Creating more effective charts
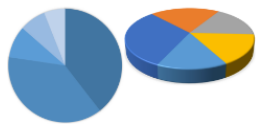
2024 MIDFIELD Institute

Richard Layton resides online at
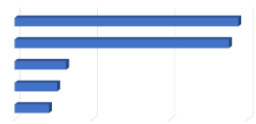
- `https://www.graphdoctor.com`
- `https://github.com/graphdr`

Perception, reasoning, and credibility

Effective alternatives to pie charts
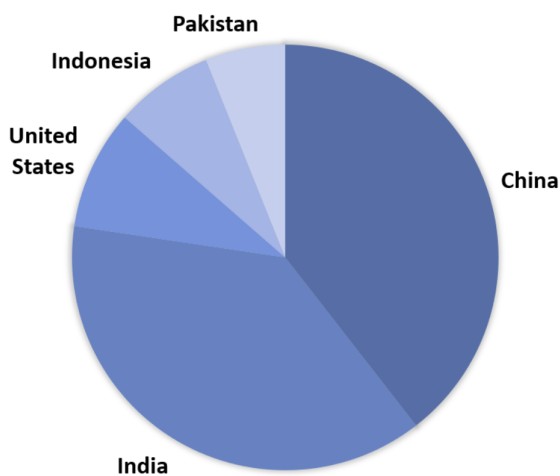
Effective alternatives to bar charts
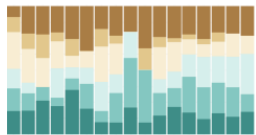
Aligning the design to the story

Advice from experts

§ Effective alternatives to pie charts

Judging pie slices is a low-accuracy task

- *Visually estimate* each country's percentage
- Fill-in the blanks in the table
- Total should be 100%

Country	Percentage
China	
India	
United States	
Indonesia	
Pakistan	

Data source: World Bank (2022)

Judging values along a common axis is a high-accuracy task

- The new chart displays the same data

- *Visually estimate* the percentages using the new chart

- Fill-in the blanks in the table

The data from the pie chart is shown below as dots along a common scale.

Country	Percentage
China	
India	
United States	
Indonesia	
Pakistan	

3D effects distort our judgment even further
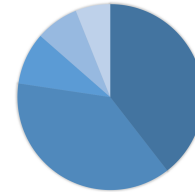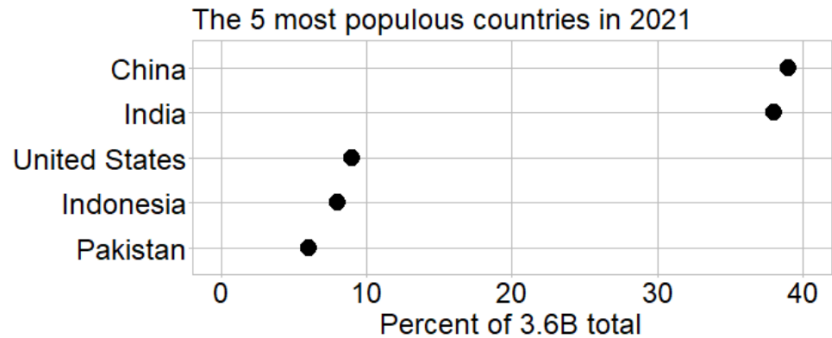

- *Visually estimate* each country's percentage

- Fill-in the blanks in the table

- Total should be 100%

| Country	Percentage
Japan	
Germany	
UK	
France	
Italy	

Data source: World Bank (2022)

Again, a common scale improves our visual judgments

- The new chart displays the same data

- *Visually estimate* the percentages using the new chart

- Fill-in the blanks in the table

The data from the pie chart is shown below as dots along a common scale.

