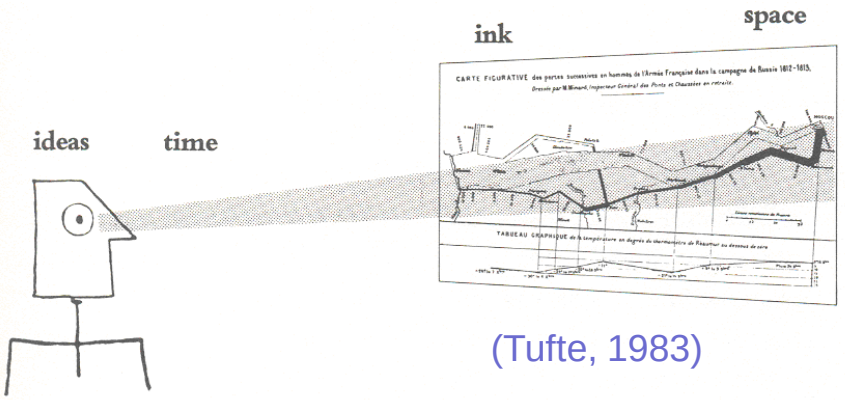
Universidade de Aveiro
Departamento de Electrónica,
Telecomunicações e Informática

Effective Visualization and evaluation



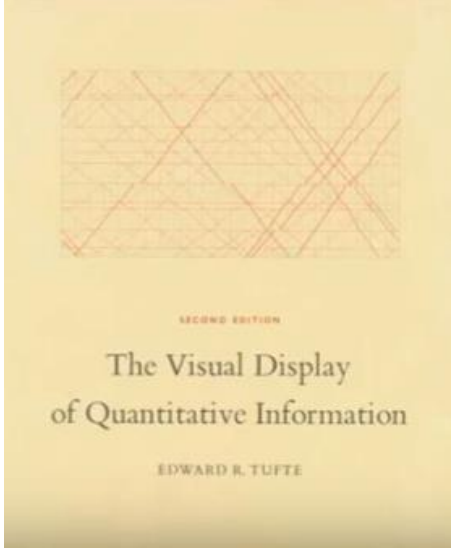
(Tufte, 1983)

Beatriz Sousa Santos, University of Aveiro, 2023

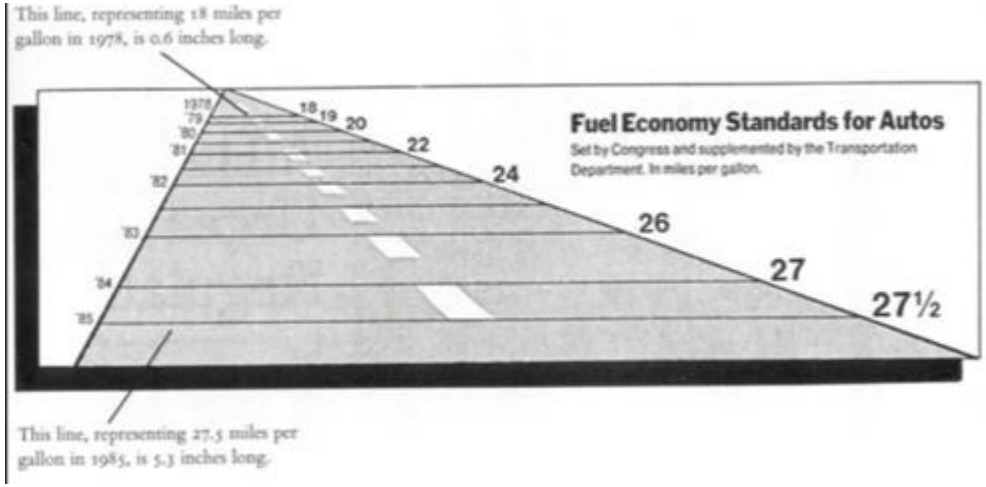
Effective visualization

Implies saying the **truth** about the data

Tufte presents a lot of commented examples in his book:



Tufte, E., *The Visual Display of Quantitative Information*, Graphics Press, 1983

