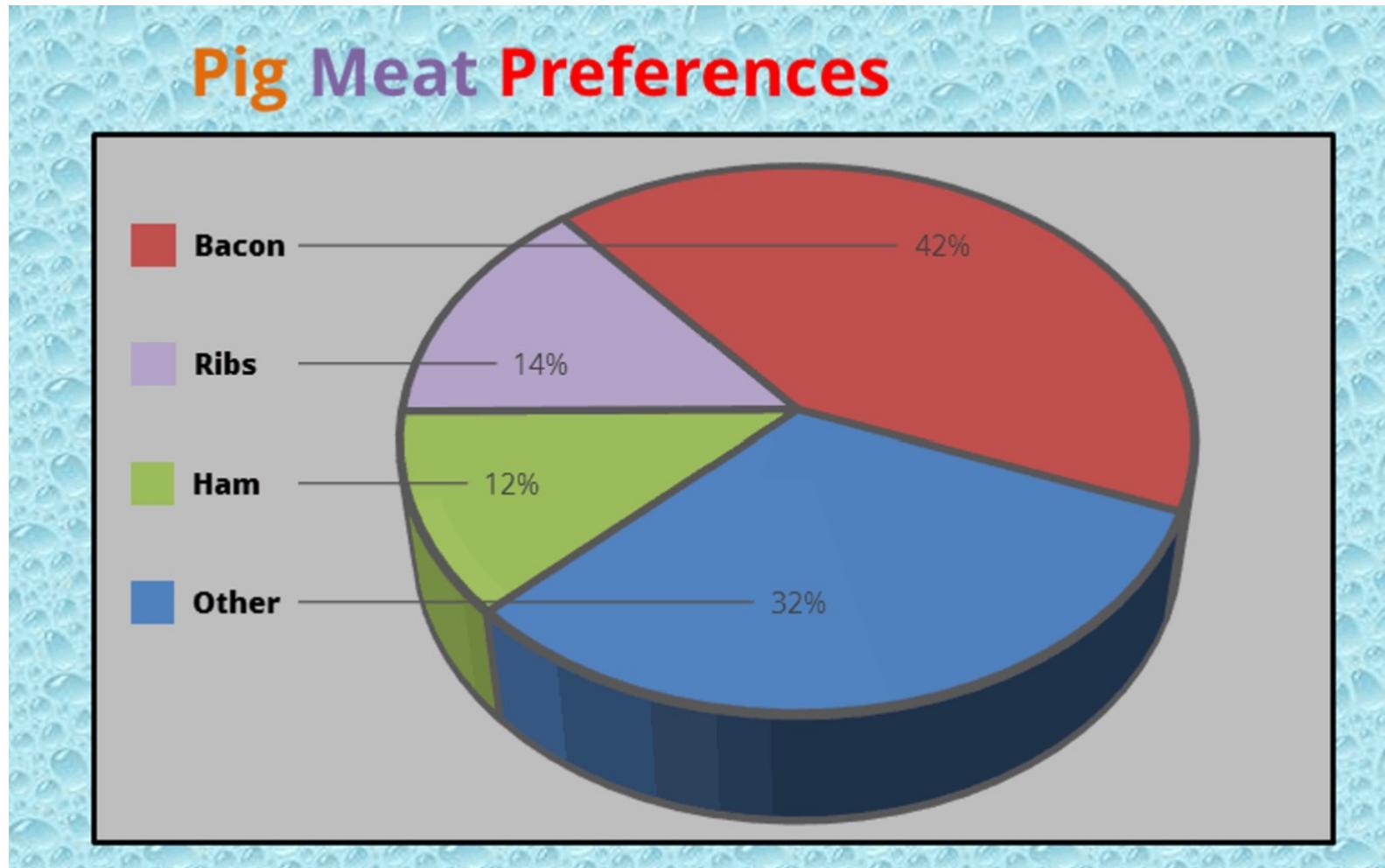
Color Hue



Color
Intensity

A pre-attentive visual property is one which is processed in spatial memory without our conscious action. In essence it takes less than 500 milliseconds for the eye and the brain to process a pre-attentive property of any image.

Principles of data visualization (1A/6): Graphical excellence



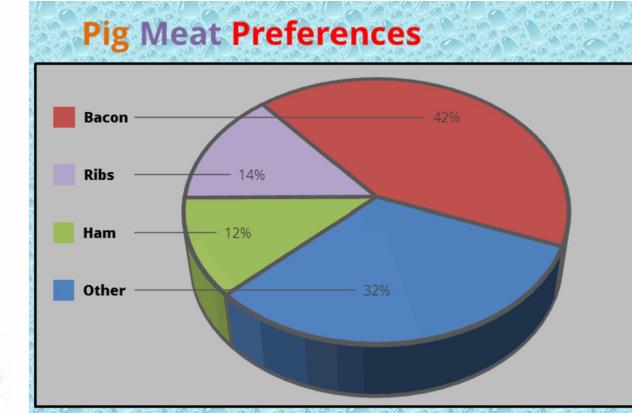
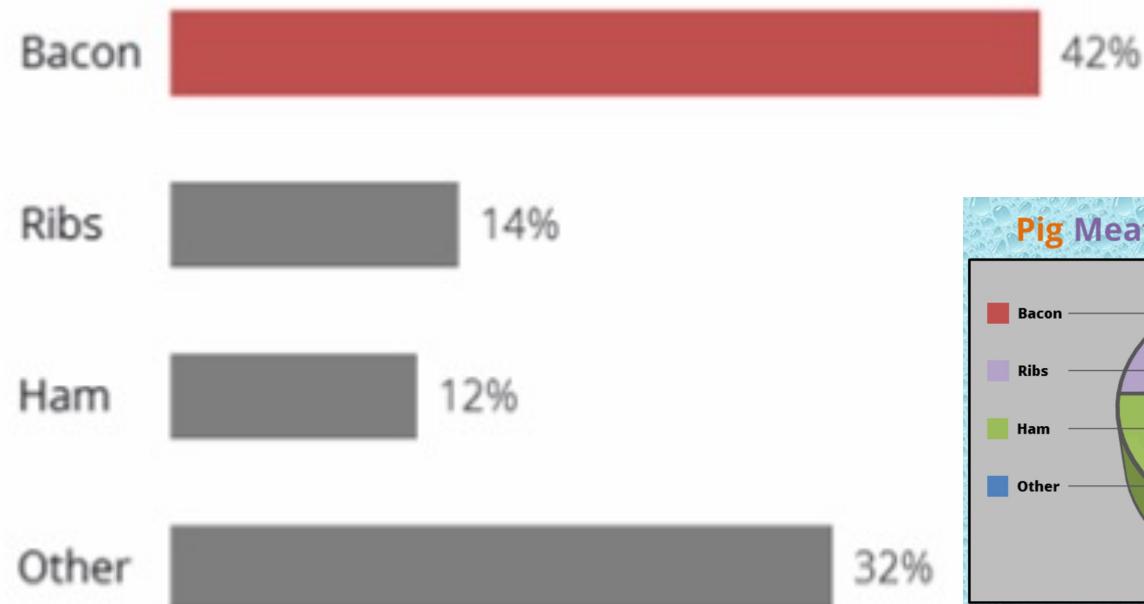
Is this an
excellent
graphic?

Principles of data visualization (1B/6): Graphical excellence

1. Show the right amount of data

Graphical excellence is that which gives to the viewer the greatest number of ideas in the shortest time with the least ink in the smallest space (Tufte, 2001).