Country	Percentage
Japan	
Germany	
UK	
France	
Italy	

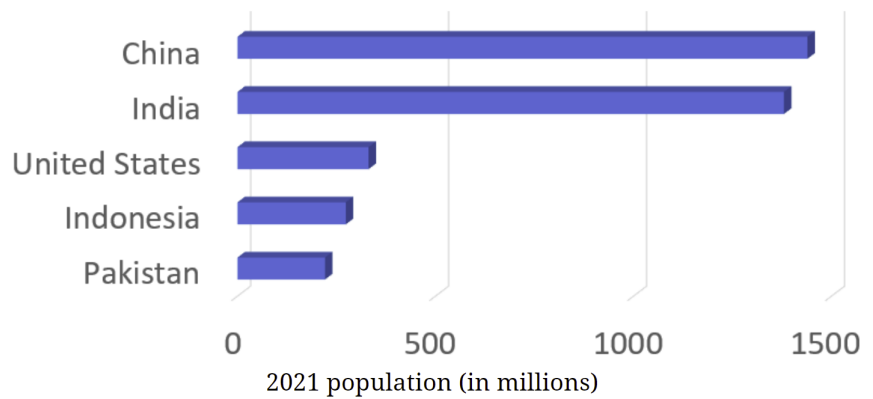Population of selected countries in 2021
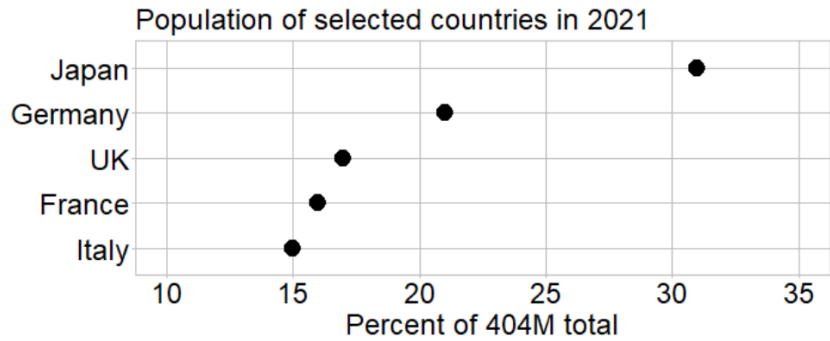
§ Effective alternatives to bar charts

3D effects always distort our judgment

- *Visually estimate* each country's population in millions

- Fill-in the blanks in the table

Country	Millions
China	
India	
United States	
Indonesia	
Pakistan	

2021 population (in millions)

Data source: World Bank (2022)

Same data—without 3D effects—along a common scale

- The new chart displays the same data

- Visually estimate the percentages using the new chart

- Fill-in the blanks in the table

The data from the 3D bar chart is shown below as dots along a common scale.

Country	Millions
China	
India	
United States	
Indonesia	
Pakistan	

The 5 most populous countries in 2021
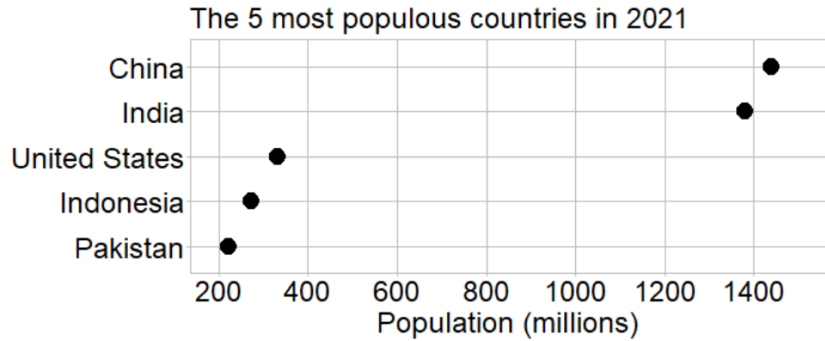
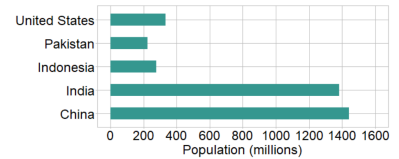*With a zero baseline and no 3D effects, bars are OK*

- Zero baseline avoids deception

- Ordered by data values

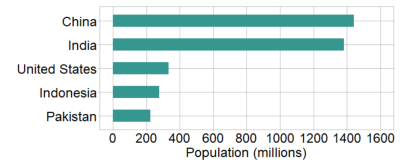- Only the endpoint encodes information

Consider dot charts for

- Visually comparing quantities

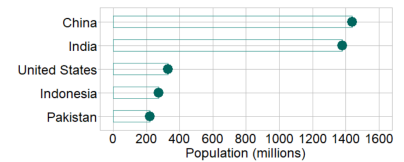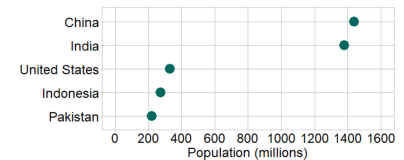- Replacing most pie and bar charts

Notes

Default bar chart:

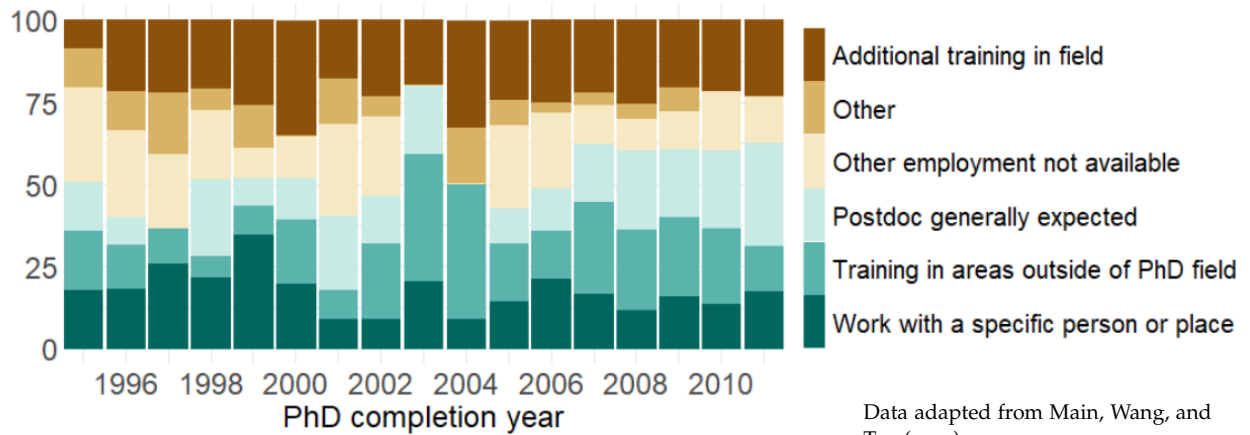Ordered by magnitude:

Omitting the fill color:

Produces a dot chart:

§ Aligning the design to the story

Visual grammar: charts encode information

Survey: "What was your reason for taking this postdoc?"
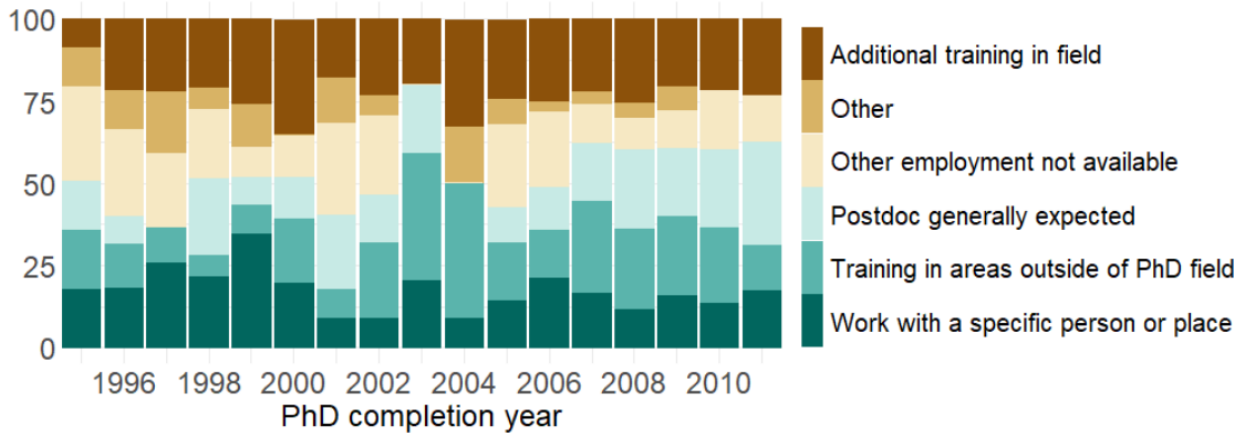

Data adapted from Main, Wang, and Tan (2021)

What information is encoded?

Before discussing what the chart *means*, we first have to agree on what the information *is*.

- Select one color.

- What *information* does the color encode?

- Write your thoughts below.

Visual rhetoric: charts convey meaning

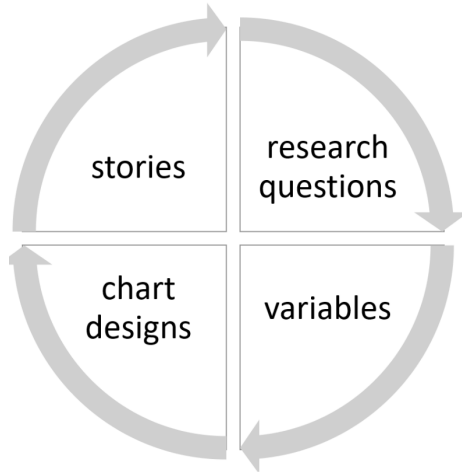Survey: "What was your reason for taking this postdoc?"

