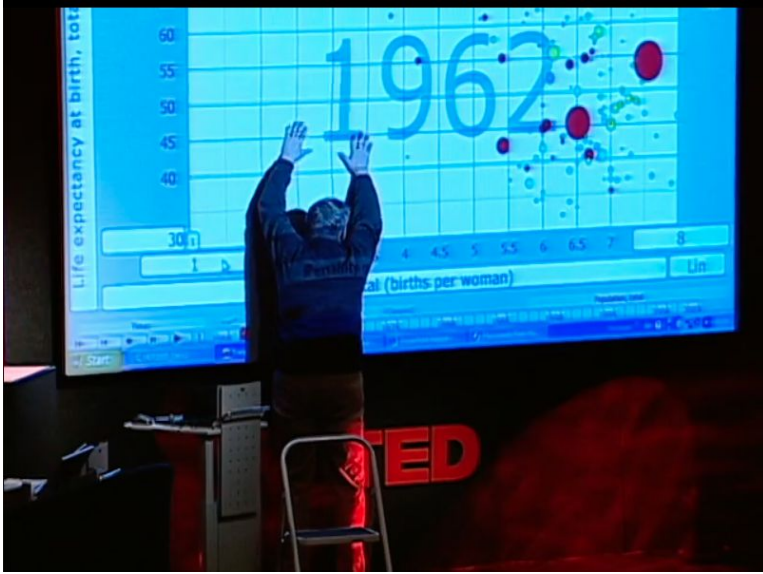


Storytelling with Data Visualization

WiMLDS Boston Talk
Elsie Lee-Robbins 2022
University of Michigan



Storytelling with Data



Hans Rosling's TED talk

https://www.ted.com/talks/hans_rosling_the_best_stats_you_ve_ever_seen

How to create effective data visualizations

- **Communicative Intent:** What is your goal? What would be a successful outcome?
- **Design Principles:** Declutter graphs of extraneous information, focus attention on the main takeaway

Eytan Adar & Elsie Lee-Robbins (2020). **Communicative visualizations as a learning problem**. IEEE Transactions on Visualization and Computer Graphics.

Kiran Ajani, Elsie Lee-Robbins, Cole Nussbaumer Knaflitz, Cindy Xiong, William Kemper, Steven Franconeri (2021). **Declutter and Focus: Empirically evaluating design guidelines for effective data storytelling**. IEEE Transactions on Visualization and Computer Graphics.

What is your purpose?

Exploratory Data Analysis

- You have hypotheses, but you aren't sure what's in the data
- You are the analyst/audience for the graph
- Quicker iterations

Communicative Visualization

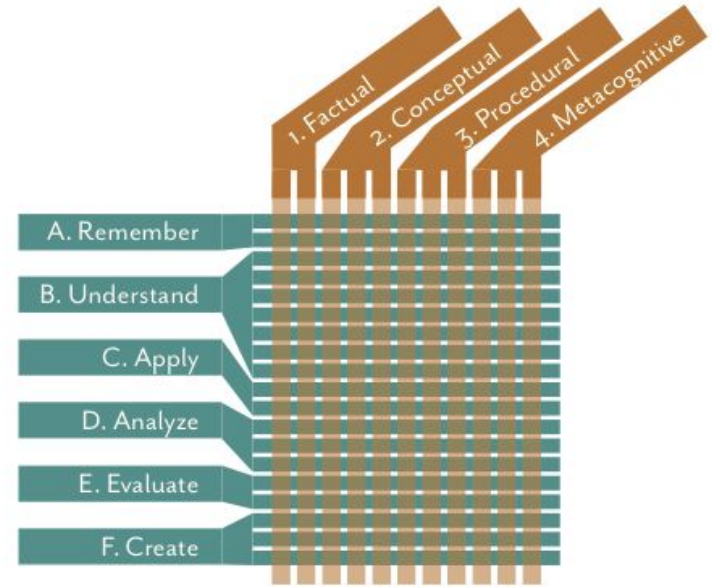
- You have a clear message
- Someone else is your audience
- Spend more time finding the best format and polishing the design

