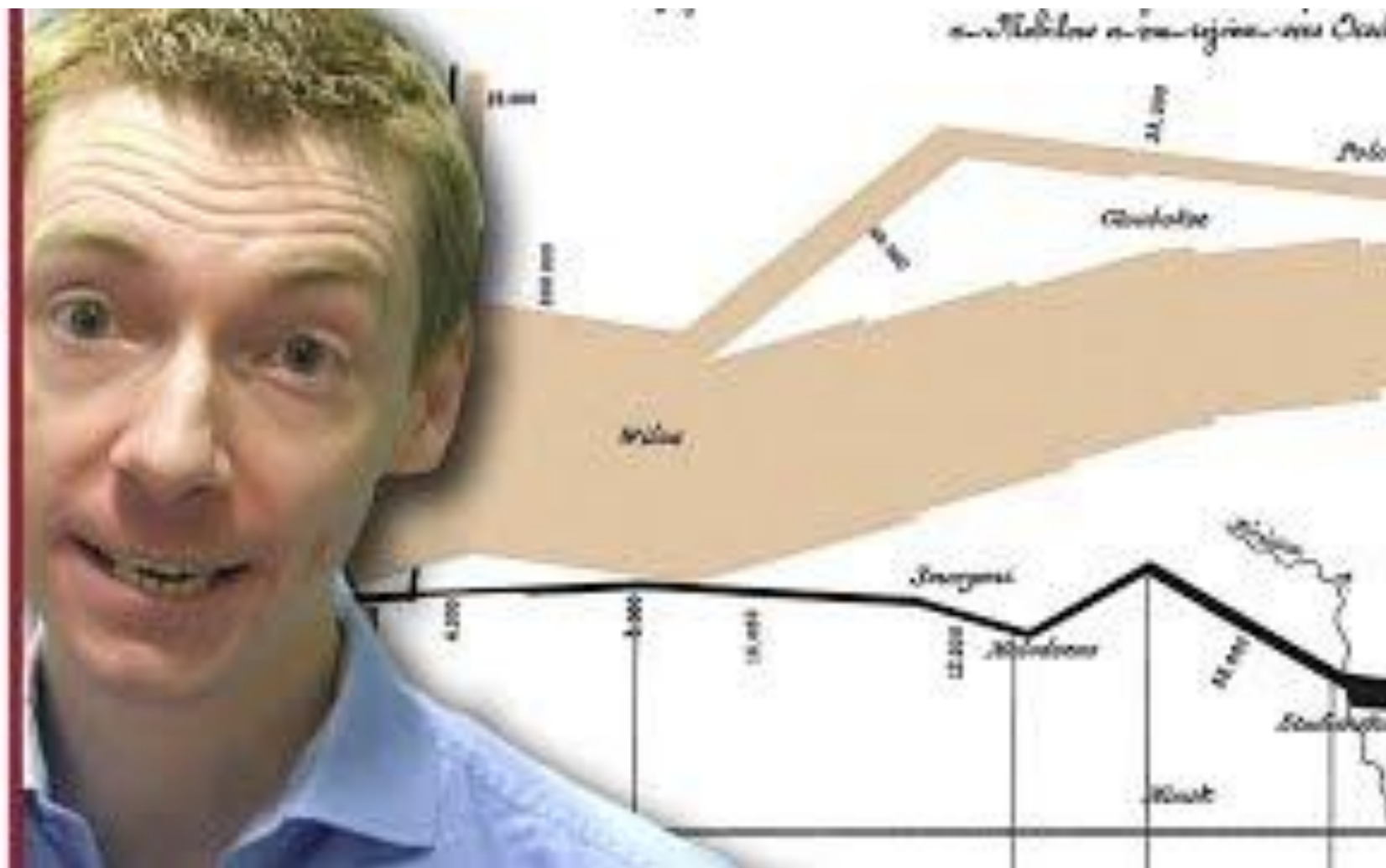


Visualization as Design

A Samuel Pottinger
Stat 198: IDSV
Feb 5, 2025

Numberphile



Overview of the second section.

Section 2:

Primitives

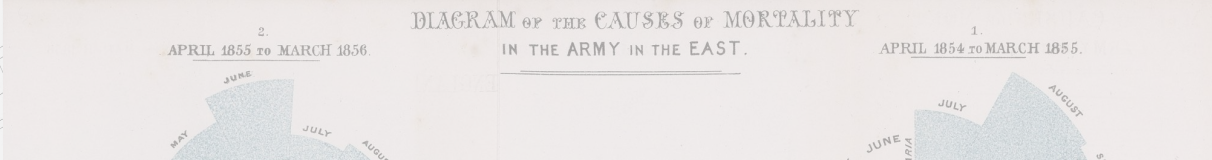
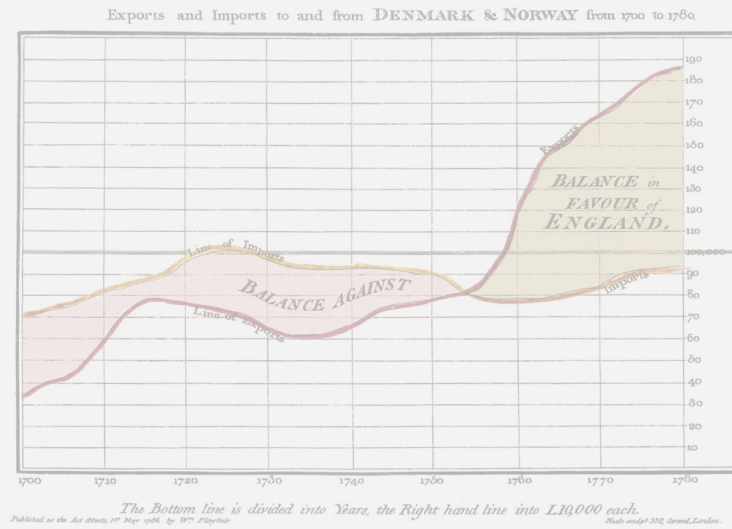
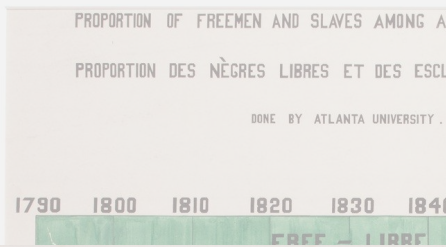
- Visualization as Design: Investigating some of the early design ideas that continue to shape data visualization and some information about how we got to now.
- Visualization as Science 1: Foundational cognitive and perception science principles and studies.
- Visualization as Science 2: What cog sci and perception principles say about data visualization.
- Skills Labs: Exploring the primitives available for drawing and how to draw with data.
- Formalizing Glyphs: Cleveland and McGill tie it all together: actionable visualization recommendations for using primitives.