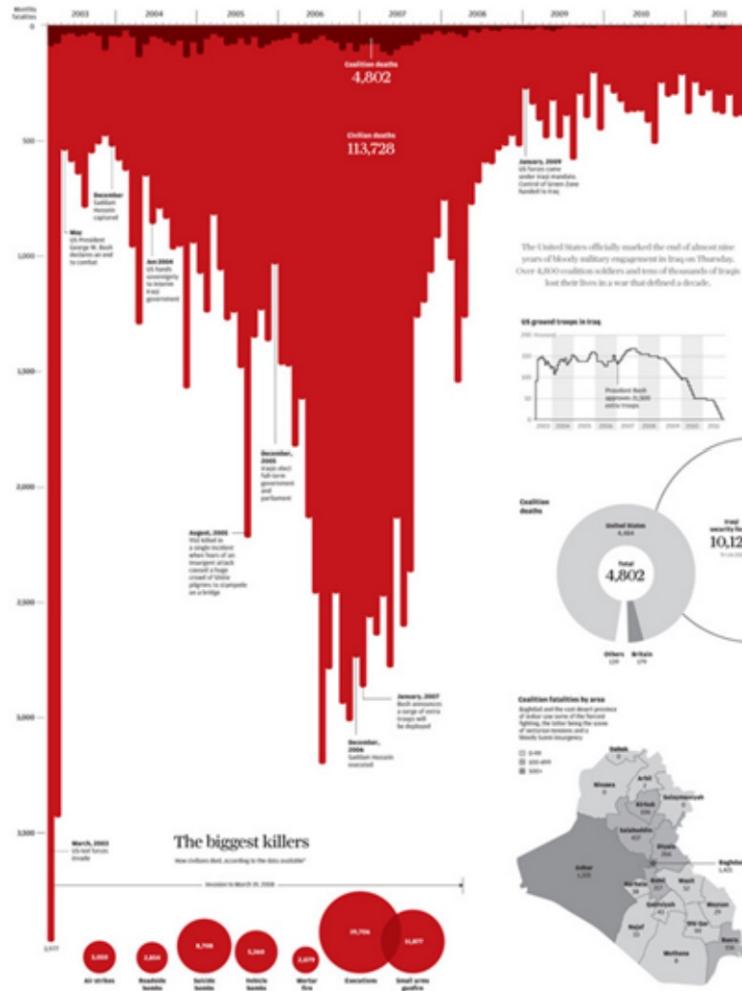
Pig Meat Preferences



Source: Tufte, Edward R. 2001. *The Visual Display of Quantitative Information*. Second. Cheshire, CT: Graphics Press.

Principles of data visualization (2A/6): Graphical excellence

Iraq's bloody toll

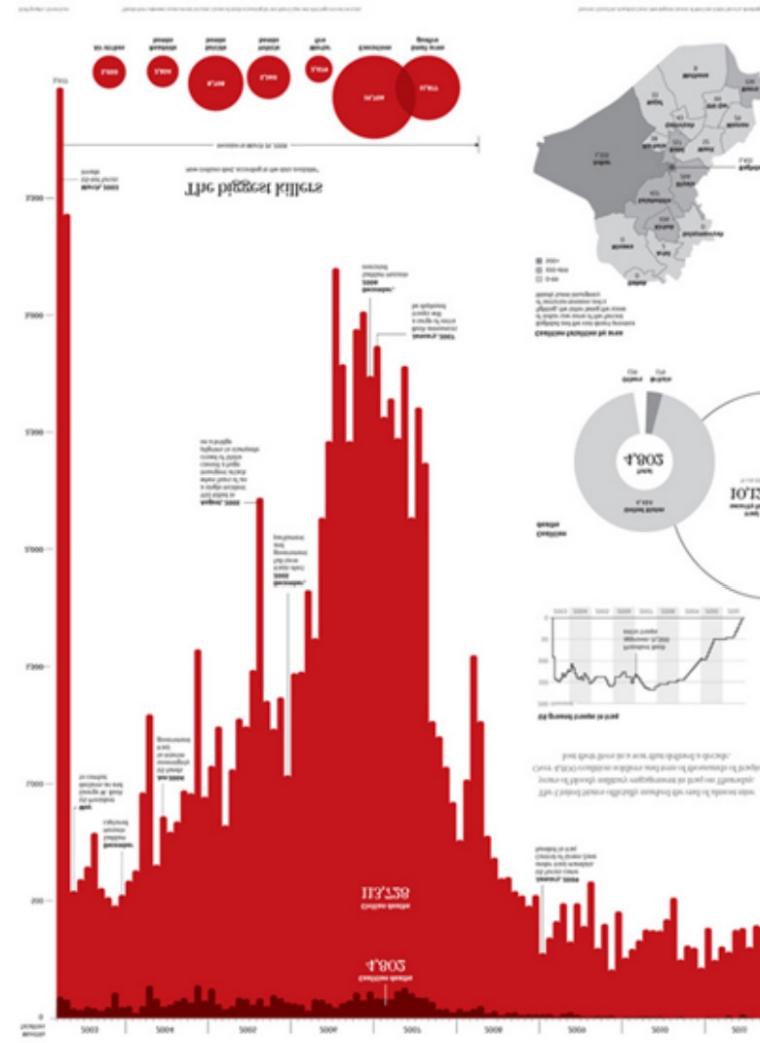
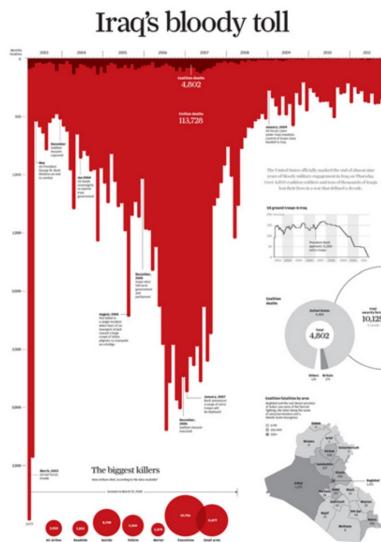


Is this an
excellent
graphic?

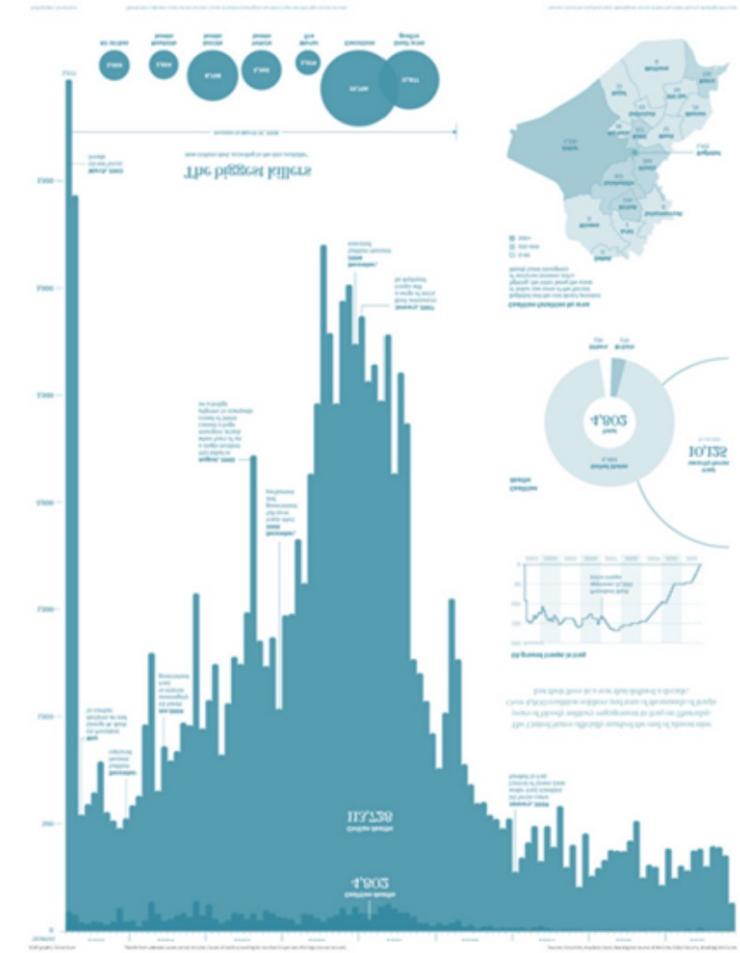
Principles of data visualization (2B/6): Graphical excellence

2. Represent the data accurately

Graphical excellence requires telling the truth about the data.