Communicative Intent

What you want to communicate to the audience

Learning Objectives

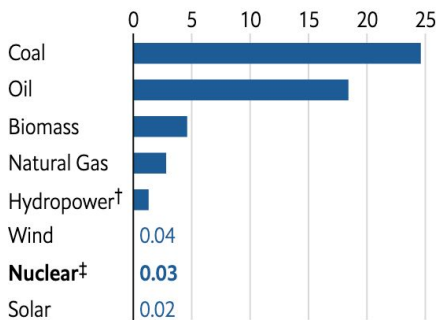
- The viewer will [**verb**] [**noun**].
- **Verbs:** Remember, Understand, Apply, Analyze, Evaluate, Create
- **Nouns:** Facts, Concepts, Procedures, Metacognitive knowledge
- <http://visualobjectives.net/>



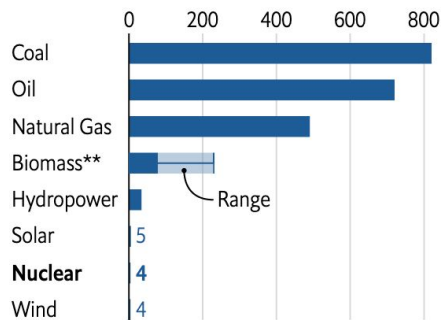
What is this graph communicating?

Fuelling the future

Deaths per TWh of energy produced*
1990-2014



Greenhouse-gas emissions, 2017 or latest
CO2 equivalent per GWh of electricity produced§, tonnes



*Based on deaths from accidents and air pollution †Includes Banqiao Dam failure in 1975

‡Includes Chernobyl disaster in 1986 §Over life-cycle of the plant

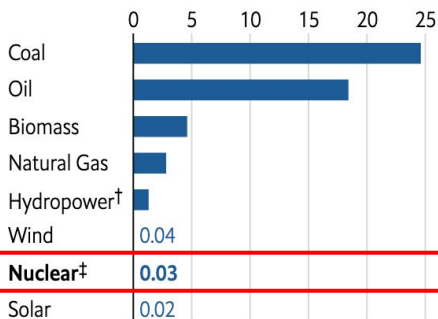
**Emissions vary depending on fuel and treatment of biogenic sources

Source: Our World in Data

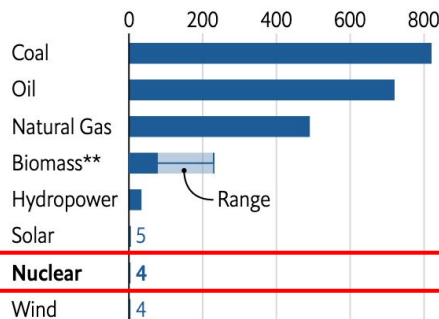
The viewer will **recall** that nuclear is a safe source.

Fuelling the future

Deaths per TWh of energy produced*
1990-2014



Greenhouse-gas emissions, 2017 or latest
CO2 equivalent per GWh of electricity produced§, tonnes



*Based on deaths from accidents and air pollution †Includes Banqiao Dam failure in 1975

‡Includes Chernobyl disaster in 1986 §Over life-cycle of the plant

**Emissions vary depending on fuel and treatment of biogenic sources

Source: Our World in Data

The Economist. "How safe is Nuclear Energy?" 2022.

