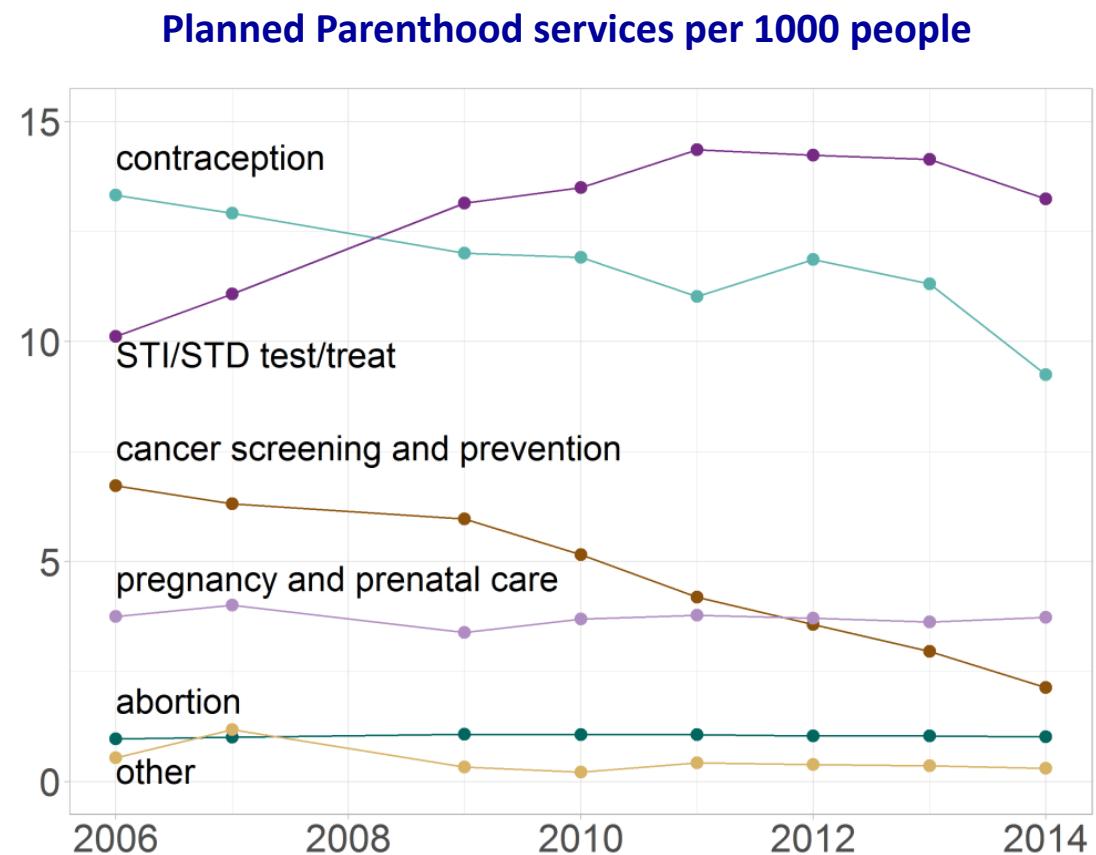


Limitations of common visual elements

ME447 Visualizing Data
Spring 2018–19

Richard Layton



Please find a partner to work with.



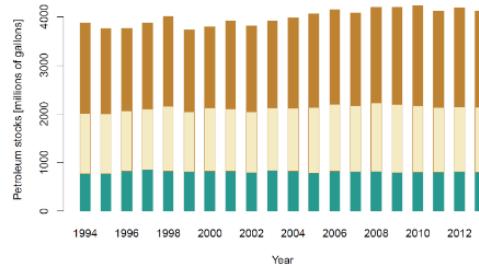
Do you have a partner?



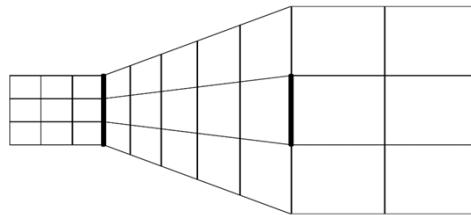
Do you have a handout?

Computers NOT needed.

We cover three main topics that explain why and what we'll be doing this term.



Avoid the limitations of common graphs



Avoid common visual illusions

Introduction

Your prose.



Displays and critiques

Display 1 Title of your graph

State the type of graph (strip plot or box plot) and :

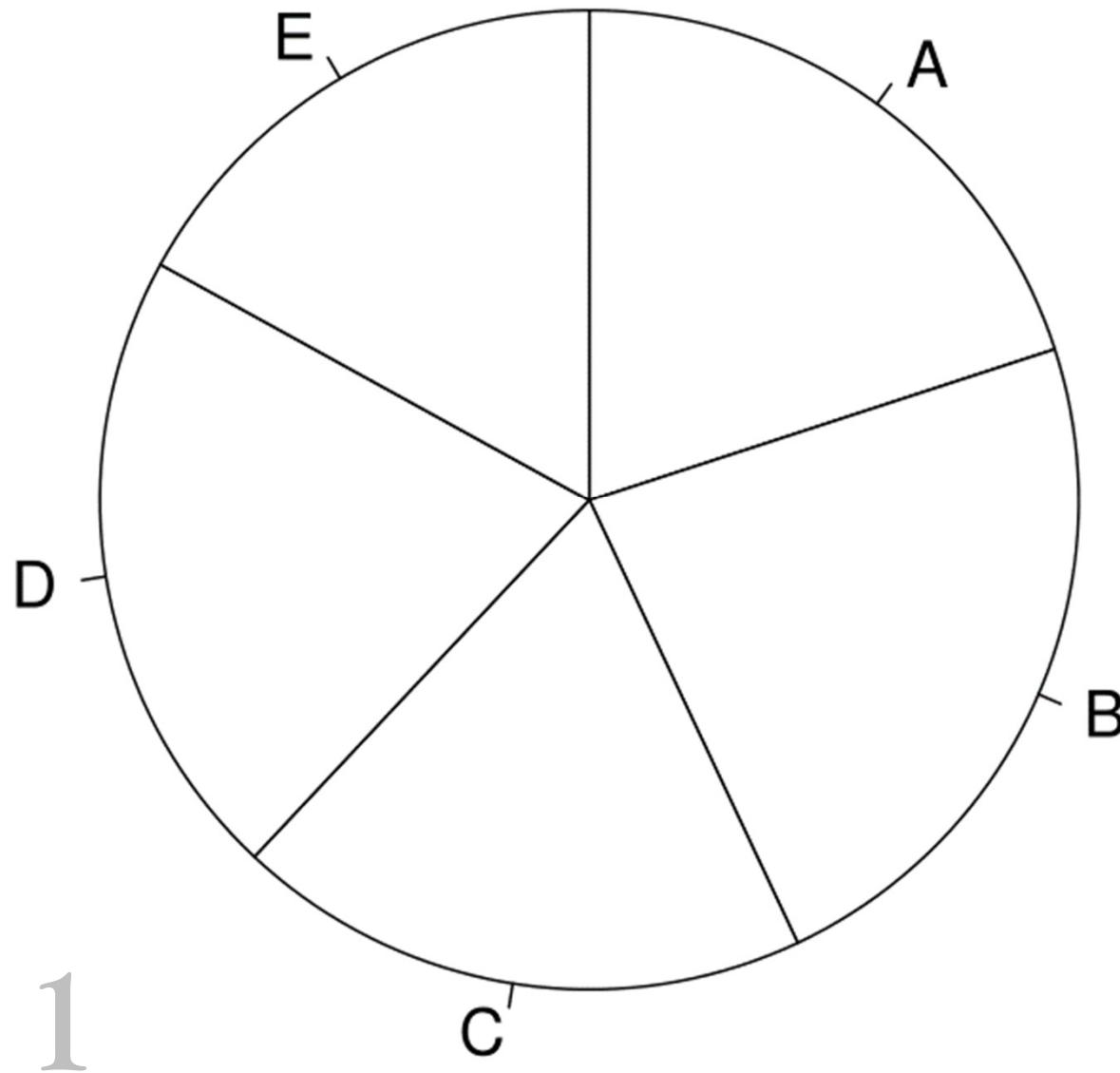
Display 2 Title of your graph

State the type of graph (multiway dot plot) and :

Put it all together in your portfolio

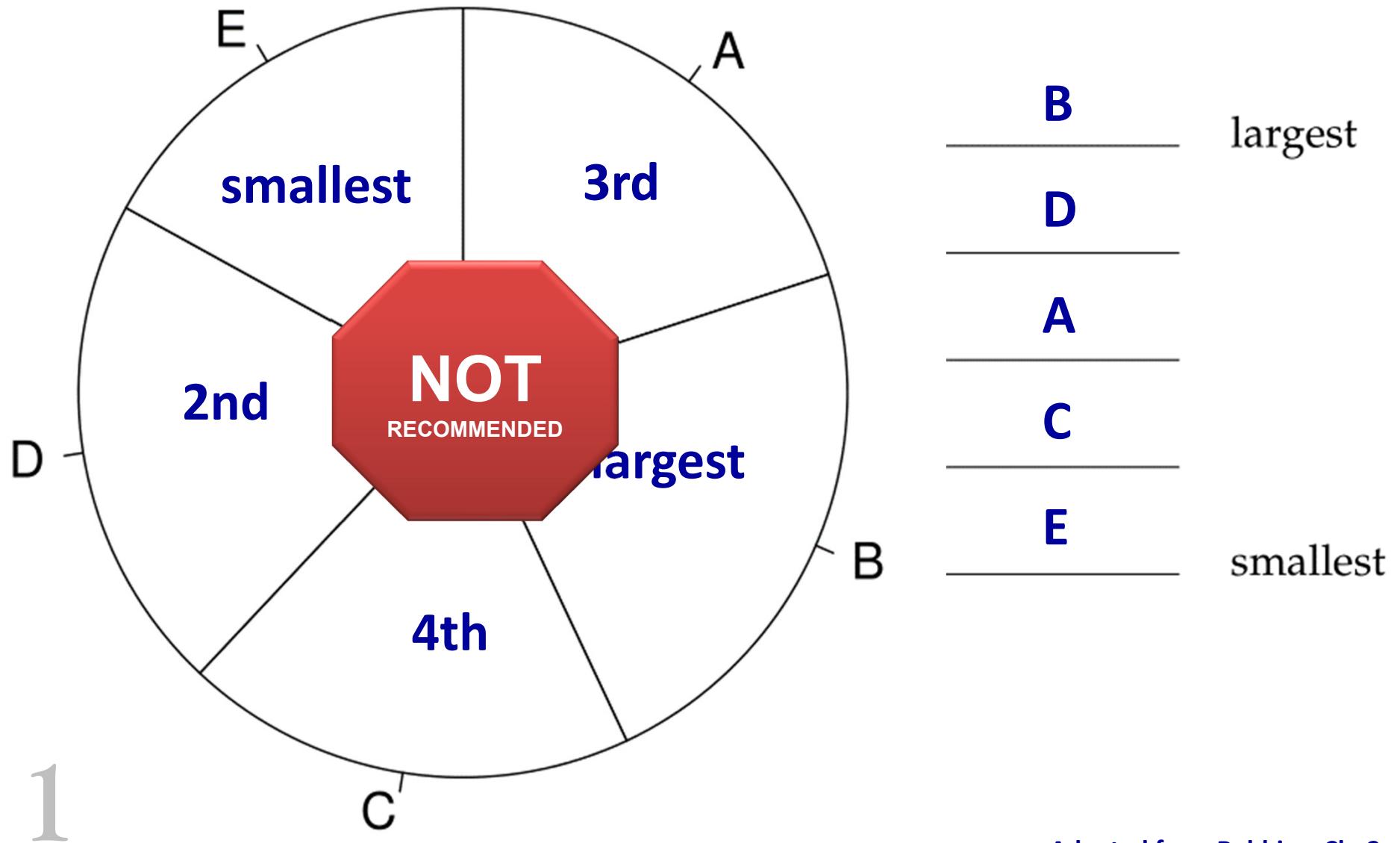
limitations of common graphs

List the slices A thru E from largest to smallest.



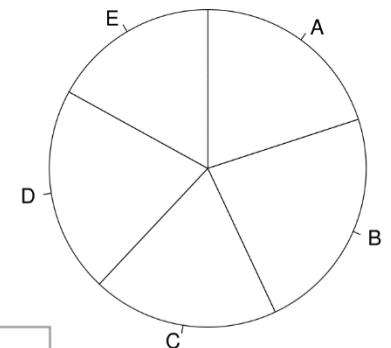
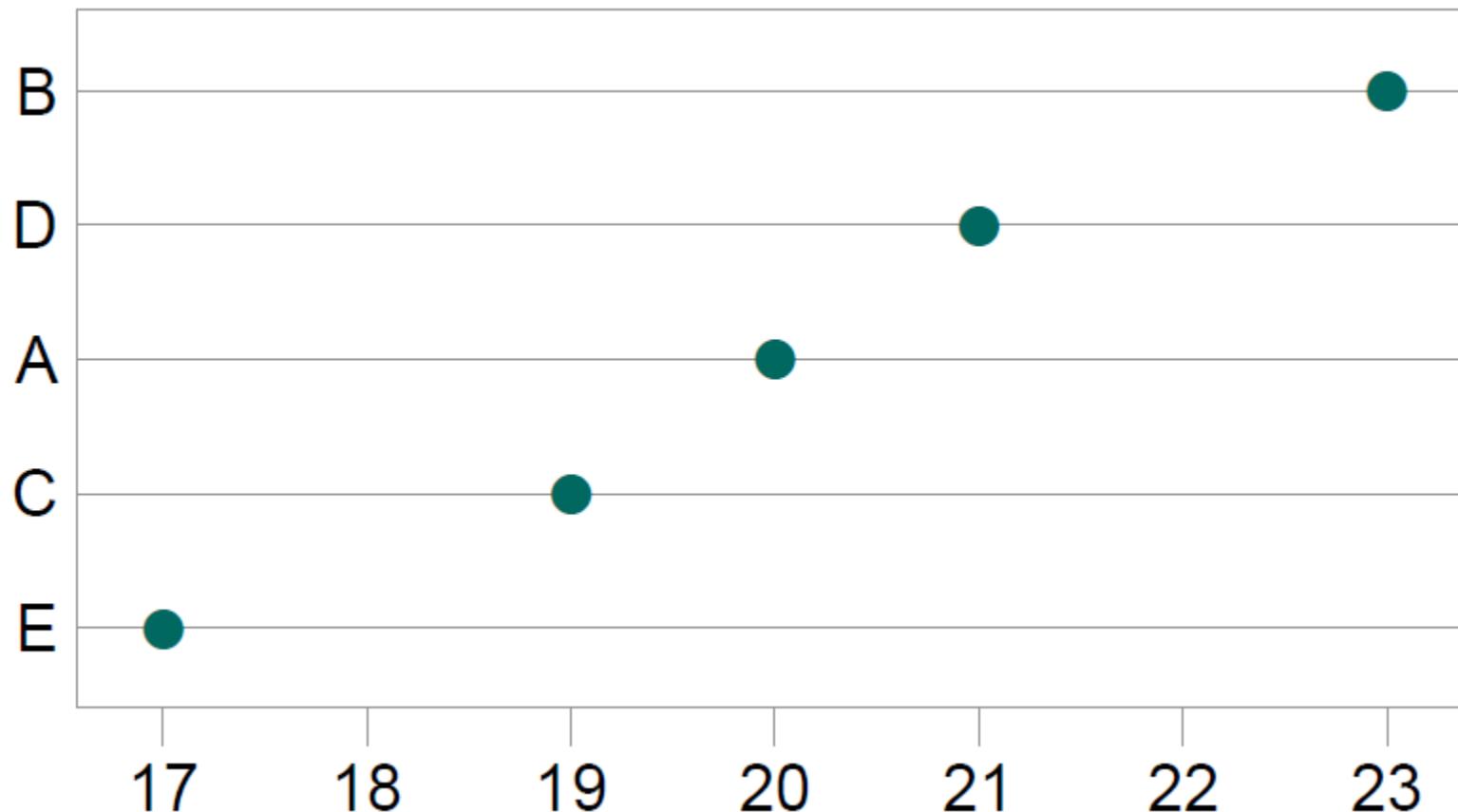
- _____ largest
- _____
- _____
- _____
- _____ smallest

Comparing angles - usually a low-accuracy task.