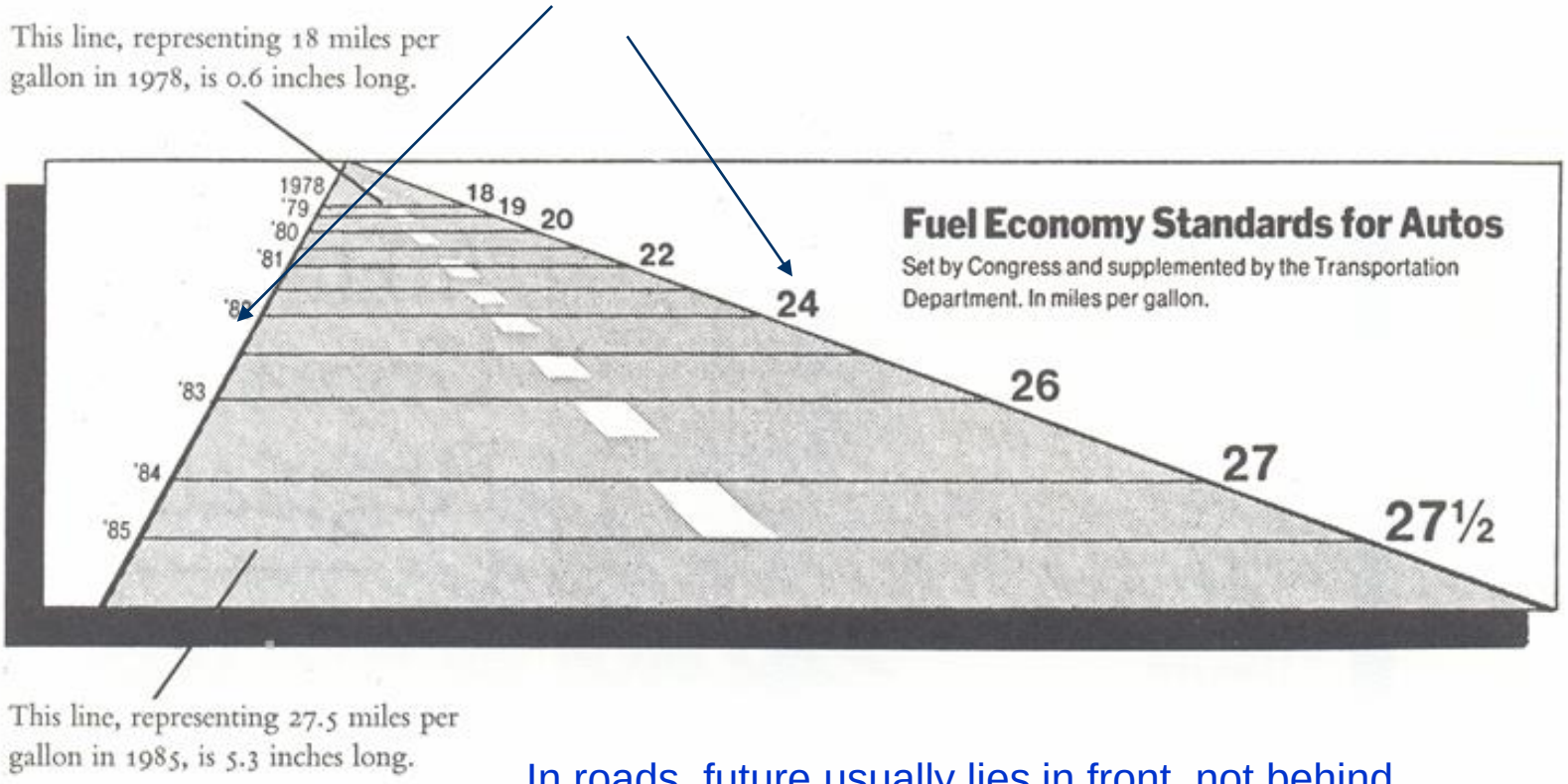


There are methods to evaluate visualizations that should be used along the process of creating a visualization

https://infovis-wiki.net/wiki/Lie_Factor

this example has several problems:

Legends have a constant size in one side and variable in the other



In roads, future usually lies in front, not behind

- Perception varies among people and with

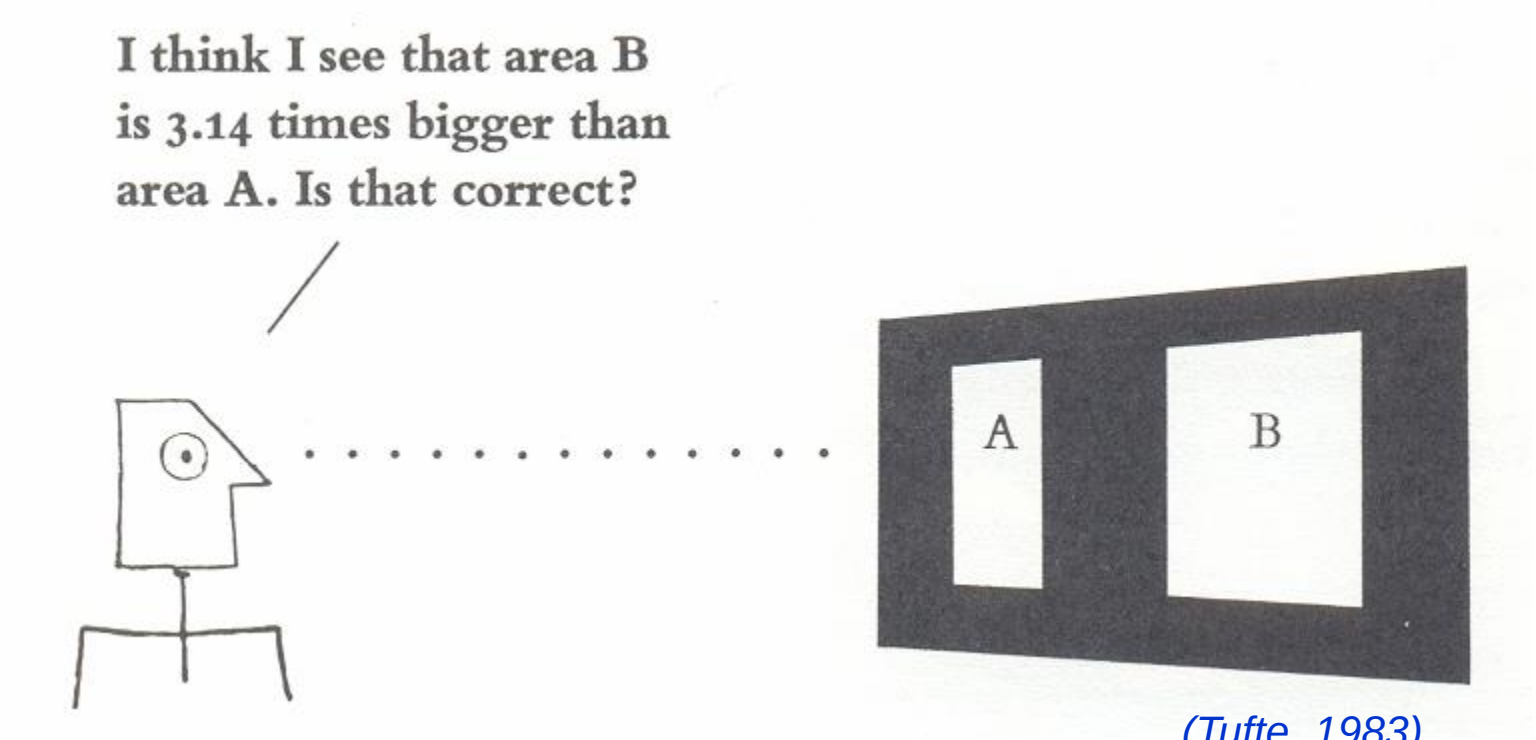
  - context

  - experience

(Tufte, 1983)

• How do we know that the visual image represents the underlying numbers?

• One way to try to answer these questions is to conduct experiments on the visual perception of graphics



(Tufte, 1983)

- What to do when we want to represent data in a graphic ?

- According to Tufte there are two fundamental principles to get graphical integrity:

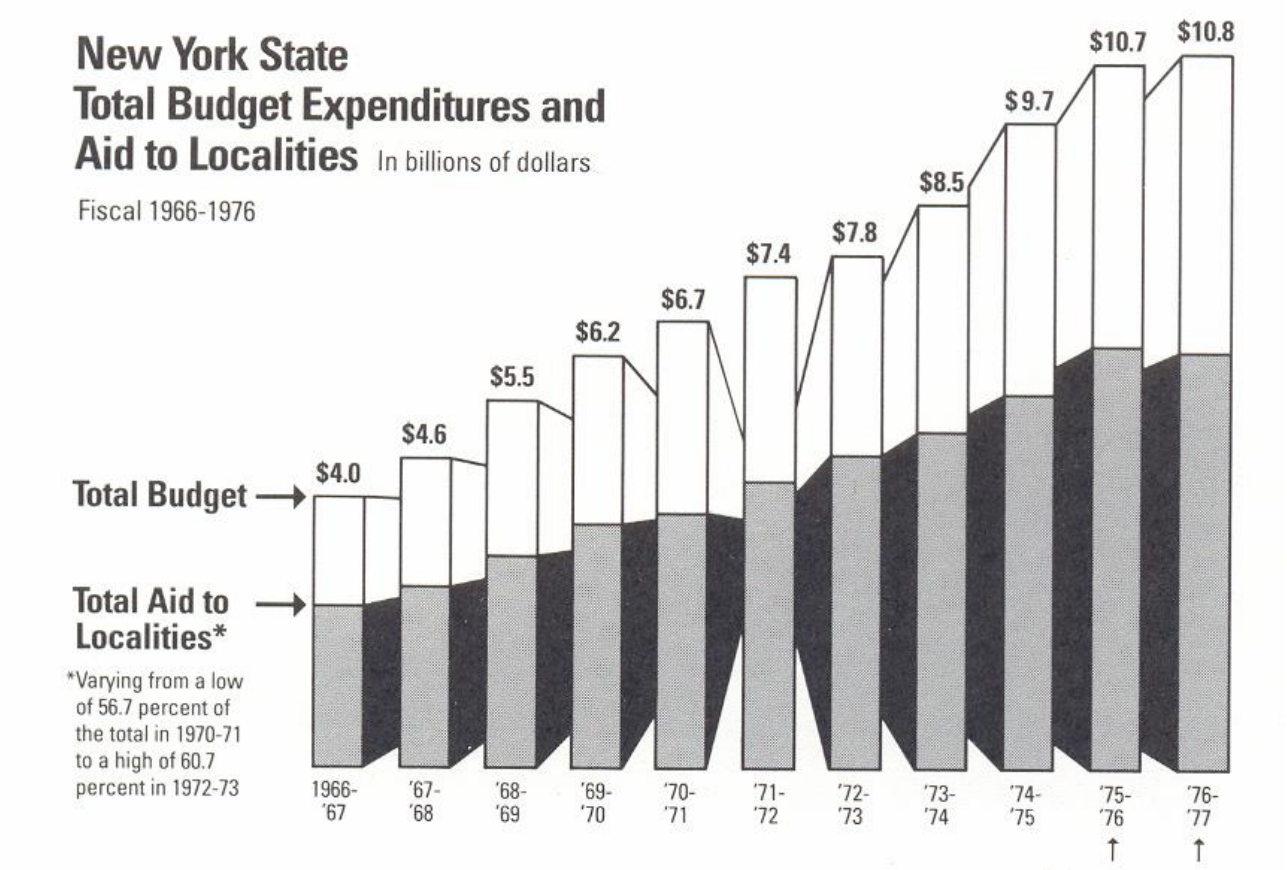
  - represent numbers, as physically measured on the surface of the graphic itself, directly proportional to the numerical quantities represented