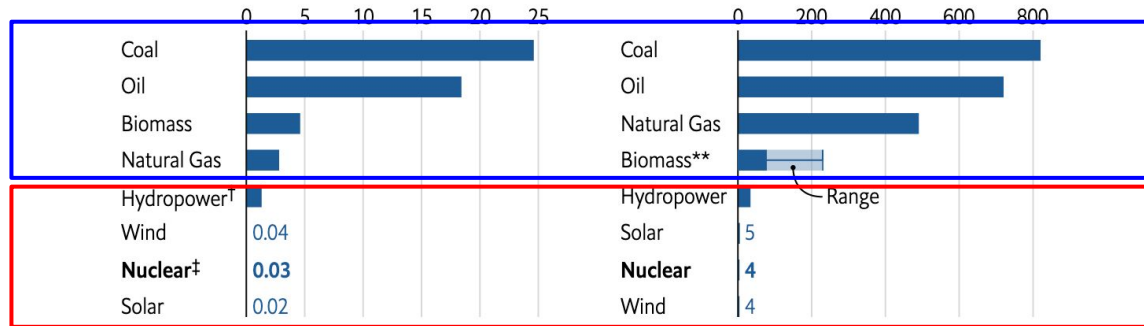
<https://www.economist.com/graphic-detail/2022/07/19/how-safe-is-nuclear-energy>

The viewer will **compare** sustainable energy sources to traditional fossil fuels.

Fuelling the future

Deaths per TWh of energy produced*
1990-2014

Greenhouse-gas emissions, 2017 or latest
CO2 equivalent per GWh of electricity produced[§],
tonnes



*Based on deaths from accidents and air pollution [†]Includes Banqiao Dam failure in 1975

[‡]Includes Chernobyl disaster in 1986 [§]Over life-cycle of the plant

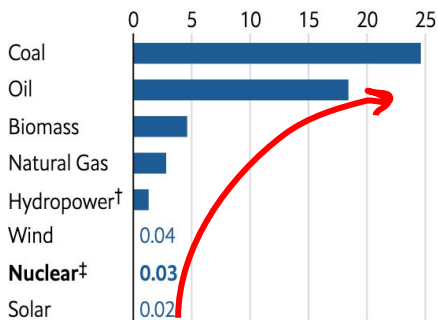
**Emissions vary depending on fuel and treatment of biogenic sources

Source: Our World in Data

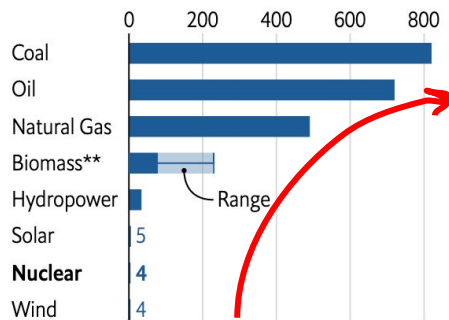
The viewer will **analyze** the correlation between deaths and greenhouse-gas emissions.

Fuelling the future

Deaths per TWh of energy produced*
1990-2014



Greenhouse-gas emissions, 2017 or latest
CO2 equivalent per GWh of electricity produced§, tonnes



*Based on deaths from accidents and air pollution †Includes Banqiao Dam failure in 1975

‡Includes Chernobyl disaster in 1986 §Over life-cycle of the plant

**Emissions vary depending on fuel and treatment of biogenic sources

Source: Our World in Data

The Economist. "How safe is Nuclear Energy?" 2022.

<https://www.economist.com/graphic-detail/2022/07/19/how-safe-is-nuclear-energy>



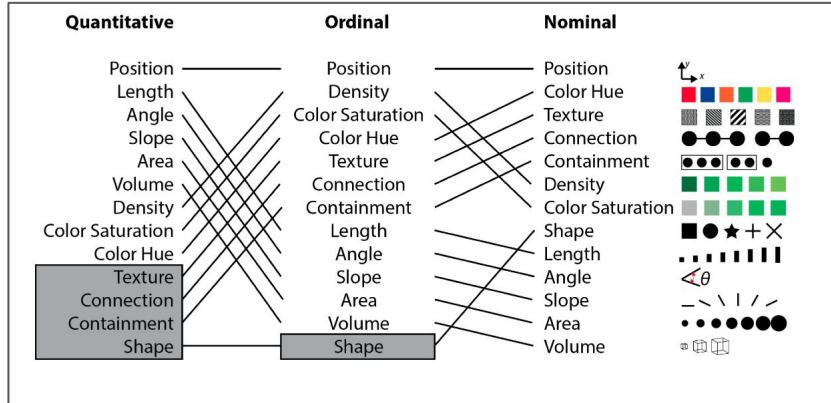
**If you don't know where
you're going, any road
will take you there.**

