

Qualitative Visualization Tips

STAT 3280

Data Visualization and Management

Lecture Material 9

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Fall 2022



Creating Effective Visuals

Five points of emphasis:

1. Simplicity is best
2. Add blank space
3. Don't distort your data
4. Make comparison easy
5. Highlight your message

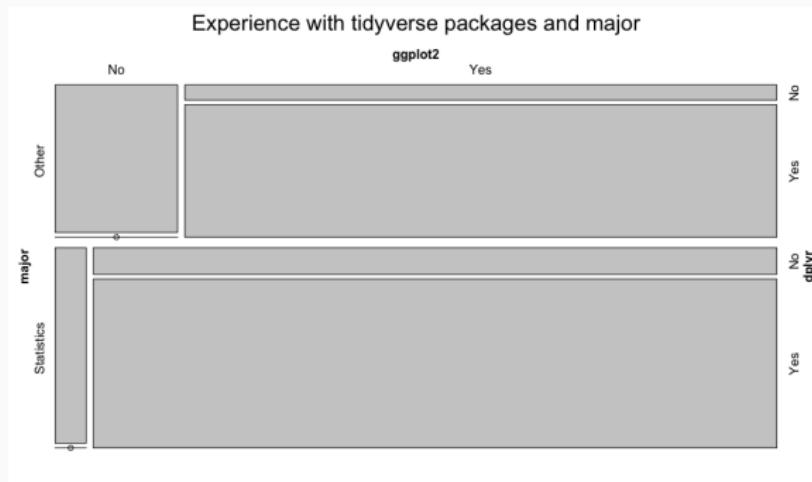
Creating Effective Visuals

1. Simplicity is best

Selection of plot type:

- No need to “reinvent the wheel” - choose a plot type that will effectively convey the subject without over-complicating the data

Too complicated?

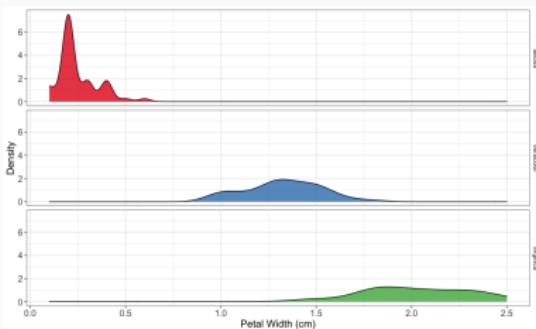
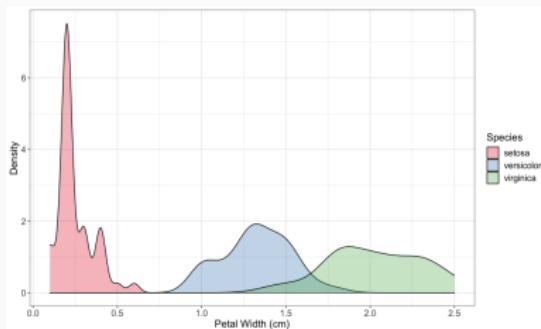


Creating Effective Visuals

1. Simplicity is best

Adjacent panels:

- Use as few plotting areas as possible while avoiding excess clutter



Creating Effective Visuals

1. Simplicity is best

Title, caption, and labels:

- Visuals should not require a paragraph explanation

Box 2

The INORMS Research Evaluation Group, in partnership with rankings expert Dr Richard Holmes, produced a rating of six key global university rankings in 2021. Using 20 community-sourced criteria across four main themes (good governance, rigour, transparency, and measure what matters) experts were invited to assess the ranking agencies both qualitatively and quantitatively. The assessment found that all rankers fell short of the community expectations, with the higher-profile agencies faring worse than others.



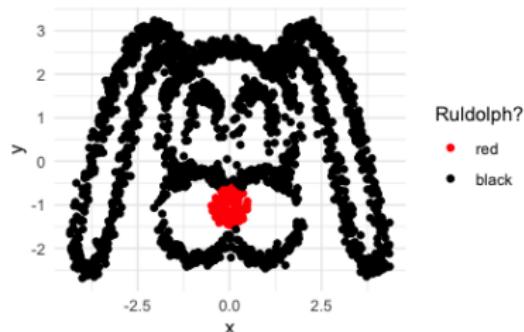
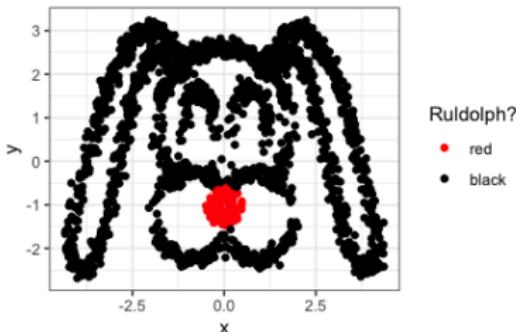
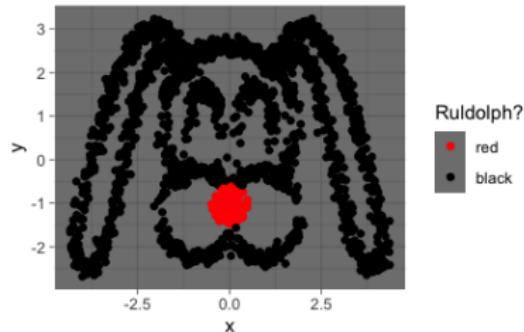
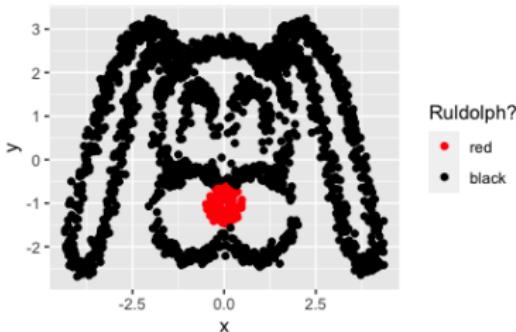
Figure 2: Global university ranking agencies assessed by international experts against criteria including transparency and rigour.