  - Clear and thoroughly label to defeat graphical distortion and ambiguity

  Note:
  Visual representations must be **tested** as to their efficiency and efficacy for the target users to perform their tasks

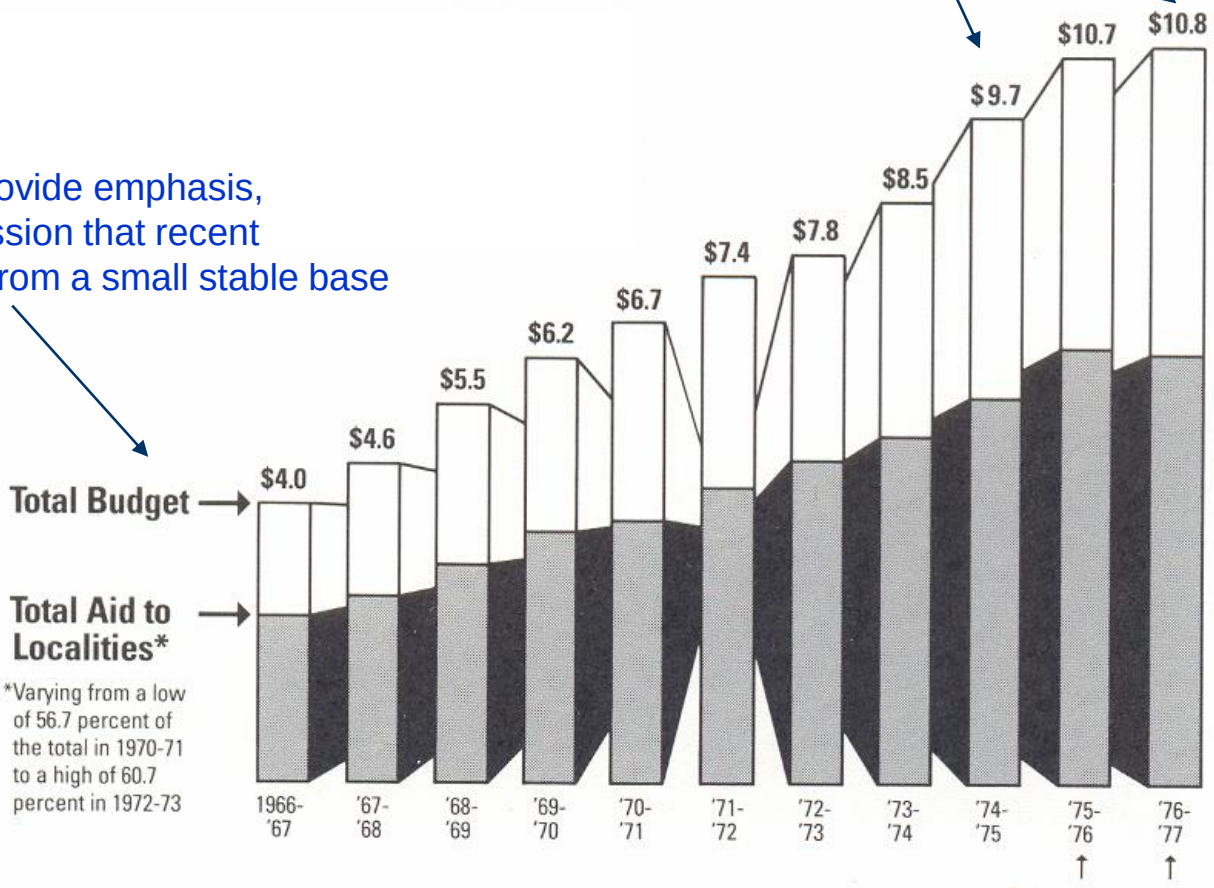
Effective visualization: anatomy of poor examples

Another example having several issues:



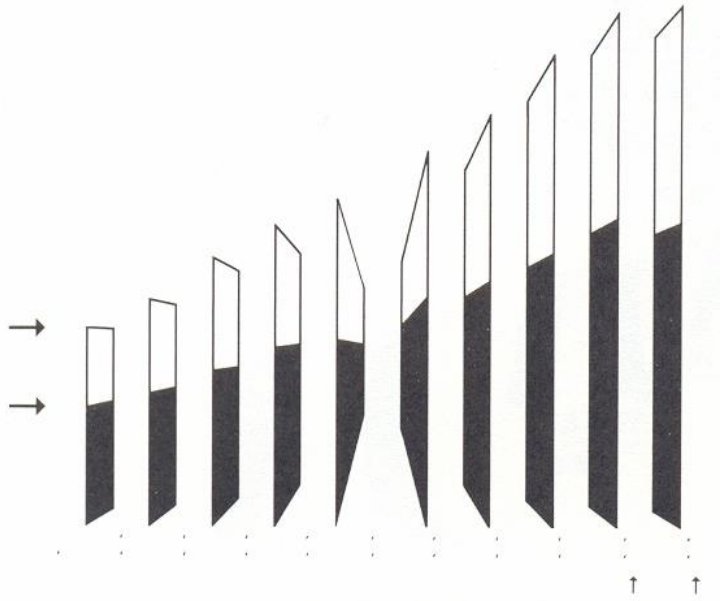
These three parallellipeds have been placed in an optical plane in front of the other eight, creating the image that the newer budgets tower over the older ones

