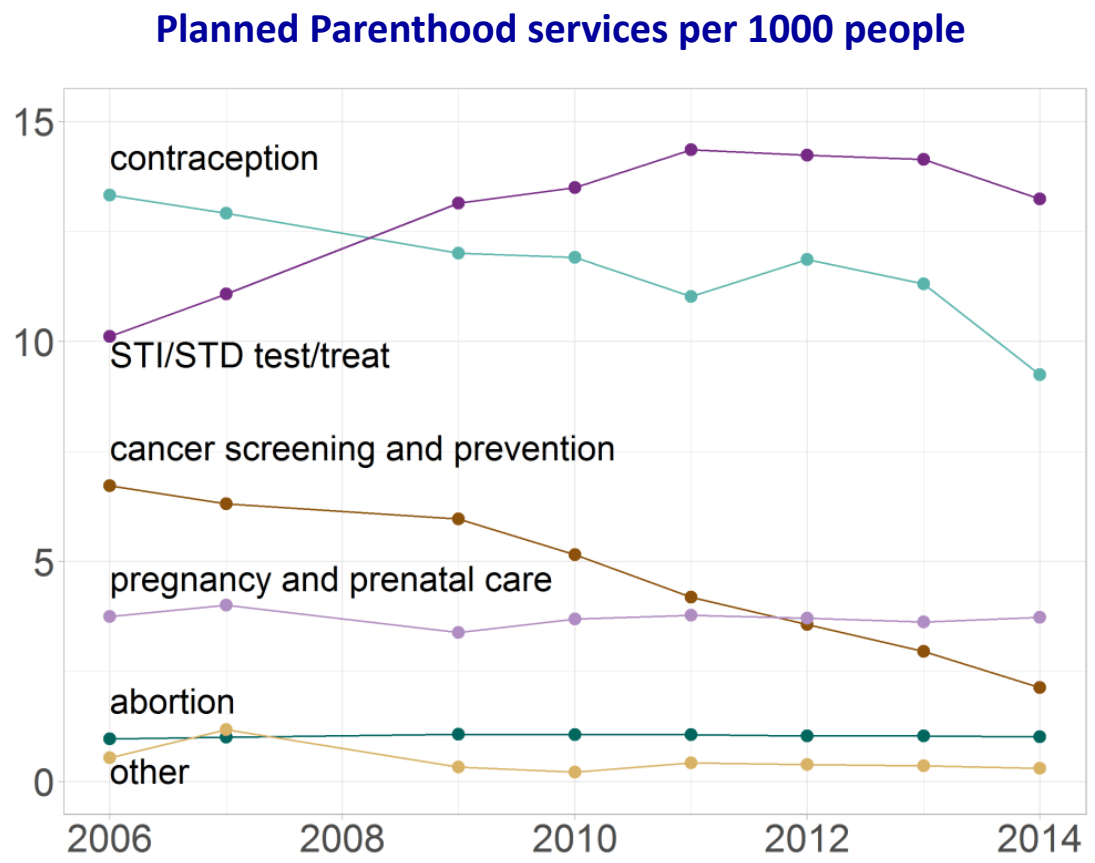
Limitations of common visual elements

ME447 Visualizing Data
Spring 2018–19

Richard Layton



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INSTITUTE OF TECHNOLOGY

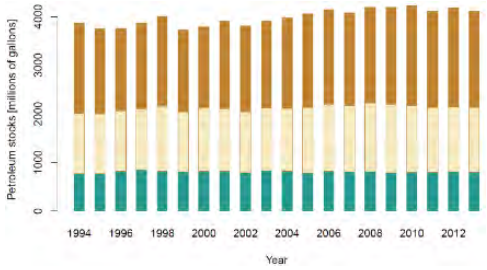
Please find a partner to work with.

Do you have a partner?

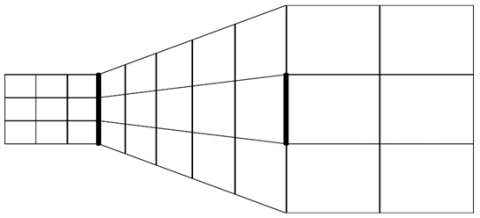
Do you have a handout?