Barnett, A. and Gadd, E. (2022), University league tables have no legs to stand on. Significance, 19: 4-7. <https://doi.org/10.1111/1740-9713.01663>

Creating Effective Visuals

2. Add blank space

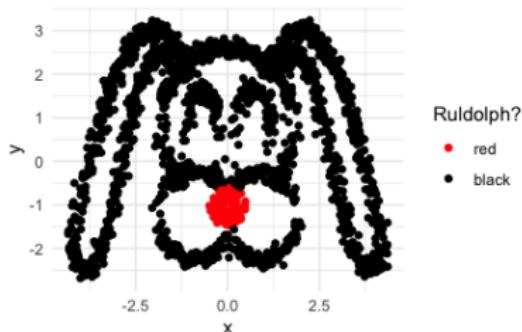
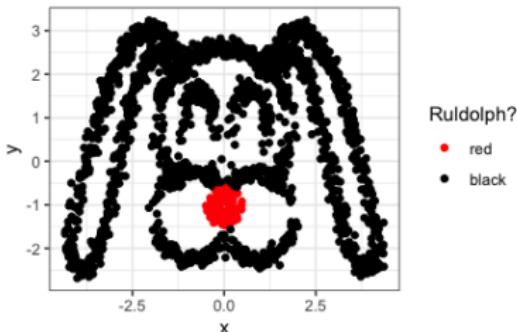
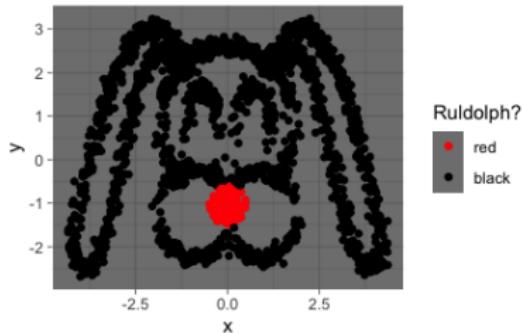
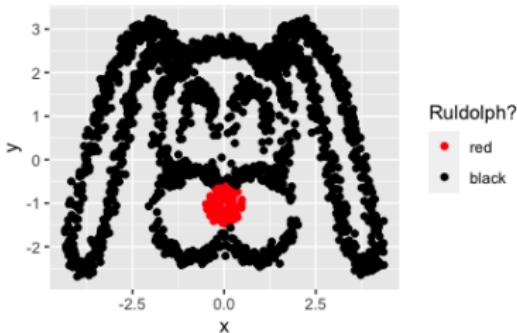
→ reduce noise in your plotting area!



Creating Effective Visuals

2. Add blank space

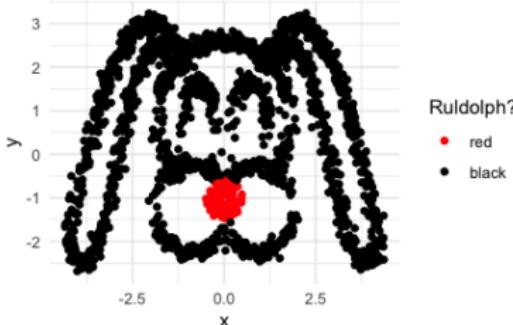
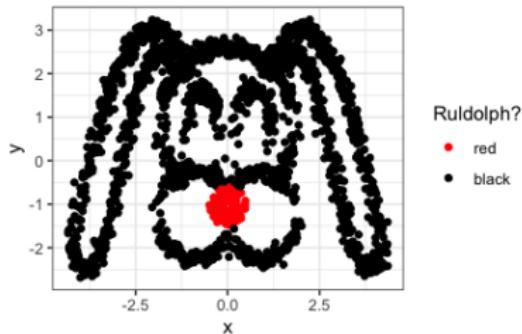
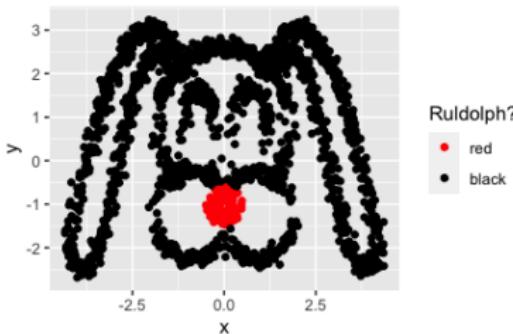
What is the benefit of a background color?



Creating Effective Visuals

2. Add blank space

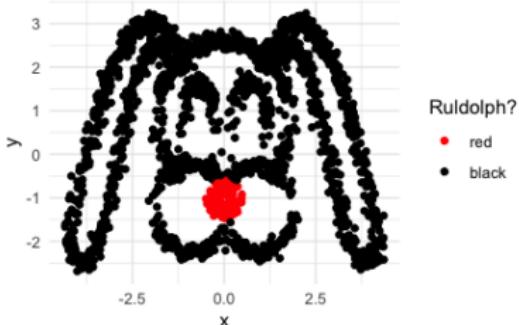
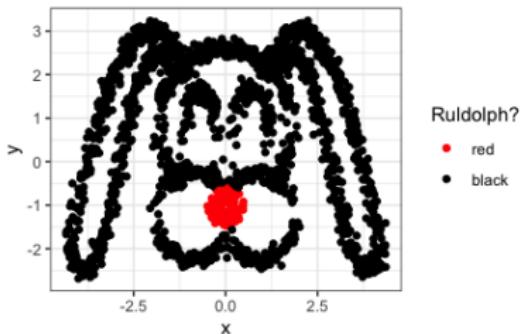
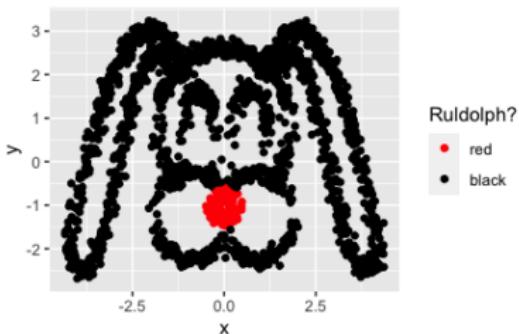
What is the benefit of a plot outline?



