


# Storytelling with Data

Emorie D. Beck, Ph.D  
University of California, Davis  
@EmorieBeck



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# What Is Data Visualization?

Data visualization is the graphical representation of data and information.



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# What Are the Goals of Data Visualization?

- Summarize complex information
- Reveal difficult to detect trends and patterns in data
- Tell a story with data



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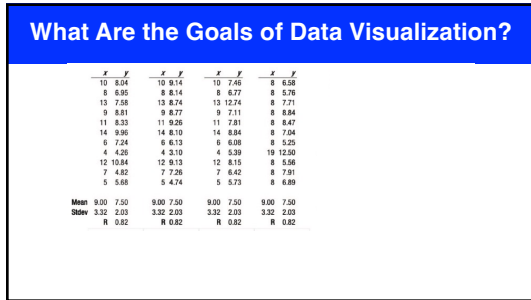
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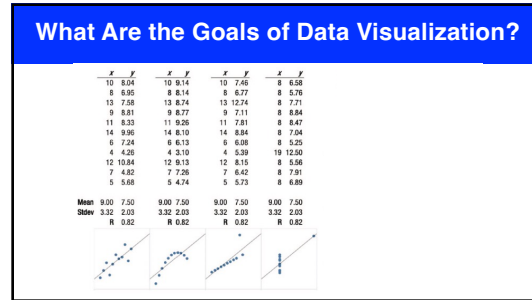
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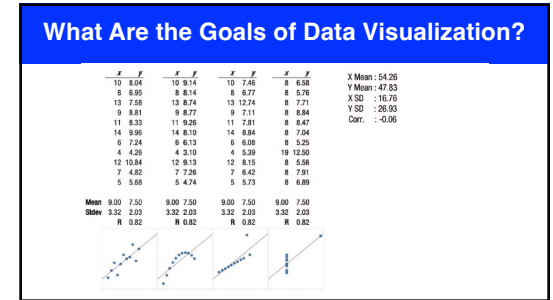
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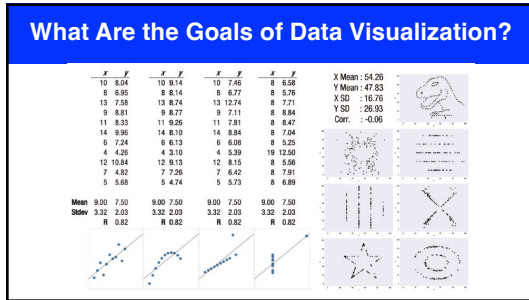
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### Why Should I Care About Data Visualization?

- Helps to clarify complex ideas
- Requires you think through your own ideas and data
- Data visualization is a skill and a rapidly evolving field / tool itself

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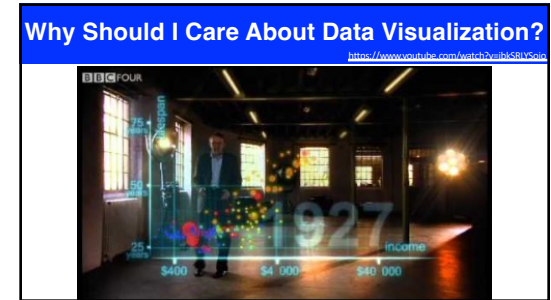
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# Activity #1

Find one example of a data visualization you think is a good and another that you think is not (take your time and look for 5-10 min). Then, share your visualization with a partner and write down what makes each good and/or bad (~5-10 min).

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# Part 1: Principles of Good Visualizations

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# Four Key Questions for Building Good Data Visualizations

What story are you / your data trying to tell?	What type of data visualization will most simply communicate your story?
Who is your audience?	What type of data are you trying to summarize?

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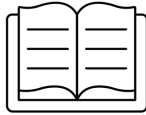
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### What story are you / your data trying to tell?

- Start at the end: what do you want your audience to walk away knowing?
- Your visualization should be a journey to that



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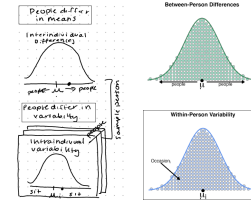
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### What story are you / your data trying to tell?