How specification formats impact design

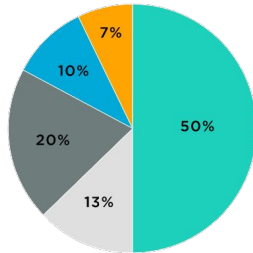
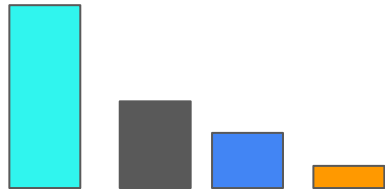
- Specifications: Insights, Learning Objectives, and Assessments
- Designer preferences
- Viewer performance
- Specifications > No guidance at all
- Insights and Learning Objectives > Assessments

Elsie Lee-Robbins, Shiqing (Licia) He, & Eytan Adar (2021). Learning objectives, insights, and assessments: How specification formats impact design. IEEE Transactions on Visualization and Computer Graphics.

How to Choose the Right Chart Type



Mackinlay, J. (1986). Automating the design of graphical presentations of relational information. *Acm Transactions On Graphics (Tog)*, 5(2), 110-141.



Which Visualization?

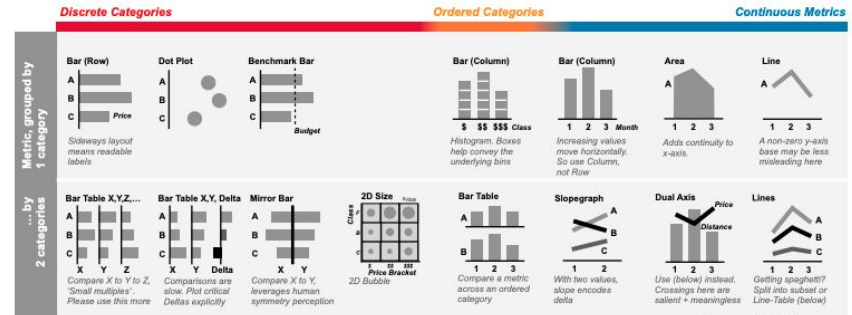
A Quick Reference

You have the following data (sample):

Discrete Categories,
Ordered categories,
and Continuous Metrics

Here's how to plot them

Categories		Ordered Cats		Continuous Metrics			
City	Airline	Class	Price	Bracket	Month	Distance	FlightTime
Alphaville	XeroTrip	Coach	\$		1	300	120
Betastan	YoloFly	Business	\$\$		2	500	185
Chicago	ZeusAir	First	\$\$\$		3	650	240



ExperCeption.net by Steve Franconeri

Iteration!