Creating Effective Visuals

2. Add blank space

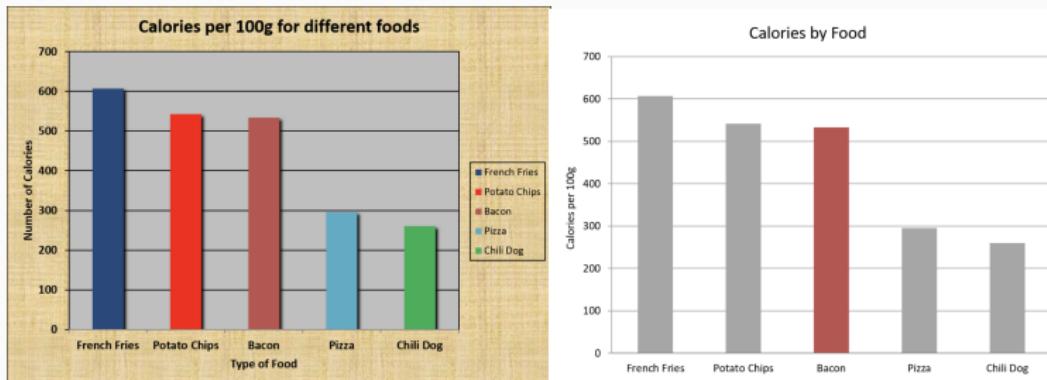
What is the benefit of grid lines?



Creating Effective Visuals

2. Add blank space

Extreme example from the textbook:



Data Visualization with R by Rob Kabacoff,
<https://rkabacoff.github.io/datavis/>

Creating Effective Visuals

2. Add blank space

Questions when working with a plot theme:

1. Do you need a frame of reference?
2. Do grid lines make comparison easier? (more discussion later)
3. Is there a concrete meaning to variable values?

→ choose the most basic theme that retains pertinent information!

→ blank space allows for a less cluttered, more clear visual!

Creating Effective Visuals

3. Don't distort your data

Axis scaling should allow for truthful interpretation!

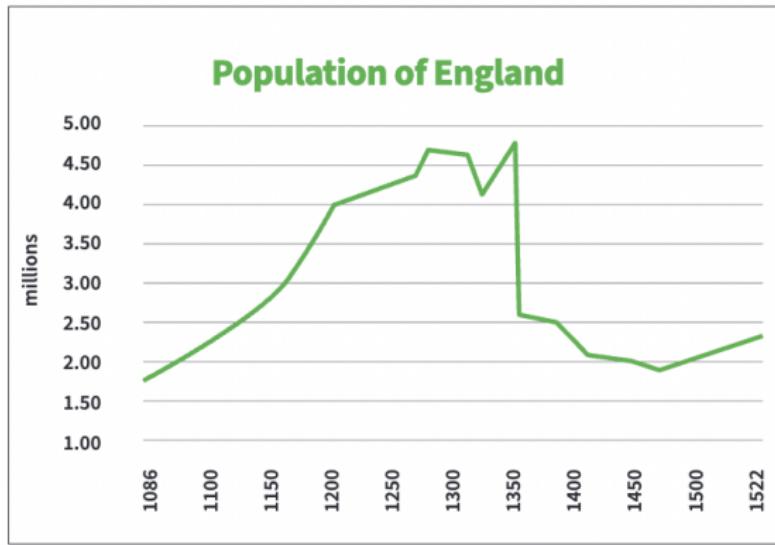


Figure 1: Estimated population of England, 1086–1522. Source: Broadberry et al., (2015) *British Economic Growth, 1270–1870*

Walker, J.T., Lee, J.S. and
Broadberry, S. (2022),
Measuring the Middle Ages.
Significance, 19: 16-23.
<https://doi.org/10.1111/1740-9713.01669>

Creating Effective Visuals

3. Don't distort your data

Log scales are a truthful, monotonic representation:

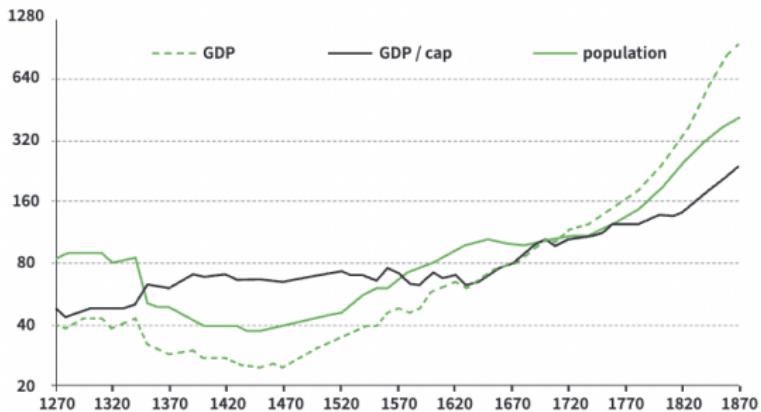


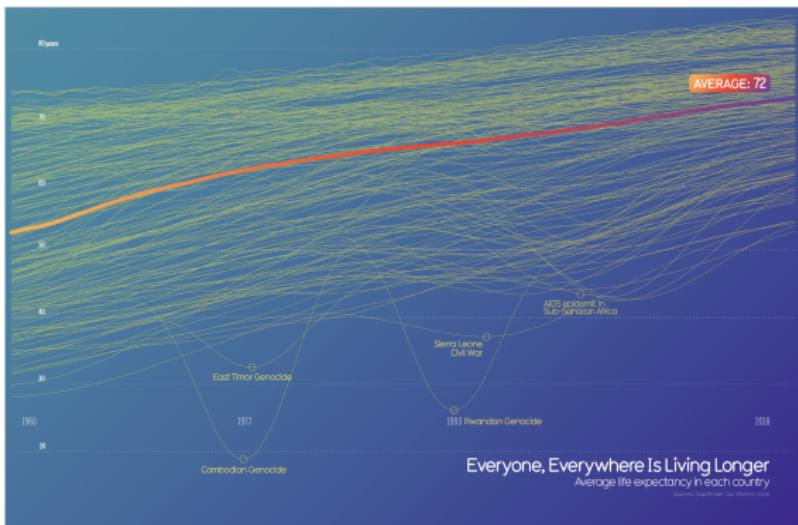
Figure 1: Real GDP, population and real GDP per head, England 1270–1700 and Great Britain 1700–1870 (averages per decade, log scale, 1700 = 100).³

Walker, J.T., Lee, J.S. and Broadberry, S. (2022), Measuring the Middle Ages. Significance, 19: 16-23.
<https://doi.org/10.1111/1740-9713.01669>

Creating Effective Visuals

3. Don't distort your data

Does restricting the y-axis hurt the data presentation?