Today

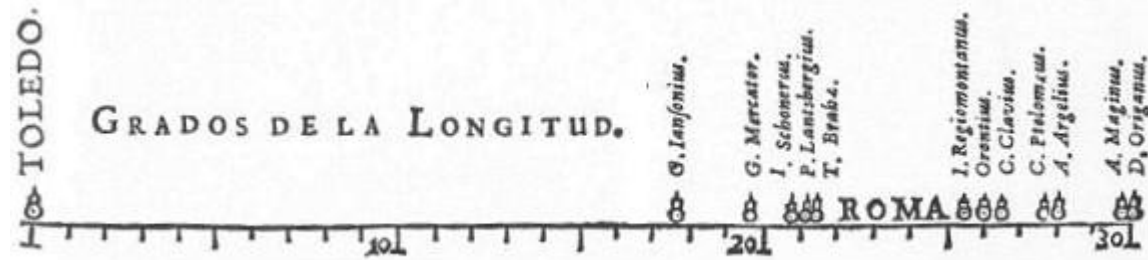
- **Pioneers of Data Visualization: Some of the important names and pieces you'll want to know.**
- Ideas of Tufte: An overview of key ideas given to us by pioneer Tufte.
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How we got to now... A Comment

The fastest imaginable look at data visualization history. Just one person per century! I want to briefly pause to comment on **who is remembered and who is left out**. We will have another chance at history later.



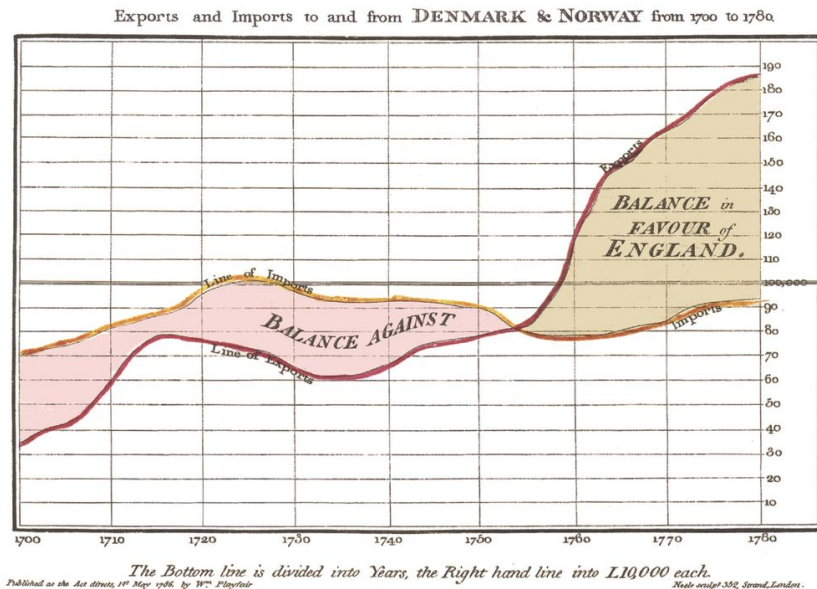
How we got to now... Michael Florent van Langren (1600s)



Though not as well known as some others, the **earliest known “statistical graphic”** (1644), this looks at different estimates of the distance from Toledo to Rome.



How we got to now... **William Playfair** (1700s)



Often called the parent of **modern data visualization**.