Design Principles

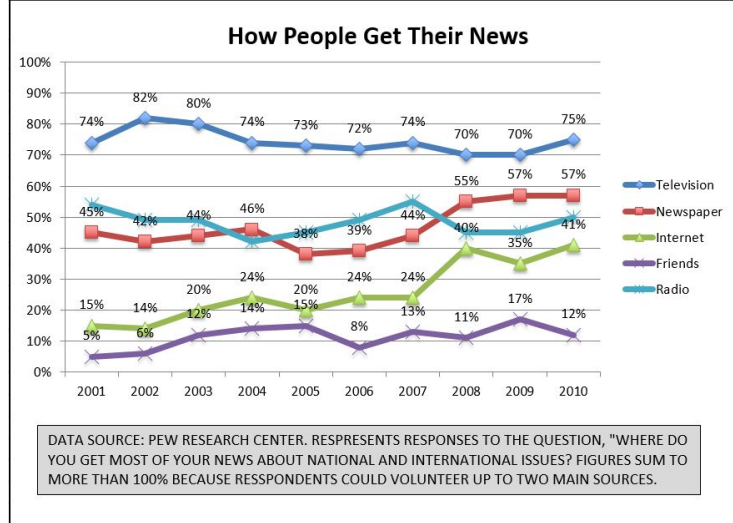
Declutter and Focus

Guidelines: Declutter and Focus

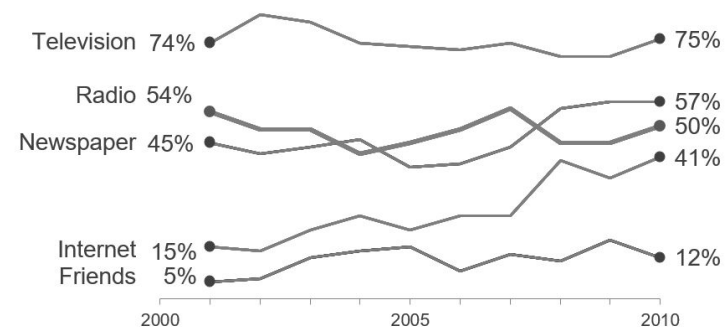
Declutter

- No 3D!
- Only a few colors
- No extraneous data labels
- No extraneous axis ticks
- No extraneous gridlines
- Directly label legend
- Left-align title

Kiran Ajani, Elsie Lee-Robbins, Cole Nussbaumer Knafllic, Cindy Xiong, William Kemper, Steven Franconeri (2021). Declutter and Focus: Empirically evaluating design guidelines for effective data storytelling. IEEE Transactions on Visualization and Computer Graphics.



How people get their news



Source: Pew Research Center Poll. Represents responses to the question *Where do you get most of your news about national and international issues?* Figures sum to more than 100% because respondents could volunteer up to two main sources.

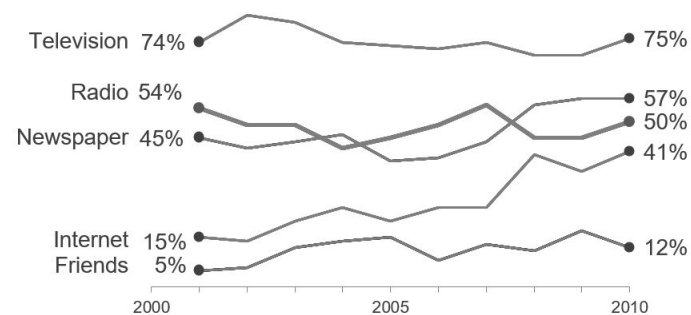
Guidelines: Declutter and Focus

Focus

- Titles that summarize the main conclusion
- Add annotations to point out interesting trends
- Use color to guide the reader

Kiran Ajani, Elsie Lee-Robbins, Cole Nussbaumer Knafllic, Cindy Xiong, William Kemper, Steven Franconeri (2021). Declutter and Focus: Empirically evaluating design guidelines for effective data storytelling. IEEE Transactions on Visualization and Computer Graphics.

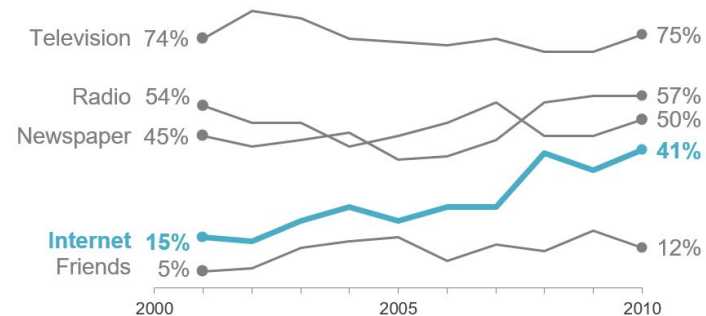
How people get their news



Source: Pew Research Center Poll. Represents responses to the question *Where do you get most of your news about national and international issues?* Figures sum to more than 100% because respondents could volunteer up to two main sources.