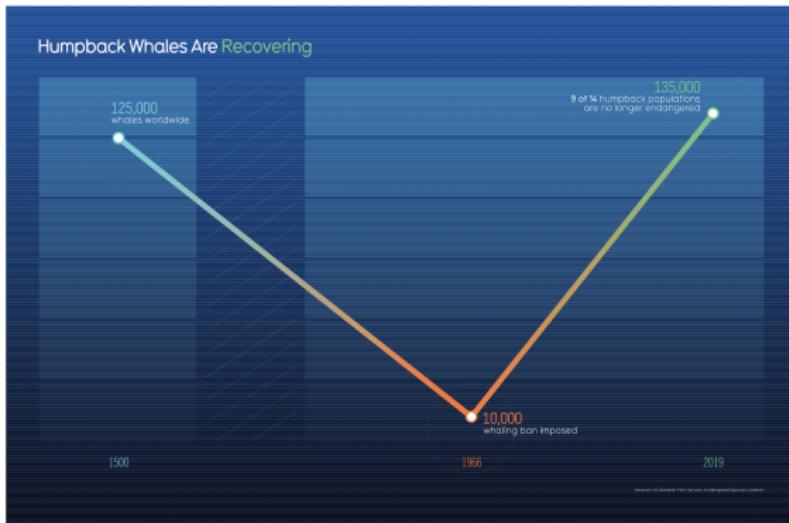
Above: Everyone, Everywhere Is Living Longer, a data visualisation taken from David's latest book *Beautiful News* (NB: based on data up to 2019).

Britten, A. (2022),
"Statisticians are particularly
attuned to the beauty of
uncertainty". *Significance*, 19:
36-40.
<https://doi.org/10.1111/1740-9713.01673>

Creating Effective Visuals

3. Don't distort your data

Does the oversimplification distort the data, or help the message?



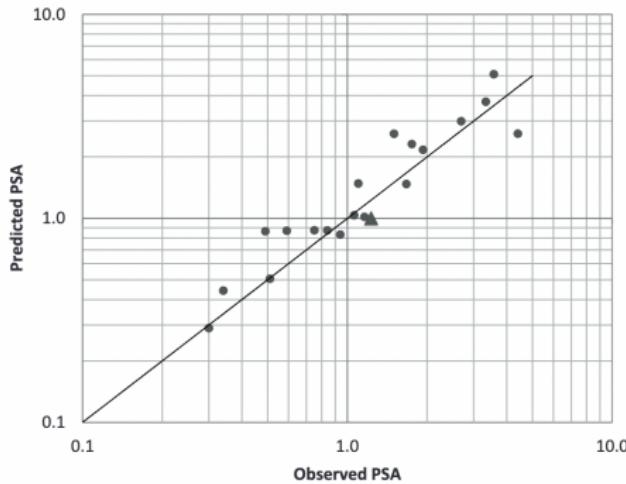
Above: Humpback Whales Are Recovering, from the book *Beautiful News*. Conservation data feature heavily in this collection of uplifting visualisations.

Britten, A. (2022),
"Statisticians are particularly
attuned to the beauty of
uncertainty". *Significance*, 19:
36-40.
<https://doi.org/10.1111/1740-9713.01673>

Creating Effective Visuals

3. Don't distort your data

Additional grid lines can help show the altered axis scales:



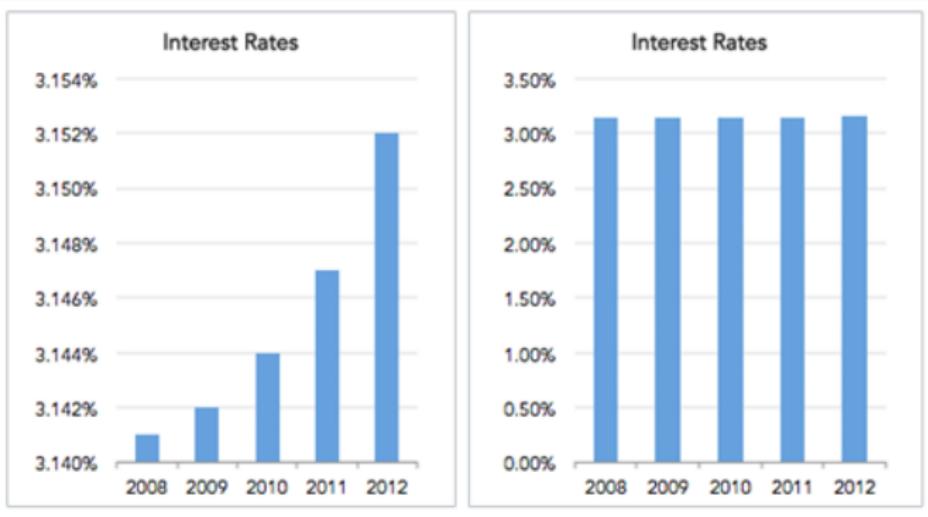
Rothman, J. (2022), My prostate predictions.
Significance, 19: 42-45.
<https://doi.org/10.1111/1740-9713.01674>

Figure 4: Logarithmic chart of predicted against observed PSA.

Creating Effective Visuals

3. Don't distort your data

Does restricting the y-axis distort the data?



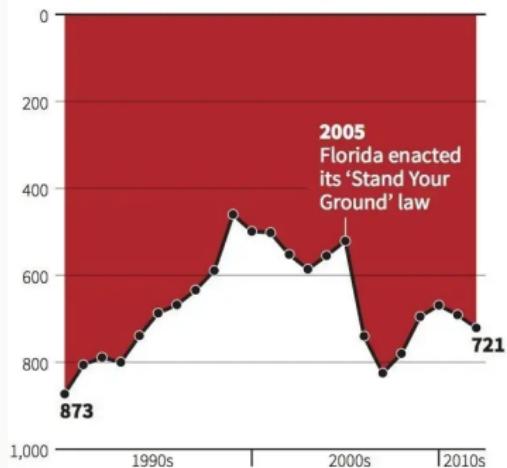
Creating Effective Visuals

3. Don't distort your data

Axis should allow for truthful interpretation!