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

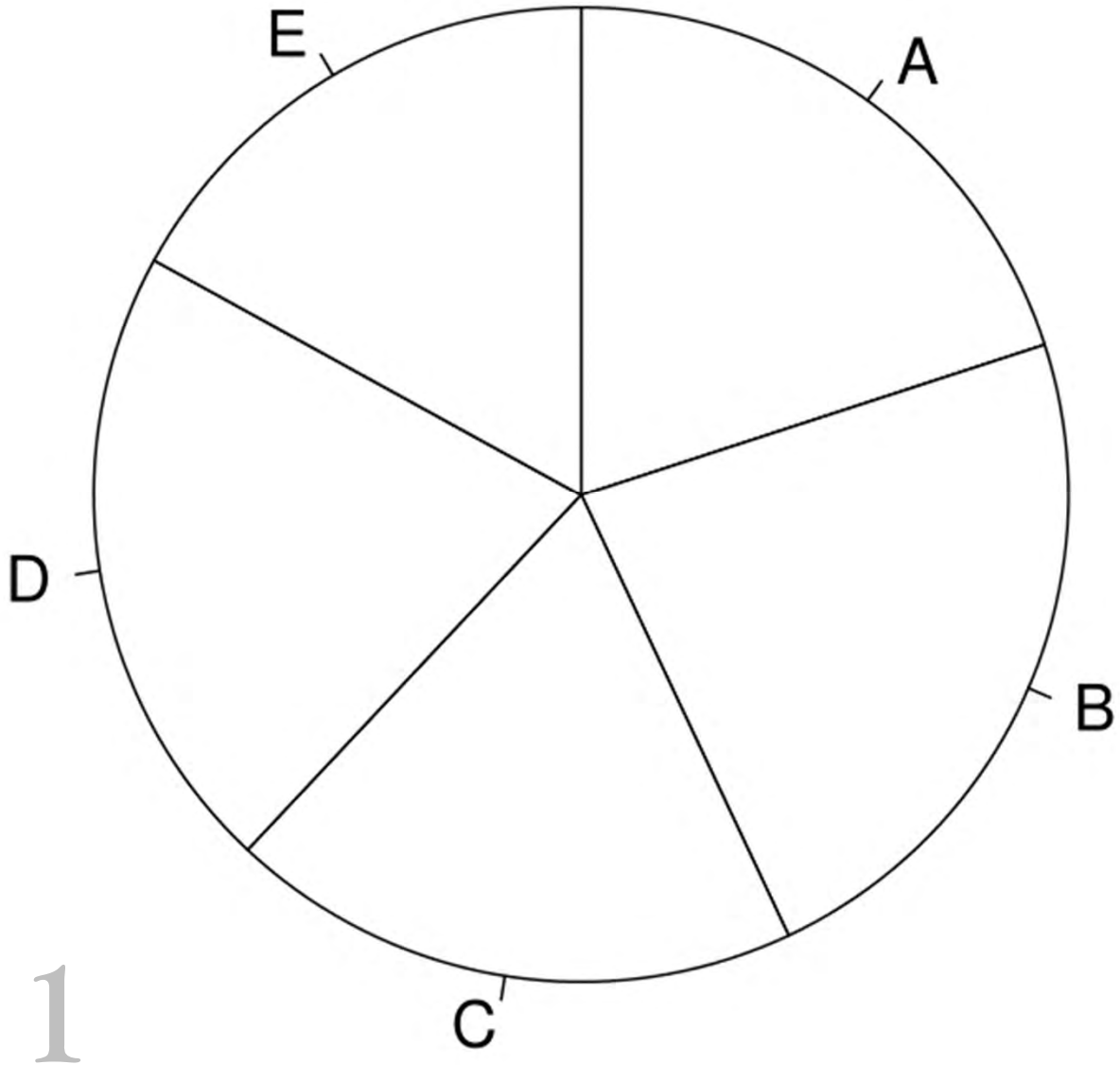


Avoid common visual illusions

Put it all together in your portfolio

limitations of common graphs

List the slices A thru E from largest to smallest.



_____ largest

_____

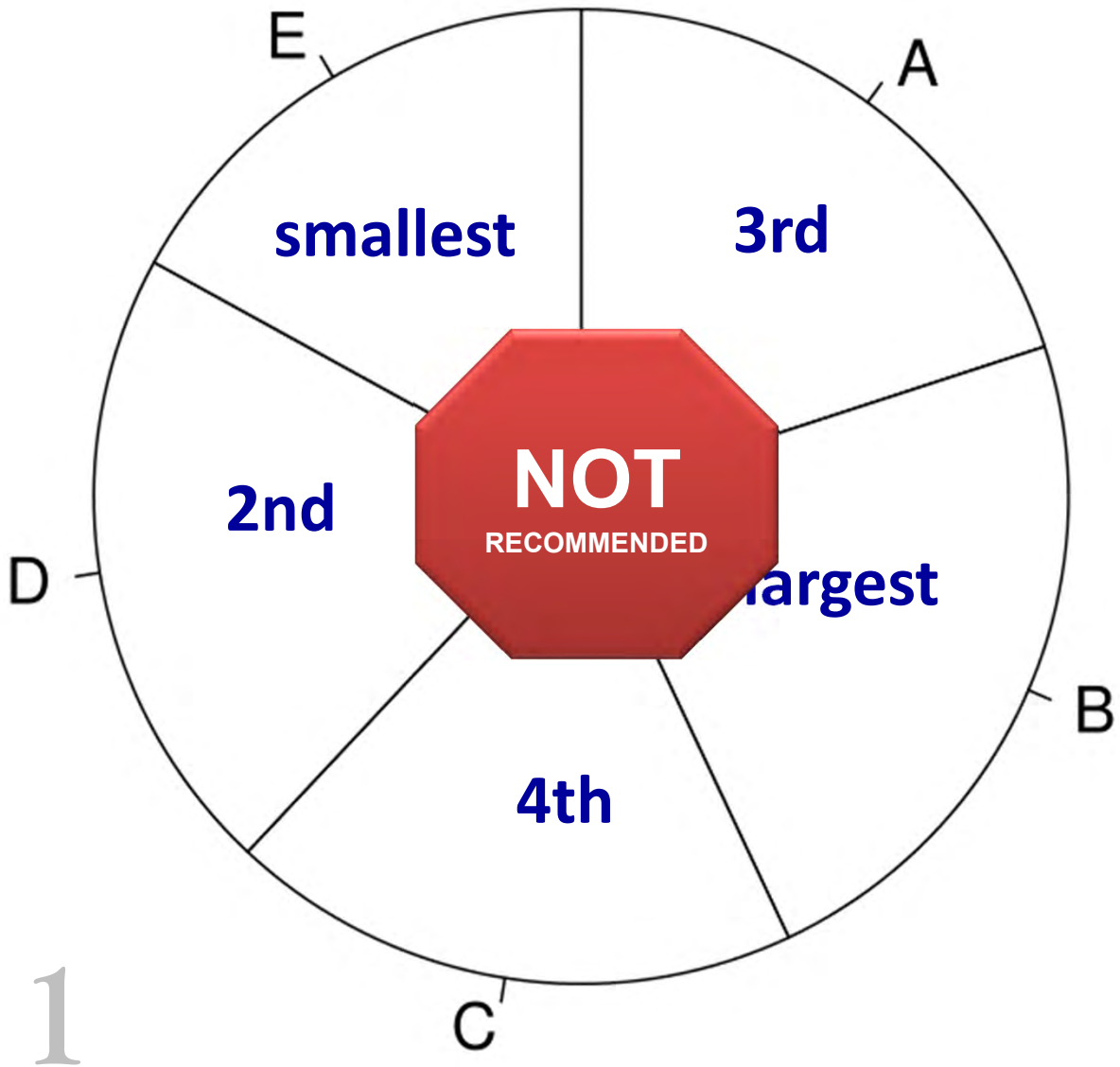
_____

_____

_____ smallest

Adapted from Robbins, Ch. 2.

Comparing angles – usually a low-accuracy task.