What story do these data tell?

We agree on what the information *is*; now we consider what it *means*.

- *Meaning.* Describe a story (if any) this chart conveys *to you*.

- Write your thoughts below.

Visual grammar and rhetoric depend on the variables

- What is your question?
- What variables are measured?
- How are the variables classified?
- What chart designs suit these variables?
- What stories do the charts convey?
- How do the stories refine your questions?
- What new variables are needed?
- Repeat

What can we say about these variables?
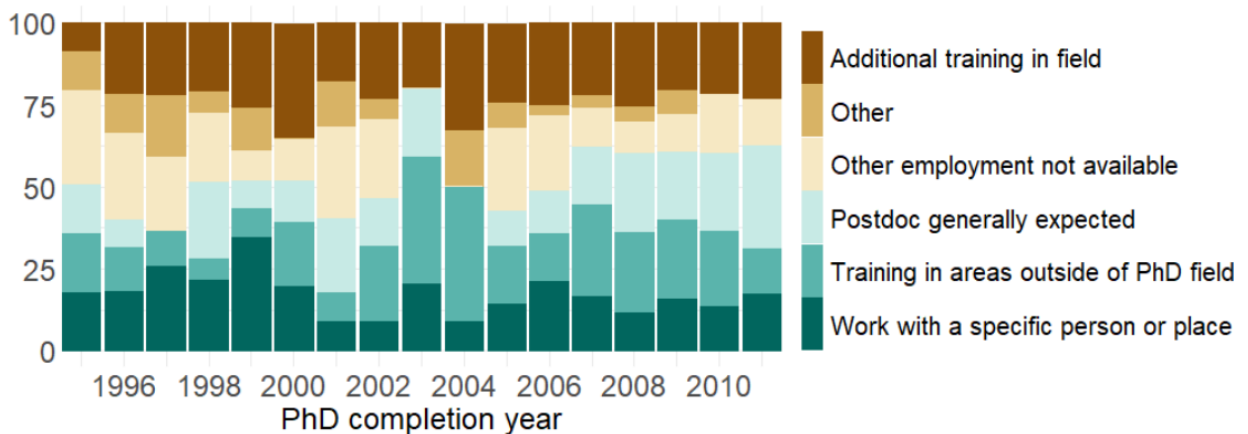

FILL IN THE BLANKS to begin summarizing the data structure.

1. _____PhD completion year_____ is a *categorical* variable.

2. _____ is a *categorical* variable

3. _____ is the *quantitative* variable

4. _____ is the *independent* variable

Note that discrete time units are not 'continuous', so the time units here are an ordered, categorical (not quantitative) variable.
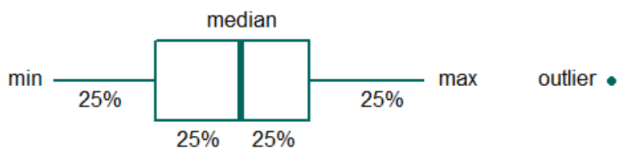
Time series? Use a line chart.

Un-clutter the display using one panel per reason.
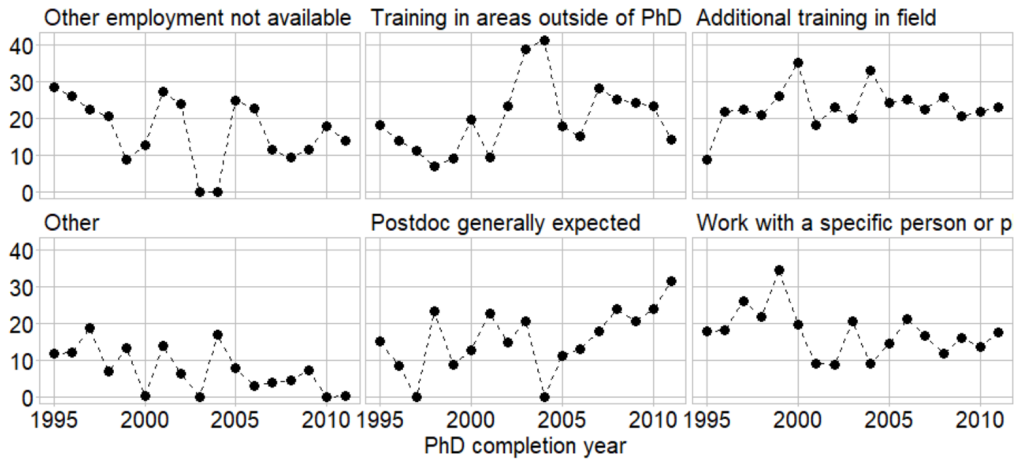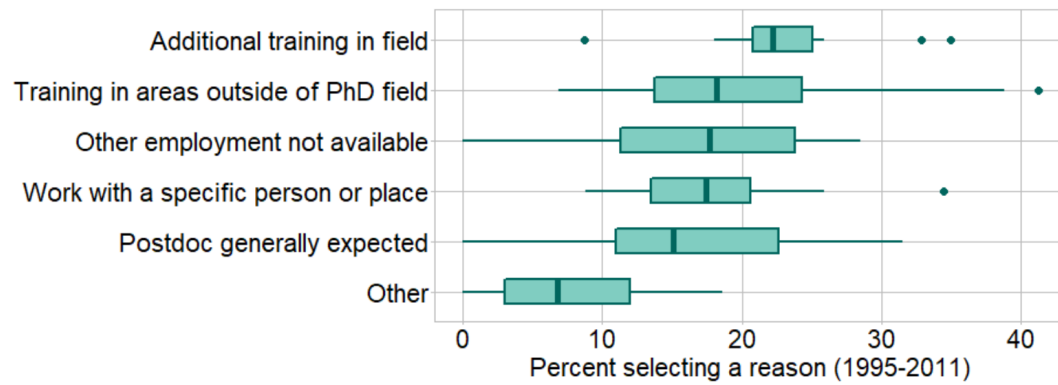