Gun deaths in Florida

Number of murders committed using firearms



Source: Florida Department of Law Enforcement

C. Chan 16/02/2014

REUTERS

Creating Effective Visuals

3. Don't distort your data

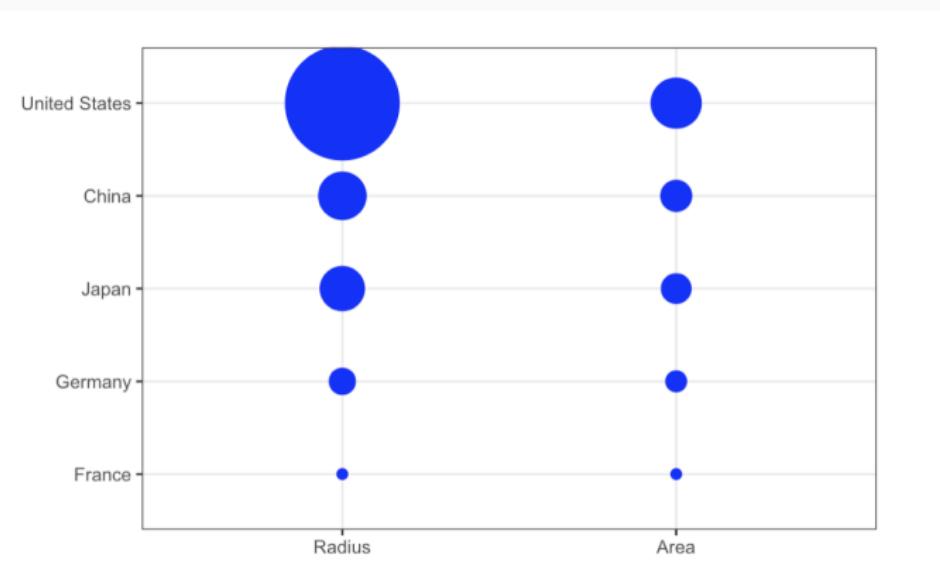
Relative plot aesthetics matter too!



Creating Effective Visuals

3. Don't distort your data

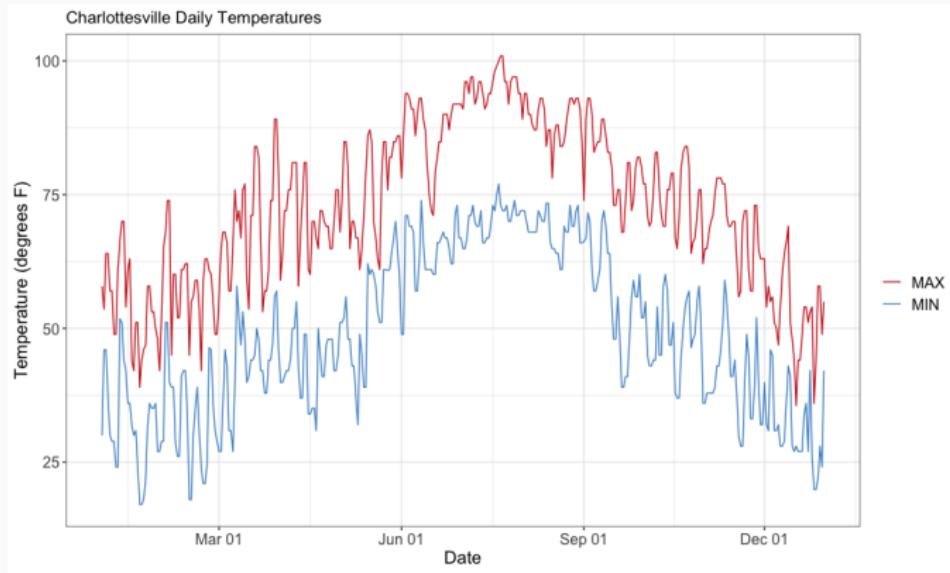
Relative plot aesthetics matter too!



Creating Effective Visuals

4. Make comparison easy

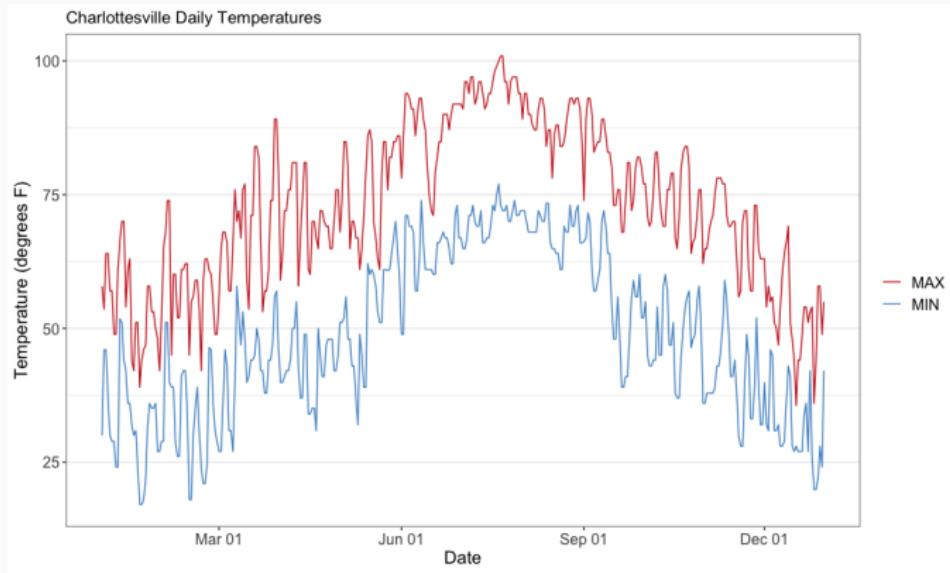
Use grid lines perpendicular to key variable(s)?