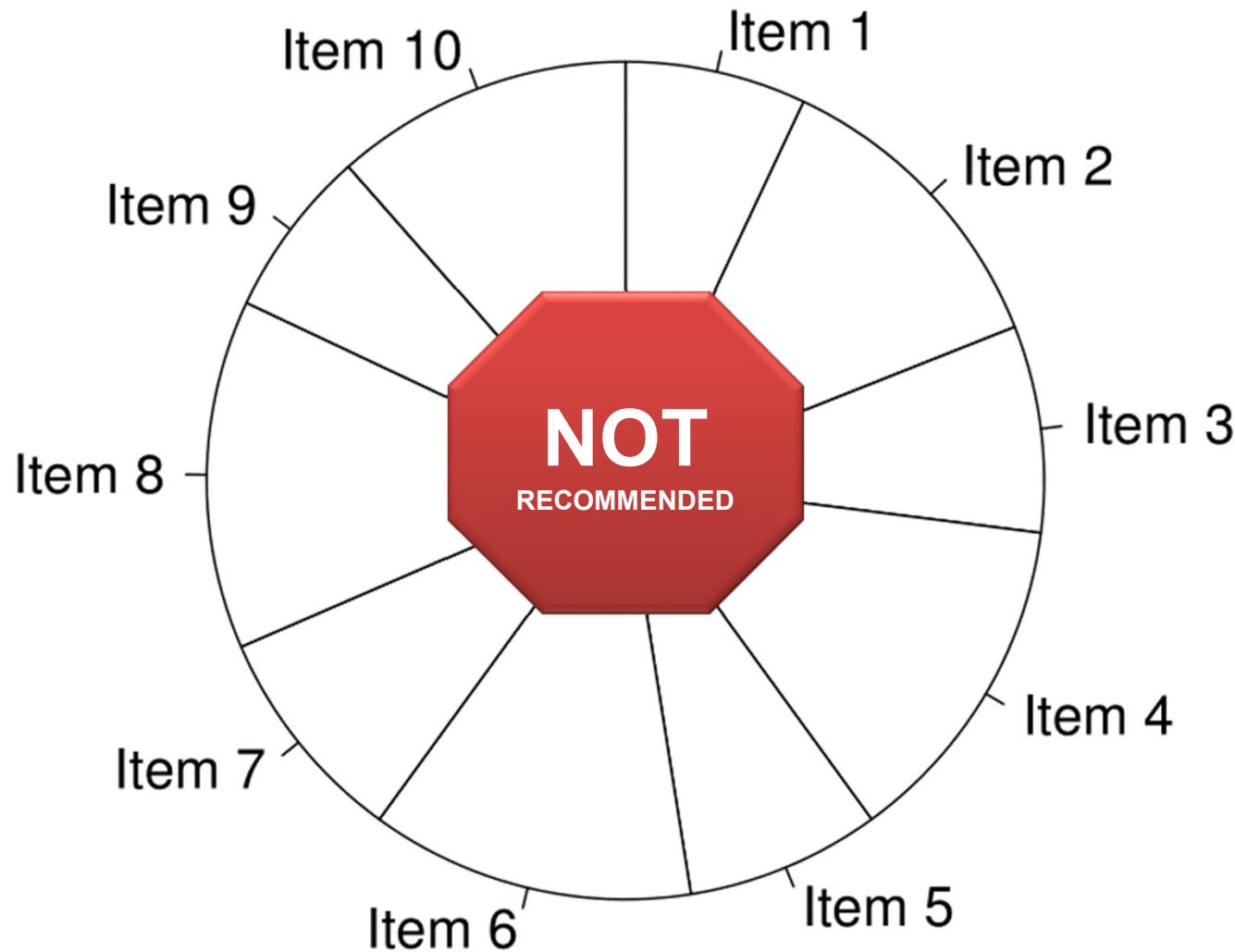


Adapted from Robbins, Ch. 2.

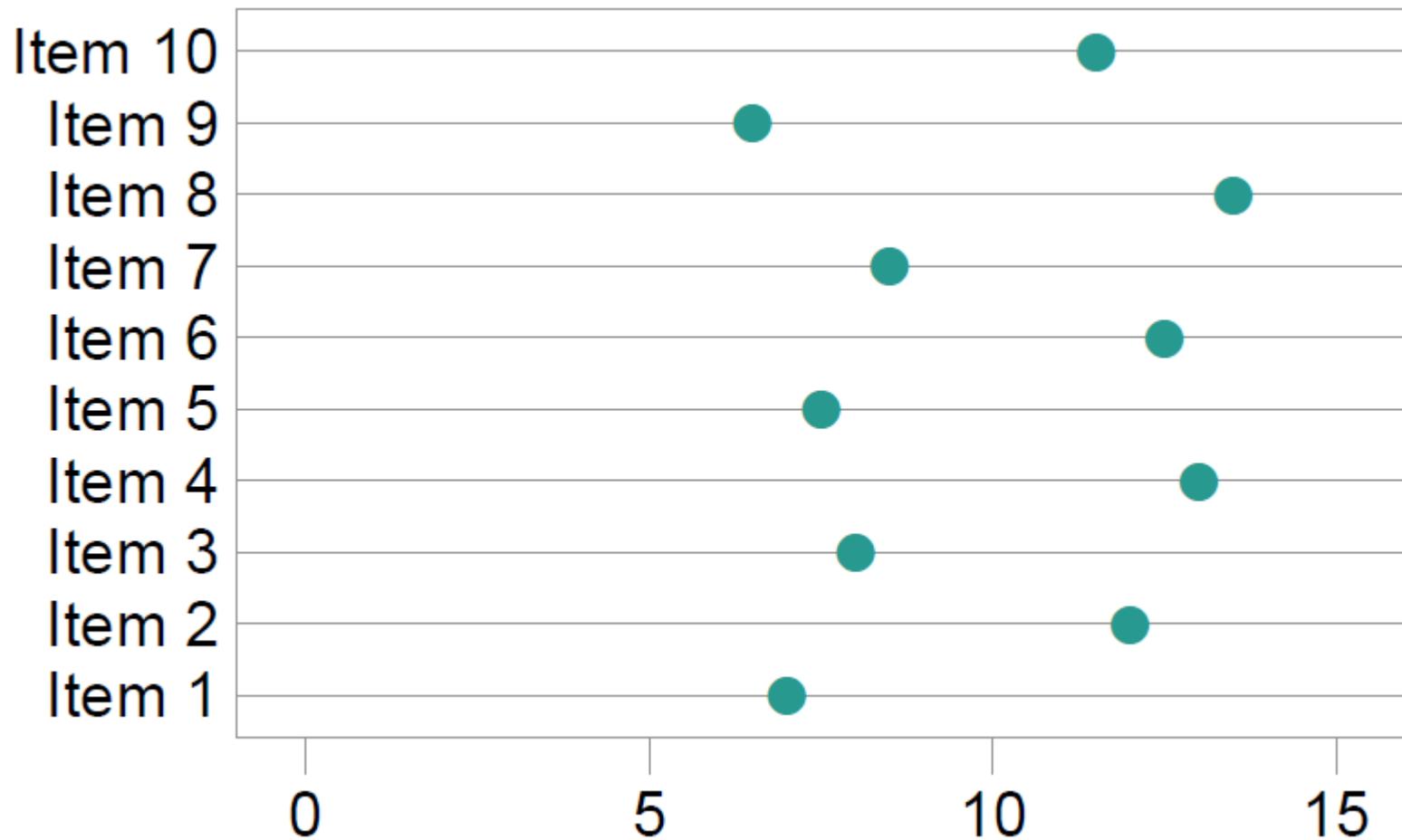
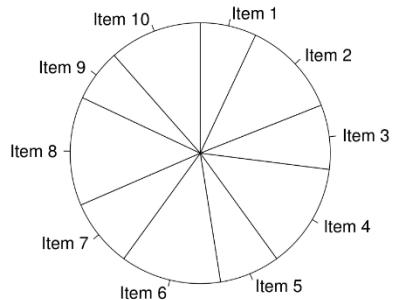
The same data arranged along a common axis – a visual task of high accuracy.



What patterns do you see in these data? Write your ideas in the workbook.

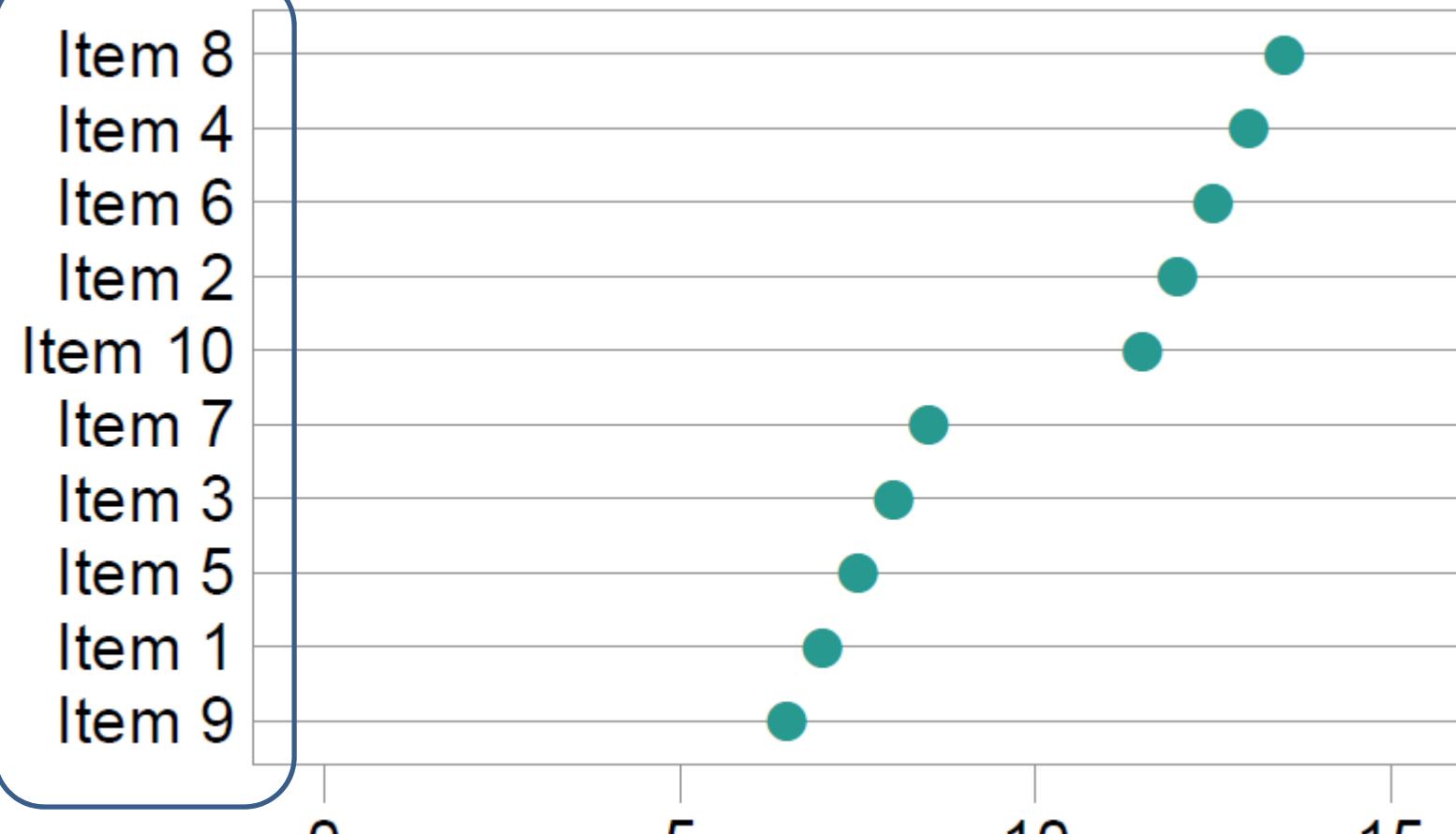
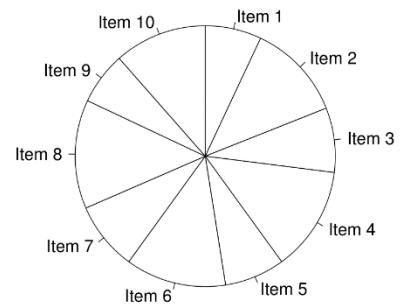


The same data graphed along a common scale. Write down any new observations.



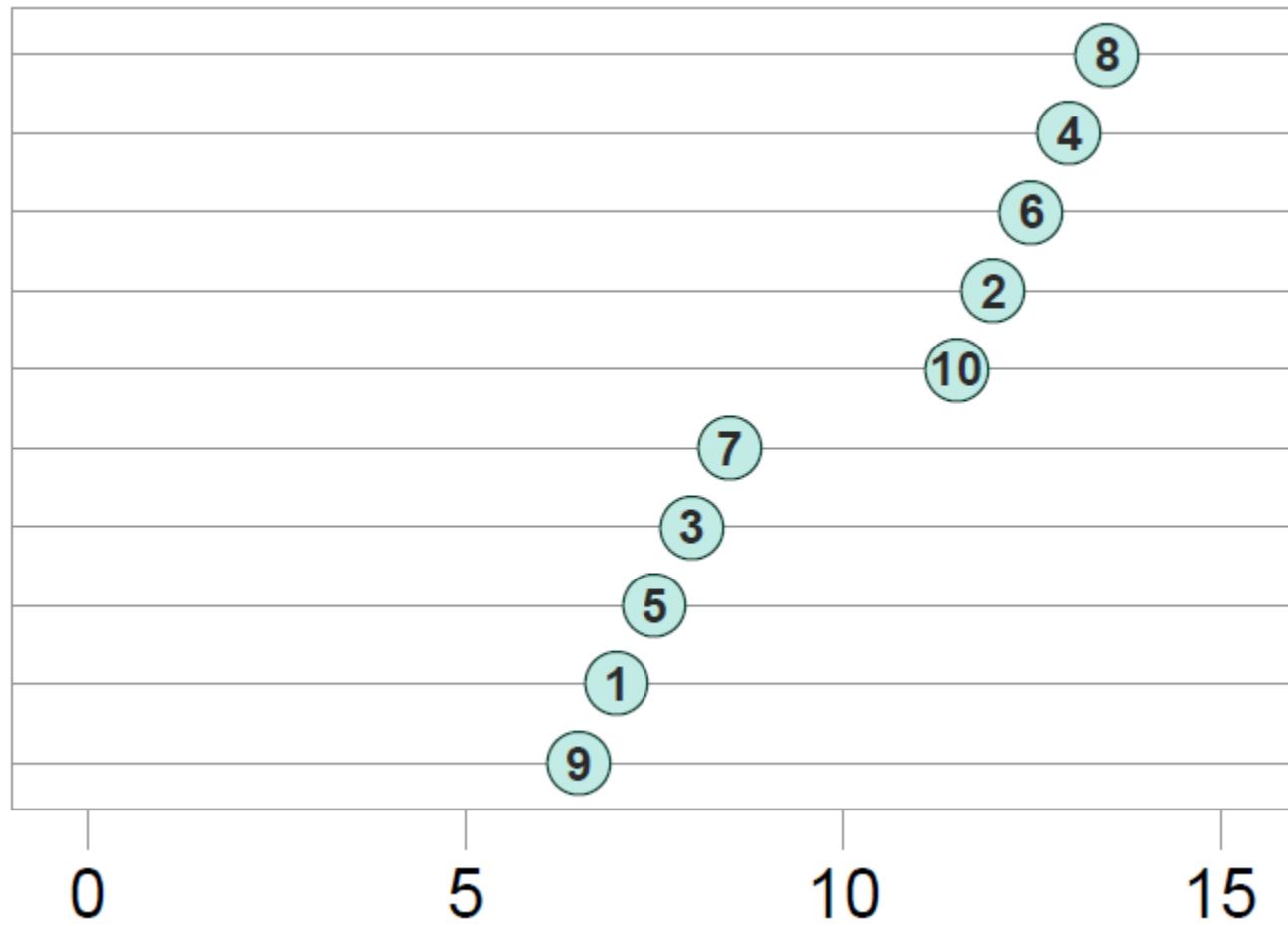
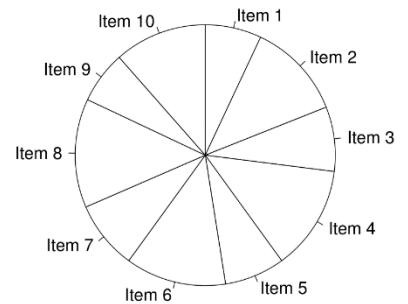
2

Rows reordered by value.



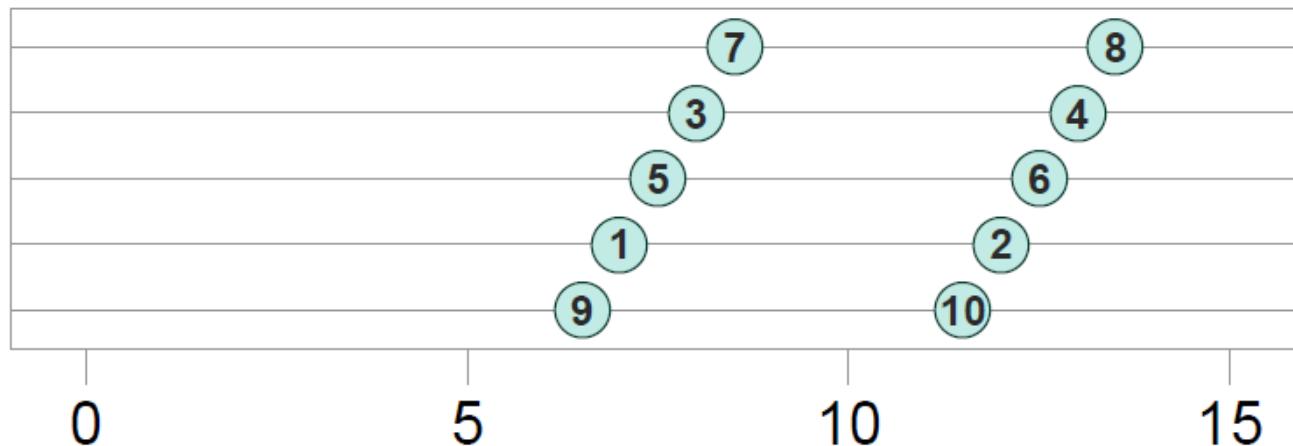
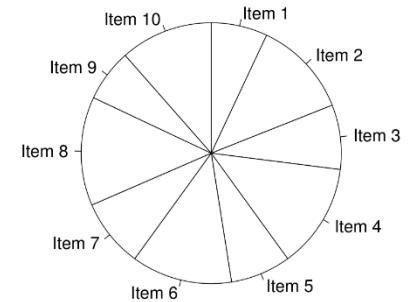
2

Move the item number to the data marker.