B — largest

D

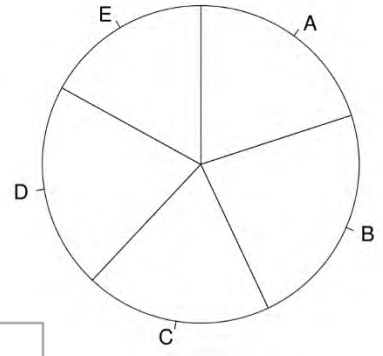
A

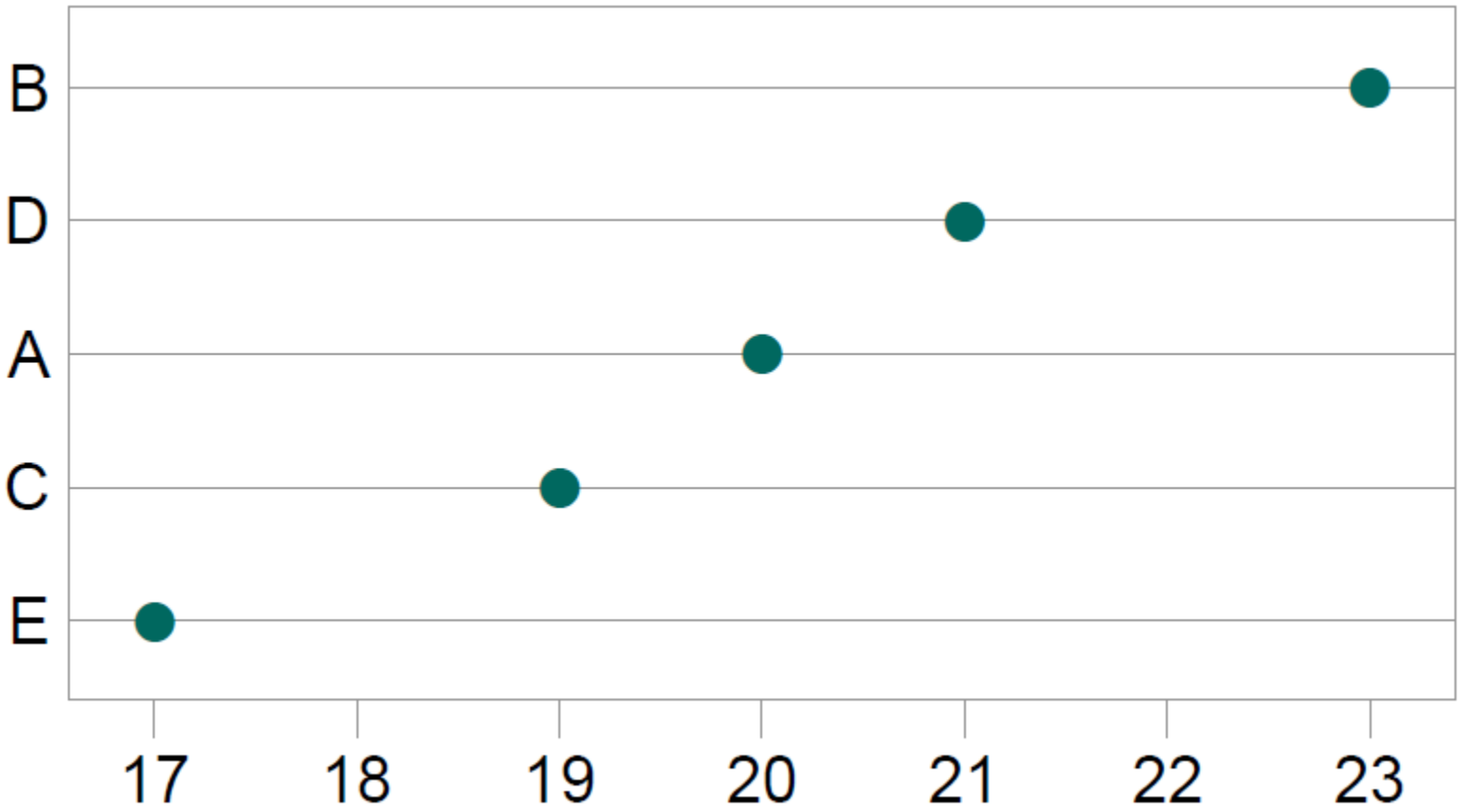
C

E — smallest

Adapted from Robbins, Ch. 2.

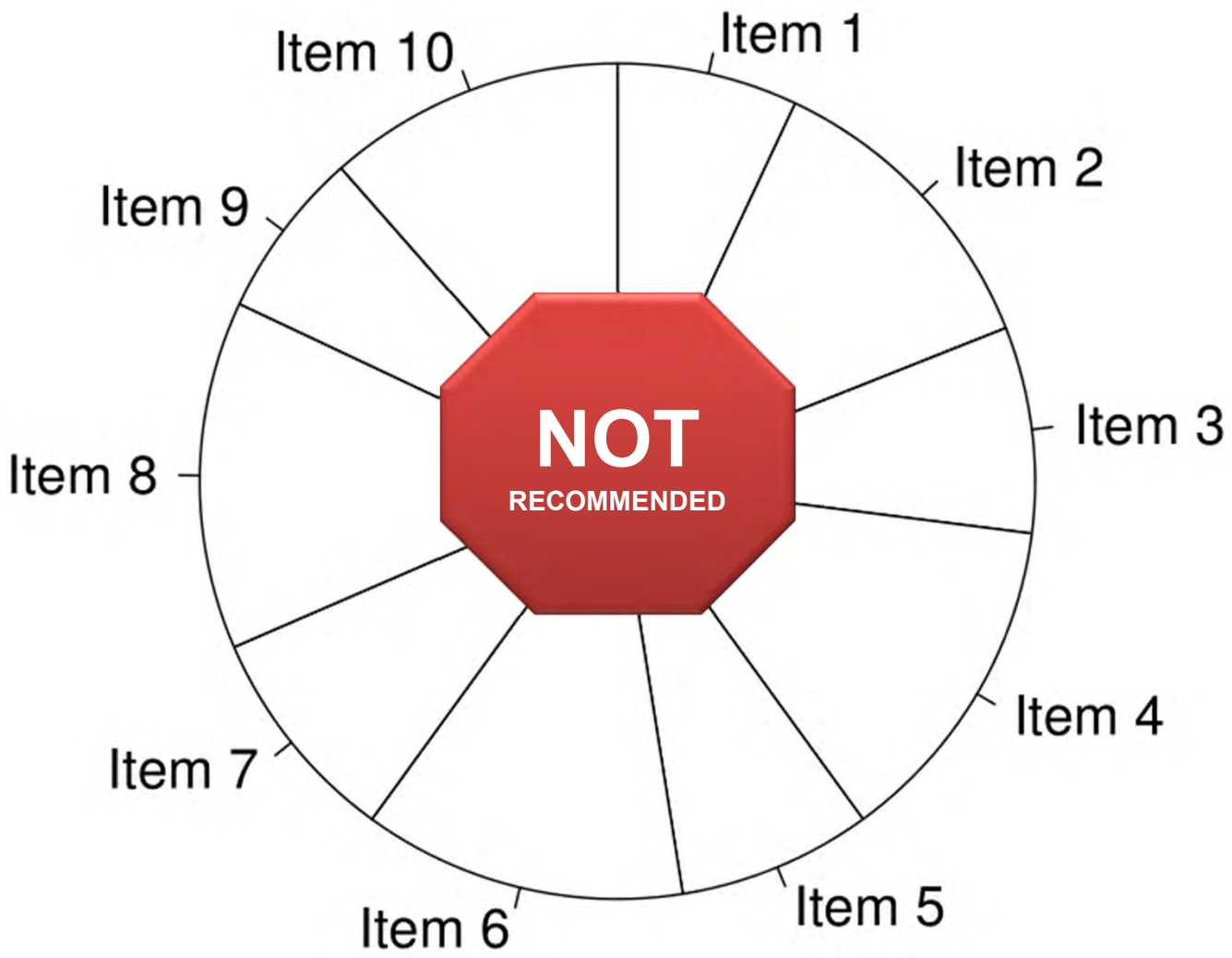
The same data arranged along a common axis – a visual task of high accuracy.