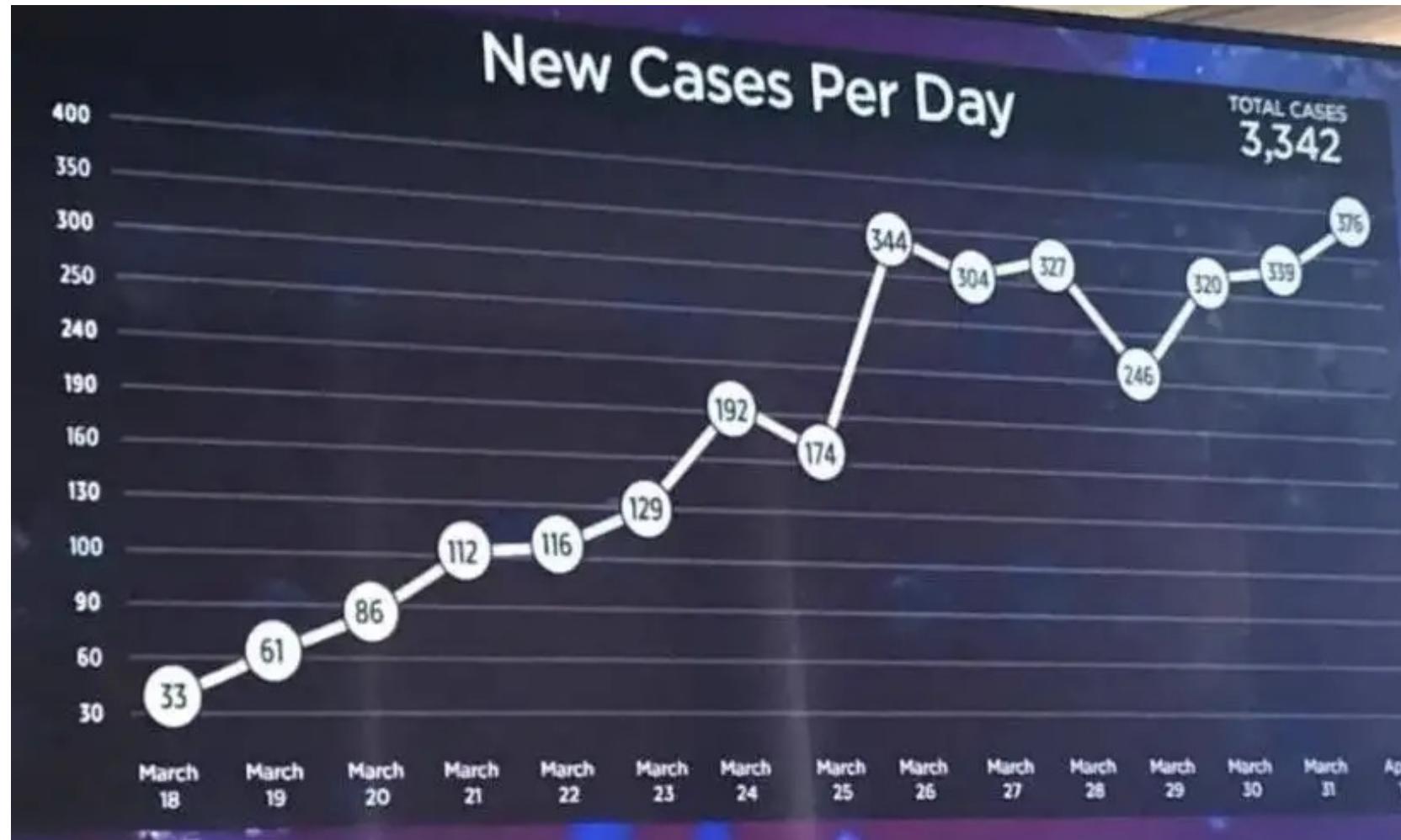


Iraq: Deaths on the Decline



Source: Tufte, Edward R. 2001. *The Visual Display of Quantitative Information*. Second. Cheshire, CT: Graphics Press.

Principles of data visualization (2C/6): Graphical excellence



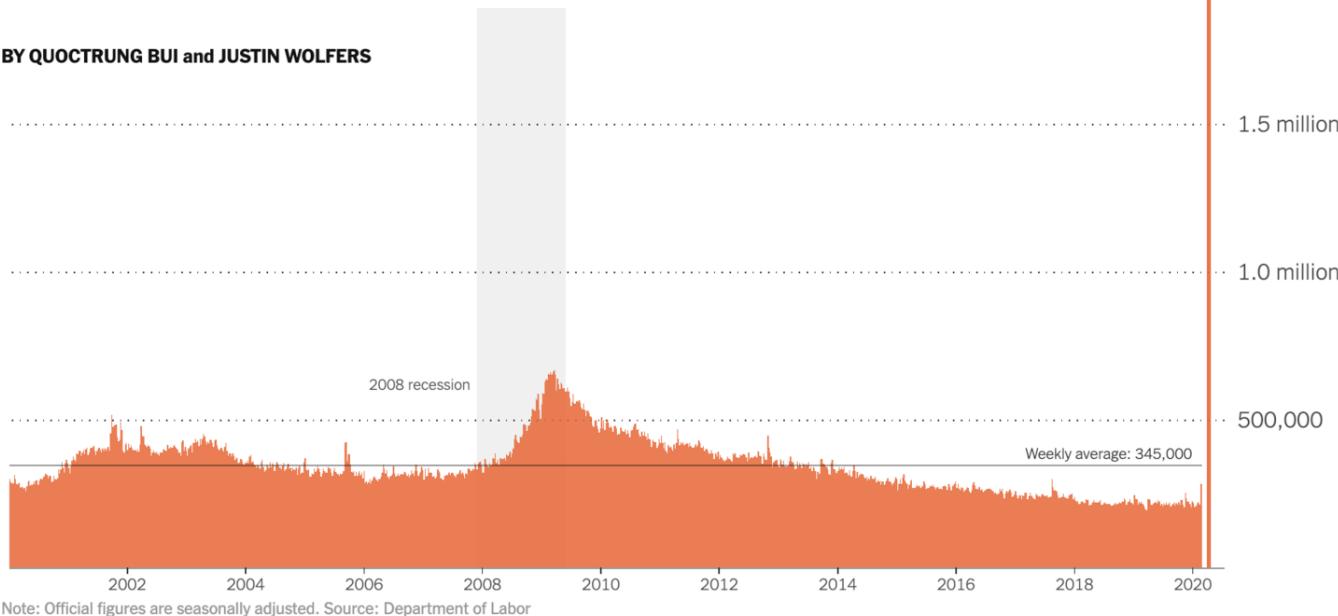
Is this an
excellent
graphic?

Principles of data visualization (3A/6): Graphical excellence

More Than 3 Million
Americans Lost Their Jobs
Last Week. See Your State.

Official statistics have revealed how severely coronavirus has hurt the job market. But it may take several months before we know whether this economic disaster will resemble a storm or a long winter.

BY QUOCTRUNG BUI and JUSTIN WOLFERS



Is this an
excellent
graphic?