2

Even-odd pairs emerge.

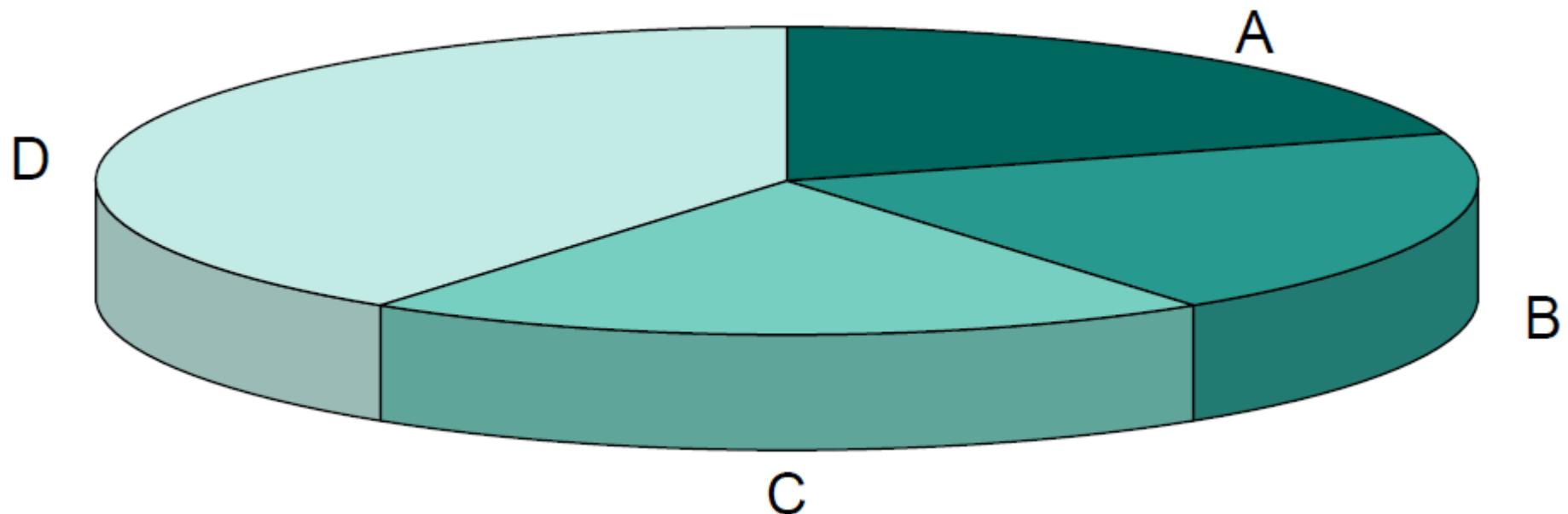


Exploratory graphics “forces us to see what we had not expected.”
– John Tukey (1915 –2000)

2

H. Wainer, *Visual Revelations: Graphical Tales of Fate and Deception From Napoleon Bonaparte To Ross Perot*. NY: Copernicus, 1997.

Slices are what percent of the whole?



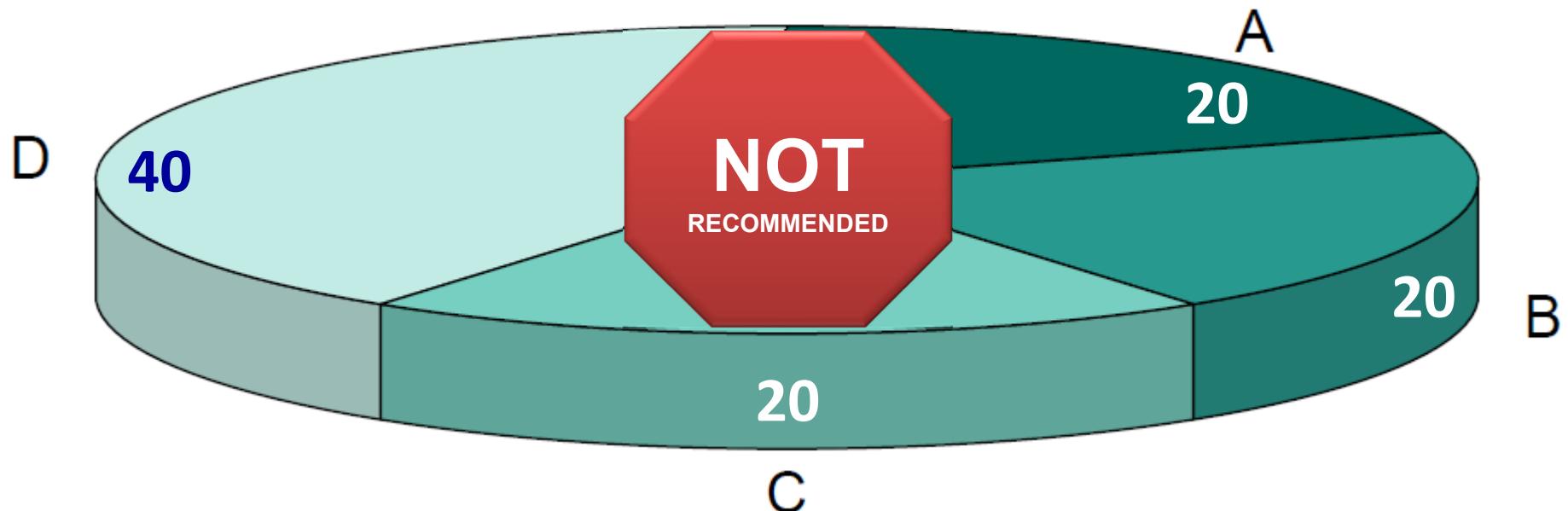
A: _____ %

B: _____ %

C: _____ %

D: _____ %

3D-effects distort our judgment.



A: 20 %

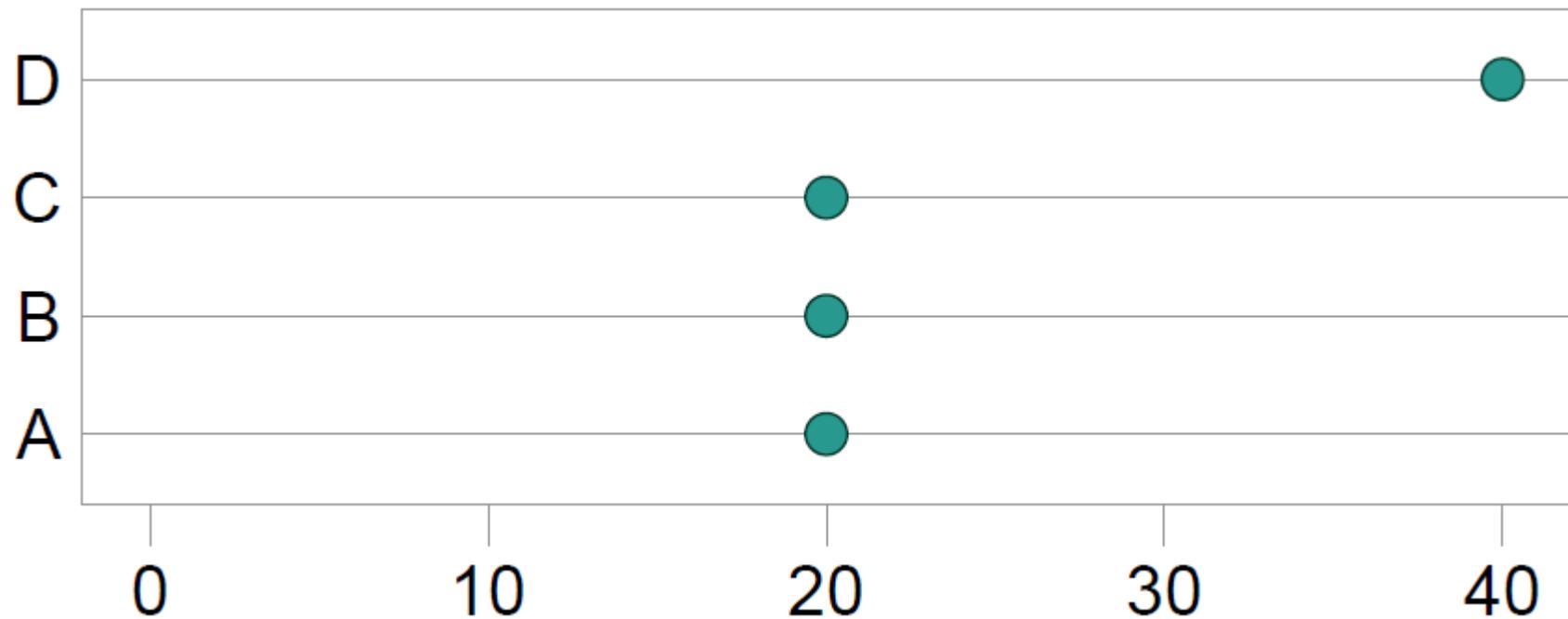
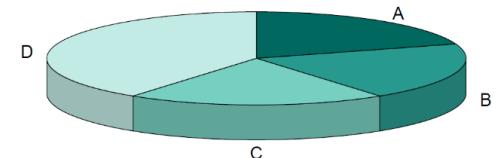
B: 20 %

C: 20 %

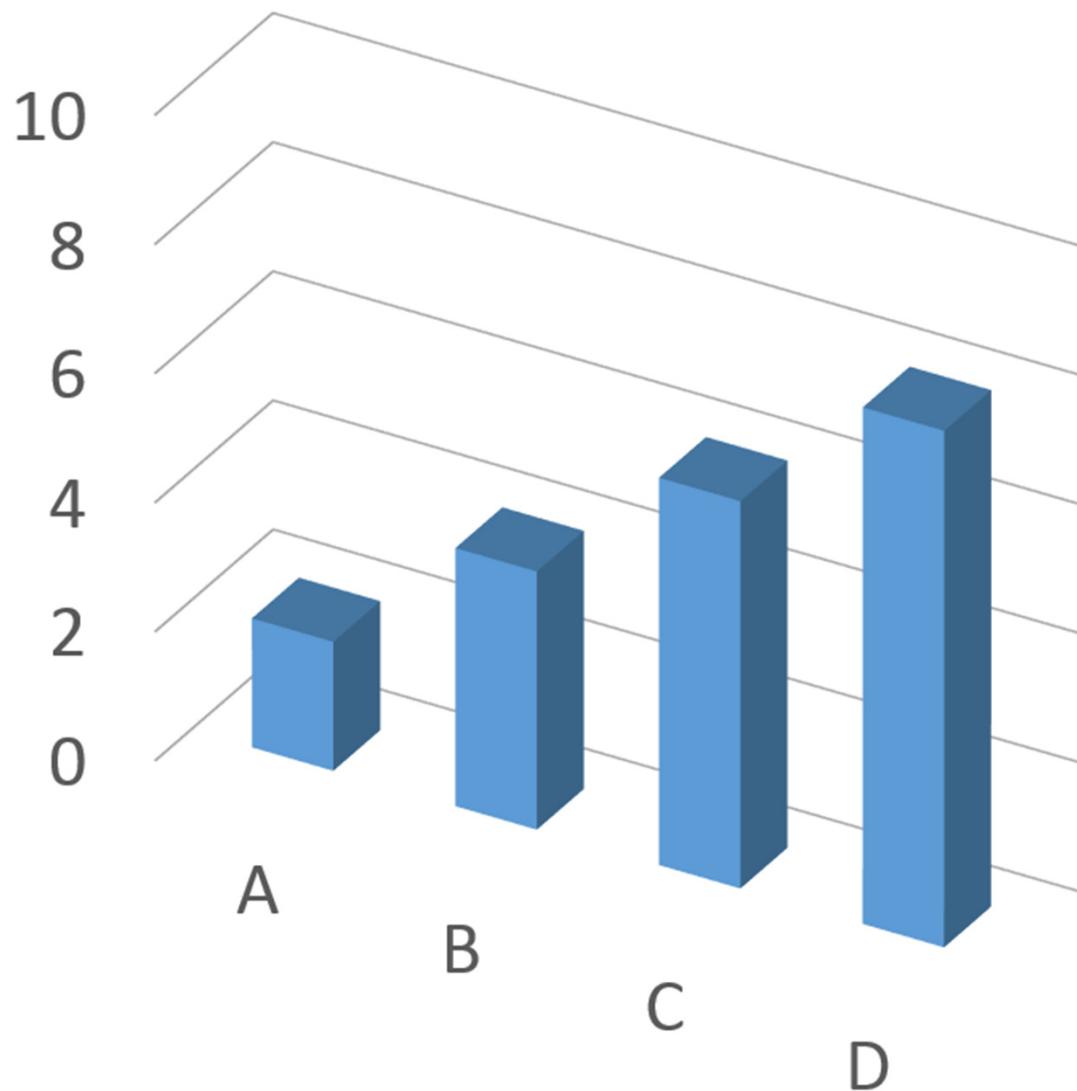
D: 40 %

Fill in the blanks.
The total should be 100%.

The same data arranged along a common axis – a visual task of high accuracy.

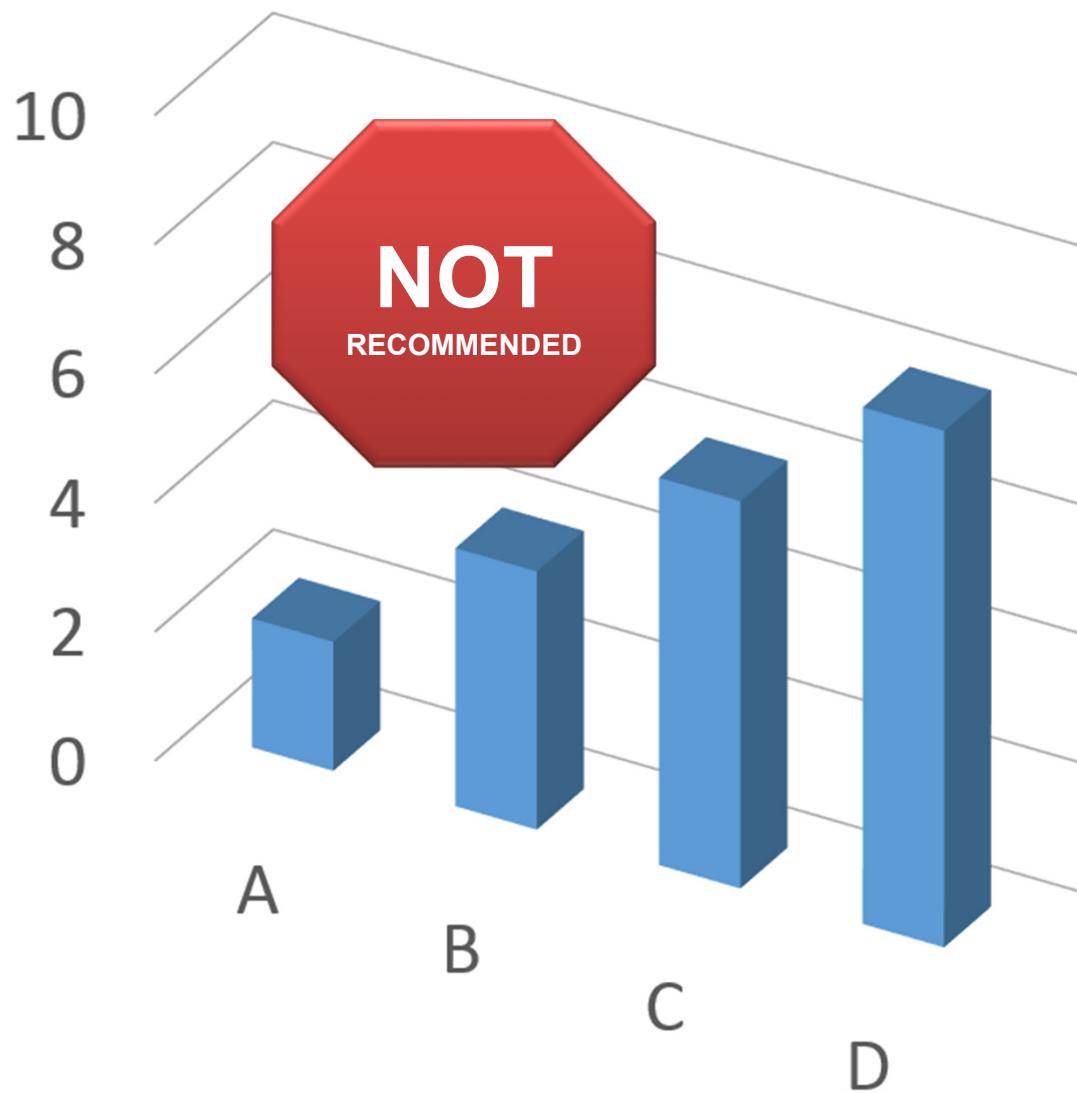


Write down the heights of the bars.