- Tip: start on paper or tablet and draw your visualization
- The story evolves, so should your visualizations



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### Who is your audience?

- The story you tell should depend on your audience
- Ask yourself: What does your audience know? What do you want your audience to know? What steps connect their current knowledge to that?



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### Who is your audience?

- Avoid jargon
- Use clear titles
- Avoid visual clutter
- Use color effectively, not liberally



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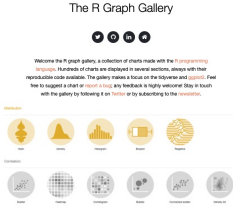
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### What type of data visualization will most simply communicate your story?

- Data visualization requires creativity, but it's also a knowledge-based skill
- Use online resources (e.g., <https://r-graph-gallery.com/>) to browse types of visualization



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### What type of data are you trying to summarize?

Data Type



Visualization Type

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## Activity #2

Go to <https://r-graph-gallery.com>. Browse some of the types of data visualizations. Choose two and write down what kinds of data may be most appropriate for different visualizations (~5-10 min).

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## The Cognitive Psychology of Data Visualization

- There is a whole field of researchers who study how we perceive data visualizations most efficiently and accurately!
- This research draws on Gestalt Principles and Cognitive Psychology to improve visualizations



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## The Cognitive Psychology of Data Visualization

### 6 Common Types of Visual Aesthetics

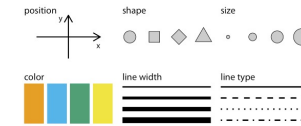


Figure 2.1: Commonly used aesthetics in data visualization: position, shape, size, color, line width, line type. Some of these aesthetics can represent both continuous and discrete data (position, size, line width, color) while others can usually only represent discrete data (shape, line type).

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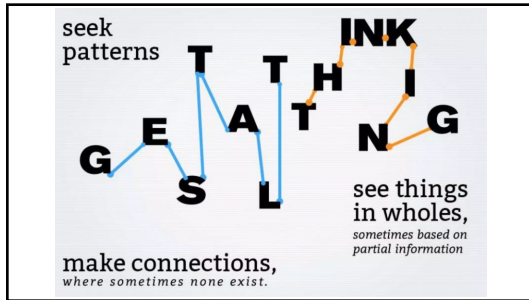
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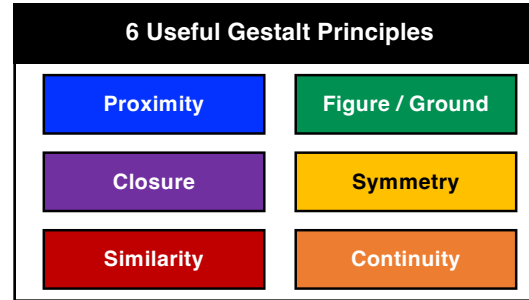
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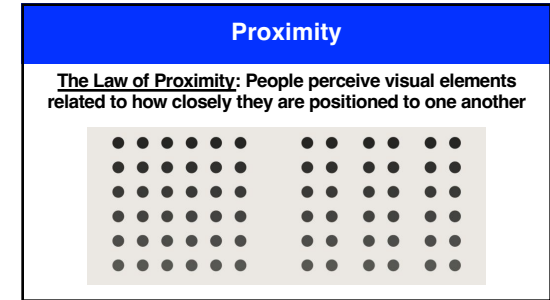
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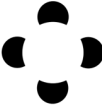
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Closure


The Law of Closure: Our tendency to perceive segmented visual elements as complete or whole objects, even when we're missing



4 SMALL CIRCLES OR  
1 BIG ONE?



5 BLACK SHAPES OR  
1 PANDA BEAR?



3 CURVES OR  
1 FULL BLACK CIRCLE?

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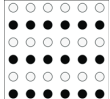
Similarity

The Law of Similarity: the human brain will group together things that appear similar (it also tends to assign them the similar function)


SHAPE



COLOR



SIZE



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Figure / Ground

The Law of Figure / Ground: the brain will unconsciously place objects either in the foreground or the background





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### Symmetry

**The Law of Symmetry:** Visual elements that are symmetrical to each other tend to be perceived as a unified group



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### Continuity

**The Law of Continuity:** human brains tend to perceive any line as continuing its established direction



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## Activity #3

Choose graphs from the previous activities and identify which Gestalt Principles they rely on. Are there other Gestalt Principles that could have improved the visualization?