Principles of data visualization (3B/6): Graphical excellence

3. Emphasize!

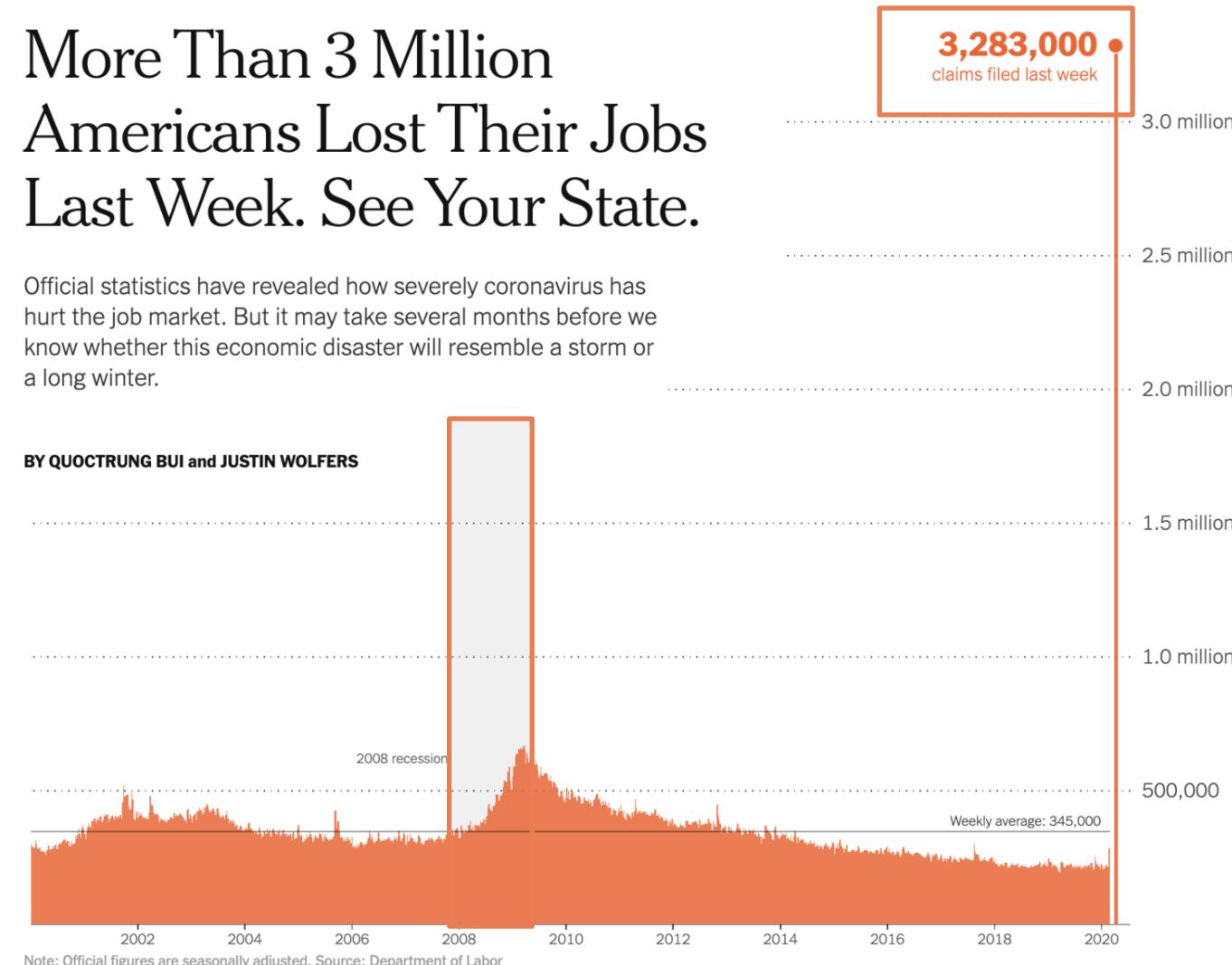
Focus on what matters

Graphical excellence is the well-designed presentation of interesting data—a matter of substance, of statistics, and of design (Tufte, 2001).

More Than 3 Million Americans Lost Their Jobs Last Week. See Your State.

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BY QUOCTRUNG BUI and JUSTIN WOLFERS



Source: Tufte, Edward R. 2001. *The Visual Display of Quantitative Information*. Second. Cheshire, CT: Graphics Press.

Principles of data visualization (3C/6): Graphical excellence

3. Emphasize!

Focus on what matters

Graphical excellence is the well-designed presentation of interesting data—a matter of substance, of statistics, and of design (Tufte, 2001).



Alex Selby-Boothroyd
@AlexSelbyB



Spent way too long trying to work out what was so special about her knee

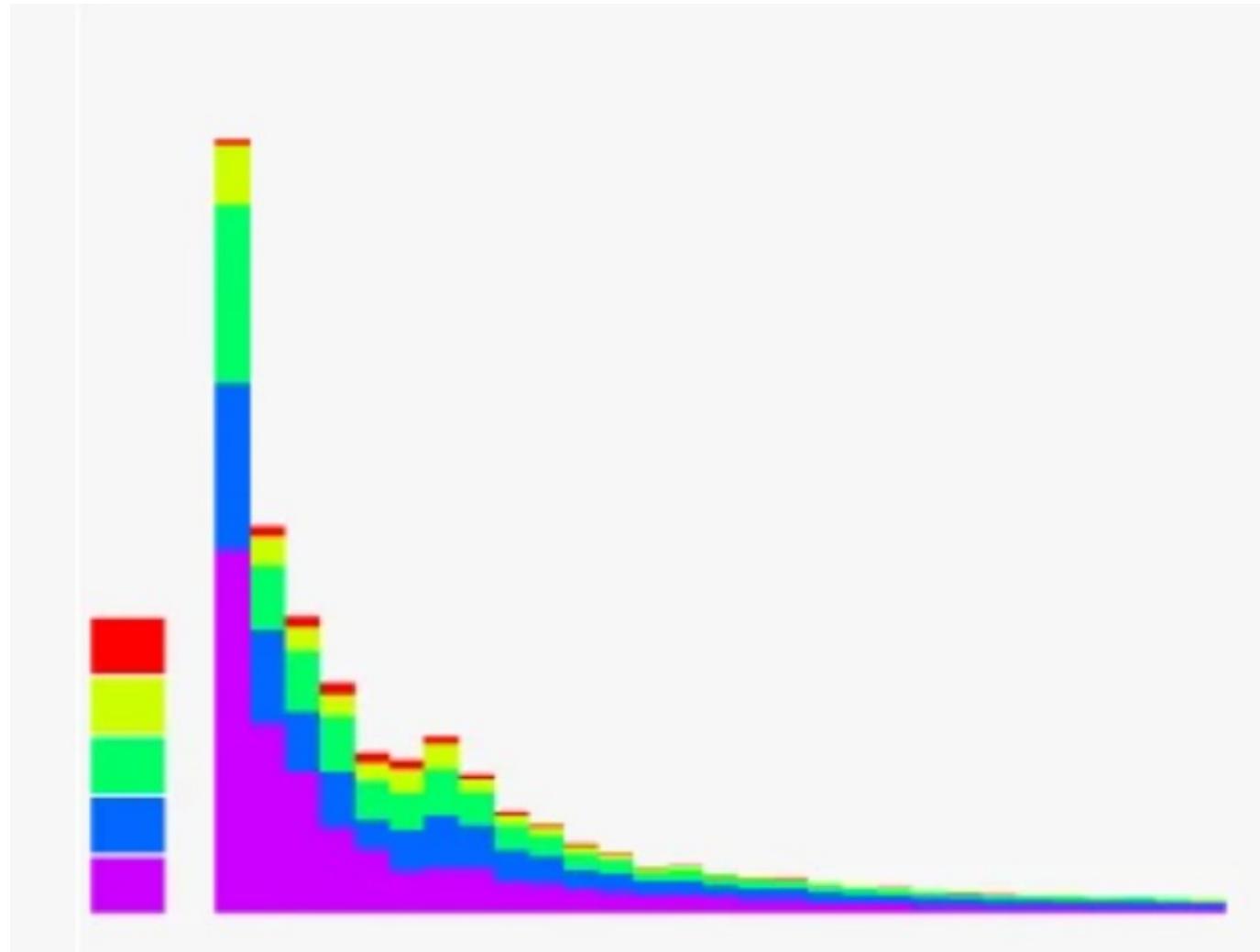


Vitor Santos @jornalistavitor · Jun 13, 2021

PAN-AMERICANO: Ginástica rítmica brasileira conquista o Pan e carimba passaporte para Tóquio x.com/Estadao/status...