- A: _____
- B: _____
- C: _____
- D: _____

3D effects distort our judgment.



A: 2

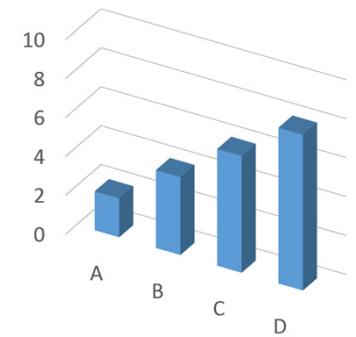
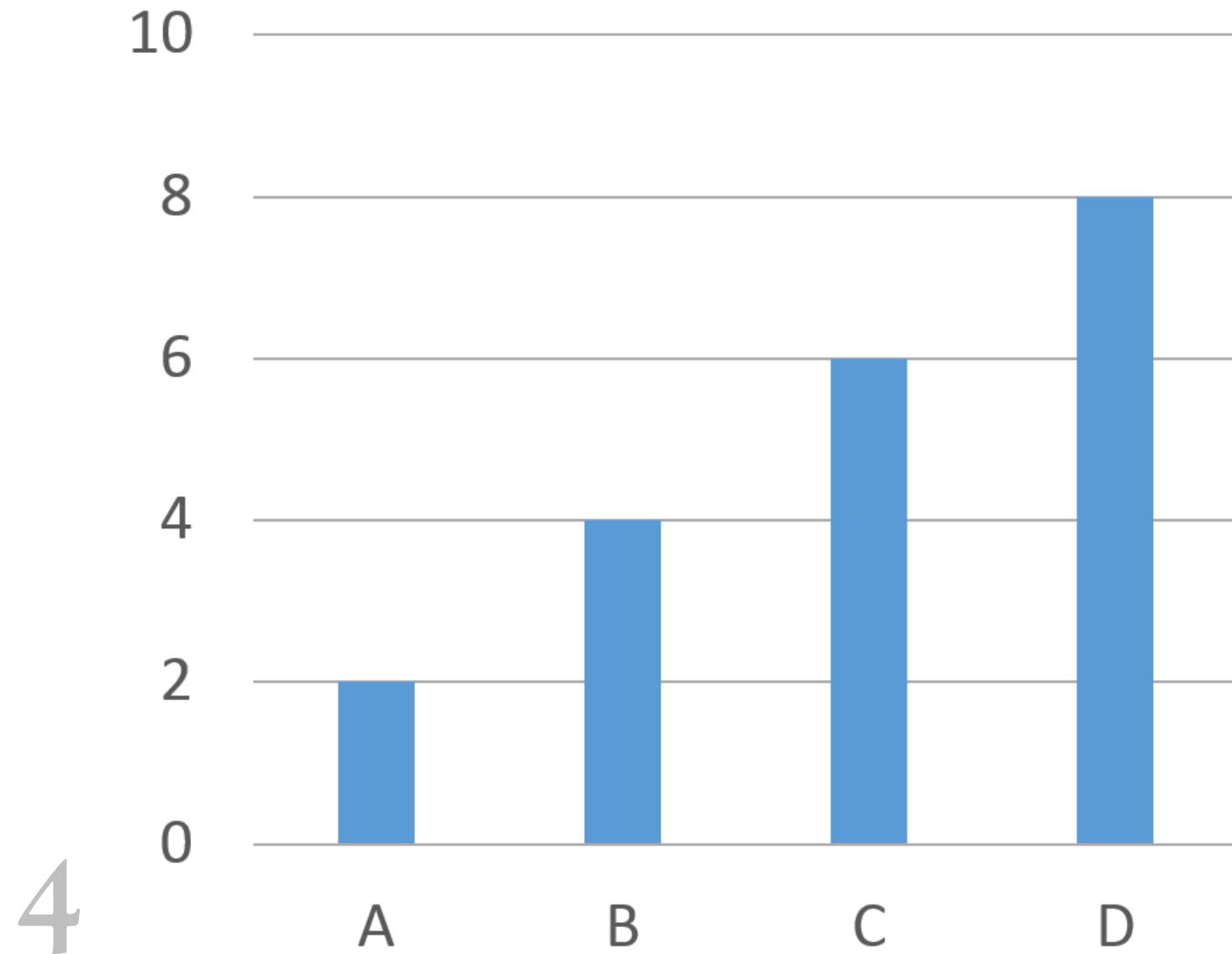
B: 4

C: 6

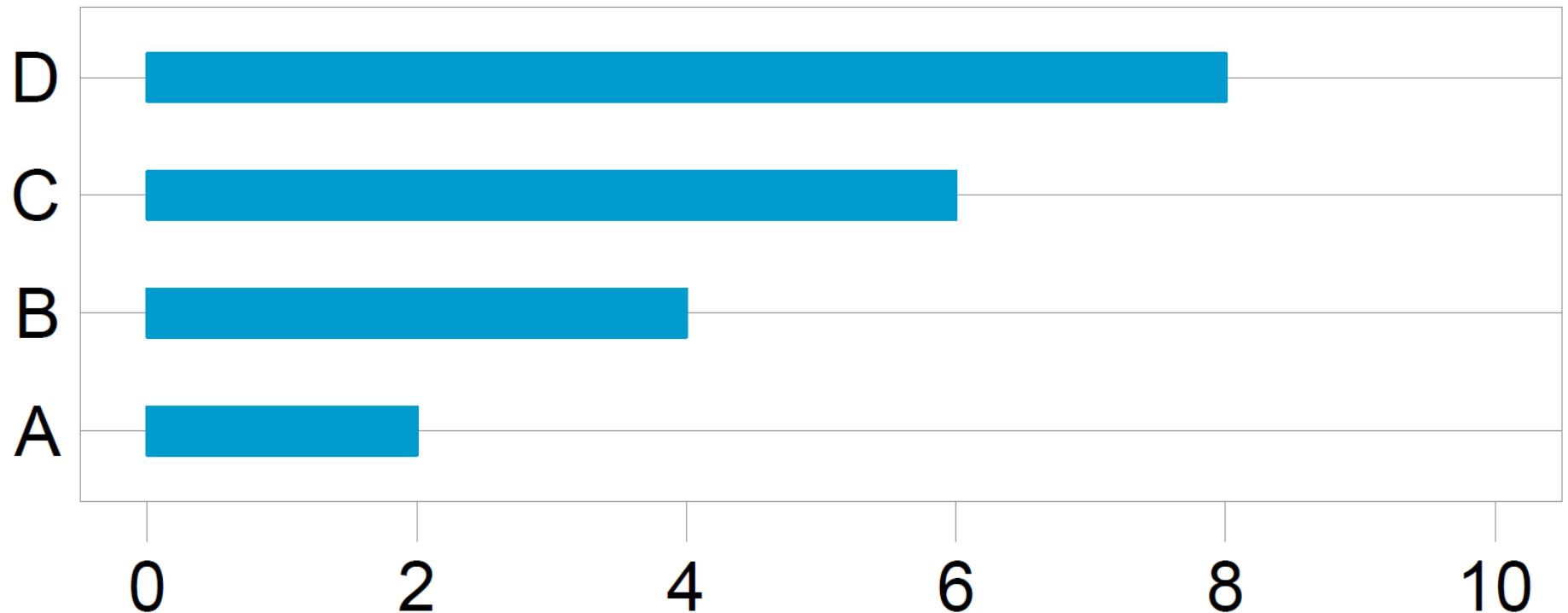
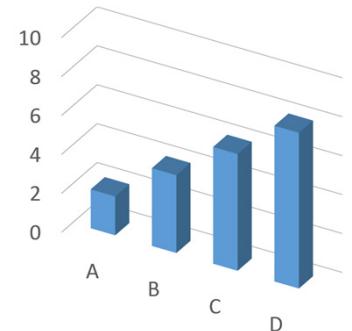
D: 8

4

You can use bars, but avoid gratuitous 3D effects.

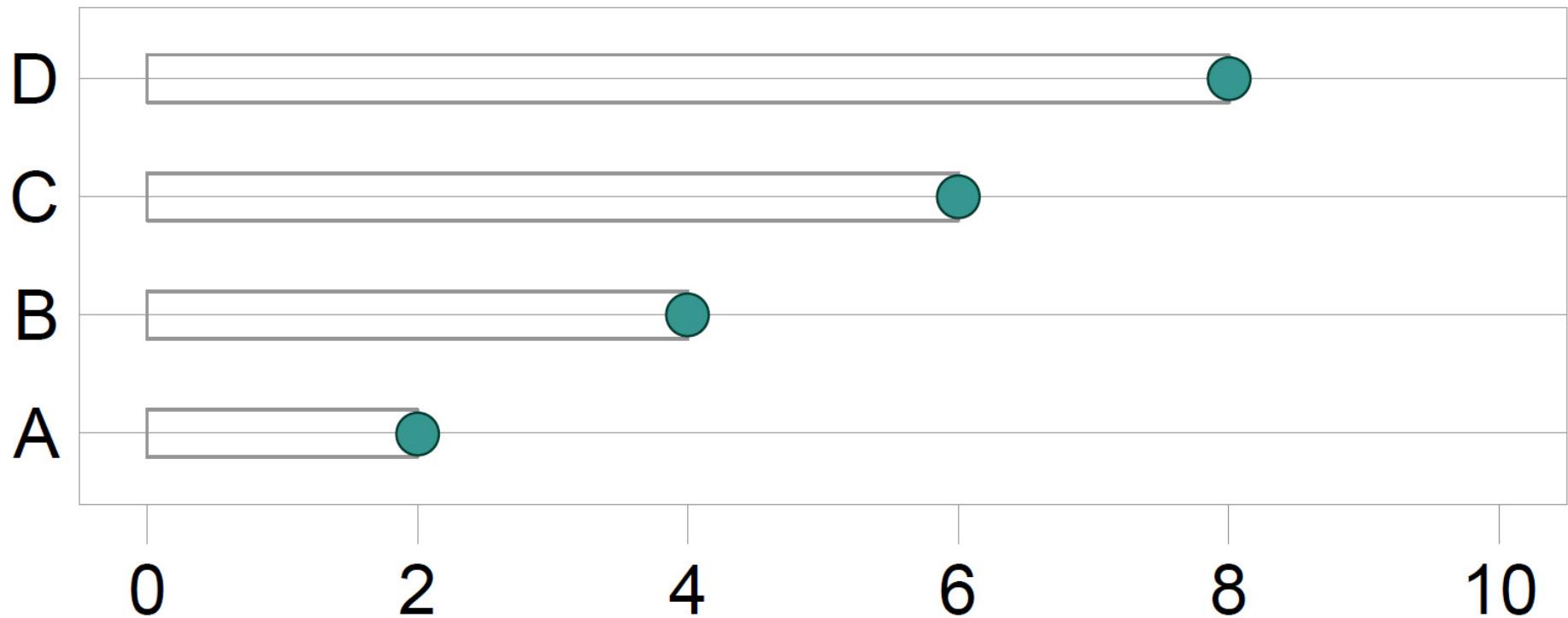
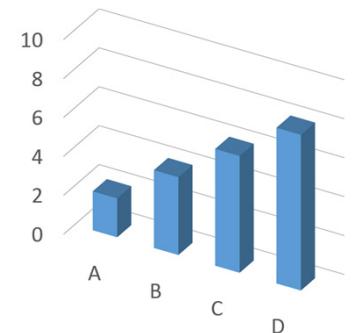


Better, use a horizontal scale, order the rows by descending magnitude...



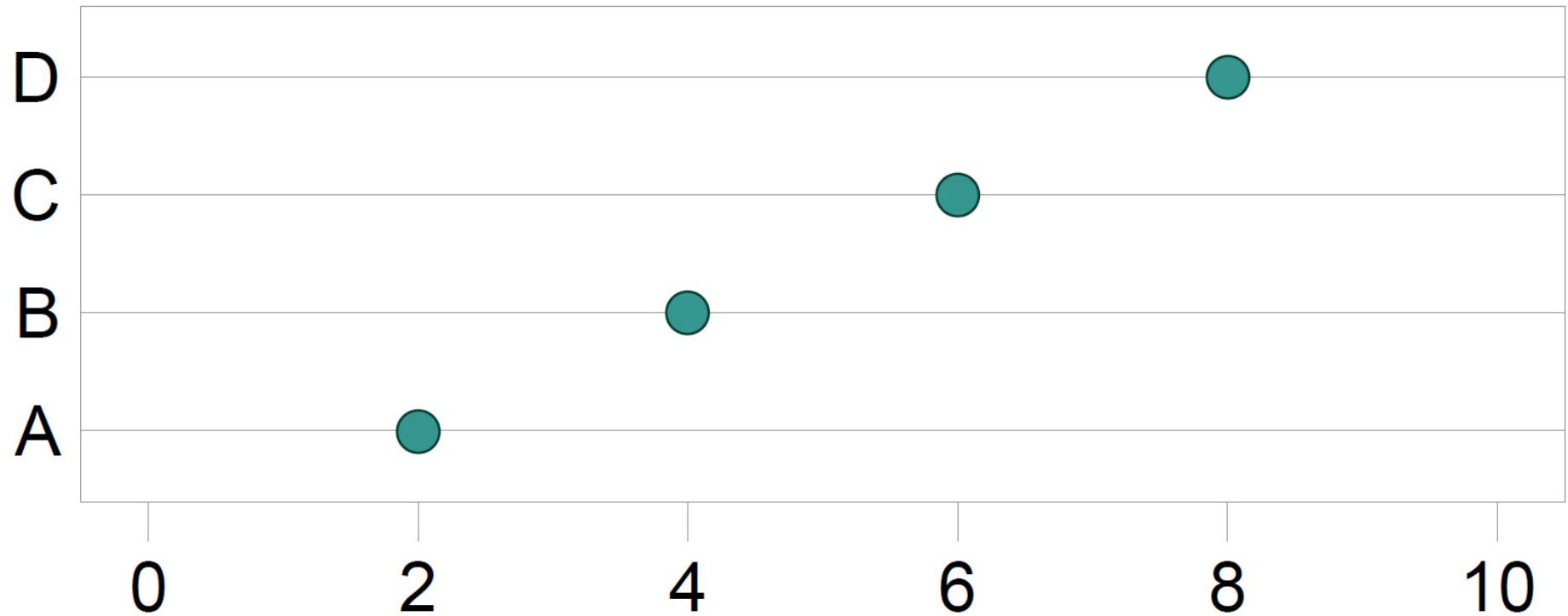
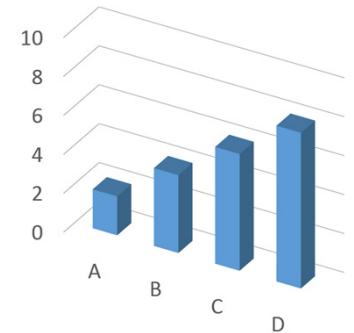
4

... mark the endpoints, ...