Creating Effective Visuals

4. Make comparison easy

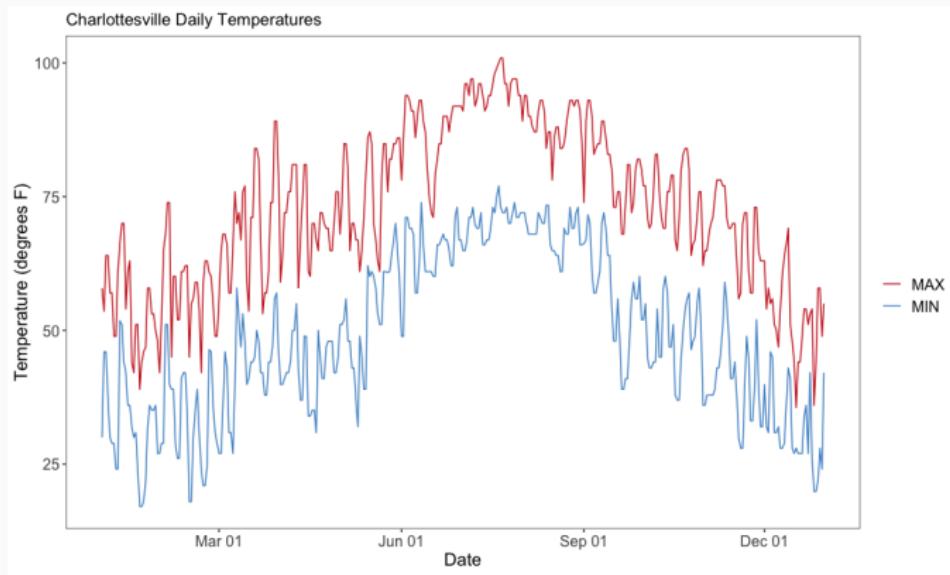
Use grid lines perpendicular to key variable(s)?



Creating Effective Visuals

4. Make comparison easy

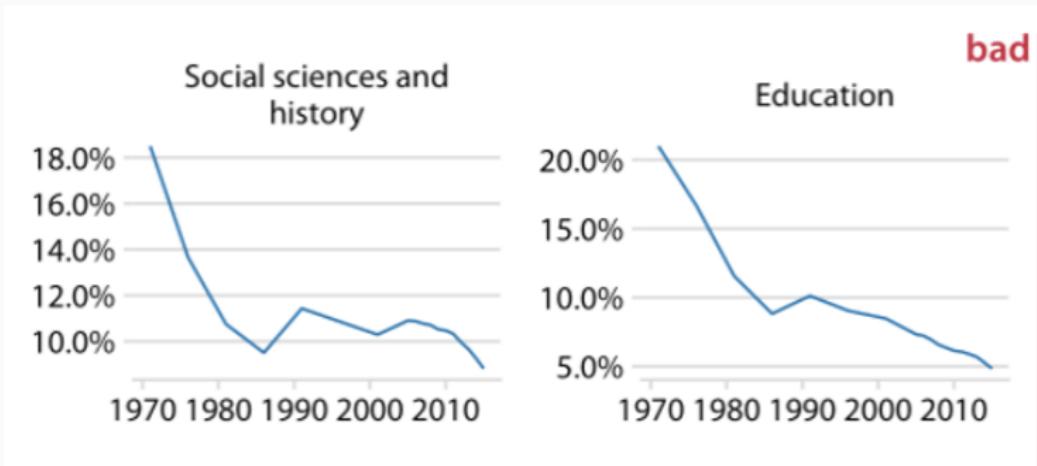
Use grid lines perpendicular to key variable(s)?



Creating Effective Visuals

4. Make comparison easy

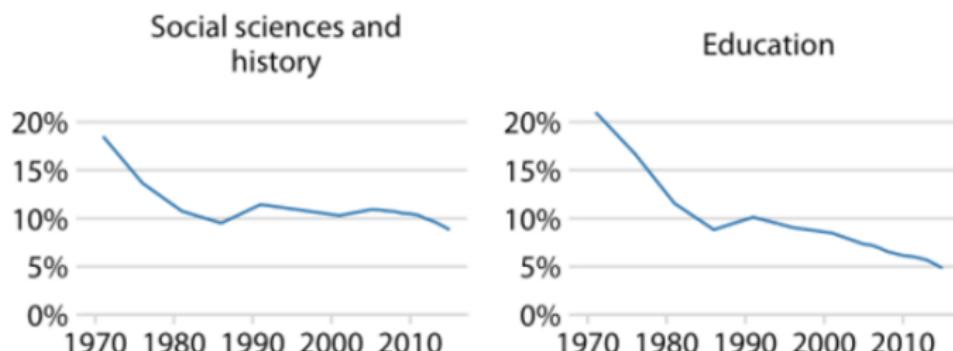
Axis scales should allow for comparison:



Creating Effective Visuals

4. Make comparison easy

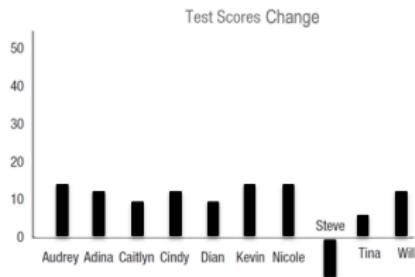
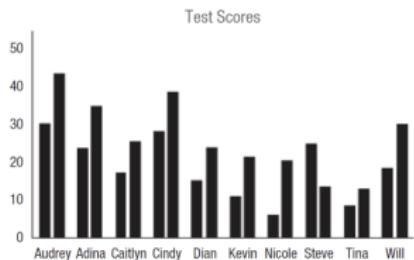
Shared axes with the same variable should have comparable scales!



Creating Effective Visuals

4. Make comparison easy

Plot type and data selection:



Creating Effective Visuals

4. Make comparison easy

Visual channels by perceptual precision:

1. Position
2. Length
3. Area
4. Angle
5. Intensity

What information do you want to convey most precisely?

Creating Effective Visuals

4. Make comparison easy

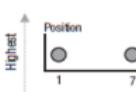
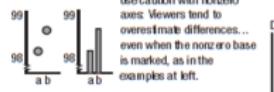
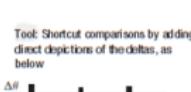
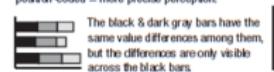
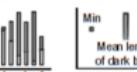
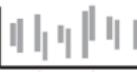
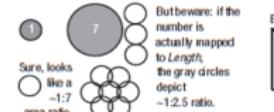
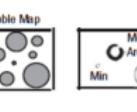
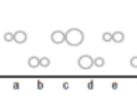
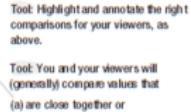
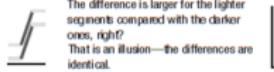
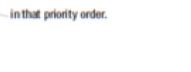
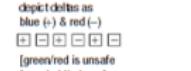
Absolute Precision Ranking for Seeing a Single Ratio	Common Illusions That Distort Data	Vision Is Powerful for Global Statistics	Vision Is Sluggish for Comparisons
Visual estimation of the 1:7 ratio is noisier toward bottom	Caveats for the visual encoding in each row	For each visualization, statistics are available quickly	Isolating pairs with "larger second values" is tough...
			 