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## The Cognitive Psychology of Data Visualization

- There is a whole field of researchers who study how we perceive data visualizations most efficiently and accurately!
- For a review see Franconeri et al. (2021)



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## The Cognitive Psychology of Data Visualization

### Principles for Efficient Visualization

1. Use visualizations to allow viewers to powerfully compute statistics
2. Avoid visual processing limits: making comparisons
3. Control comparison with visual grouping cues
4. Guide viewer to the most important comparison
5. Avoid taxing limited working memory

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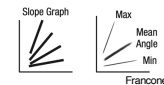
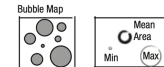
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## The Cognitive Psychology of Data Visualization

1. Use visualizations to allow viewers to powerfully compute statistics



Franconeri et al., 2021

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### The Cognitive Psychology of Data Visualization

2. Avoid visual processing limits: making comparisons

Vision Is Sluggish for Comparisons

Isolating pairs with "larger second values" is tough...

Franconeri et al., 2021

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### The Cognitive Psychology of Data Visualization

2. Avoid visual processing limits: making comparisons

Vision Is Sluggish for Comparisons

Isolating pairs with "larger second values" is tough...

So guide viewers to the right comparisons

Tool: Shortcut comparisons by adding direct depictions of the deltas, as below

Franconeri et al., 2021

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### The Cognitive Psychology of Data Visualization

2. Avoid visual processing limits: making comparisons

Vision Is Sluggish for Comparisons

Isolating pairs with "larger second values" is tough...