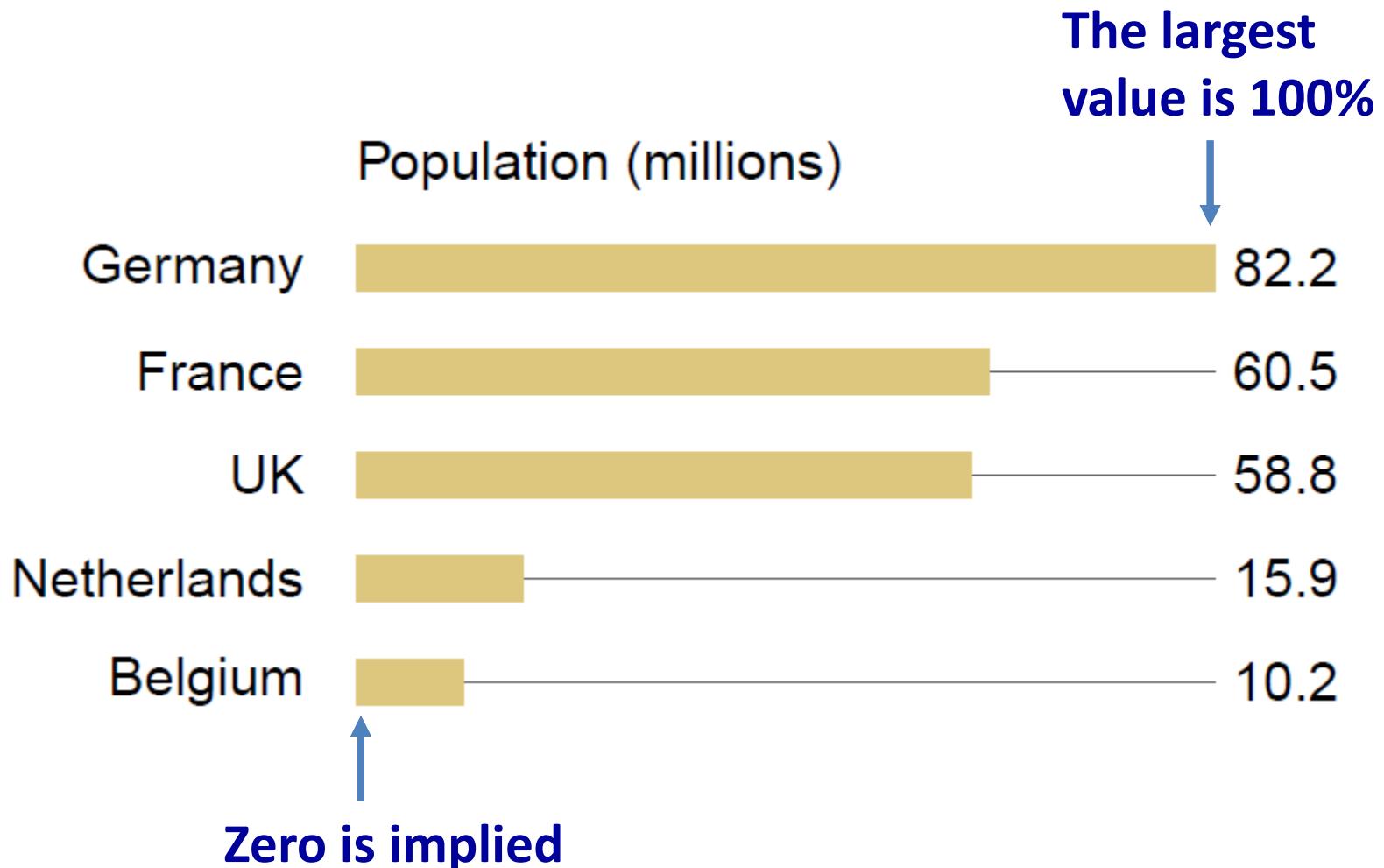
4

... and omit the bar. This is a dot plot.

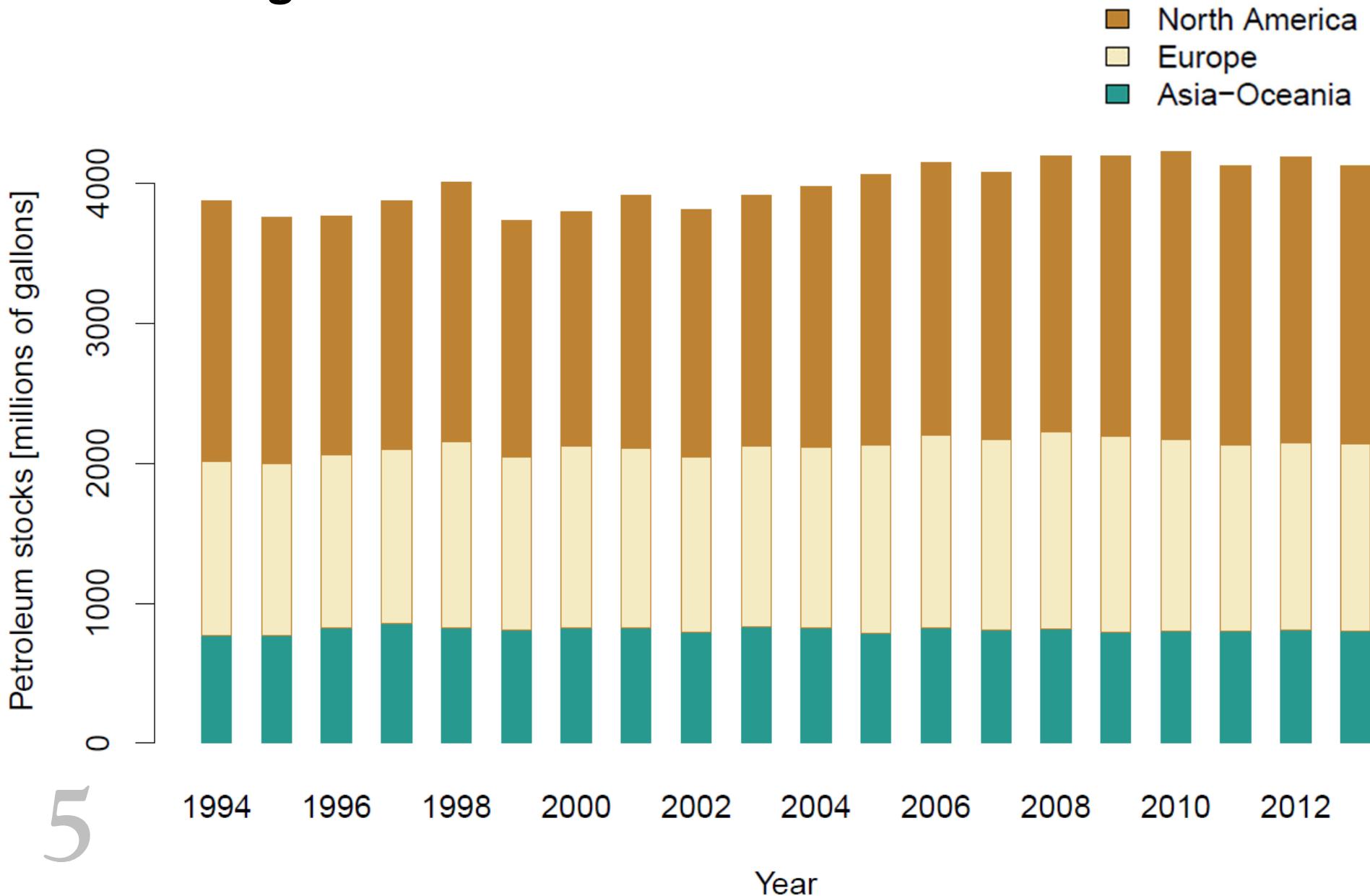


4

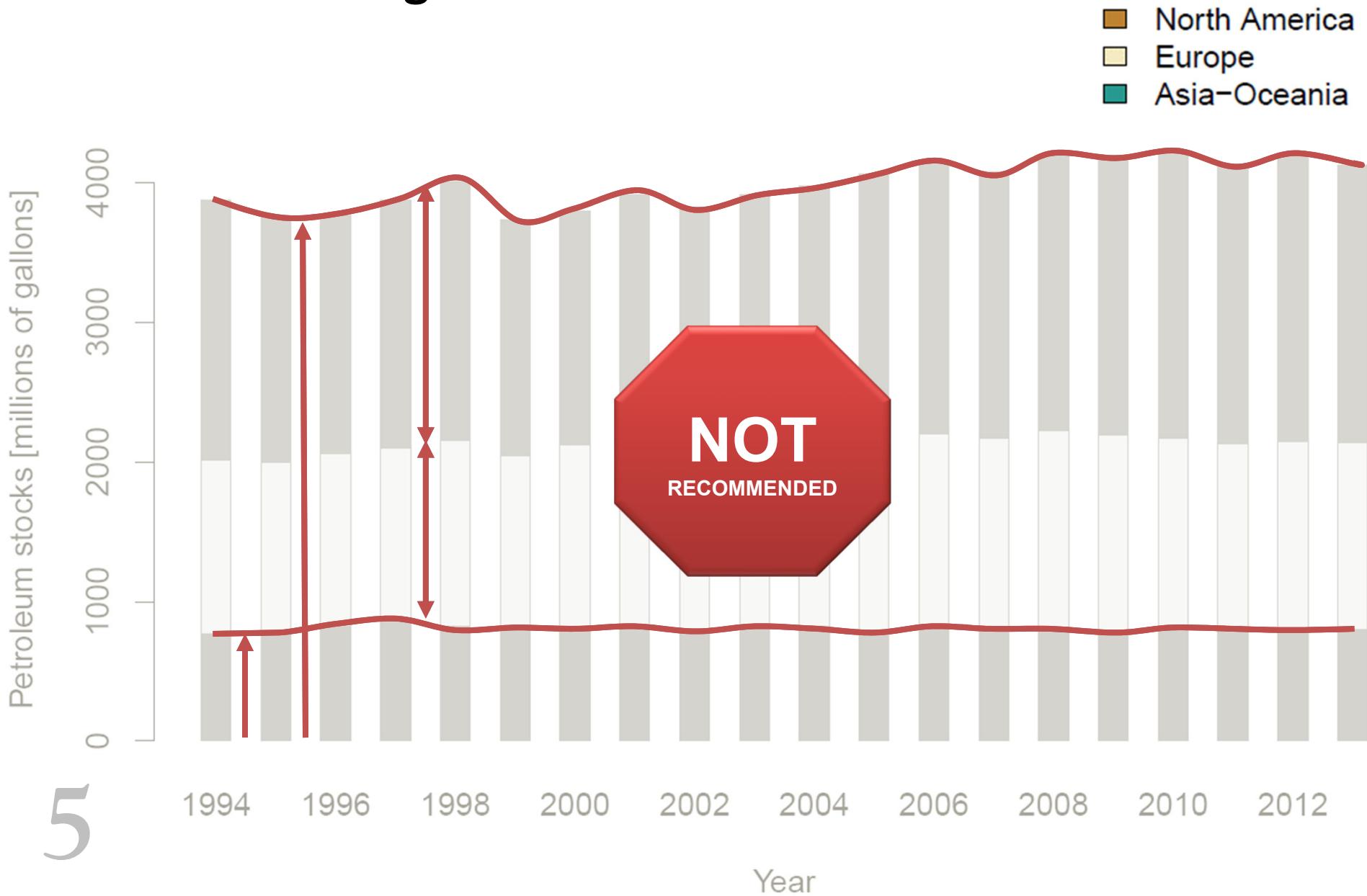
Not all bars are bad.



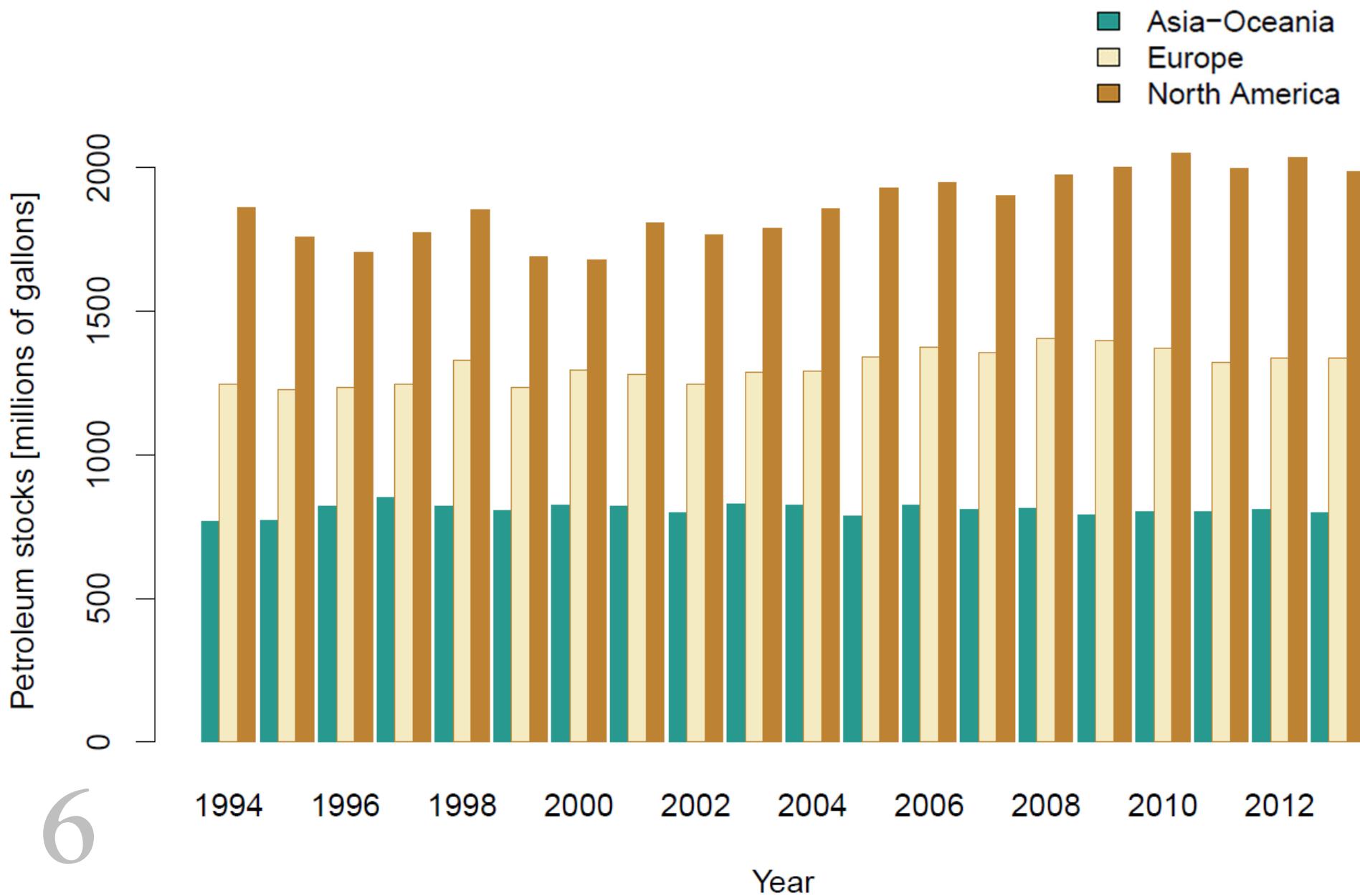
What story do you see in the petroleum stocks of these regions?



What story do you see in the petroleum stocks of these OECD regions?

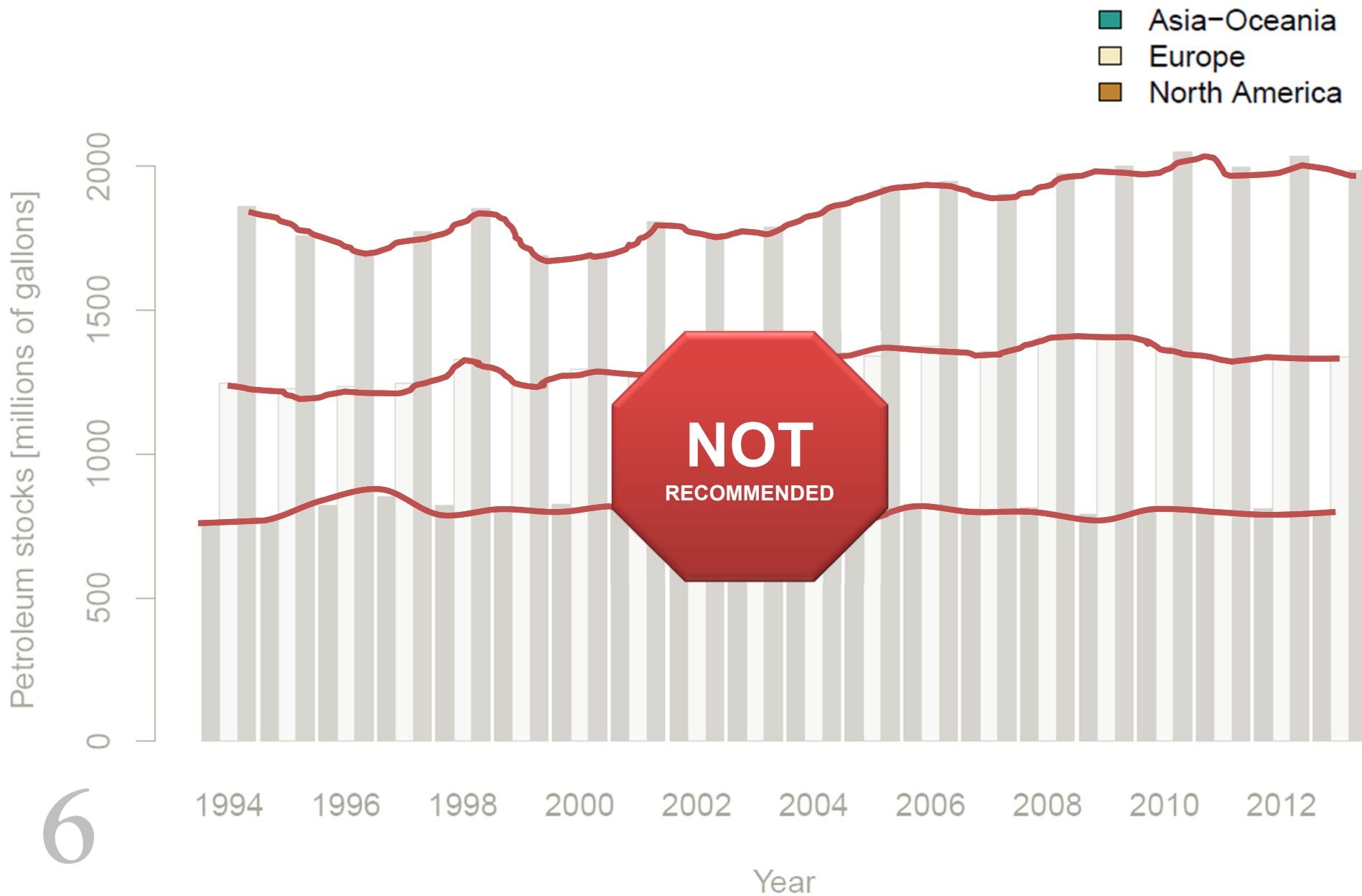


What stories do you see now?