Length	Stacked bar: Bars on baseline are position-coded = more precise perception. 	Stacked Bar: Min, Mean length of dark bars 	 
Area	Sure, looks like a ~1:7 area ratio. 	Bubble Map: Min Area, Mean Area, Max Area 	 
Angle	The difference is larger for the lighter segments compared with the darker ones, right? That is an illusion—the differences are identical. 	Slope Graph: Max Angle, Mean Angle, Min Angle 	 
Intensity	Intensity values can look different depending their backgrounds. Do not plot intensities on intensities. 	Heat Map: Min Intensity, Mean Intensity, Max Intensity 	 

Fig. 2. A summary of the power and limits of visual data processing. The two columns on the left show a quick reference guide to channels that can depict data visually and common illusions for each channel. The column in the center presents a summary of how visual statistics are powerful. The two columns on the right illustrate how comparisons are severely limited and present a set of design techniques that focus viewers on the “right” ones.

4. Make comparison easy

Visual channels for grouping:

1. Connecting lines
2. Similarity in position
3. Color similarity
4. Shape similarity

What groupings are most important? Do lines clutter your visual?

Creating Effective Visuals

4. Make comparison easy

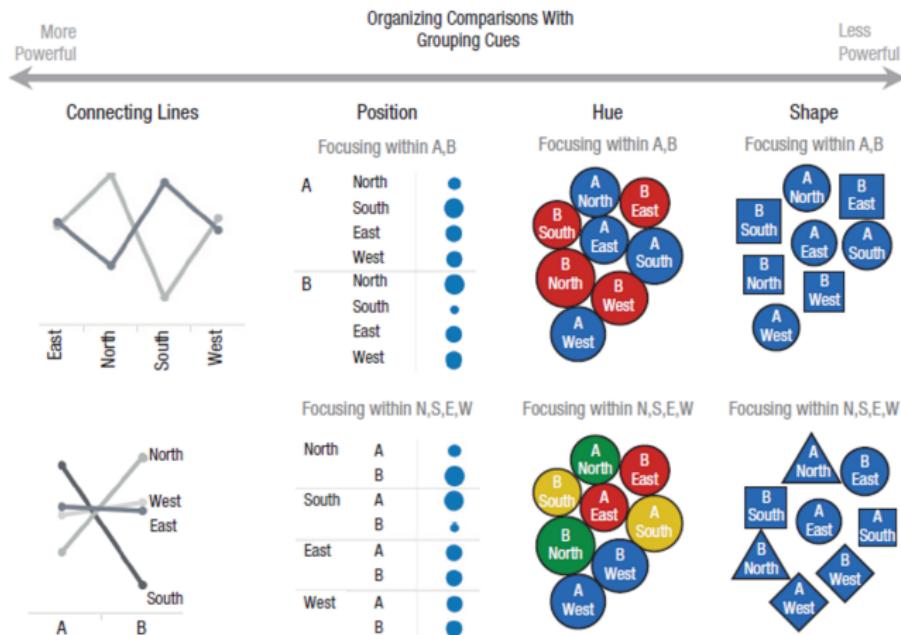


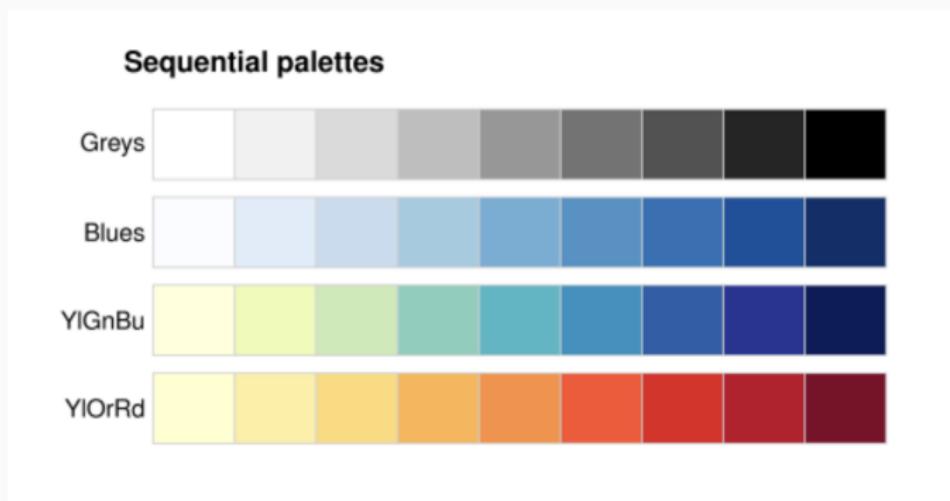
Fig. 8. Several grouping cues that can control how data values are compared. Connecting lines are particularly powerful cues, followed by proximity, color, and shape (Brooks, 2015).