Horizontal arrows provide emphasis, Encorage the impression that recent years have shot up from a small stable base

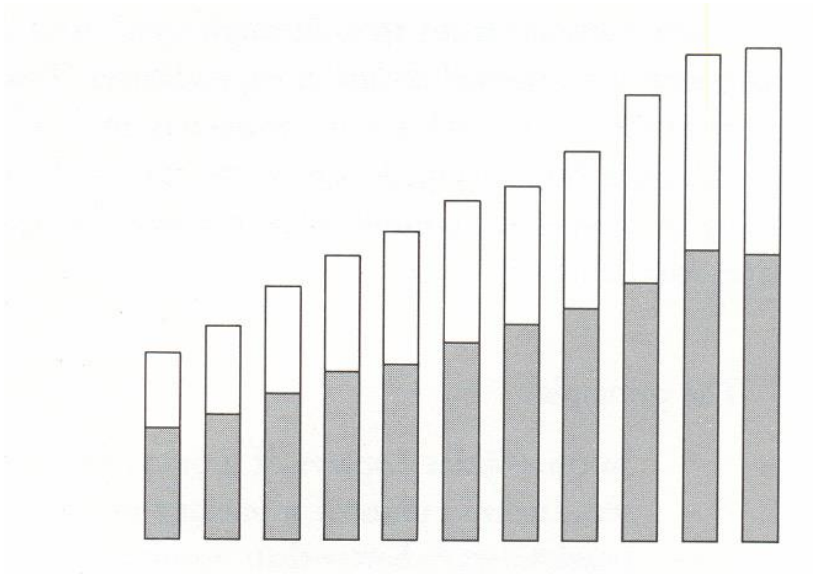


Arrows pointing straight up emphasize recent growth

Leaving behind the distortion



we have a calmer view:

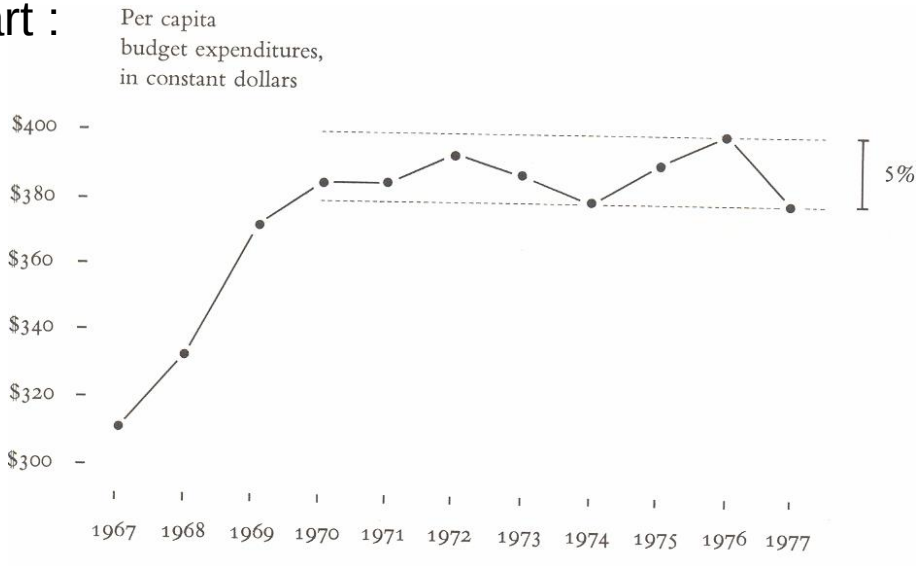


Two statistical lapses also bias the chart :

- Population increased10%

- there was substantial inflation

Final result →



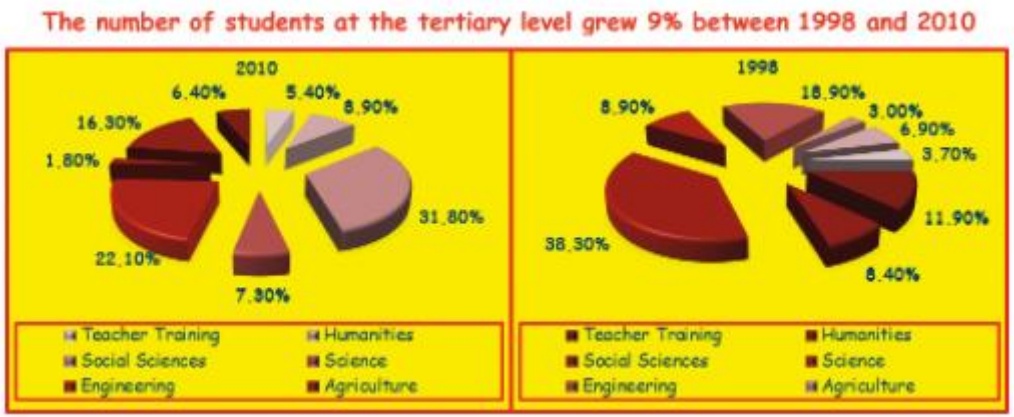
Effective Visualization: another poor example

Consider the following questions to be answered based on a data set:

- Which area of study grew the most?
- Which area of study decreased the most?
- How did Humanities behave?
- How many areas of study are increasing and how many are decreasing?