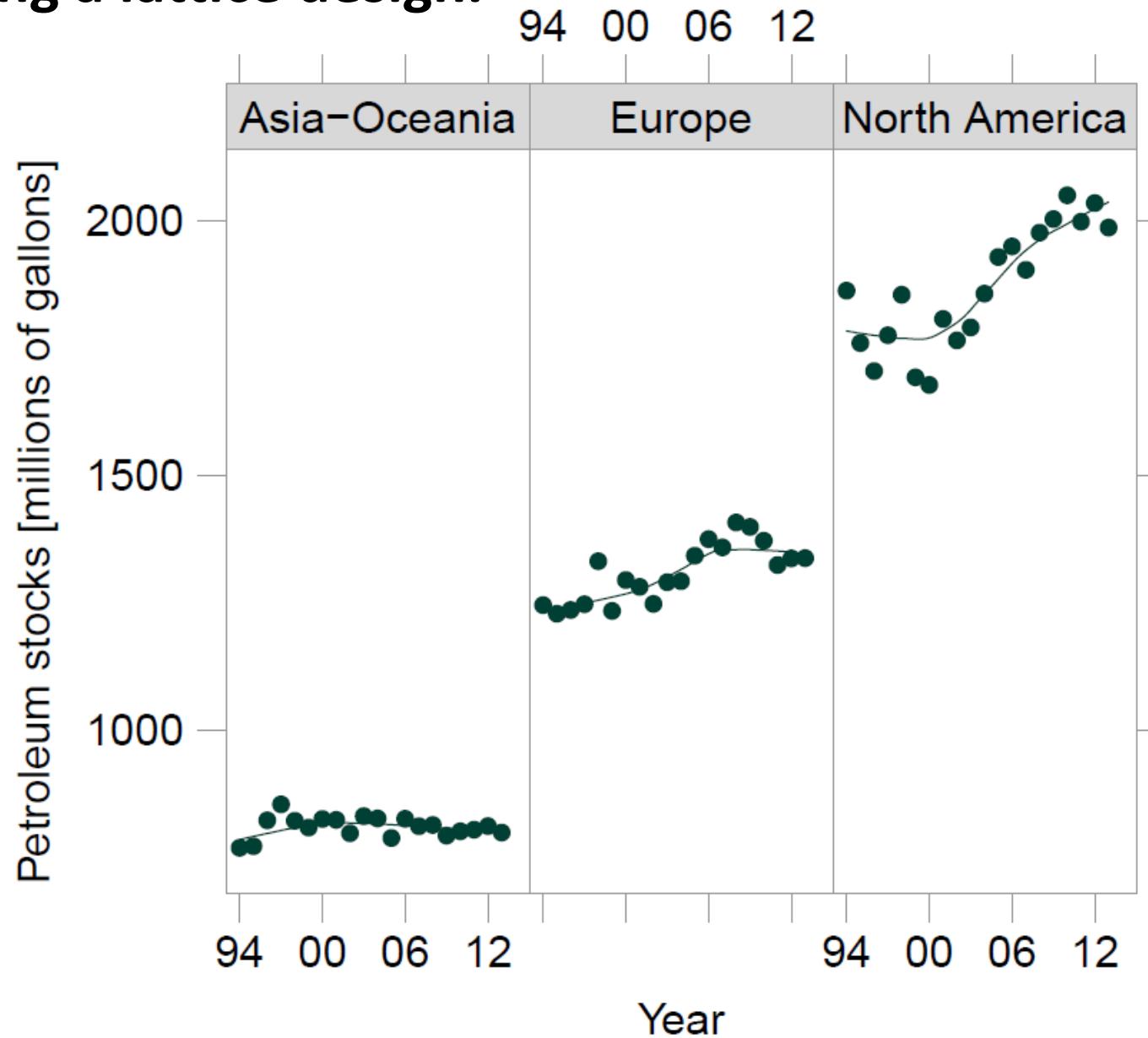
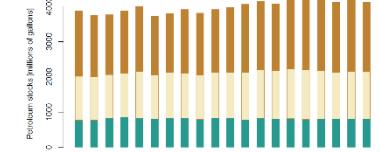


6

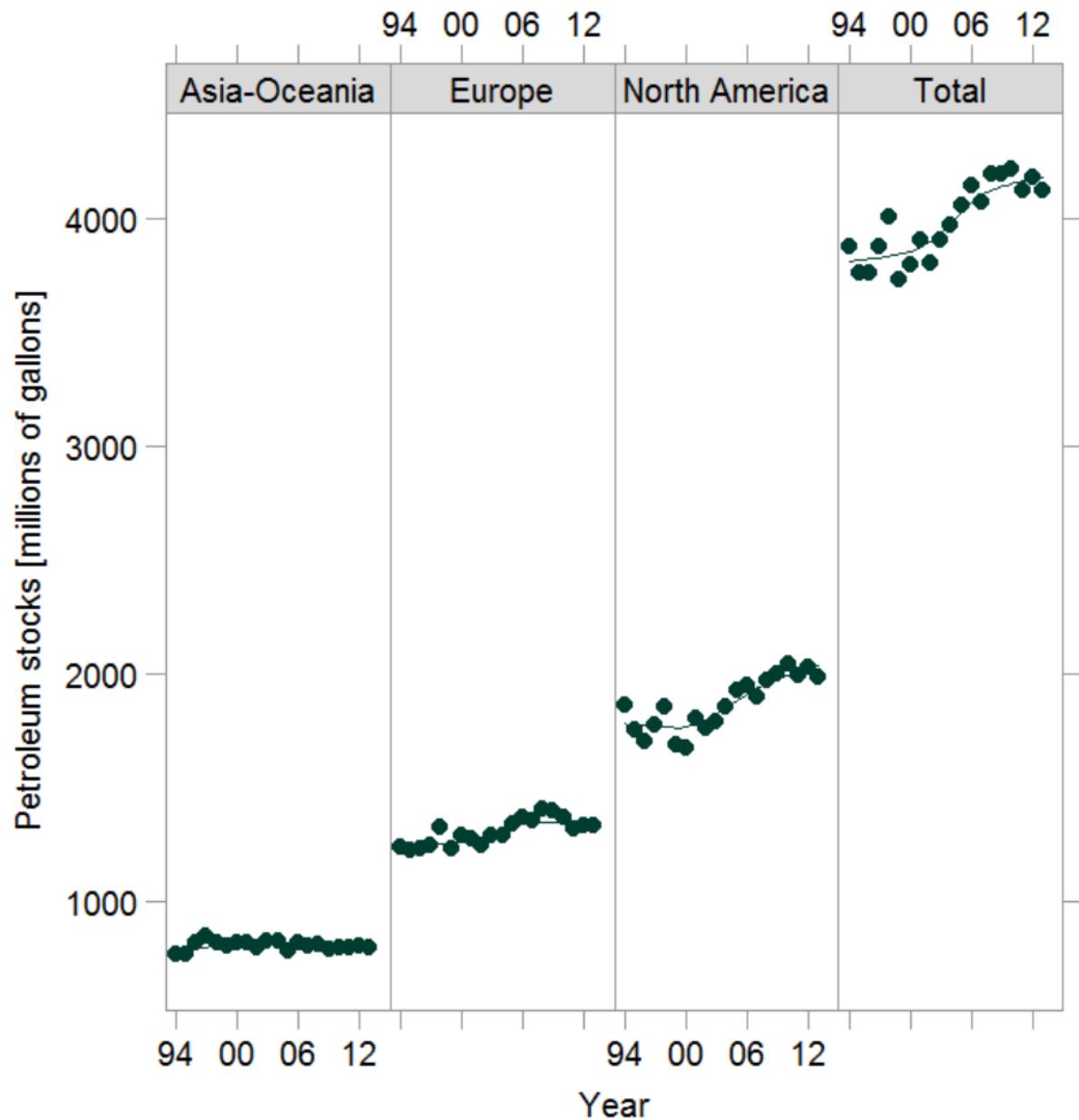
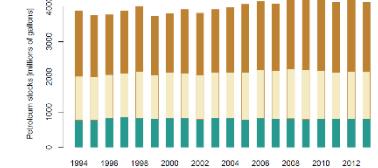
What stories do you see now?



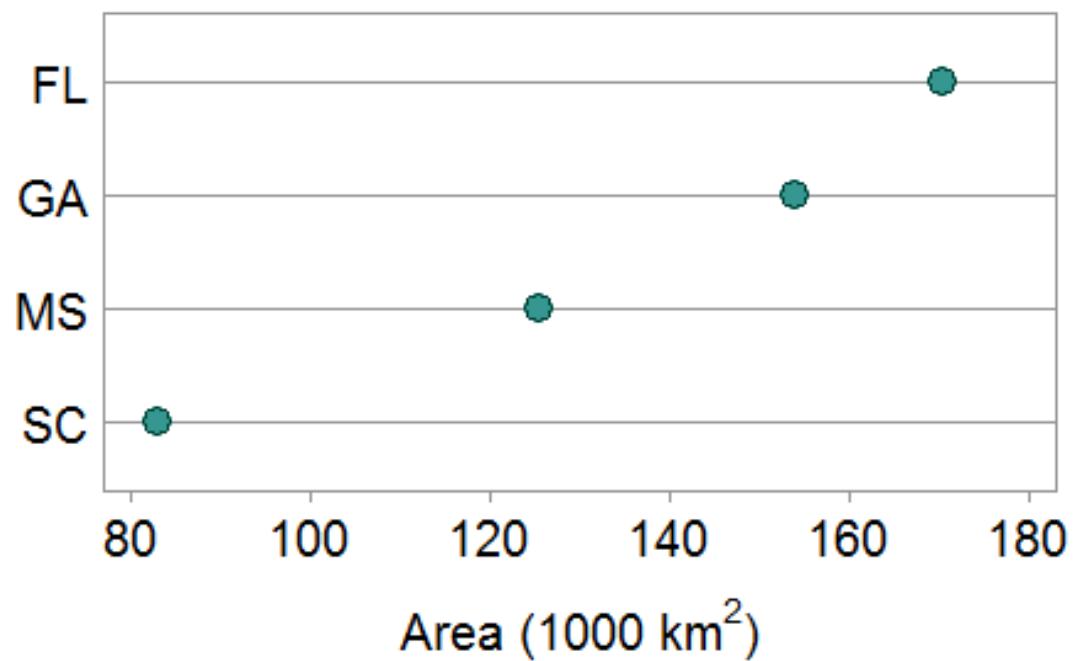
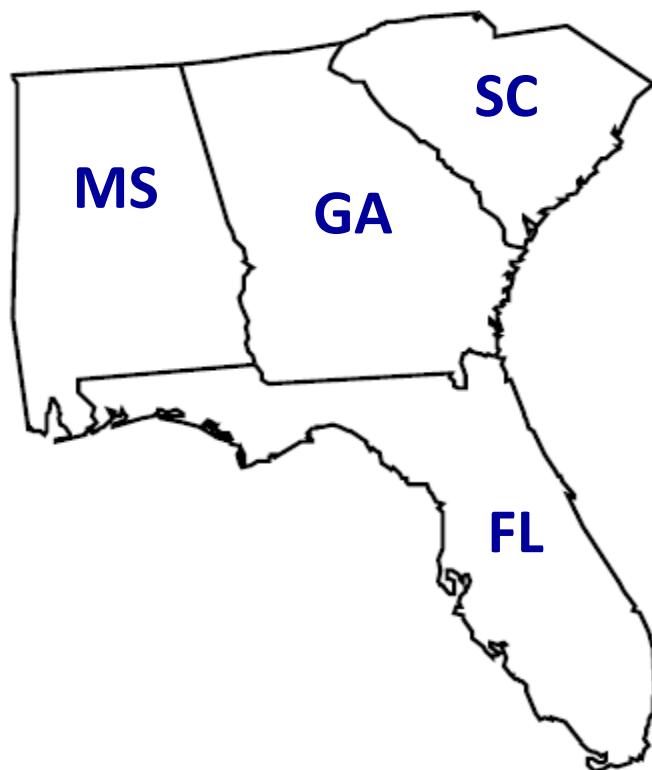
Time-series comparisons are more readily seen using a lattice design.



If the total is important,
we can add a panel.



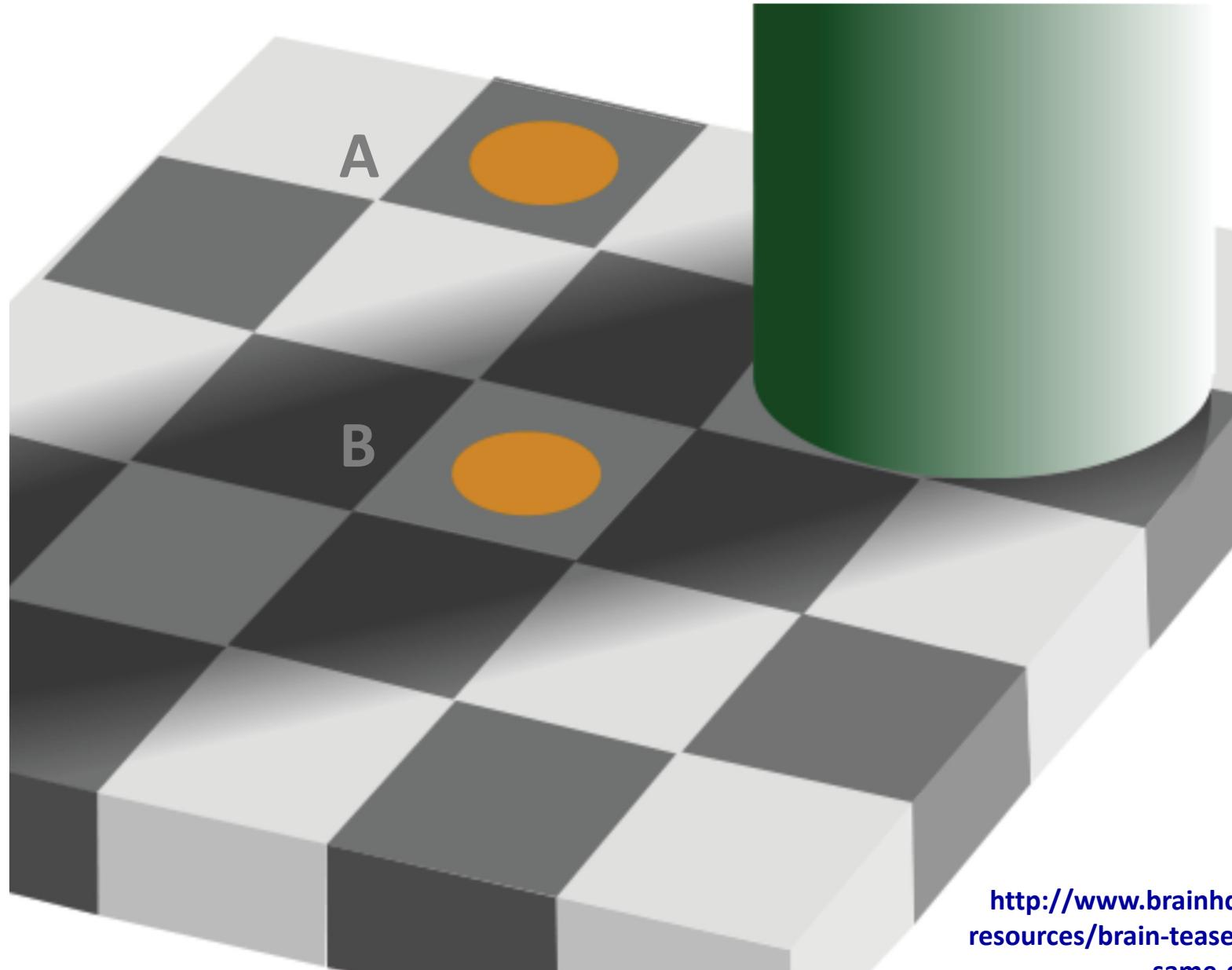
Area. List the states from largest to smallest.