Principles of data visualization (4A/6): Graphical excellence



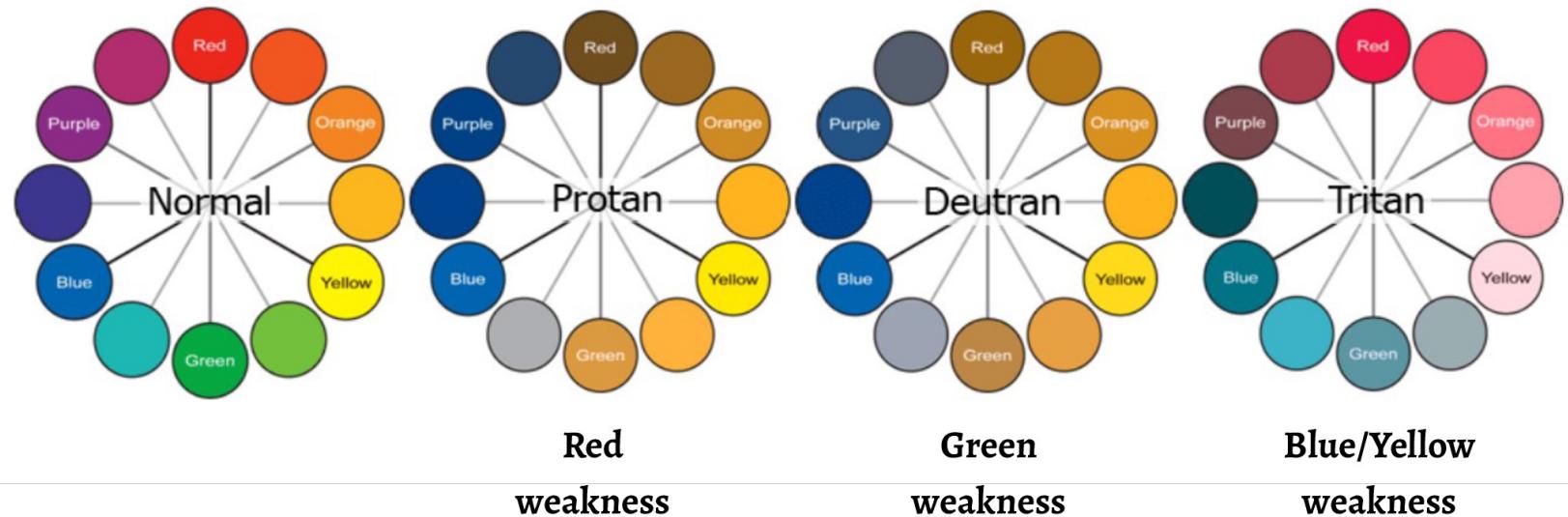
Is this an
excellent
graphic?

Principles of data visualization (4B/6): Graphical excellence

4. Be inclusive!

Use color-blindness friendly palettes.

About 1 in 20 people are colorblind in some way. This means that two colors which appear distinct to a person may appear to be the same to another.

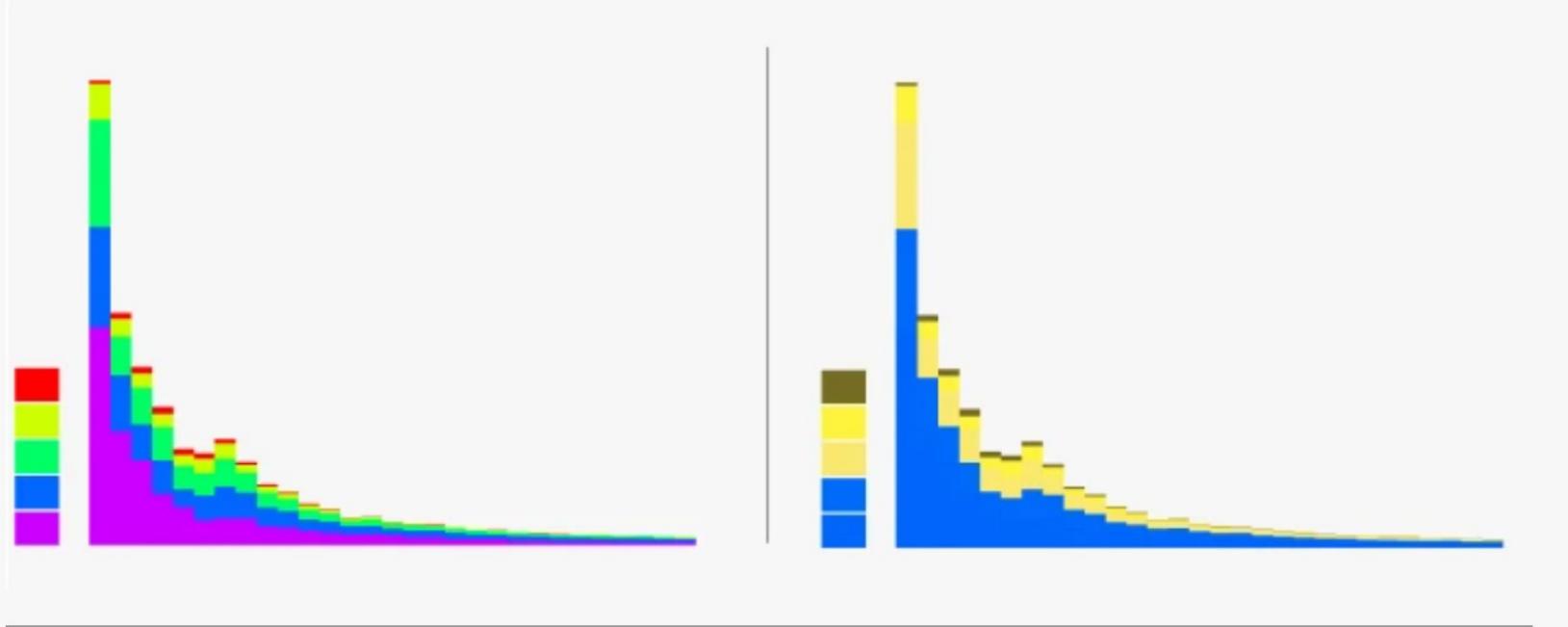


Principles of data visualization (4C/6): Graphical excellence

4. Be inclusive!

Use color-blindness friendly palettes.

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When viewed by people with protanopia, a form of red-green colour blindness, a histogram [created in the programming language R](#) using a rainbow colour scheme (left) would lose a lot of its colour, and make some data points effectively disappear (right).