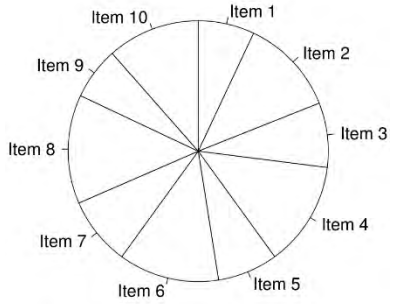
Cleveland & McGill (1984) Graphical perception: Theory, experimentation, and application to the development of graphical methods. *J. Am Statistical Assoc*, 79(387). (Sep., 1984), pp. 531-554.

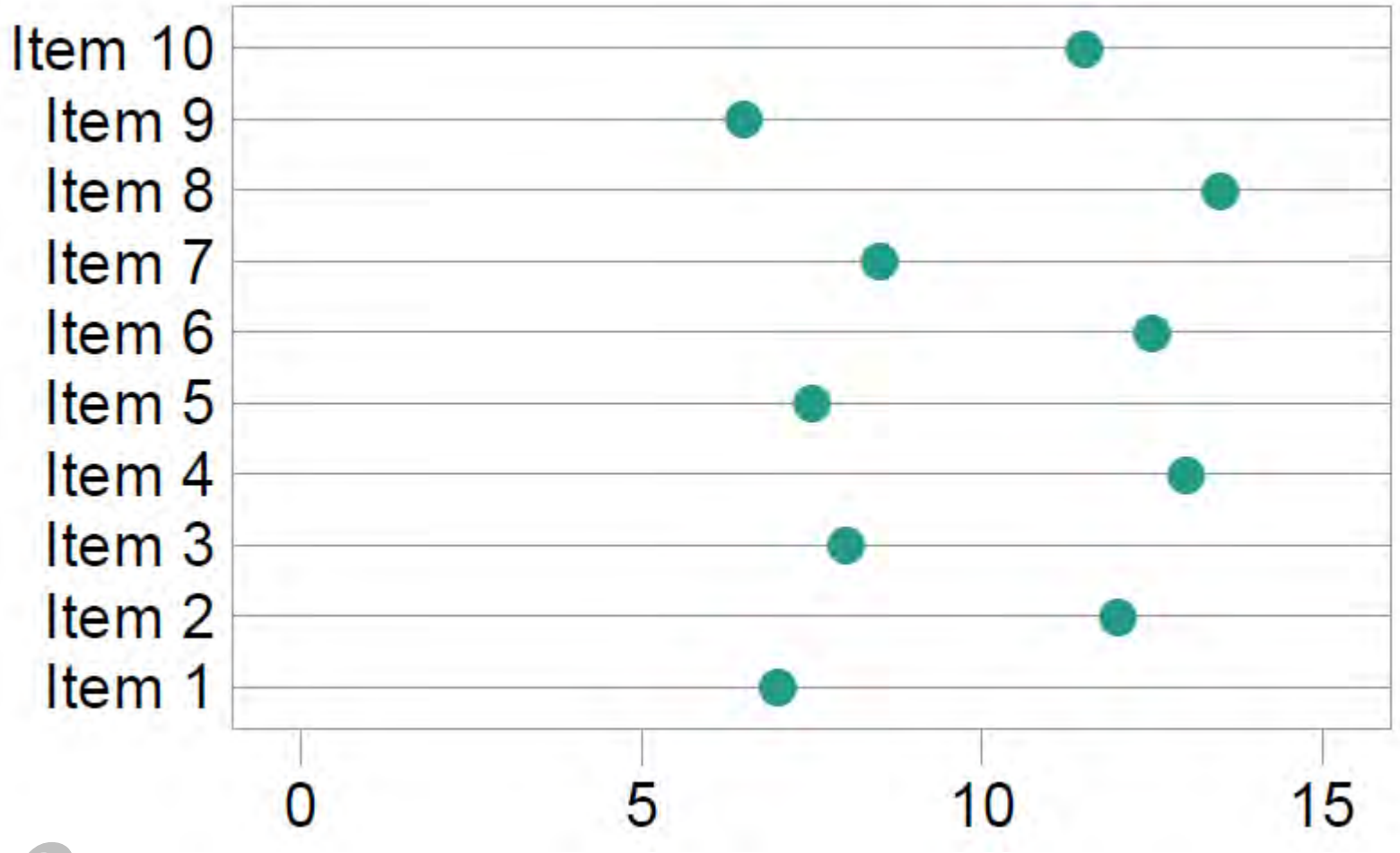
What patterns do you see in these data? Write your ideas in the workbook.