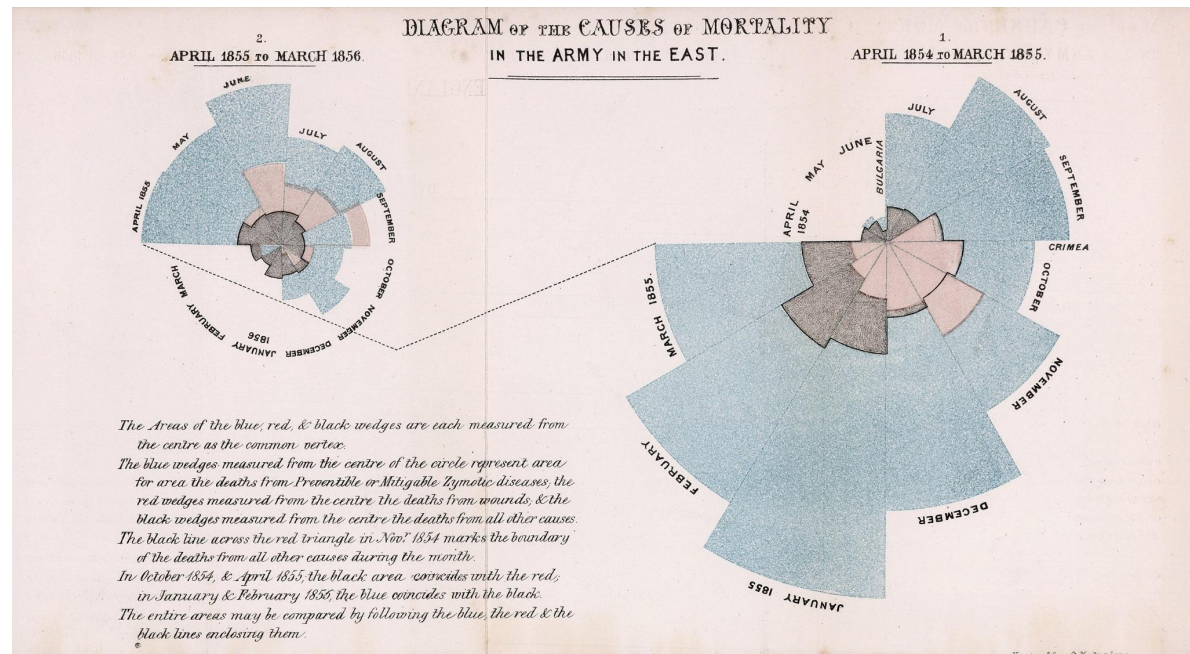
Created common patterns we use today like the pie chart.

Popularized prior forms like the bar chart and area chart.

Piece to the left is from 1786.

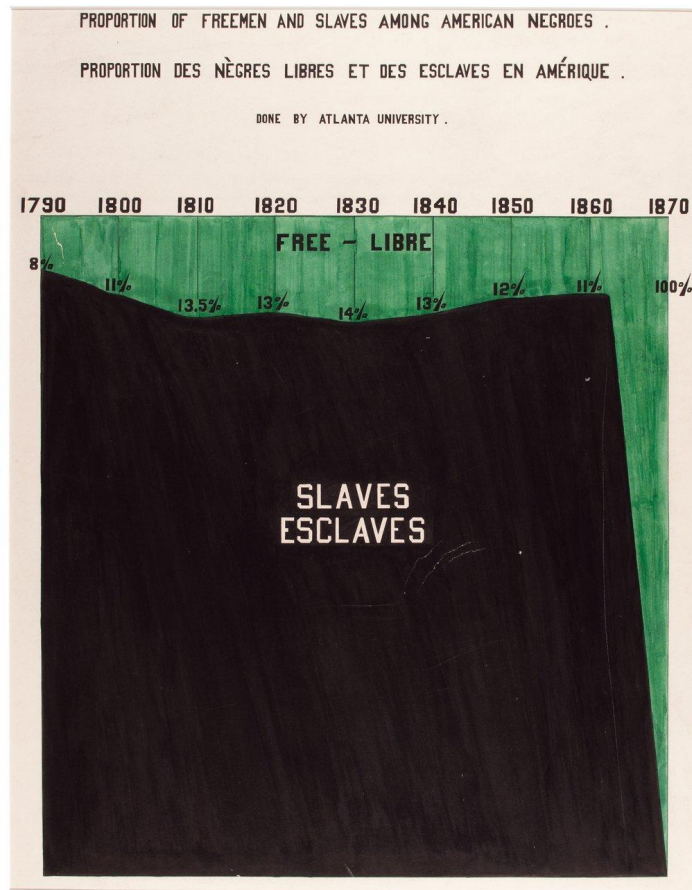


How we got to now... Florence Nightingale (1800s)



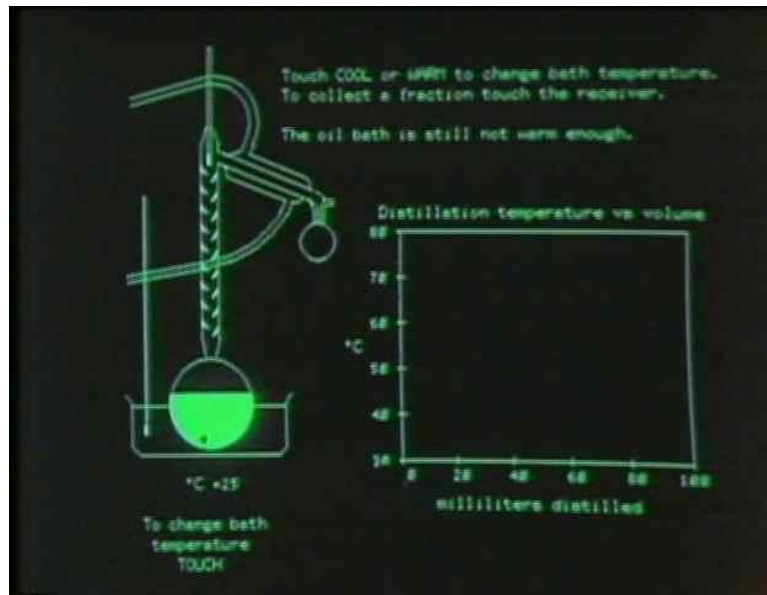
Causes of death (1858). Often known for pioneering **graphical storytelling**. Effective use of data visualization for change and argument. Epidemic diseases vs battlefield injury.