- *Meaning.* Describe a story (if any) this chart conveys *to you*.

- Write your thoughts below.

An unstated assumption underlies the visual muddle

- Emphasizing the trivial

- A distributed quantity is displayed in a box-and-whisker plot.

Distributions? Use a box-and-whisker plot.

- *Meaning.* Describe a story (if any) this chart conveys *to you*.

- Write your thoughts below.

Reflect on perception, reasoning, and credibility
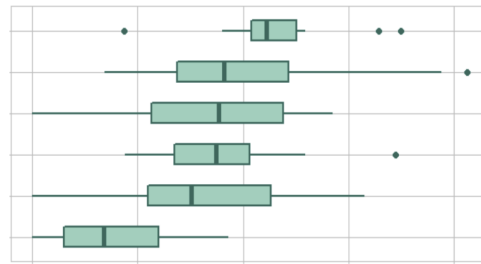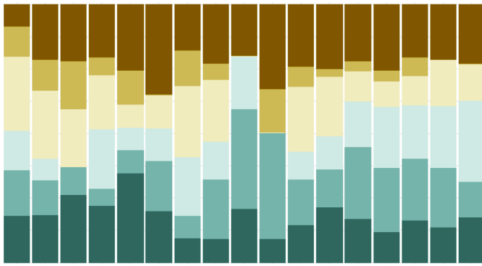
Select any prompt. Compare the stacked bar design to the box-and-whisker chart. Outline your response:

- Compare designs: Quantitative data are *perceived* accurately.

- Compare designs: *Reasoning* about the data is supported effectively.

- Compare designs: An argument is given *credible* visual support.

§ Advice from experts

Match the expert to the advice.

Fill in the blanks with letters A–D.

Expert	Letter	Emphasizes the importance of
A. Alberto Cairo	_____	message
B. Jean-luc Doumont	_____	variables
C. Stephanie Evergreen	_____	revealing the complex
D. Edward Tufte	_____	knowing your main point
	_____	not lying to yourself

Ideas to consider

• Characterize the data structure and content

• Explore a story's context, causality, and complexity

• Align visual and verbal logic by revising iteratively

• Edit to suit the rhetorical goals for each audience

• Control every pixel—avoid thoughtless conformity

• Question are you seeing only what you want to believe?

References

Alberto Cairo. *How Charts Lie*. W.W. Norton, New York, 2019.

Jean-luc Doumont. *Trees, Maps, and Theorems*. Principiae, Belgium, 2009.

Stephanie D. H. Evergreen. *Effective Data Visualization*. Sage, Thousand Oaks, CA, 2017.

Joyce B. Main, Yanbing Wang, and Li Tan. The career outlook of engineering PhDs. *Journal of Engineering Education*, 110(4):977–1002, 2021. URL `https://doi.org/10.1002/jee.20416`.

Naomi Robbins. *Creating More Effective Graphs*. Chart House, Wayne, NJ, 2013.

Edward Tufte. *The Visual Display of Quantitative Information*. Graphics Press, Cheshire, CT, 1983.

World Bank. Population total for United States, 2022-01. URL `https://fred.stlouisfed.org/series/POPTOTUSA647NWDB`.