N. Robbins, *Creating More Effective Graphs*. Chart House, 2013. p. 12.

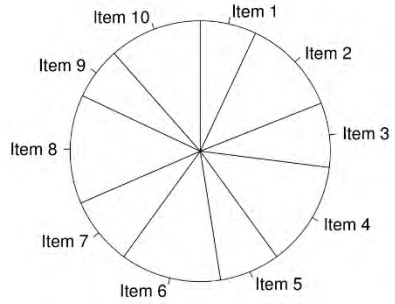
The same data graphed along a common scale. Write down any new observations.

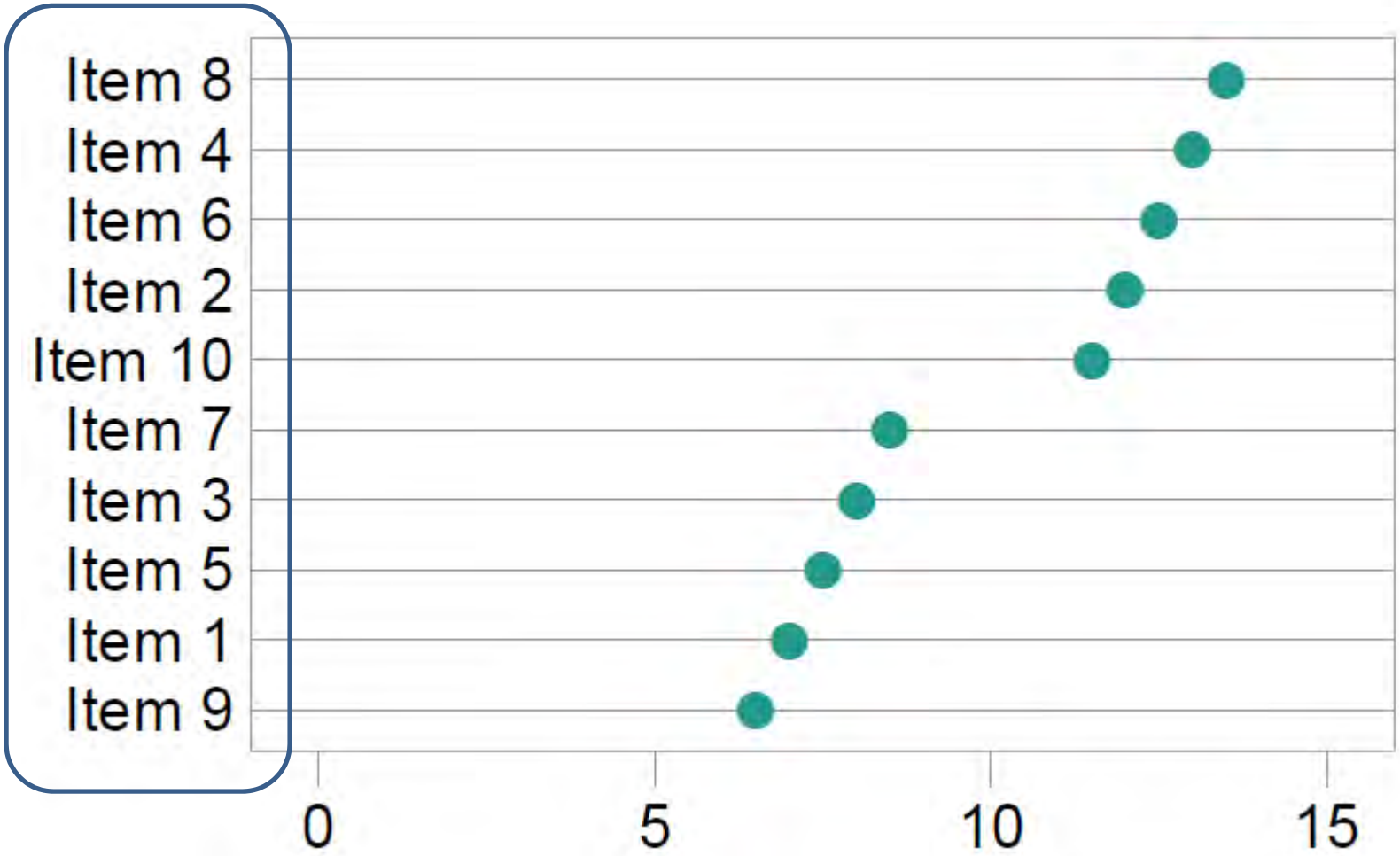




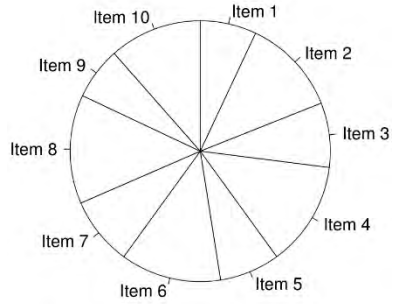
N. Robbins, *Creating More Effective Graphs*. Chart House, 2013. p. 14.