How we got to now... **W.E.B. Du Bois** (1900s)



Changed the way we think about data **visualization as message**. The design ideas and use in sociological settings continues to stem from this early work. Influential in data visualization at the start of the 20th century.

How we got to now... **Donald Blitzer** (today)



Pioneered ideas around
interactive media and
explorable explanations.

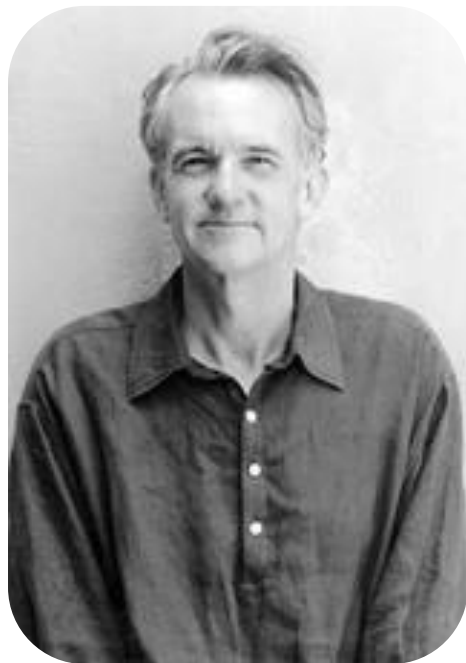
1960s precursor to the
work we saw from Bret
Victor.



Today

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Introducing **Edward Tufte**



It's hard to describe just how influential Tufte has been. He brought a lot of people into information design through touring workshops and popular books.

Many people disagree with some of his ideas now but his perspective has and continues to **fundamentally shape data visualization** today.

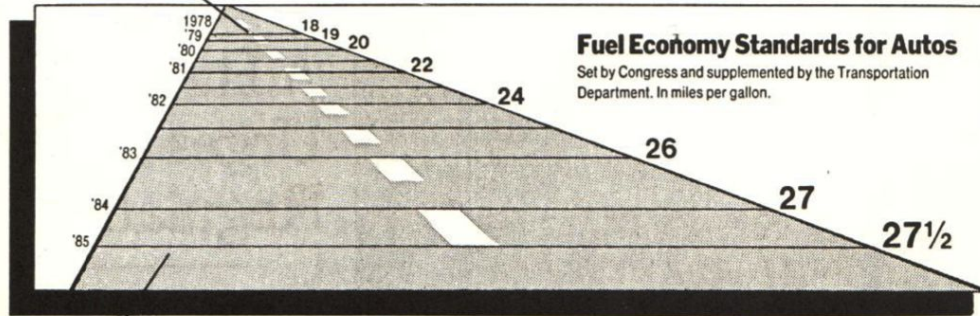
We discuss these ideas not as rules but as guidelines many follow as standard advice.

His ideas are readily applicable. I'll do all of the following charts in Google Sheets.

Tufte's ideas: **Lie-Factor**

$$\text{Lie Factor} = \frac{\text{size of effect shown in graphic}}{\text{size of effect in data}}$$

This line, representing 18 miles per gallon in 1978, is 0.6 inches long.

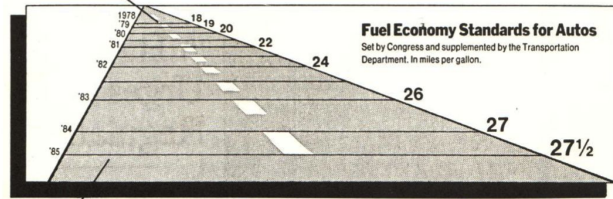


This line, representing 27.5 miles per gallon in 1985, is 5.3 inches long.

Tufte's ideas: **Lie-Factor**

$$\text{Lie Factor} = \frac{\text{size of effect shown in graphic}}{\text{size of effect in data}}$$

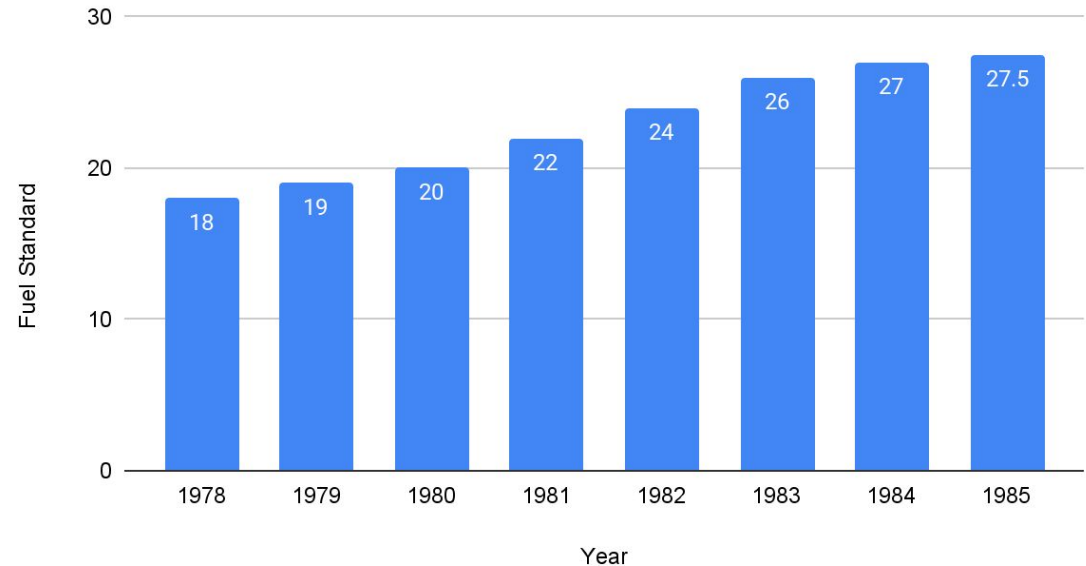
This line, representing 18 miles per gallon in 1978, is 0.6 inches long.