Principles of data visualization (4D/6): Graphical excellence

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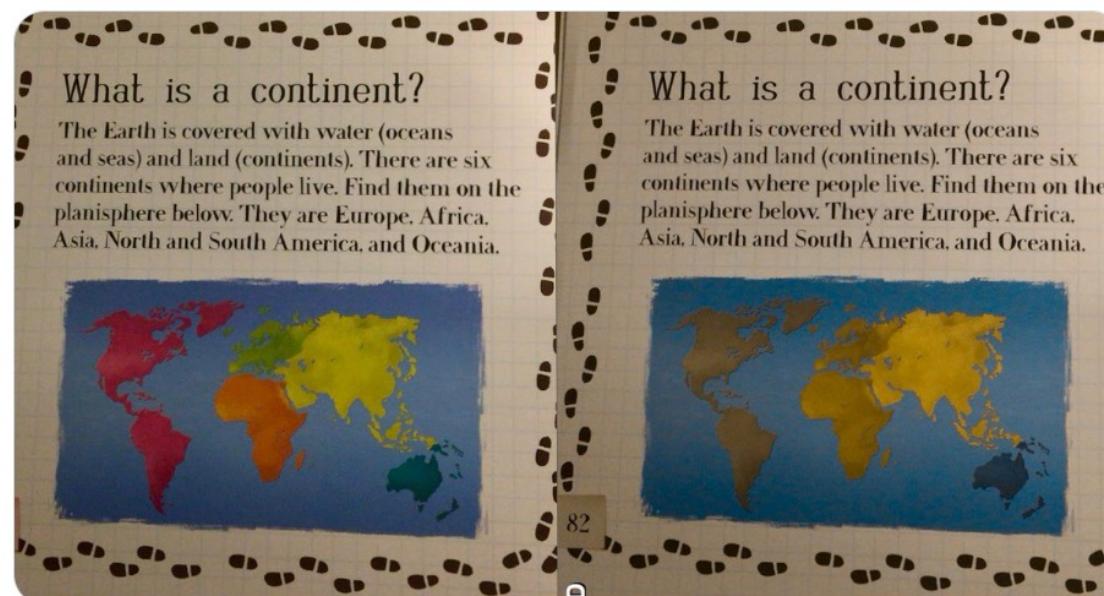
Color Blind Probs reposted



Myma Osborne
@ptmyma



We had to spend a little more time labeling the continents. My 8 yo #cvd #colourblind kid had trouble with this map. #accommodate #adapt #raiseawareness #mapsneedlabels @colourblindorg @WeTheColorBlind @LifeWithoutColr

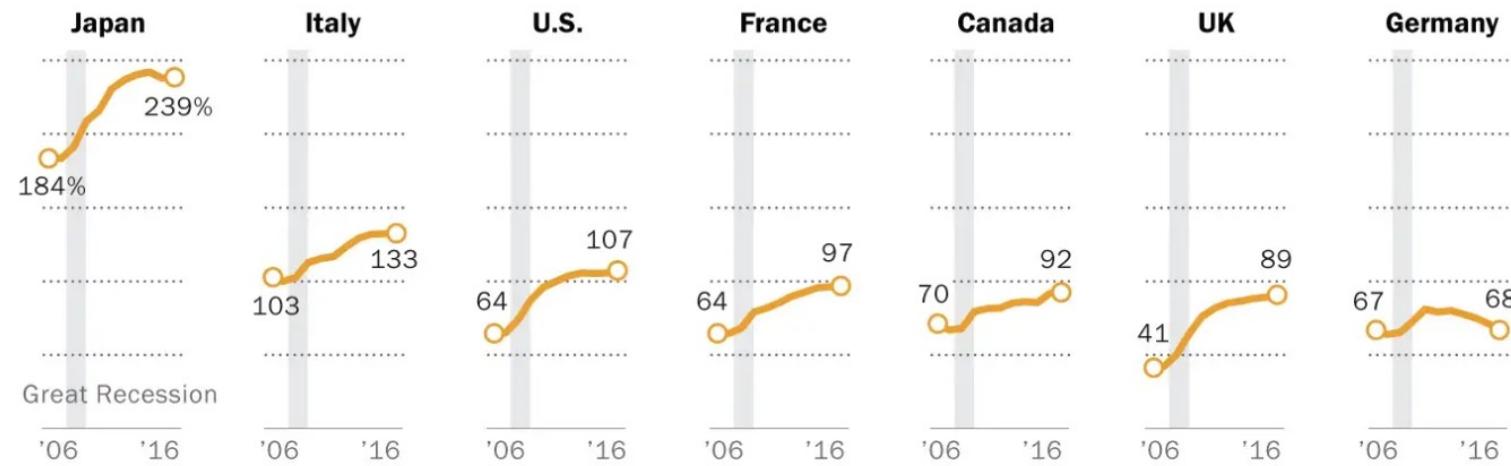


4:32 AM · Aug 19, 2018

Principles of data visualization (5A/6): Graphical excellence

After Great Recession, debt increased substantially in most G-7 economies

Total gross debt as a share of GDP in the Group of Seven nations



Note: Gross debt represents total liabilities of all levels and units of government — national, state/provincial and local — less liabilities held by other levels or units of government, unless otherwise noted by source.

Source: The International Monetary Fund, World Economic Outlook, accessed Sept 7, 2017.

PEW RESEARCH CENTER

Is this an
excellent
graphic?

Principles of data visualization (5B/6): Graphical excellence

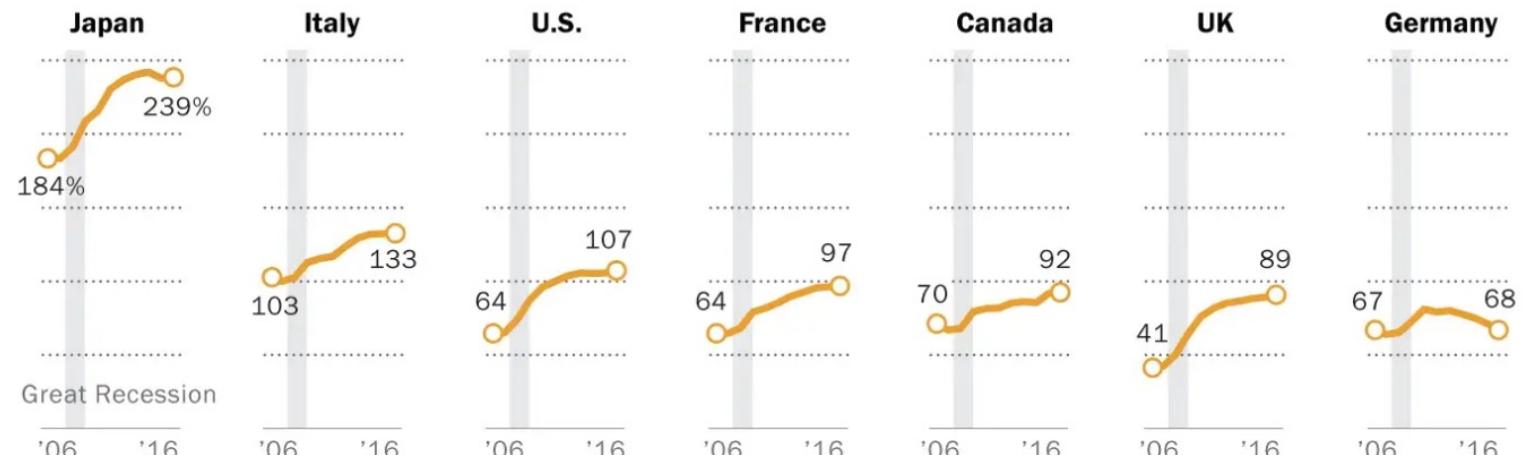
5. Small multiples!

Use them to your advantage.

Using small multiples allows your audience to quickly see broad trends.

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PEW RESEARCH CENTER

Principles of data visualization (5C/6): Graphical excellence

5. Small multiples!

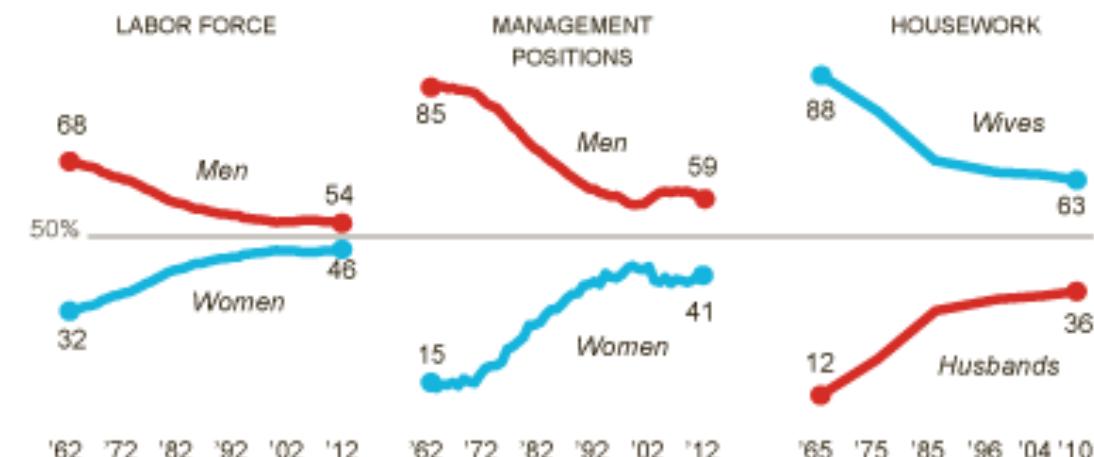
Use them to your advantage.