Creating Effective Visuals

4. Make comparison easy

Color choices:

- (a) Sequential scales for quantitative variables

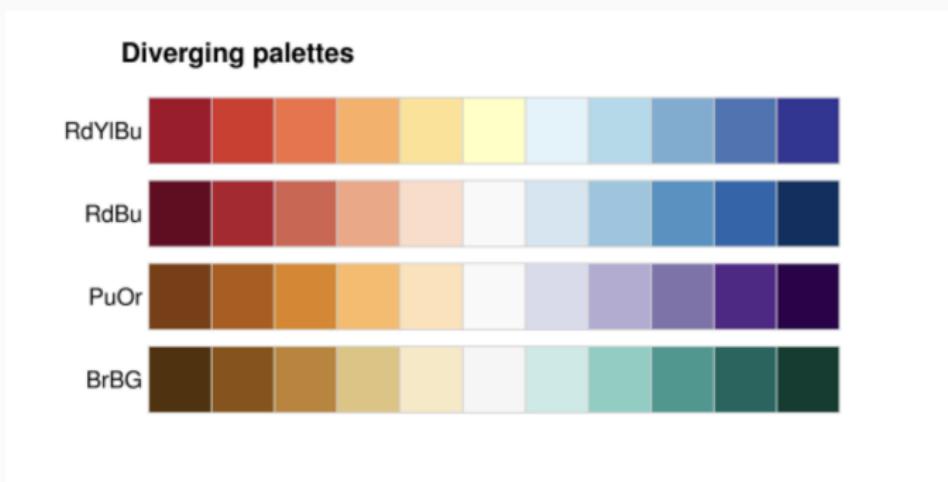


Creating Effective Visuals

4. Make comparison easy

Color choices:

- (b) Diverging scales to highlight extremes or groups of a continuous variable (emphasis placed on both edges)

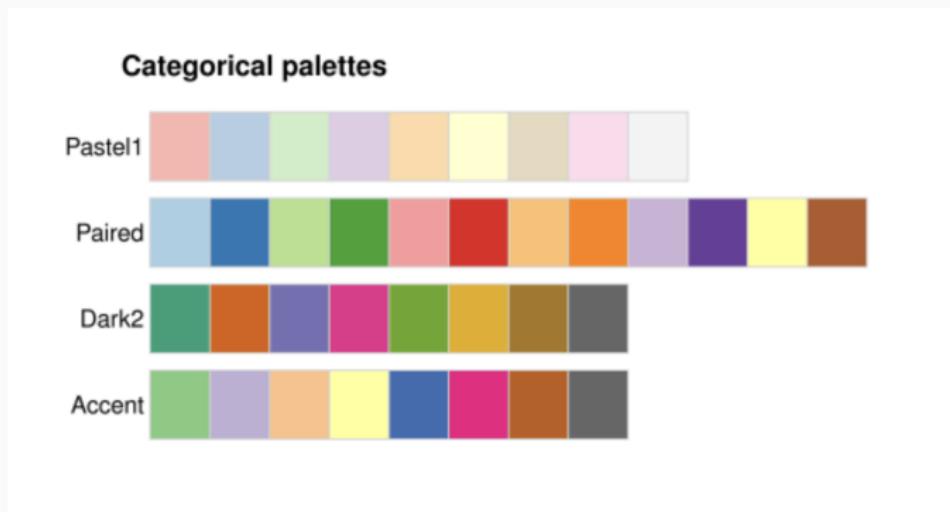


Creating Effective Visuals

4. Make comparison easy

Color choices:

- (c) Categorical scales highlight categories or groups

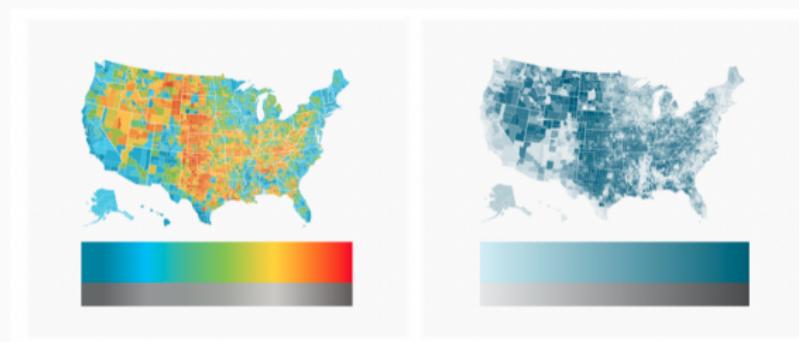


Creating Effective Visuals

4. Make comparison easy

Color choices:

- More colors in a scale → more emphasis on large deviations
- Fewer colors in a scale can highlight small changes
- Color blindness limitations (what does the gray-scale look like?)



[https://academy.datawrapper.de/article/
140-what-to-consider-when-choosing-colors-for-data-visualization](https://academy.datawrapper.de/article/140-what-to-consider-when-choosing-colors-for-data-visualization)

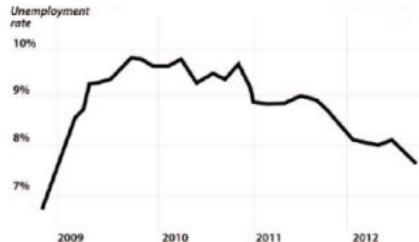
Creating Effective Visuals

5. Highlight your message

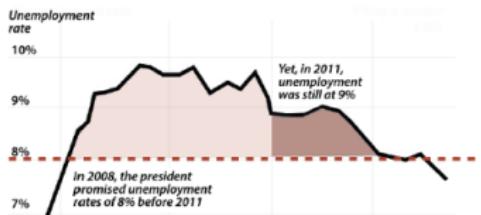
We can create vastly different visuals from the same set of data:

Unemployment is higher than stated goals

In 2008, the president promised unemployment rates under 8% before 2011.
Yet, in 2011, unemployment was still at 9%



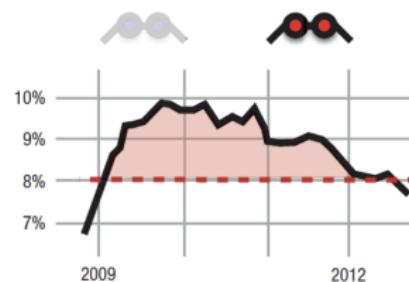
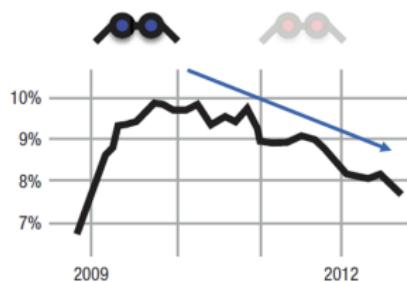
Unemployment is higher than stated goals



Creating Effective Visuals

5. Highlight your message

Consider the information you want to convey!



Creating Effective Visuals

You can tell good visuals from bad with intuition:

- Use your best judgement!
- When in doubt, go for the simpler layout
- Avoid unnecessary elements
- Emphasize your message!

*Some lecture material taken from Jesse Helman, PhD Student, University of Virginia