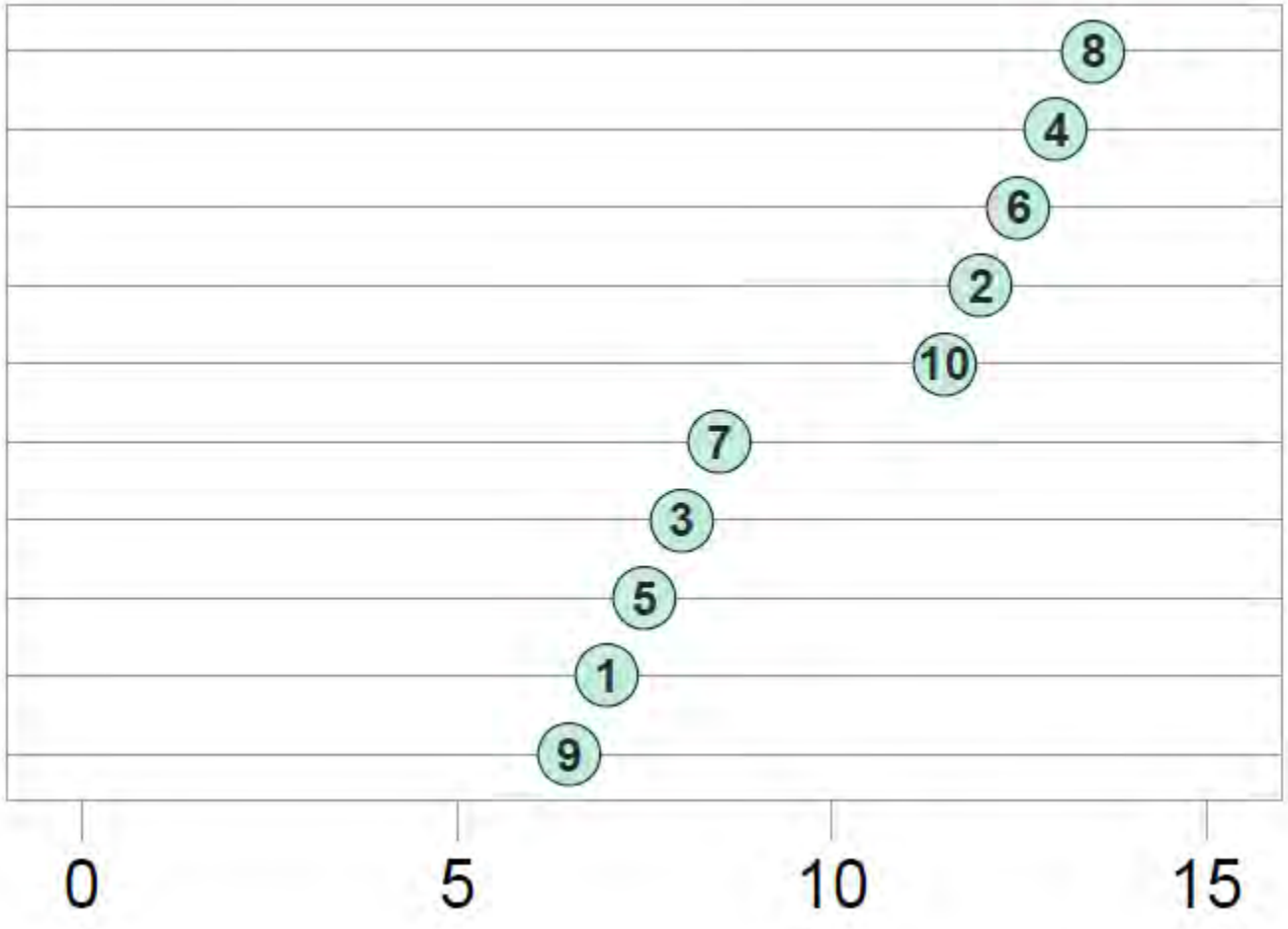
Rows reordered by value.



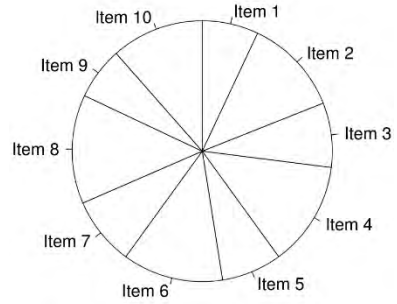


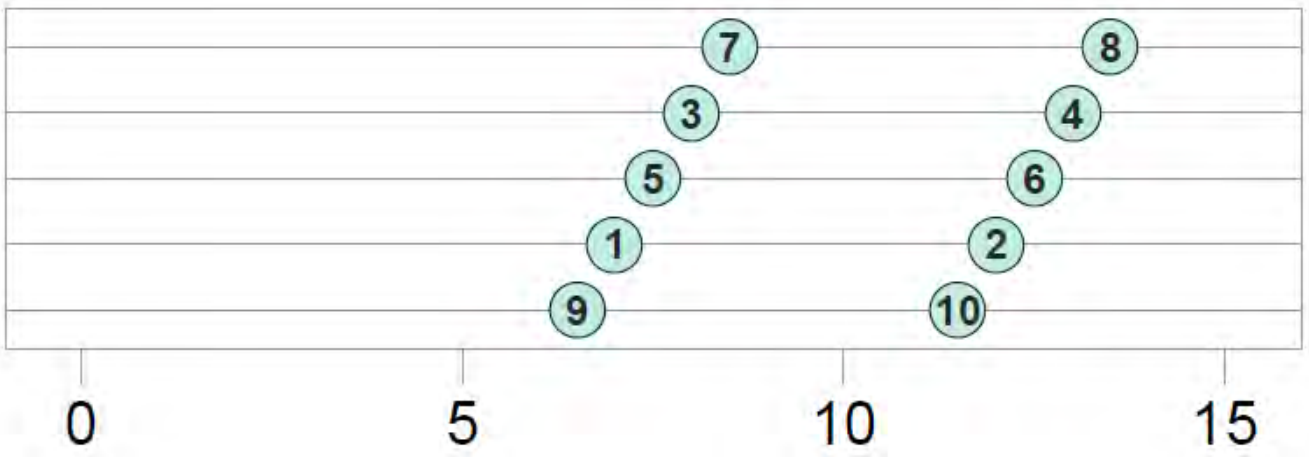
Move the item number to the data marker.





Even-odd pairs emerge.