How people get their news

An increasing proportion cite the **internet** as their primary news source



Source: Pew Research Center Poll. Represents responses to the question *Where do you get most of your news about national and international issues?* Figures sum to more than 100% because respondents could volunteer up to two main sources.

Context and Other Media

- In a tweet or an instagram post
- Embedded in an article
- Featured in a video
- Alongside personal narratives
- Presented by a narrator

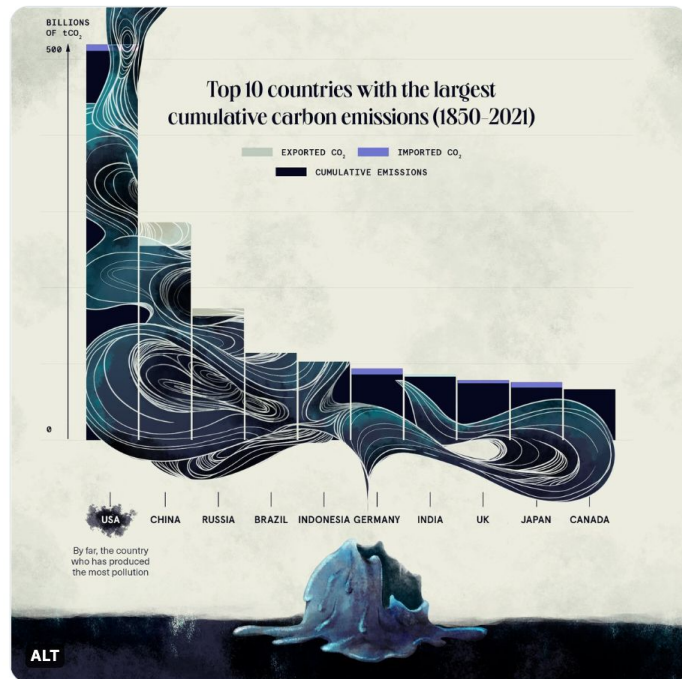


Gabrielle Merite (She/Her)

@Data_Soul



Here is the top 10 countries with the largest cumulative carbon emissions from 1851 to 2021. The U.S is leading the pack.



1:01 PM · Nov 8, 2021 · Twitter Web App

Affective Intent

Reaction or a response to an appraisal, attitude, or value

U.S. GUN KILLINGS IN 2018

11,356
PEOPLE KILLED

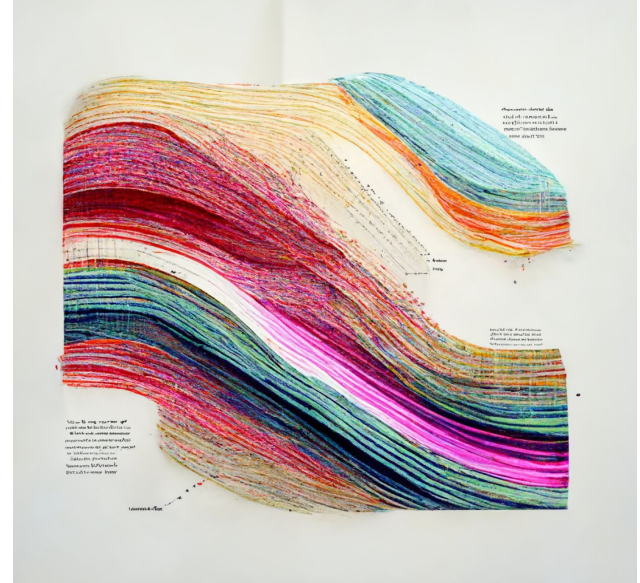
472,332
STOLEN YEARS



Periscope, 2018. guns.periscope.com

Affective Objectives

- Data visualizations are not neutral
- Some designers perceive that “persuasive” goals are not socially acceptable
- Designers should acknowledge their affective intent and subjective biases



Elsie Lee-Robbins & Eytan Adar (2022). Affective Learning Objectives for Communicative Visualizations. IEEE Transactions on Visualization and Computer Graphics.