Using small multiples allows your audience to quickly see broad trends.

Women's Work

Gender roles changed rapidly for a time, with women streaming into the job market and men assuming a greater share of housework. Attitudes about the traditional roles of men and women in families also changed rapidly. Then the trends leveled off.

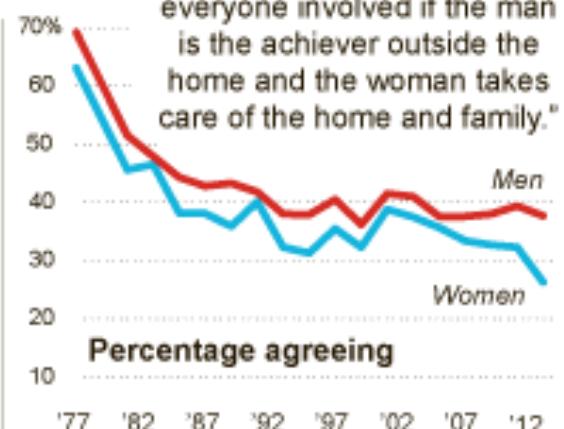
Gender share of . . .



Sources: Integrated Public Use Microdata Survey, University of Minnesota; time use surveys; General Social Survey

Breadwinner-homemaker family

"It is much better for everyone involved if the man is the achiever outside the home and the woman takes care of the home and family."



THE NEW YORK TIMES

Source: <https://archive.nytimes.com/opinionator.blogs.nytimes.com/2013/11/23/how-can-we-jump-start-the-struggle-for-gender-equality/>

Source: Tufte, Edward R. 2001. *The Visual Display of Quantitative Information*. Second. Cheshire, CT: Graphics Press.

Principles of data visualization (6A/6): Graphical excellence

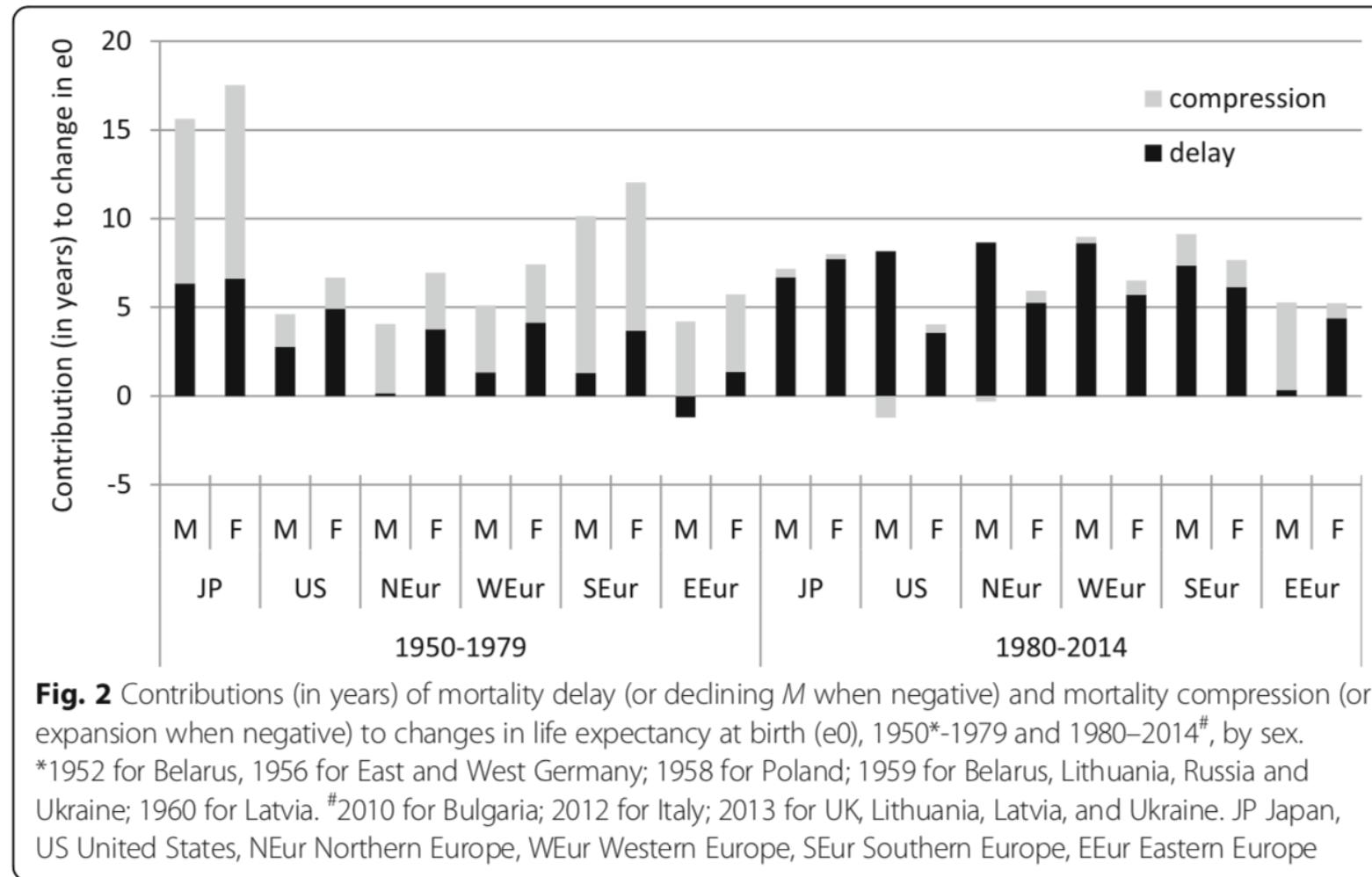


Fig. 2 Contributions (in years) of mortality delay (or declining M when negative) and mortality compression (or expansion when negative) to changes in life expectancy at birth (e0), 1950*-1979 and 1980–2014[#], by sex.