Rows ordered by the data values.
(Not alphabetical on purpose.)

common visual illusions

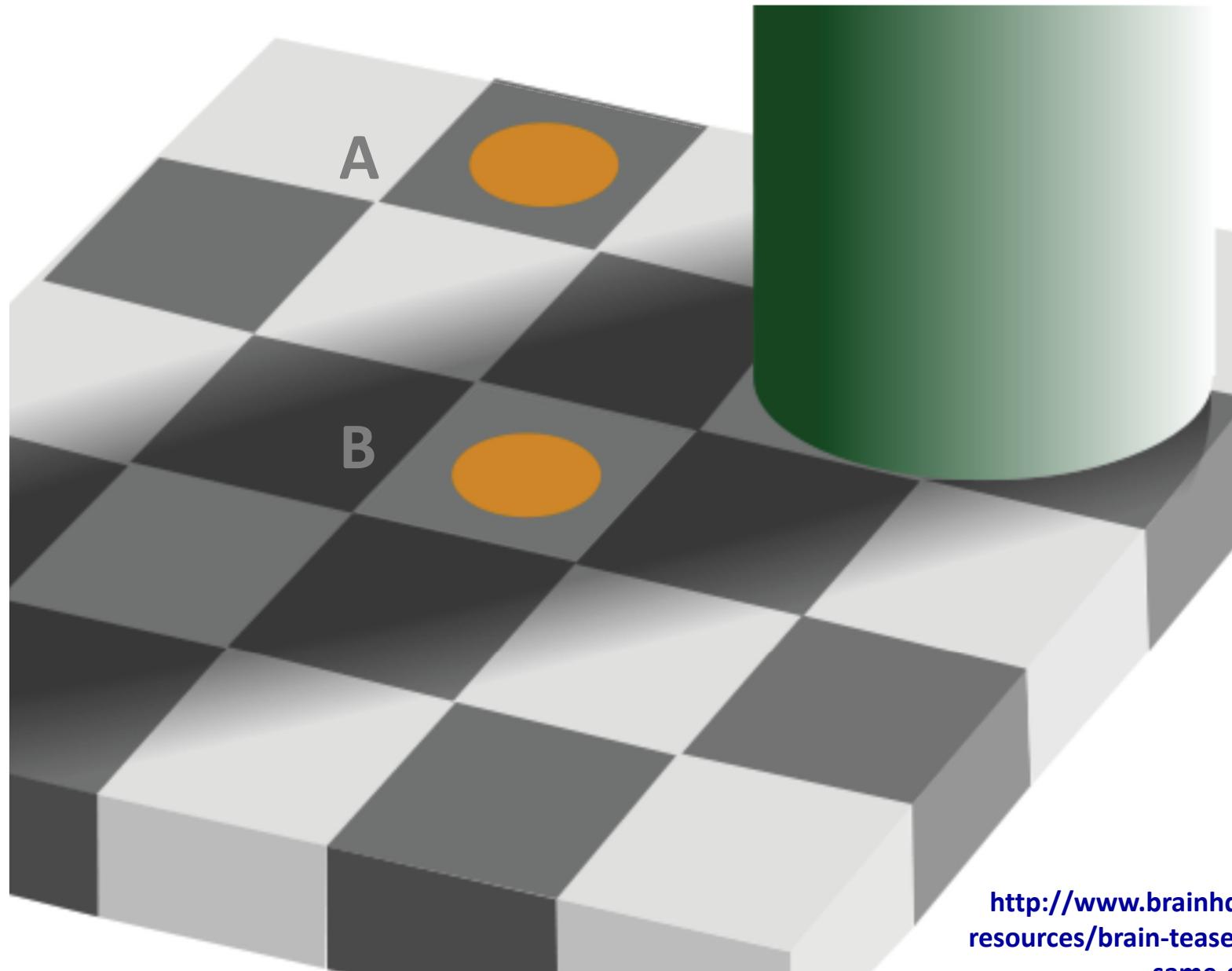
Color. Perception of color occurs in your brain.



8

<http://www.brainhq.com/brain-resources/brain-teasers/adelsons-same-color-illusion>

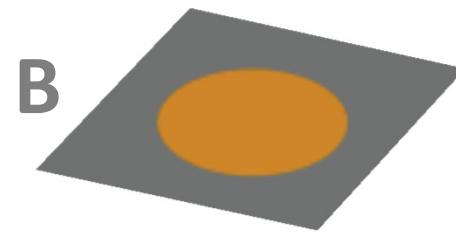
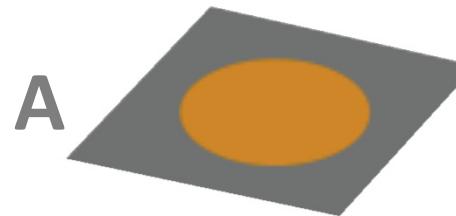
Color. Perception of color occurs in your brain.



8

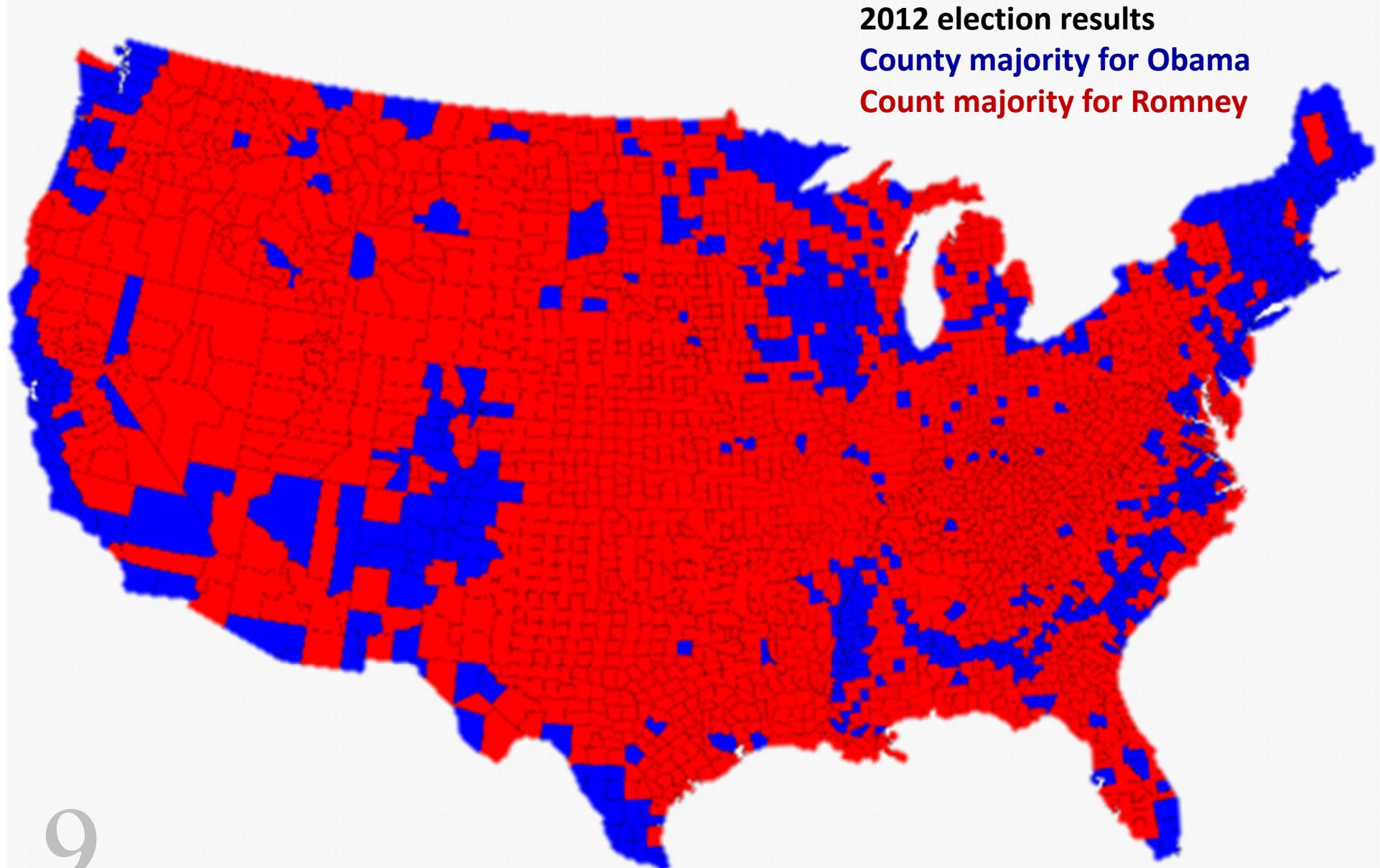
<http://www.brainhq.com/brain-resources/brain-teasers/adelsons-same-color-illusion>

Color. Perception of color occurs in your brain.

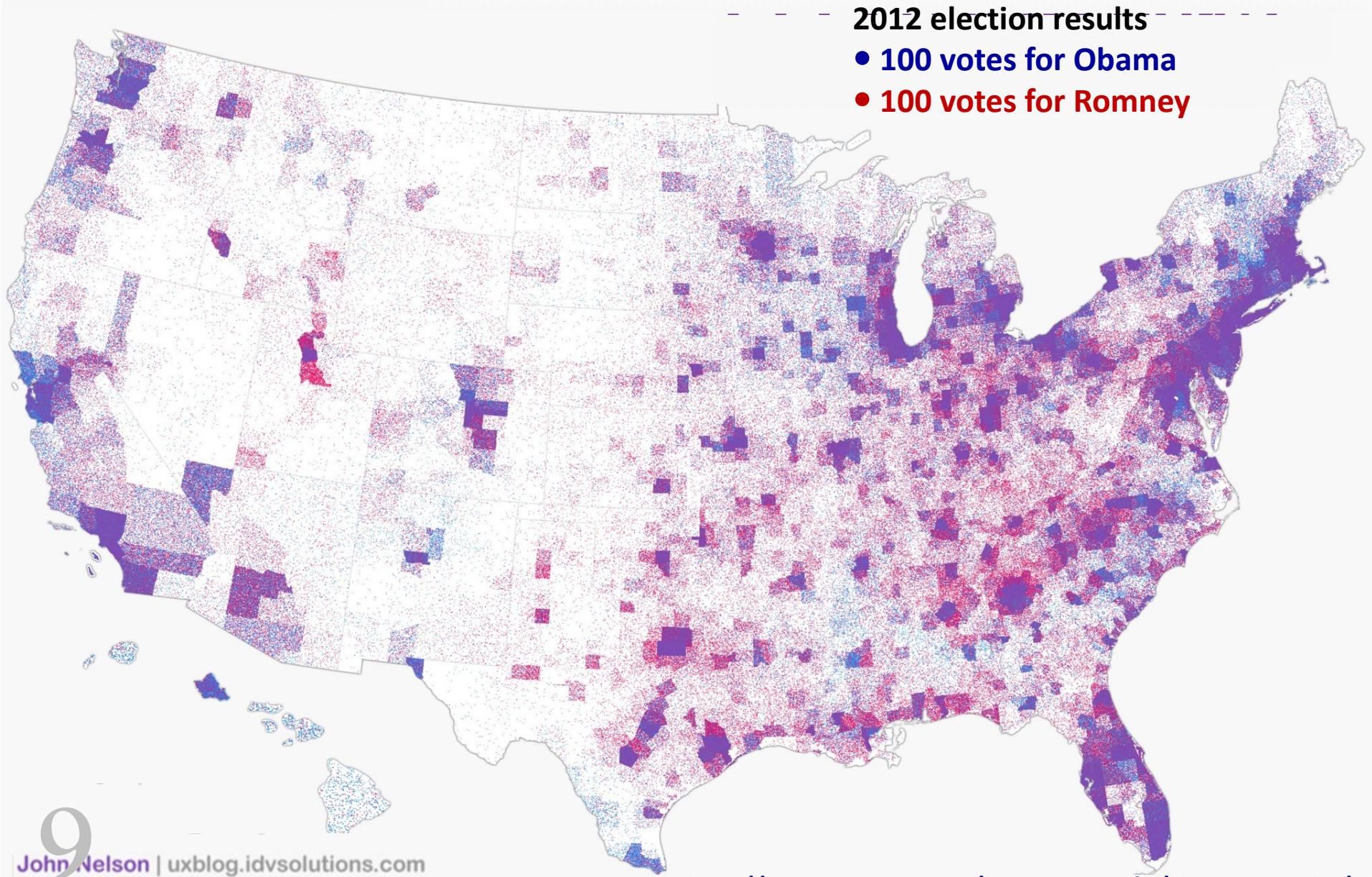


Differences in color are easily misperceived.

Color represents area. What story do you see?



Color represents **votes**. What story do you see?



9

John Nelson | uxblog.idvsolutions.com
IDV Solutions | idvsolutions.com

<http://coach.weinstein.to/lets-get-specific/election-results/>

Perspective illusion. Are the SUVs different sizes?



10

<http://www.moillusions.com/optical-illusion-of-3-terrain-vehicles/>

Perspective illusion. Are the SUVs different sizes?



Beware of perspective illusions.

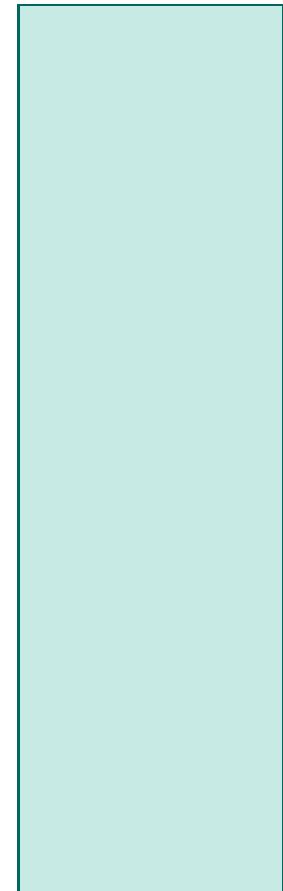
<http://www.moillusions.com/optical-illusion-of-3-terrain-vehicles/>

Length

Which bar is longer, A or B?



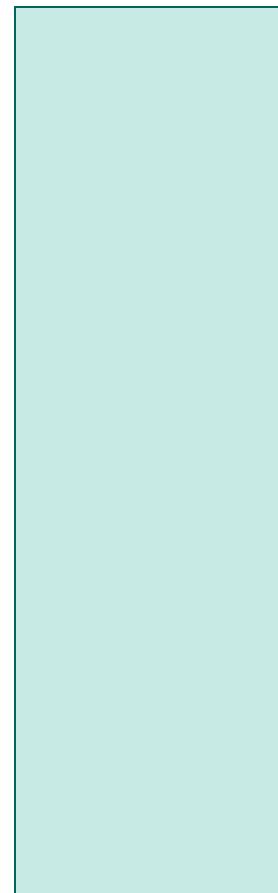
A



B

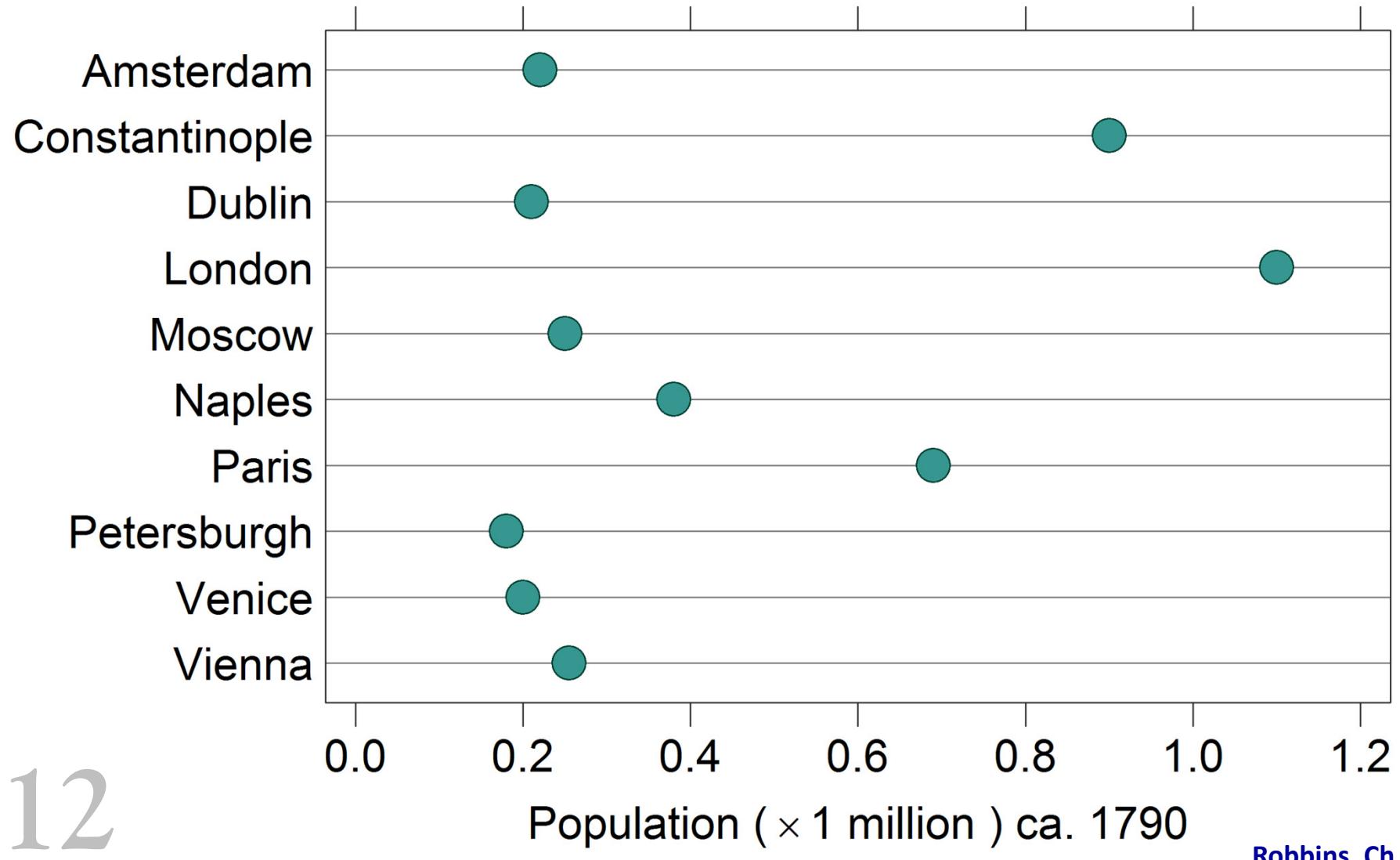
Length

Which bar is longer, A or B?