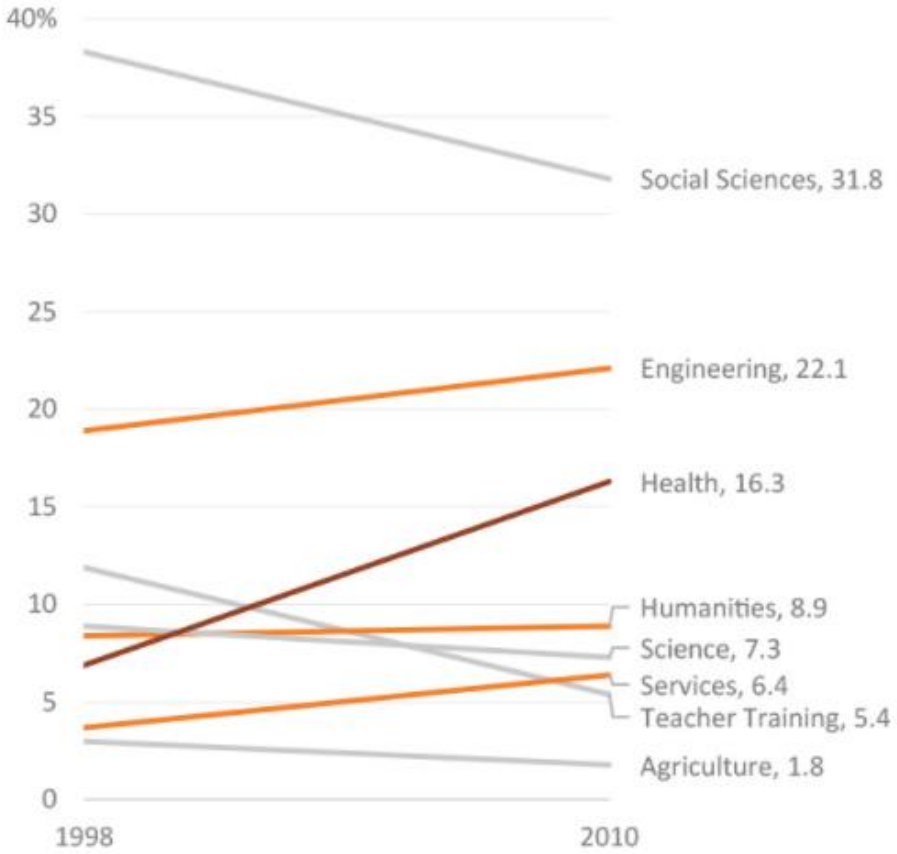
These pie charts have several issues:

- Chart type
- Time direction
- 3D effect
- Exploded slices and n. of slices
- Color usage …



The “graphenstein” (Camões, 2016)

A better way to answer the questions and provide insights from the same data:

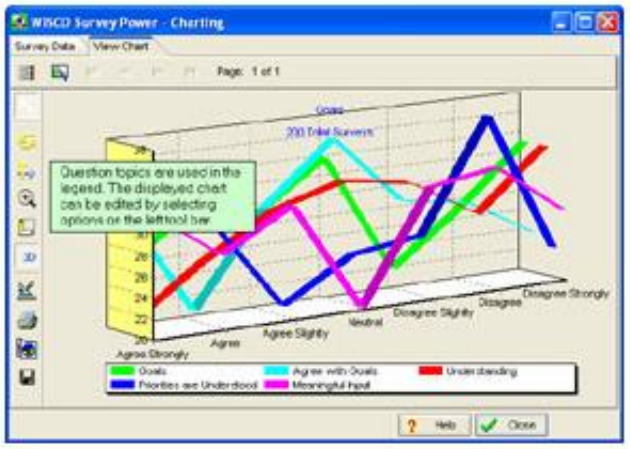


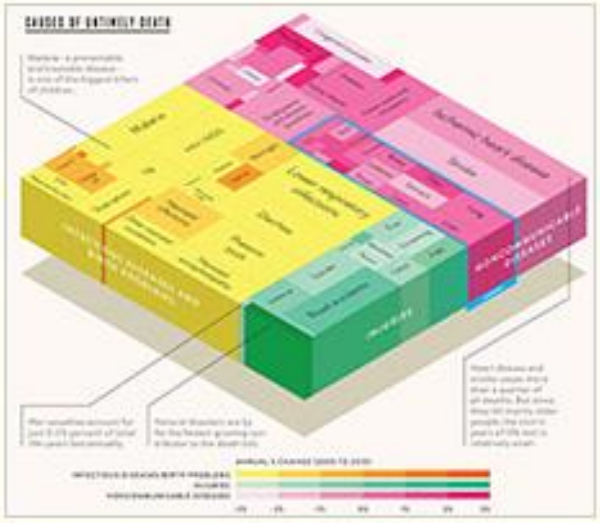
(Camões, 2016)