This line, representing 27.5 miles per gallon in 1985, is 5.3 inches long.

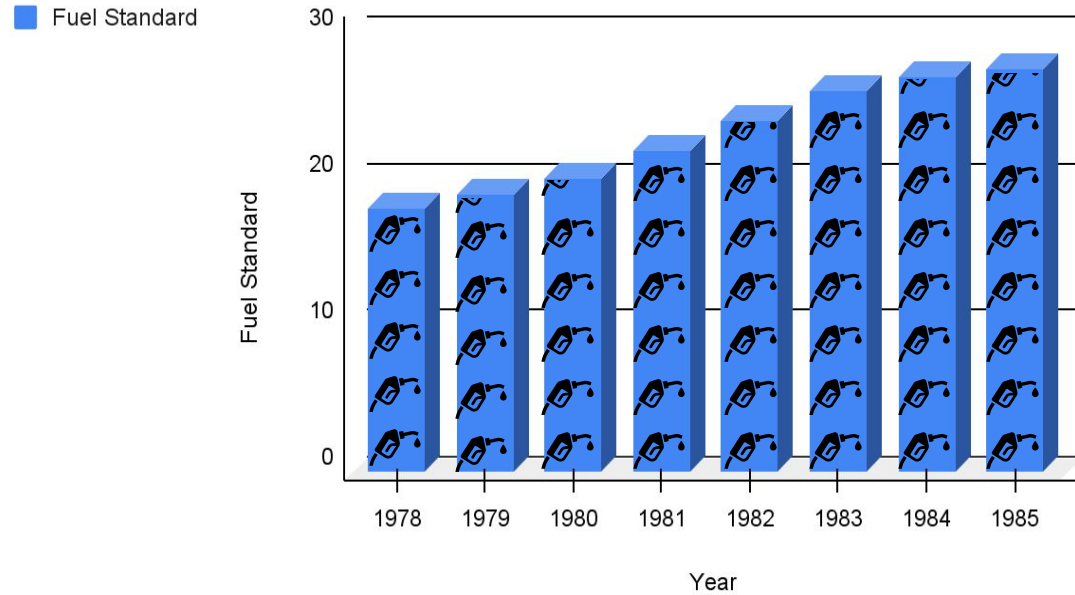
New York Times, August 9, 1978, p. D-2.

Fuel Standard vs. Year

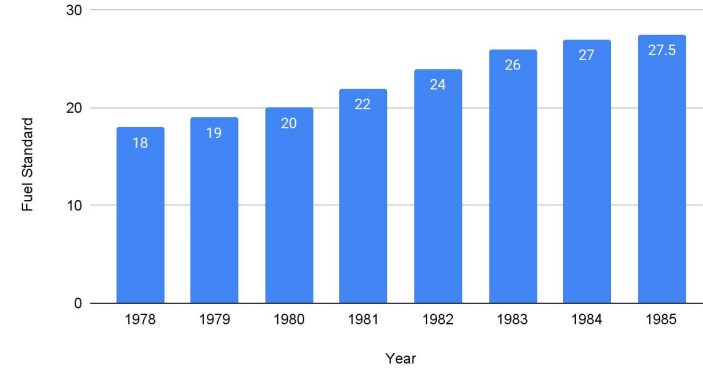


Tufte's ideas: **Chartjunk**

Fuel Standard vs. Year

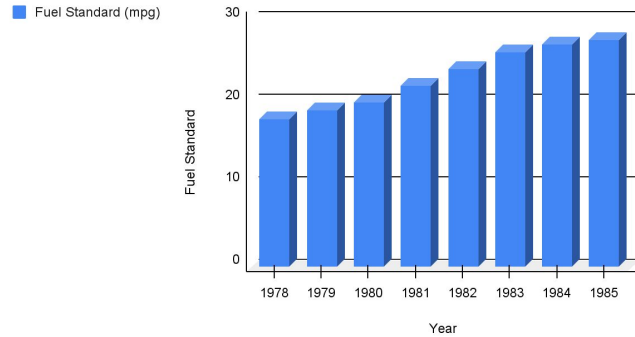


Fuel Standard vs. Year



Tufte's ideas: Data-Ink Ratio

Fuel Standard vs. Year



Fuel Standard Each Year (1978 - 1985)