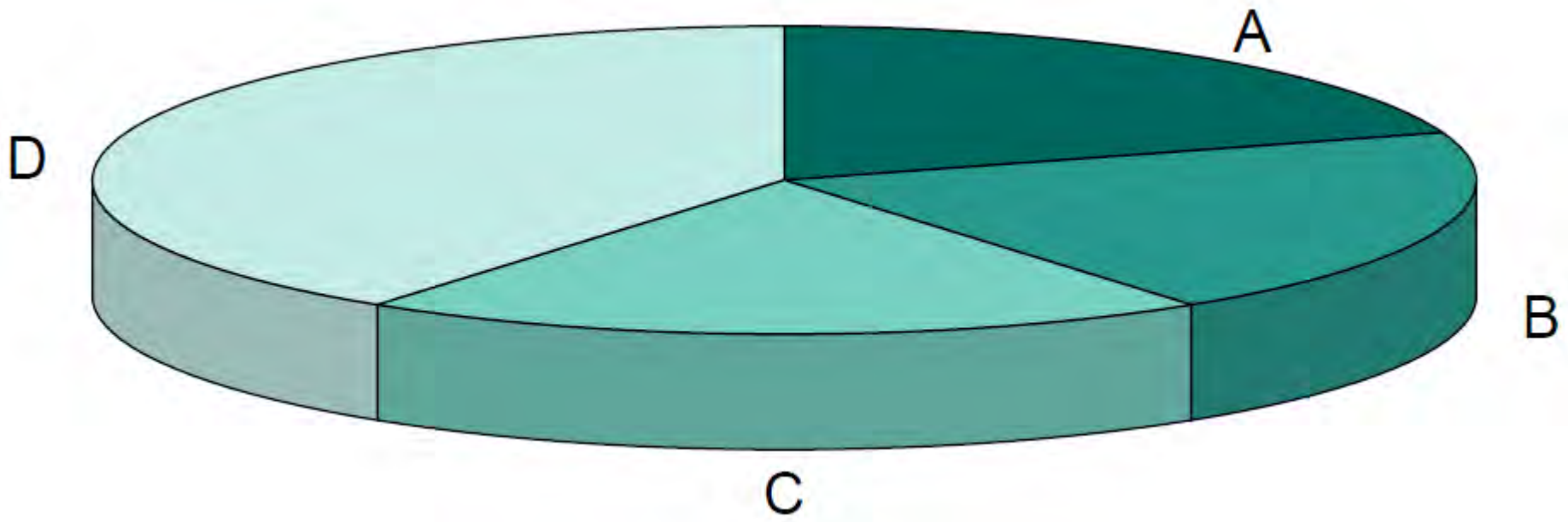




Exploratory graphics "forces us to see what we had not expected."
– John Tukey (1915 –2000)

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: _____ %

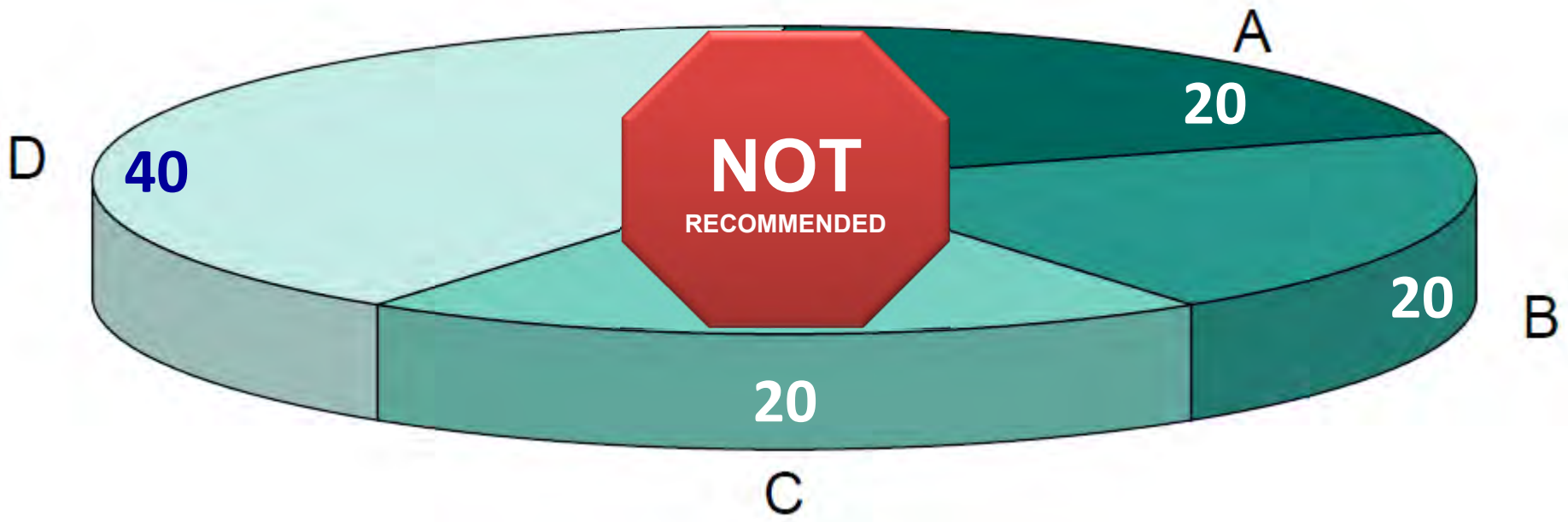
B: _____ %

C: _____ %

D: _____ %

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

3D-effects distort our judgment.