Storytelling with Data Visualizations

Purpose/Goals

- Who is your audience?
- What is your communicative intent?

Storytelling with Data Visualizations

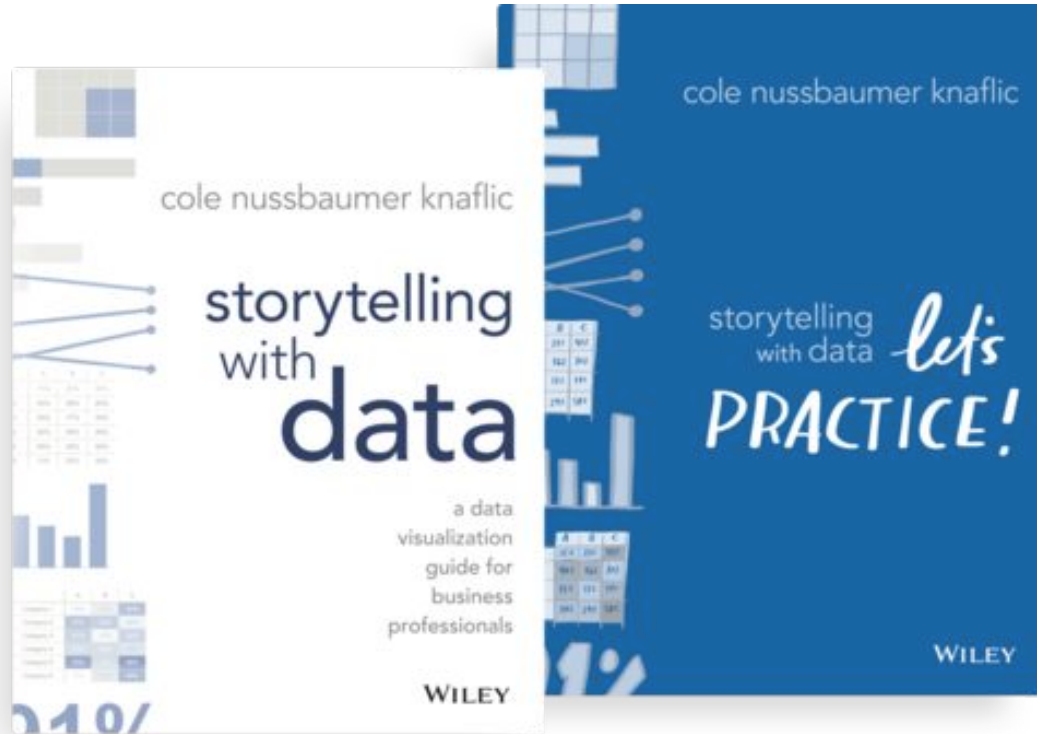
Purpose/Goals

- Who is your audience?
- What is your communicative intent?

Design Decisions

- What is the best visualization format?
- Declutter and Focus
- Get feedback! Test it out! Iterate!

Storytelling with Data by Cole Nussbaumer Knaflic





Thank you!

Elsie Lee-Robbins

elsielee@umich.edu

www.elsieleerobbins.com

[@elsieleerobbins](#)

Additional Resources

Some of my personal favorite books:

- **Data Feminism** by Catherine D'Ignazio and Lauren F. Klein (favorite)
- **How Charts Lie** by Alberto Cairo
- **Data Sketches** by Nadieh Bremer and Shirley Wu (fun!)
- **Making Numbers Count** by Chip Heath and Karla Starr (not about dataviz specifically, but a recent favorite of mine)

Colors:

- [ColorBrewer](#)
- [Viz Palette](#)
- [Coolers](#) (more just for fun)
- [More Info](#)

More places I like:

- [The Pudding](#)
- [Nightingale](#)
- [Data Visualization Society](#)