.....
27.5 mpg target set by the ECPA

1978

18

First year of standards
saw 18 mpg

1979

19

1980

20

1981

22

1982

24

1983

26

1984

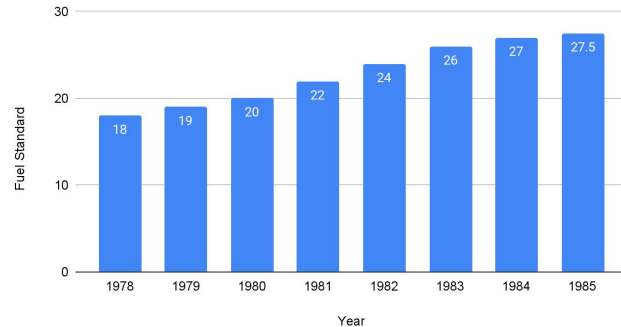
27

1985

27.5

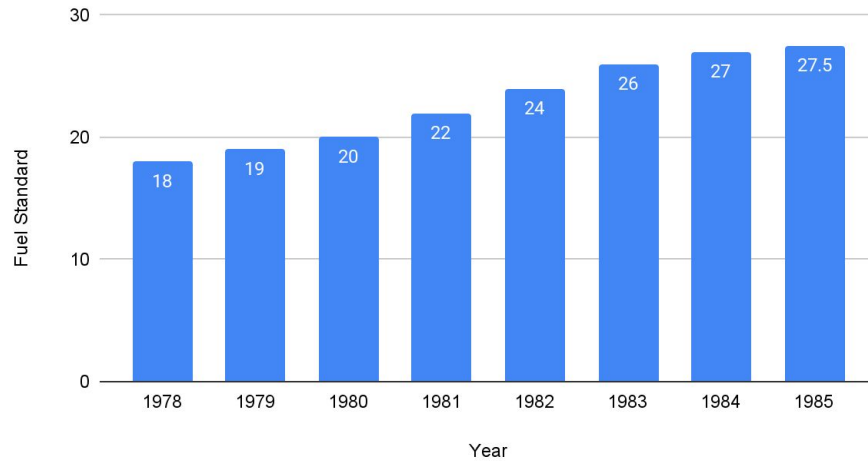
.....
0 mpg

Fuel Standard vs. Year

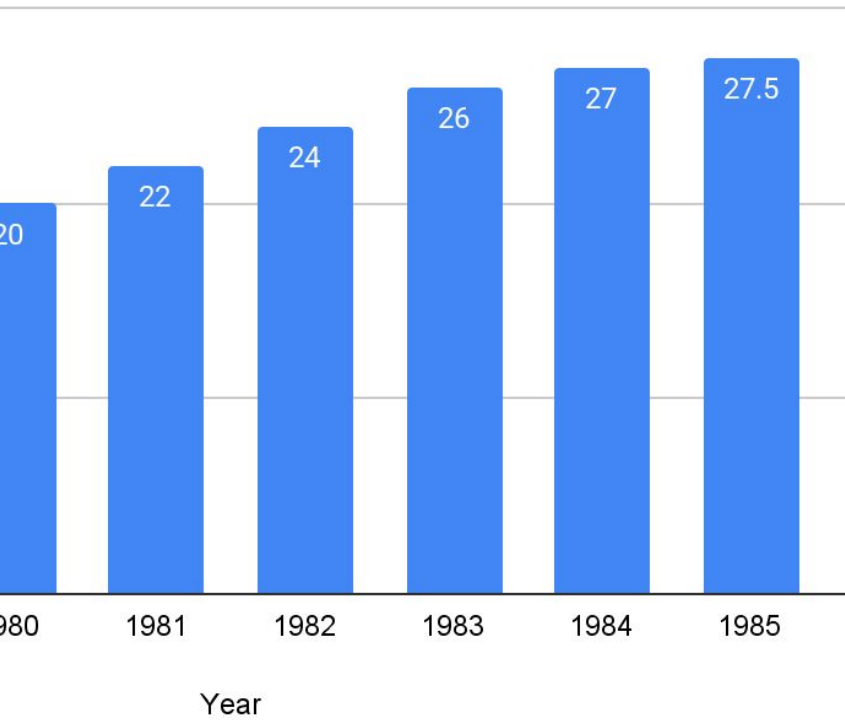


Tufte's ideas: **Data Density**

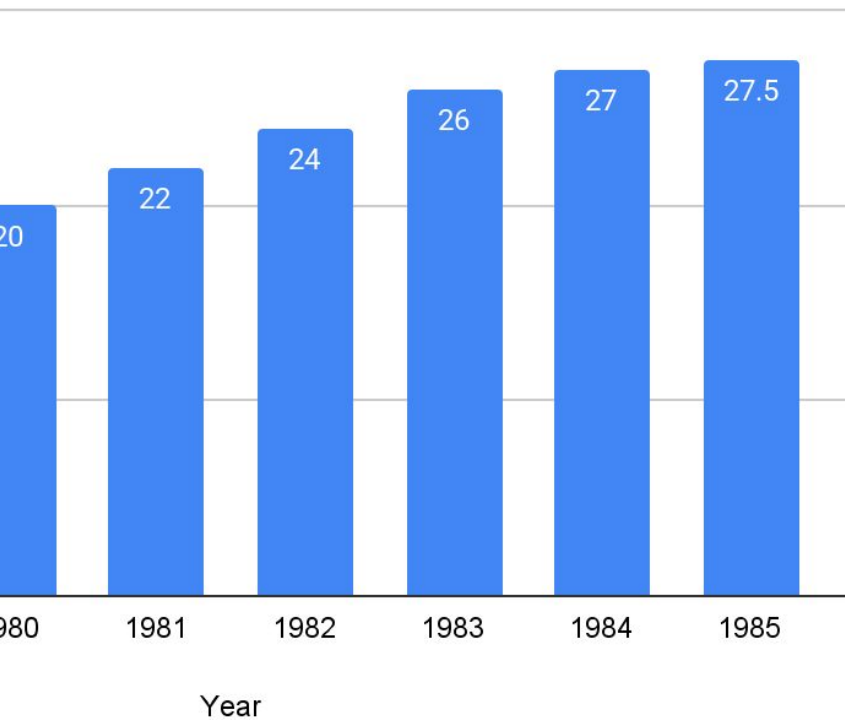
Fuel Standard vs. Year



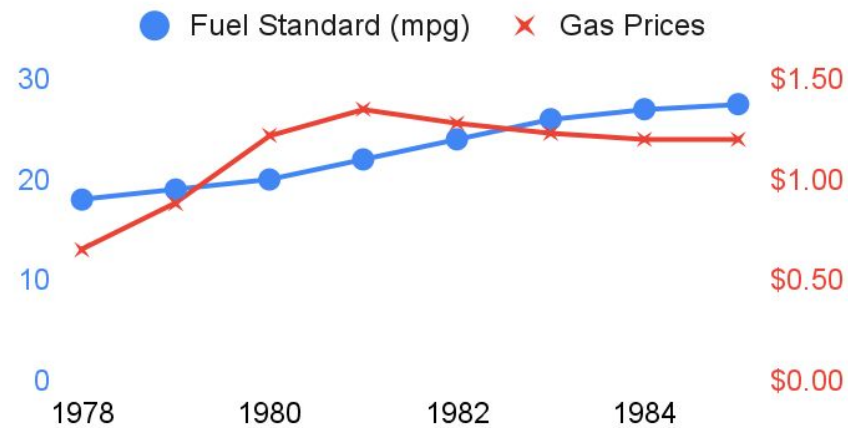
Tufte's ideas: **Data Density**



Tufte's ideas: **Data Density**

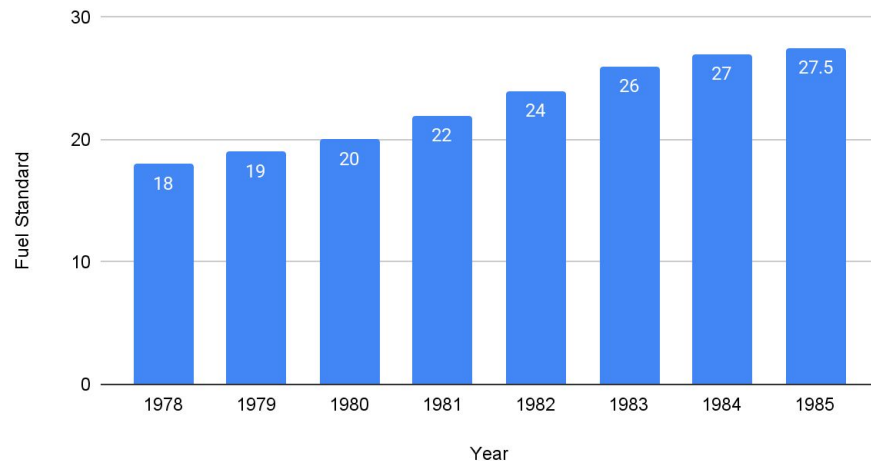


Fuel Standard and Gas Prices

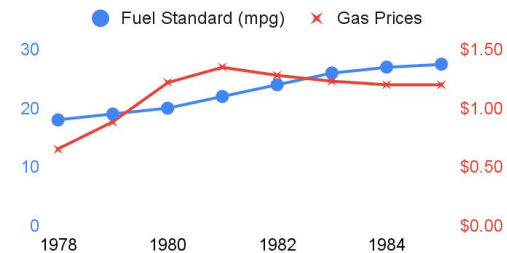


Tufte's ideas: Data Density

Fuel Standard vs. Year