So guide viewers to the right comparisons

Tool: Shortcut comparisons by adding direct depictions of the deltas, as below

Franconeri et al., 2021

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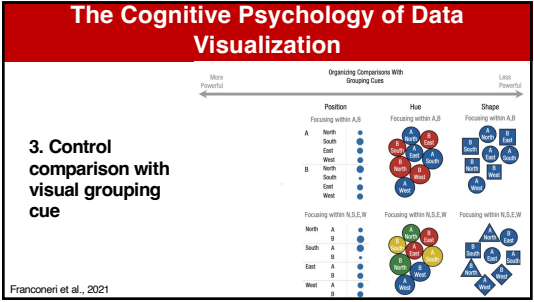
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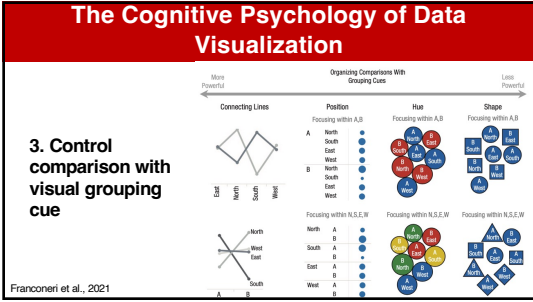
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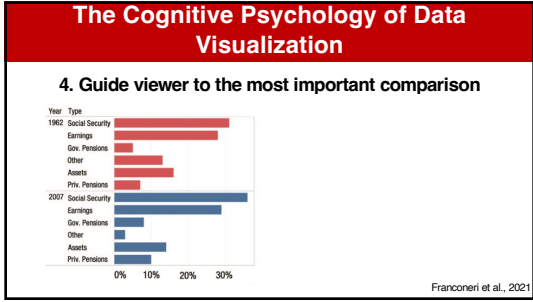
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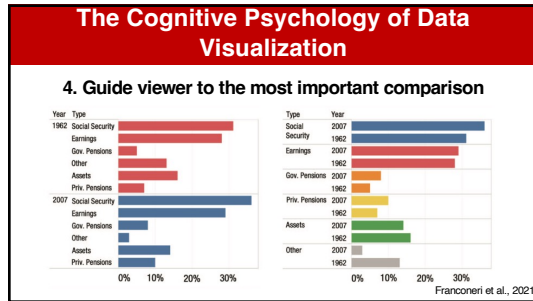
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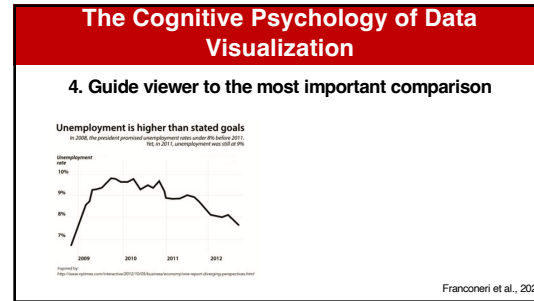
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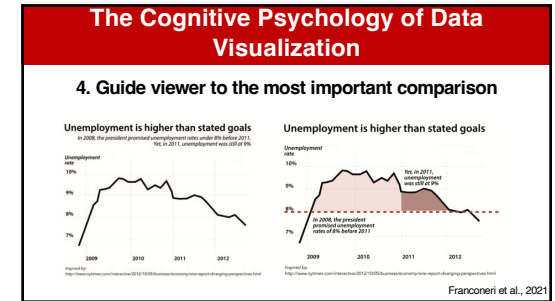
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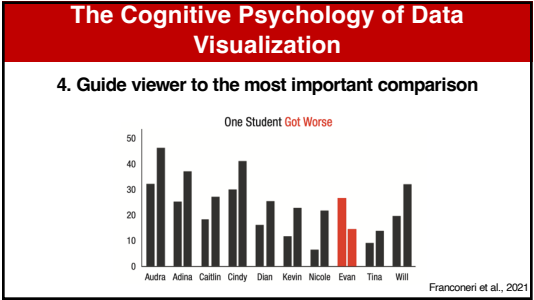
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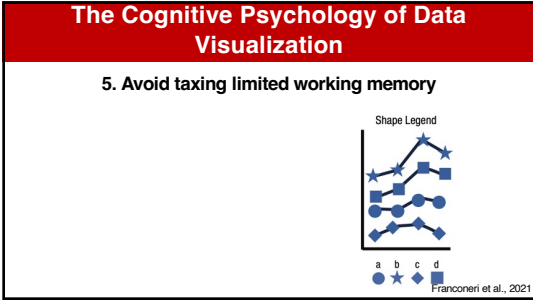
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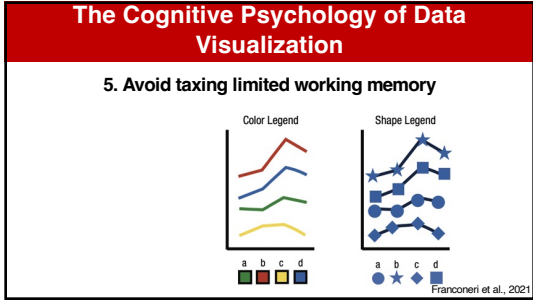
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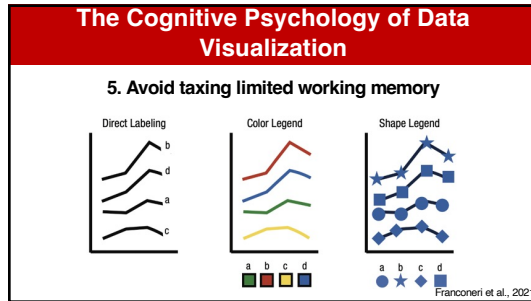
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- ### Some Final Notes
1. Increase your font size on all labels and titles
  2. Use colorblind friendly palettes
  3. Note all visualizations reflect data. Adobe, powerpoint, etc. are great tools for this.
  4. Good visualizations can take time, planning, and feedback
  5. Avoid 3D visualizations in most cases
  6. Use animations and interactive graphics sparingly / when appropriate
  7. Have fun!