*1952 for Belarus, 1956 for East and West Germany; 1958 for Poland; 1959 for Belarus, Lithuania, Russia and Ukraine; 1960 for Latvia. [#]2010 for Bulgaria; 2012 for Italy; 2013 for UK, Lithuania, Latvia, and Ukraine. JP Japan, US United States, NEur Northern Europe, WEur Western Europe, SEur Southern Europe, EEur Eastern Europe

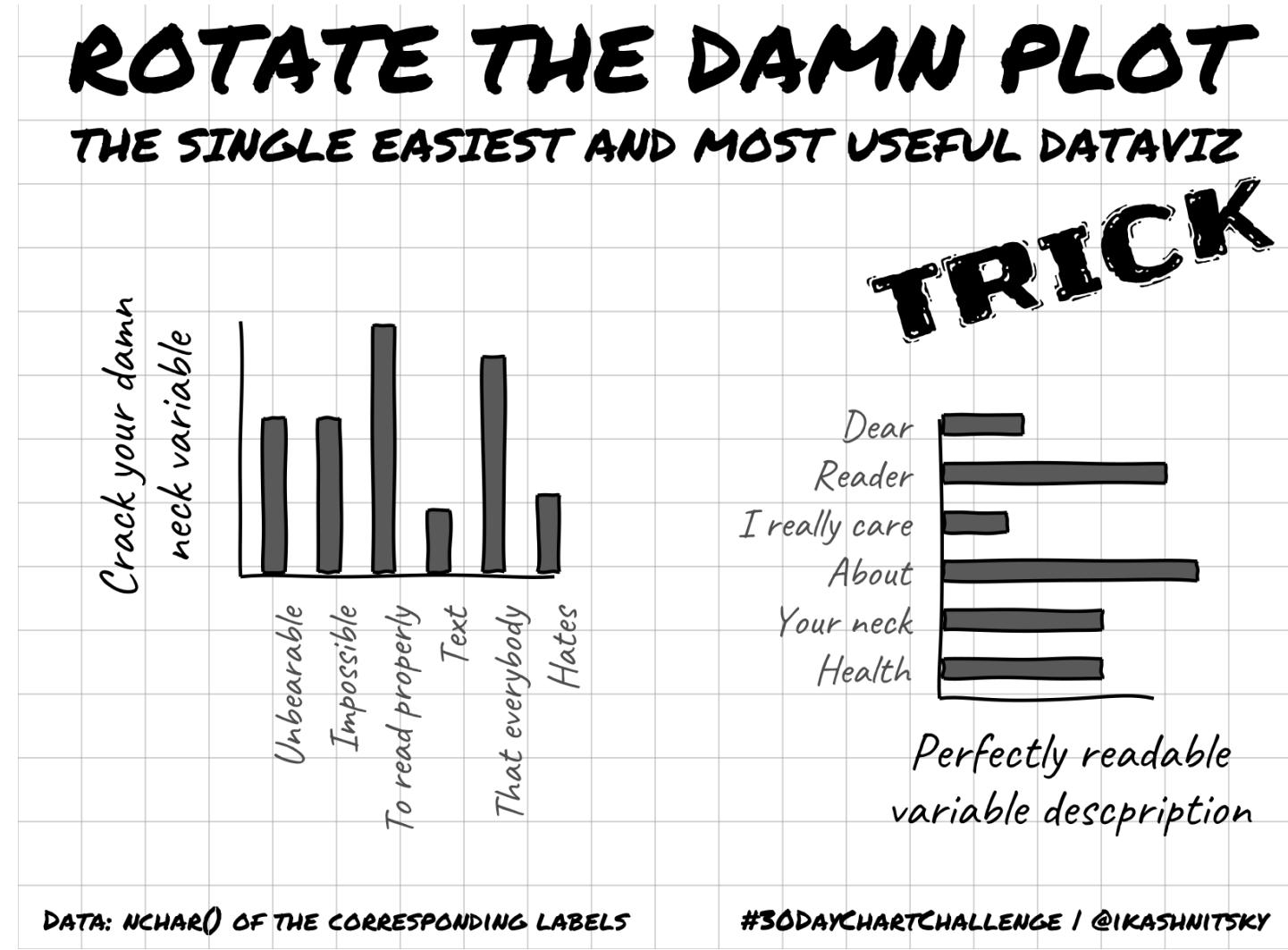
Is this an excellent graphic?

Principles of data visualization (6B/6): Graphical excellence

6. Rotate the plot!

Text should be horizontal.

Your variable descriptions should be perfectly readable.



Principles of data visualization (6C/6): Graphical excellence

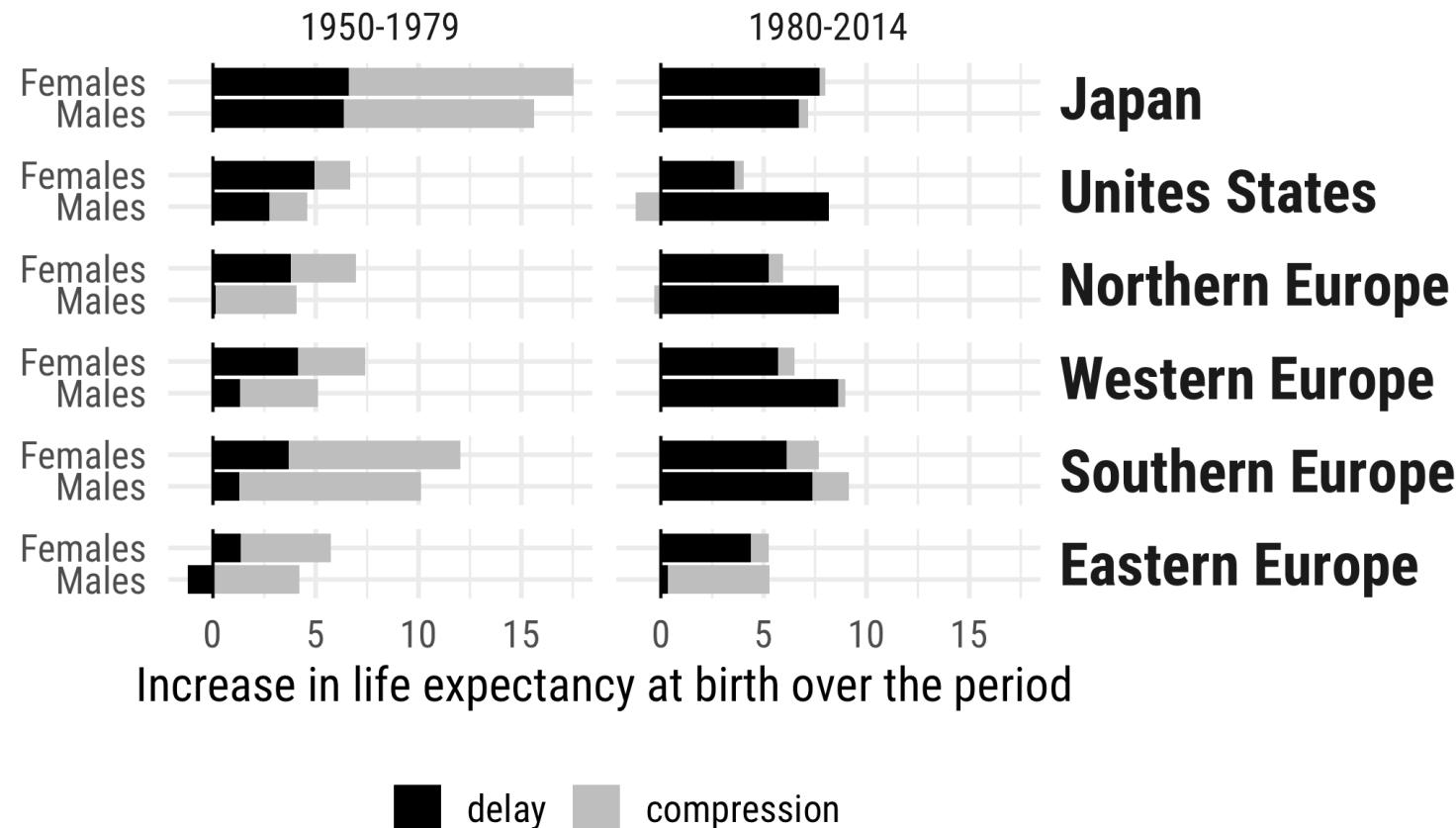
6. Rotate the plot!

Text should be horizontal.

Your variable descriptions should be perfectly readable.

Increase in life expectancy at birth

Decomposition into the effects of compression and delay



Source: <https://gist.github.com/ikashnitsky/2800295e304b4858be553432de4a0d11>

Your Turn

In small groups, start by introducing yourselves. Then, each person should share a graph or data visualisation they've seen online recently. As a group, discuss whether each graphic is excellent or not. What works well, and what could be improved? If time allows, choose one graphic to highlight when we come back together as a full group.

Got questions?

Email me: e.olamijuwon@st-andrews.ac.uk