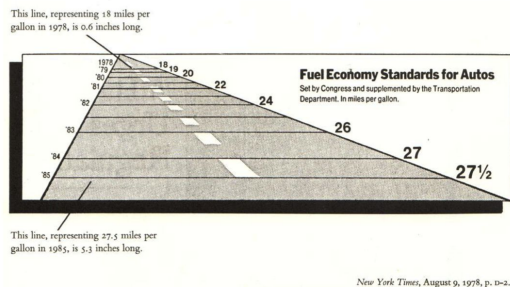


Fuel Standard and Gas Prices



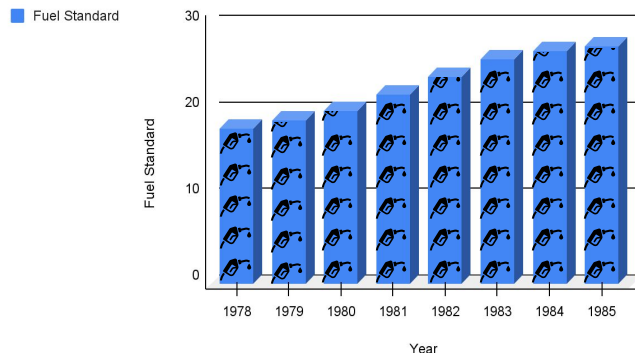
Tufte's ideas: Summary

Lie Factor



Chartjunk

Fuel Standard vs. Year



Fuel Standard Each Year (1

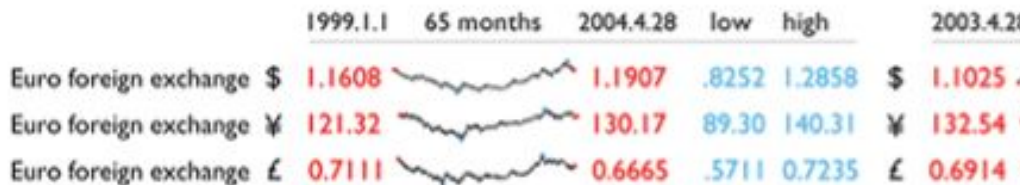
27.5 mpg target set by the ECPA

1978 18
1979 19
1980 20

First year of standards saw 18 mpg

0 mpg

Data Density



Data-Ink Ratio

Today

- Pioneers of Data Visualization: Some of the important names and pieces you'll want to know.
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Problematic graphics: **Group Activity**



We are going to look at some bad charts (“darts”) identified by Michael Friendly.