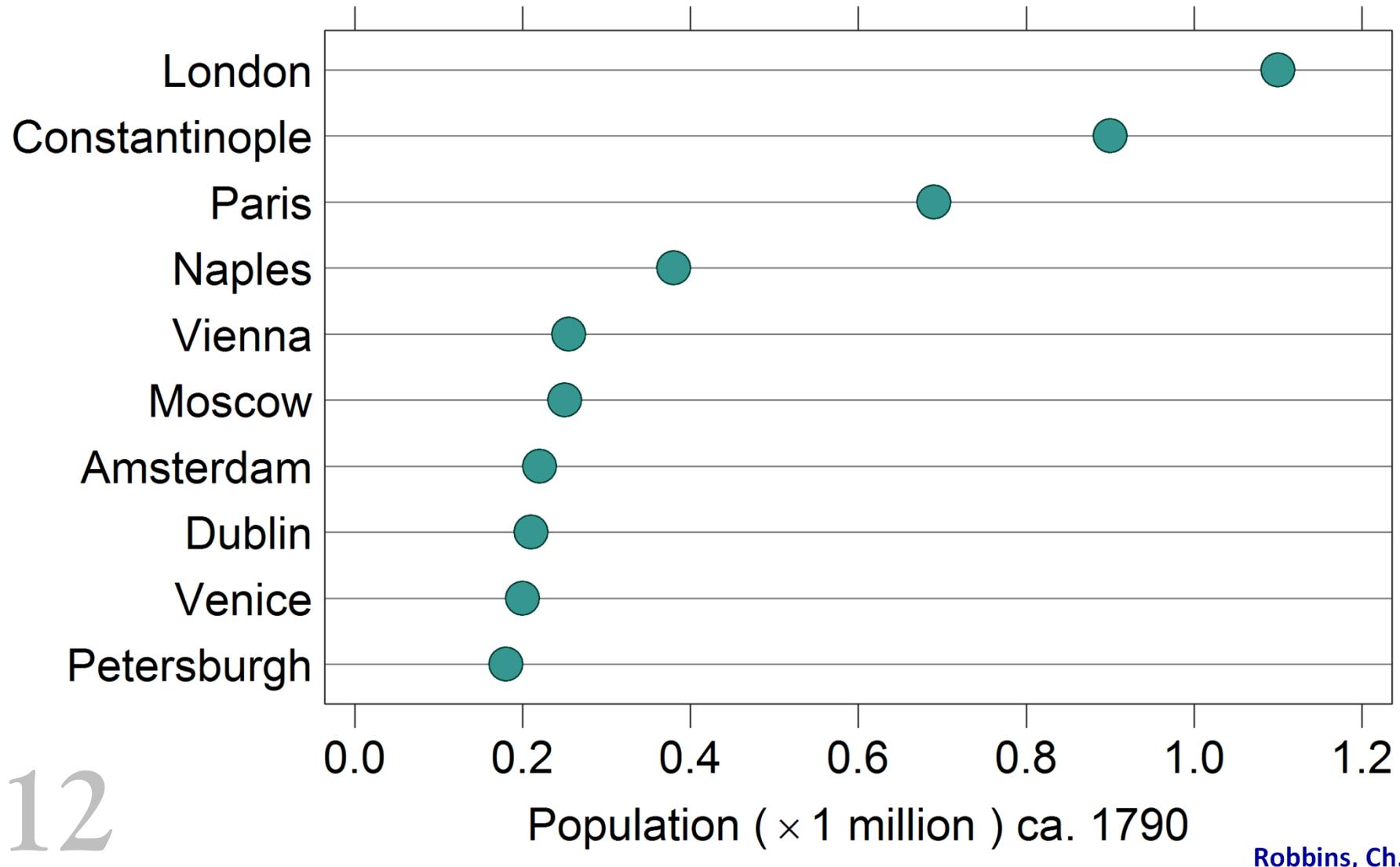
Position along a common scale

What conclusion do you draw from these data?

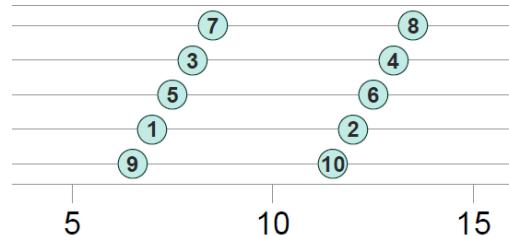


Position along a common scale, with ordered rows

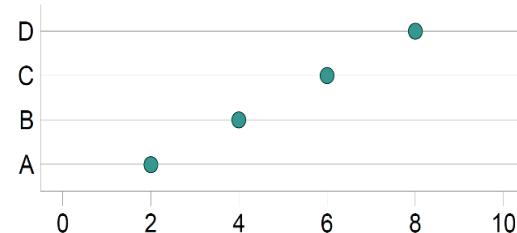
Do you see anything now you did not see before?



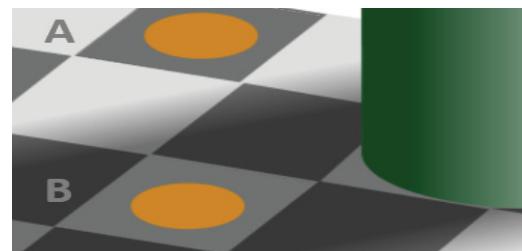
Implications for the designer.



Explore, revise, and edit until a story emerges.



Use effective visual coding.



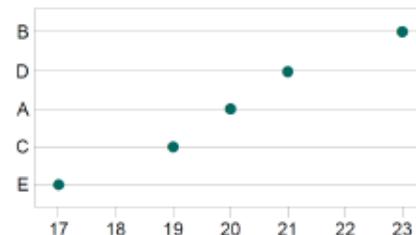
Avoid quantitative encoding using color or area.



Avoid illusions and 3D effects.

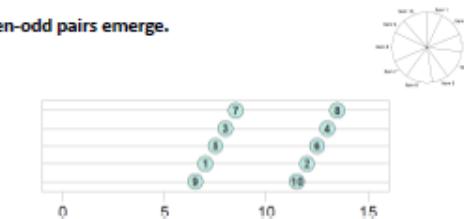
I've provided a page of the “more effective” versions of the example graphs.

The same data arranged along a common axis – a visual task of high accuracy.



Cleveland & McGill (1984) Graphical perception: Theory, experimental, and application to the development of graphical methods. *J. Am. Statistical Assoc.*, 79(387), (Sep., 1984), pp. 545-564.

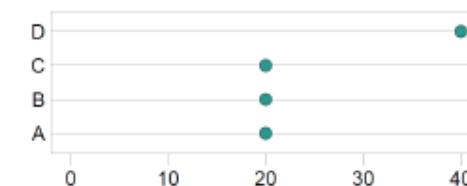
Even-odd pairs emerge.



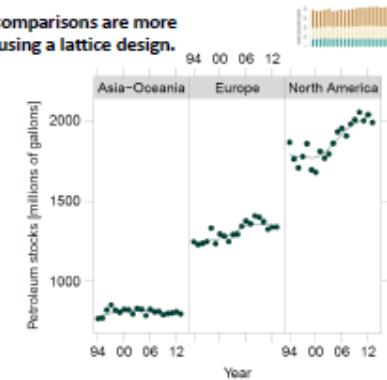
Exploratory graphics “forces us to see what we had not expected.”
— John Tukey (1915–2000)

H. Walker, Visual Revelations: Graphical Tales of Note and Deception From Napoleon Bonaparte to Ross Perot, NY: Copernicus, 1997.

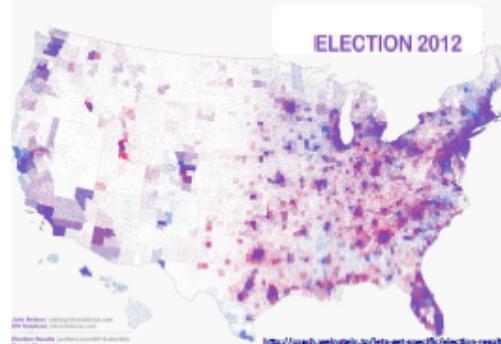
The same data arranged along a common axis – a visual task of high accuracy.



Time-series comparisons are more readily seen using a lattice design.

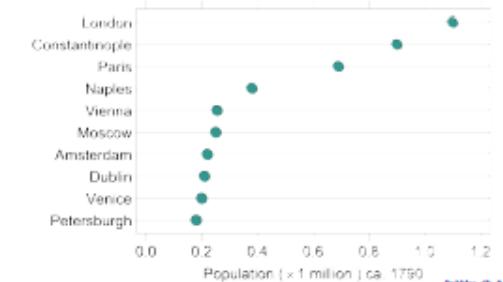


Color. Color represents a quantity – each dot is 100 votes.



Position along a common scale, with ordered rows

Do you see anything now you did not see before?



your portfolio

Your portfolio is a GitHub repository



graphdr / portfolio-sample

Unwatch 1 Star 0 Fork 0

Code Issues 0 Pull requests 0 Projects 0 Wiki Insights Settings

Introduction

Your prose.

Displays and critiques

Display 1 Title of your graph

State the type of graph (strip plot or box plot) and summarize the main points of the report.

Display 2 Title of your graph

State the type of graph (multiway dot plot) and summarize the main points of the report.

Display 3 Title of your graph

State the type of graph (scatterplot) and summarize the main points of the report.

Display 4 Title of your graph

State the type of graph (dot plot, line graph, or scatterplot) and summarize the main points of the report.

Display 5 Title of your graph

State the type of graph (dot plot, line graph, or scatterplot) and summarize the main points of the report.

Portfolio requirements are described on the website



Display requirements

- D1 distributions
- D2 multiway
- D3 correlations
- D4 injuries or fatalities
- D5 redesign a graphical lie
- D6 multivariate
- D7 self-taught

Resources

- Portfolio display requirements
- Setup reading responses
- BiBTeX entry types
- Document design
- Fonts
- Headings
- Text color
- Emphasis
- Hyphens and dashes

Portfolio studio

- Media
- Preparation
- Organize the README file
- Importing images
- Start a report
- Data tables
- Create the bib file
- BiBTeX entry types
- YAML bibliography argument
- Add a citation
- Add a references heading
- Format the citations and references
- Presentation prompts
- Reading prompts

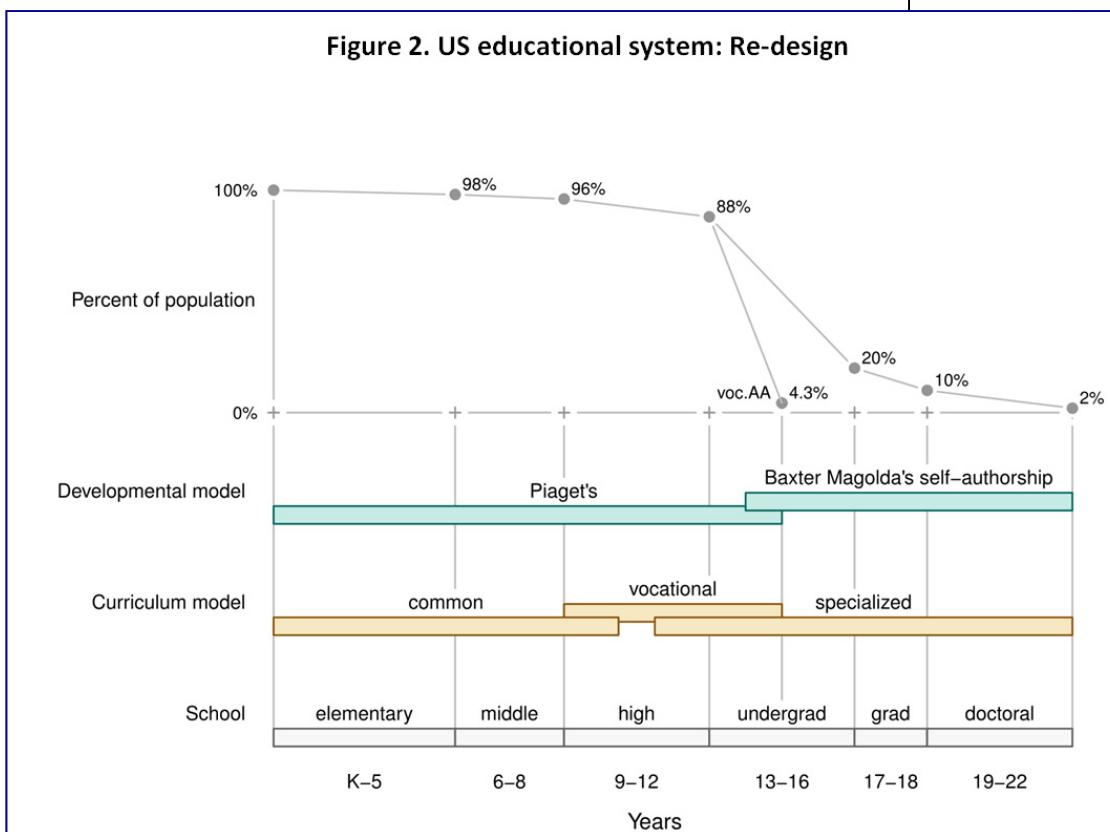
Portfolio requirements are described on the website



display	type	quantitative	categorical
D1 distributions	strip plot or box plot	one	one or two
D2 multiway	multiway	one	two
D3 correlations	scatterplot	two	one
D4 injuries or fatalities	dot plot	one	optional
	line graph or scatterplot	two	optional
D5 redesign a graphical lie	dot plot	one	optional
	line graph or scatterplot	two	optional
D6 multivariate	conditioning plot	three or four	
	scatterplot matrix or parallel coordinate	four or more	
D7 self-taught	cycle plot	one	two
	mosaic plot	one	three or more
	financial (OHLC) plot	four	one
	linked micromaps	one	
	diverging stacked bar	one	one

I will provide some sample critiques.

- page layout
- voice, tone, and persona
- using citations



The data are of two types: univariate spans of years and a bivariate time series. The data sets have the same time framework so a horizontal time scale unifies the graph structure.

The time scale is conventionally oriented from left to right as suggested by Robbins [4, pp. 283]. With the start of kindergarten (K) as year 0, the year axis is drawn to scale [4, pp. 197], providing the common, aligned scale recommended by Cleveland [3]. This new structure is de-emphasized by drawing it in shades of gray [4, pp. 185]. Because the school labels "elementary", "middle", etc., describe spans of years, the year axis labels are also shown as spans of years. Axis tick marks are unnecessary.

In this type of data in one graph, the data rectangle is divided into upper and lower regions by a horizontal line. Vertical grid lines span the lower portion only, enhancing separation between the two regions and helping a viewer compare the spans and the categorical data. At the top of the grid lines, a small plus symbol acts as a tick for the time series, subtly emphasizing that the upper region is a conventional scatter plot.

The upper region of the graph is devoted to the time series data: the percent of the US population by educational level. The appropriate graph type is a time series showing the percentage over time [5]. The data are discrete, so the line from point to point is obvious. The vertical scale labeled 0-100% gives another visual cue that the data are discrete. The data markers are labeled with values to meet the needs of the audience. The data are enough that the value labels do not crowd the data rectangle [4, pp. 175]. Labeling the points makes additional tick marks on the vertical scale unnecessary.

The lines between data markers help dramatize the sharp decline in the percent of the population completing post-secondary education. A separate line indicates those completing a vocational associates degree. This observation was not in the original concept but was included once the new design was established.

The lower region of the graph is devoted to the univariate, categorical data. The spans are drawn contrary to Tufte's advice to reduce non-data ink [2, pp. 96]. The bars give the lower region prominence equal to that of the upper graph region, balancing the importance of the two types [5]. The bars also provide higher contrast to the background structure and easier comparison of the spans and overlaps. Following Few's advice [6], the bars are colored according to a categorical palette that separates the categorical data into distinct groups. The level of color saturation is moderate for the bar area but higher for the outlines.

A striking story of the graph is the sharp decline of people completing post-secondary education. The graph raises several questions about the population decline and the specialized and self-authorship developmental models of the post-secondary years. Are they related? Does another variable underlie both? If so, can it be measured?

**See my blog for additional samples
of critiques and redesigns.**

<http://www.graphdoctor.com>