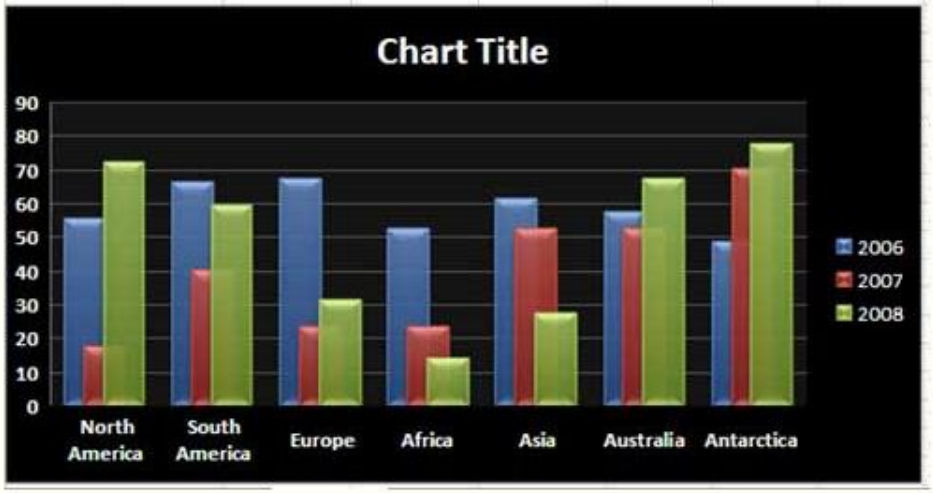
Hard-to-spot variations in the pie charts are now obvious:

- Line slopes display changes clearly
- color is used to make the chart easier to read.

Effective visualization: more poor examples analyzed







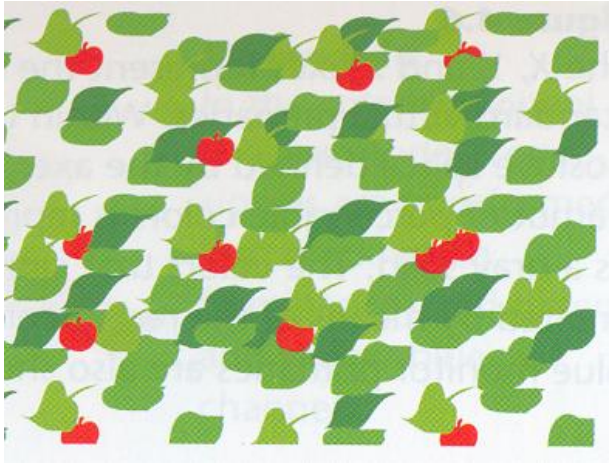
Remember: There are methods to evaluate visualizations that should be used along the process of creating a visualization

http://www.perceptualedge.com/examples.php

Color may help a lot in some tasks

…

How many cherries?

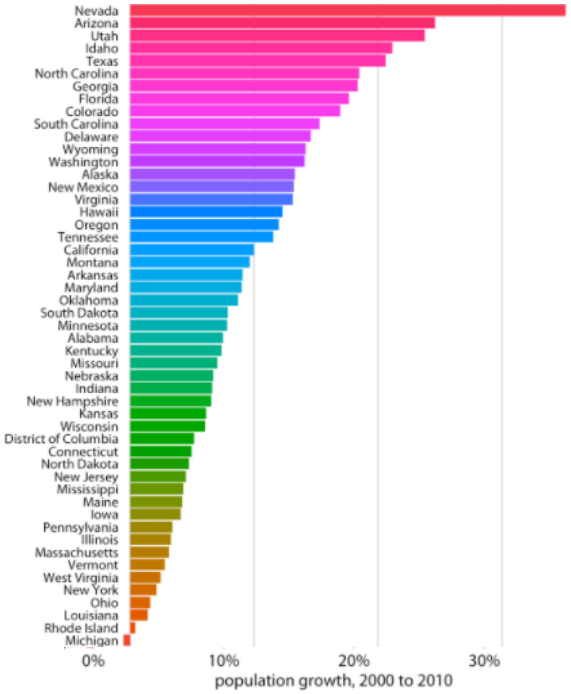


It may hinder if not properly applied …

It should be applied sparingly and carefully

should serve a purpose, be clear, and not distract

Common pitfalls of color use

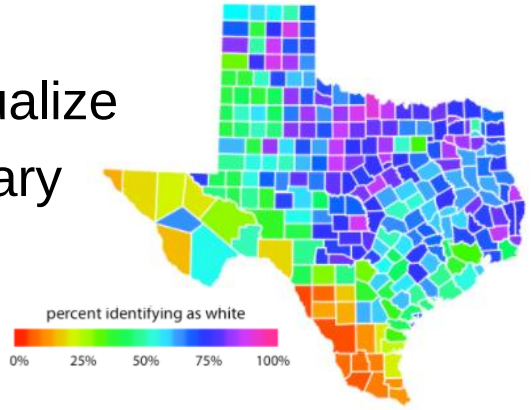


- **Encoding too much or irrelevant information**

  (the coloring of states serves no purpose, colors are over saturated; it is distracting)

- **Using non-monotonic color scales to encode data values**

  (The rainbow color scale is not an appropriate to visualize continuous data values; it tends to emphasize arbitrary features of the data)



- **Not designing for color-vision deficiency**

https://clauswilke.com/dataviz/color-pitfalls.html

Color Blindness

- The most common type is deuteranopia (“daltonism”)
  (affects ~10% of men; is residual in women)