These were a motivation for Tufte, our next friend along this journey.

Break into groups and take a look at each section. Find a favorite and we will share with the class.

About 10 minutes to look through your section!
Link in Zulip.

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The **legacy** of Tufte

“

Specifically, it seems like he pulls some of his design principles out [of] thin air, and the design improvements they generate are **not scientifically validated...**

”



Matthew Dunnigan

Principal User Research Manager
Microsoft

Bringing in **empirical approaches**.

This lecture brought us to the doorstep of modern data visualization.

We cross the threshold in the next lecture where we will start to bring in scientific understanding of cognitive and perception science, exploring encoding devices.

All of this will culminate in bringing in one of the most important ideas: channel effectiveness.

A quick word from **Fung**



About your homework...

Have you finished your homework?

Make sure to complete
#assign-2-ex-viz and
#assign-3-four-persp.

Note that #assign-viz-4-ex-2 was just assigned.

Note that Assignment 2 can no longer be completed for full credit.

Do you need help?

We have double office hours this week.
See #coffee-and-office-hours for options available on Friday.

Works cited

B. Adhikari, "Marey's train schedule," University of Missouri Saint Louis, 2021. Available: <https://badriadhikari.github.io/data-viz-workshop-2021/minards/>

M. van Langren, "Grados de la Longitud," 1644. Available: https://commons.wikimedia.org/wiki/File:Grados_de_la_Longitud.jpg

J. Norman, "Michael Florent van Langren issues the Earliest Known Graph of Statistical Data," History of Information, 2013. Available: <https://www.historyofinformation.com/detail.php?id=3415>

W. Playfair, "Time Series of Exports and Imports of Denmark and Norway," Commercial and Political Atlas, 2011. Available: https://en.wikipedia.org/wiki/William_Playfair#/media/File:Playfair_TimeSeries-2.png

D. Bellhouse, "The Flawed Genius of William Playfair: The Story of the Father of Statistical Graphics," University of Toronto Press, 2023. Available: <https://www.jstor.org/stable/10.3138/jj.6167271>

Works cited

M. Callejon, "Masters series: William Playfair, the father of statistical graphics," Flourish, 2023. Available: <https://flourish.studio/blog/masters-william-playfair-father-of-statistical-graphics/>

H. Hering, "Florence Nightingale Portrait," 1860. Available: [https://en.wikipedia.org/wiki/Florence_Nightingale#/media/File:Florence_Nightingale_\(H_Hering_NPG_x82368\).jpg](https://en.wikipedia.org/wiki/Florence_Nightingale#/media/File:Florence_Nightingale_(H_Hering_NPG_x82368).jpg)

J. Mansky, "W.E.B. Du Bois' Visionary Infographics Come Together for the First Time in Full Color," Smithsonian Magazine, 2018. Available: <https://www.smithsonianmag.com/history/first-time-together-and-color-book-displays-web-du-bois-visionary-infographics-180970826/>

University of Illinois, "Faculty portrait photograph of Professor of Electrical Engineering Donald Bitzer," University of Illinois, 1971. Available: <https://archon.library.illinois.edu/archives/index.php?p=digitallibrary%2Fdigitalcontent&id=7887>

Works cited

J. Scott, "5.08 of BBS: The Documentary," Textfiles, 2005. Available:

https://en.wikipedia.org/wiki/PLATO_%28computer_system%29#/media/File:PLATO_chem_exp.jpg

B. Leroy, "Review of Tufte's The Visual Display of Quantitative Information," Carnegie Mellon University, 2018. Available:

<https://benjaminleroy.github.io/pages/blog/public/post/2018/05/16/review-of-tufte-s-the-visual-display-of-quantitative-information/>

M. Friendly, "Darts," York University, 2025. Available: <https://www.datavis.ca/gallery/lie-factor.php>.

Princeton University, "Public Lectures: Edward Tufte (Photo)," Princeton University. Available:

<https://lectures.princeton.edu/lectures/2013/edward-tufte>

Union of Concerned Scientists, "Brief History of US Fuel Efficiency Standards," Union of Concerned Scientists, 2017. Available: <https://www.ucsusa.org/resources/brief-history-us-fuel-efficiency>

Works cited

N. Vega, "A gallon of gas was 65 cents in 1978—here's how much it cost every year since," CNBC, 2022. Available: <https://www.cnbc.com/2022/04/13/how-much-gas-cost-every-year-since-1978.html>

M. Dunnigan, "Why Tufte is Wrong," Medium, 2014. Available: <https://medium.com/@MattDuignan/why-tuftes-wrong-a9bd6a14ff8e>

B. Adhikari, "Data Density," University of Missouri Saint Louis, 2021. Available: https://badriadhikari.github.io/data-viz-workshop-2021/Tufte/Chapter_8/

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