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Part 2:

## Building Data Visualizations

Tool: <https://www.graphica.app/>  
 Data: <https://tinyurl.com/mvvs6ne>

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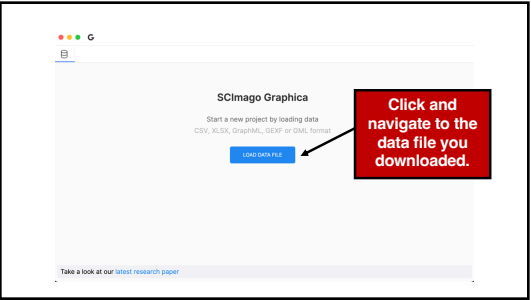
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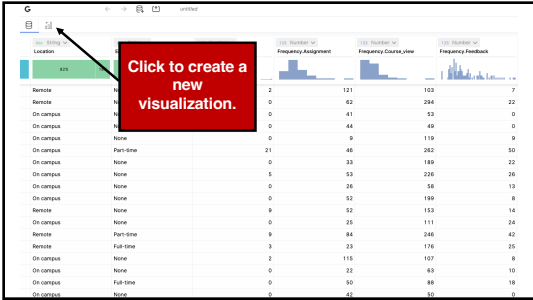
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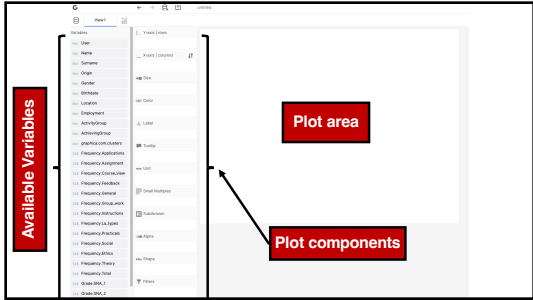
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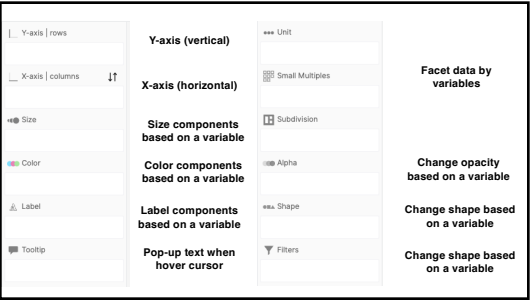
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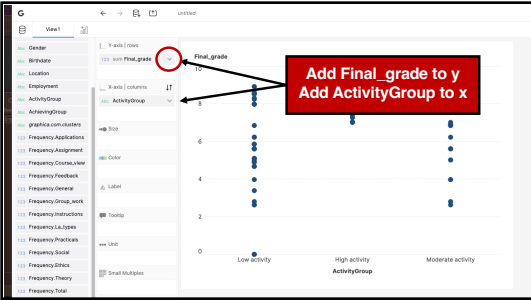
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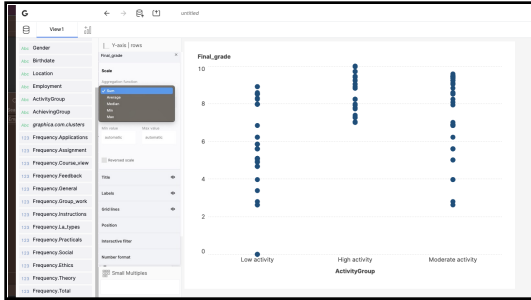
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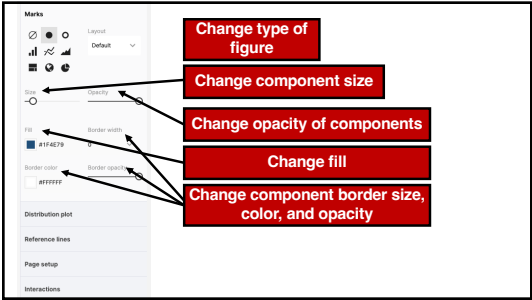
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# Activity #4

1. Choose two continuous variables and create a figure with a trend line, with color based on a categorical variable and size based on a frequency variable.
2. Choose one continuous and one categorical variable and create a figure with color based on a second categorical variable, and small multiples based on a third categorical variable.
3. Choose two categorical variables and create a figure capturing the proportion of people in different groups.

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## Resources & Learning More

- Wilke's [Fundamentals of Data Visualization](#)
- Healy's [Perception in Visualization](#)
- Healy's [course site](#)
- [Kazakova \(2021\)](#)
- [Franconeri \(2021\)](#)
- Jessica Hullman's [website](#)
- Matthew Kay's [work on visualizing uncertainty](#)
- My (2022) [course GitHub](#)

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