- There are color blindness simulators and colorblind-friendly color scales

http://www.color-blindness.com/coblis-color-blindness-simulator

Normal vision

Deuteranopia

Tritanopia

http://www.colourblindawareness.org/

Guidelines to use color

- Design first in black and white; then color apply sparingly and carefully
- Use direct labeling instead of colors when you need to distinguish between more than about eight categorical items
- Avoid large filled areas of overly saturated colors. They make it difficult for the reader to carefully inspect the figure
- To make sure figures work for people with cvd, don't just rely on specific color scales. Instead, test figures in a cvd simulator
- Do not use blue to color small objects (will be difficult to see)

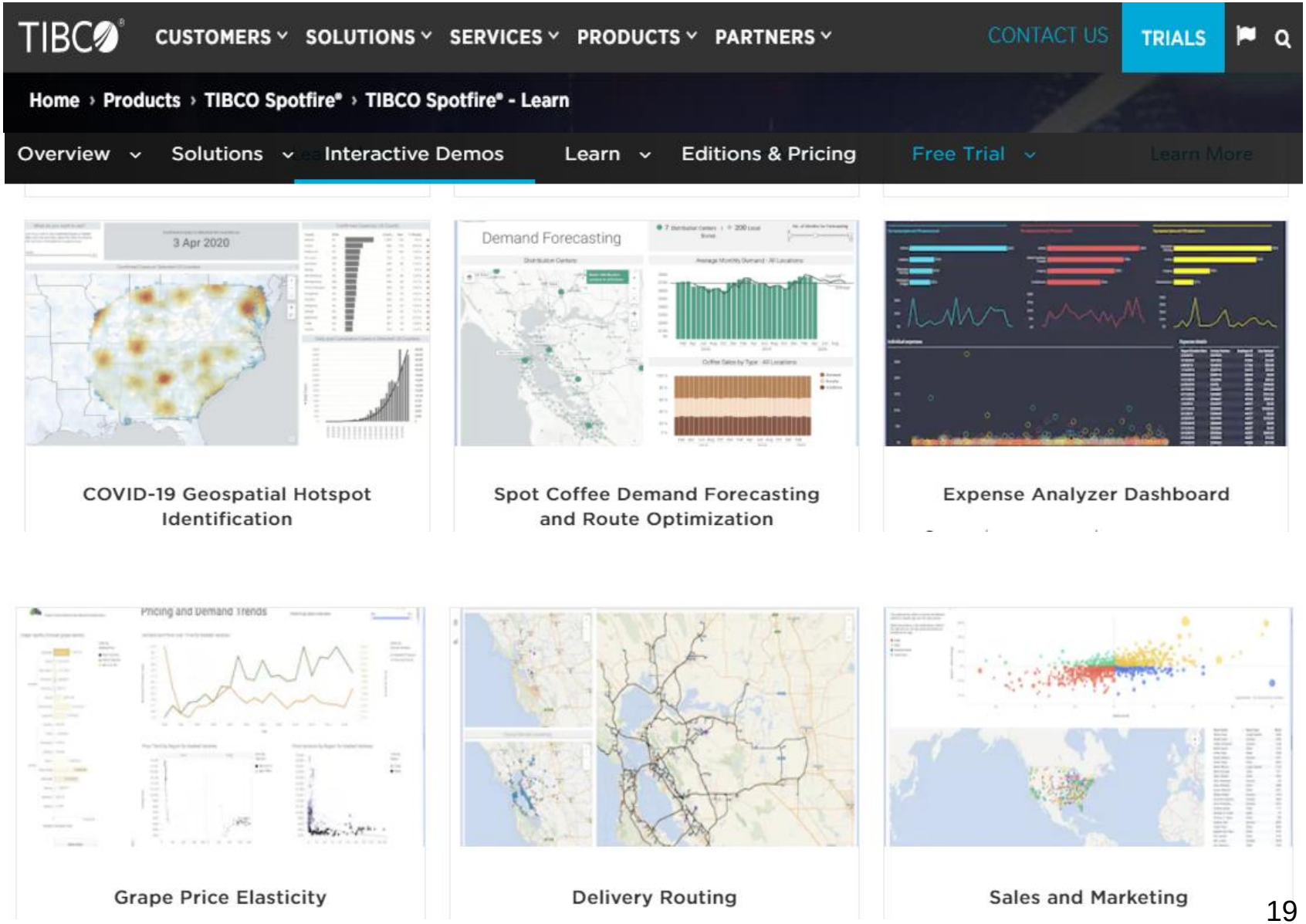
https://clauswilke.com/dataviz/color-pitfalls.html

- Visualizations produced to be used by many users should be evaluated to improve their effectiveness

- There are several methods that can be used to evaluate

At least review your visualizations considering the questions they should help users to answer and ask some target users to use them and provide feedback… Then, improve your visualizations!

Examples of visual data mining simple applications



https://www.tibco.com/products/tibco-spotfire/learn/demos

Main bibliography

- Tufte, E., *The Visual Display of Quantitative Information*, Graphics Press, 1983

- Camões, J., *Data at Work : Best practices for creating effective charts and information graphics in Microsoft Excel*, Pearson Education, 2016

  https://learning.oreilly.com/library/view/data-at-work/9780134268798/title.html

- Wilke, C., *Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures*, O′Reilly, 2019

  https://clauswilke.com/dataviz/
  https://learning.oreilly.com/library/view/fundamentals-of-data/9781492031079/