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

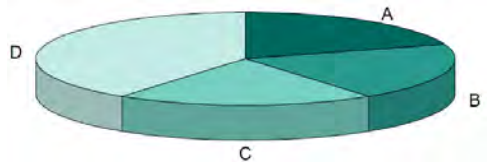
A: **20** %

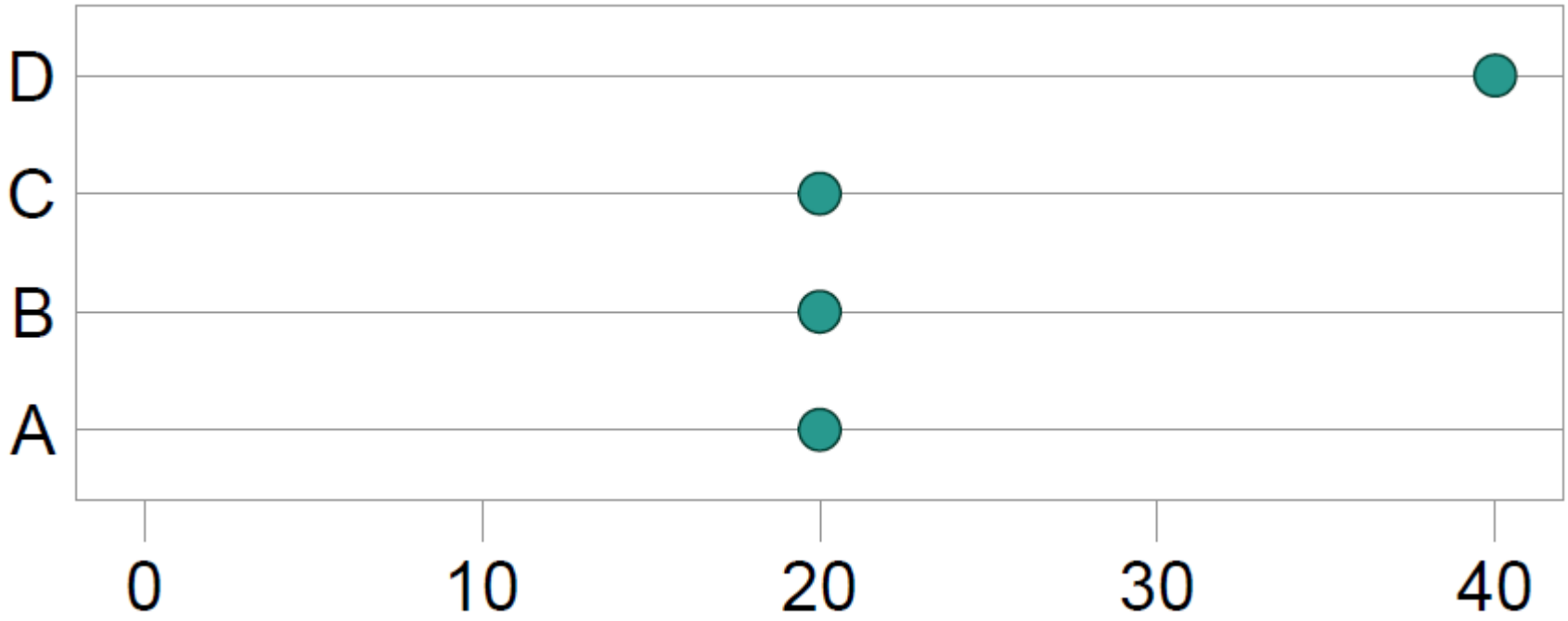
B: **20** %

C: **20** %

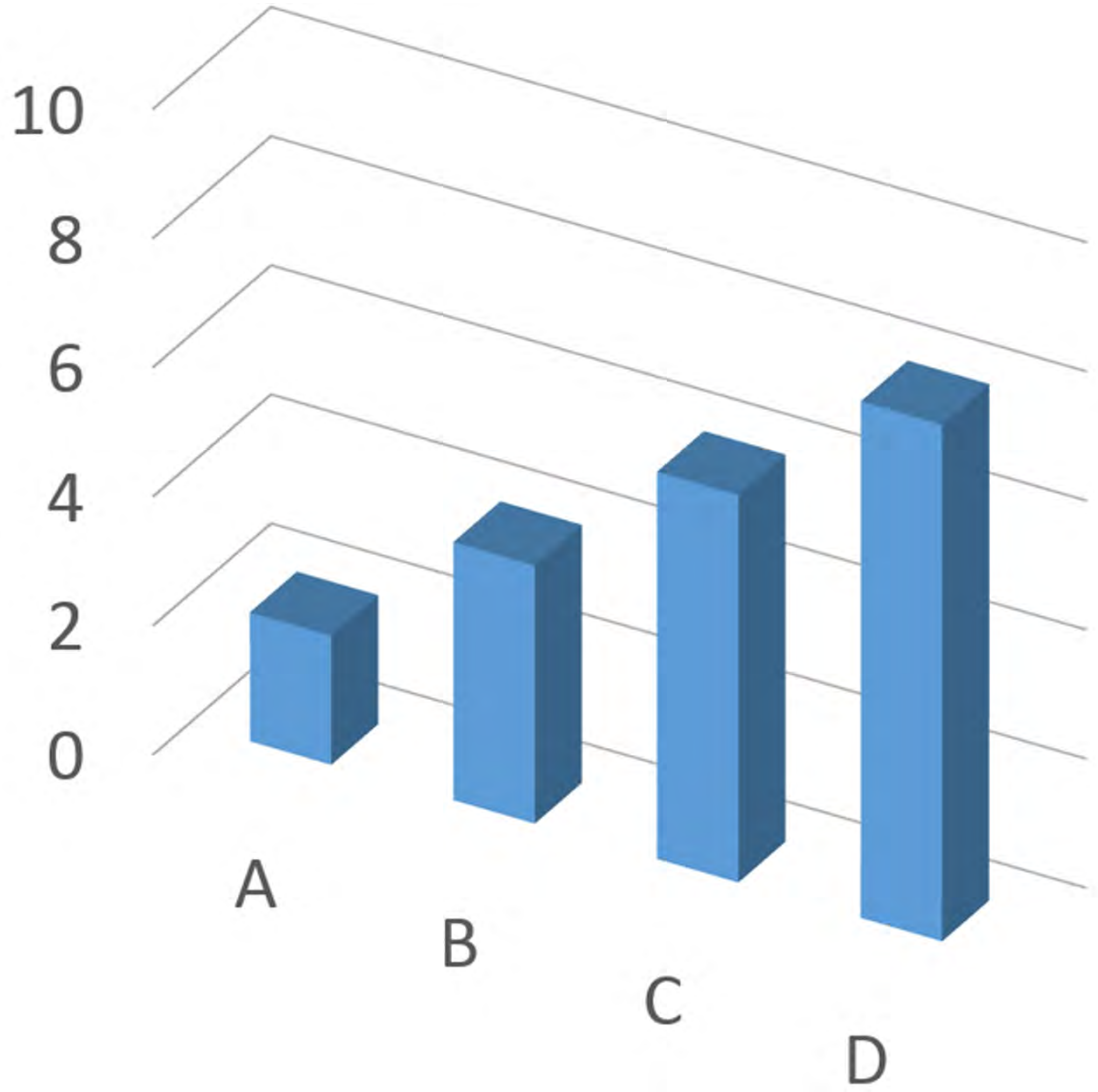
D: **40** %

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: _____

Robbins p. 22

3D effects distort our judgment.

A: 2

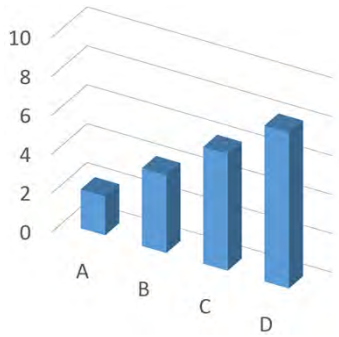
B: 4

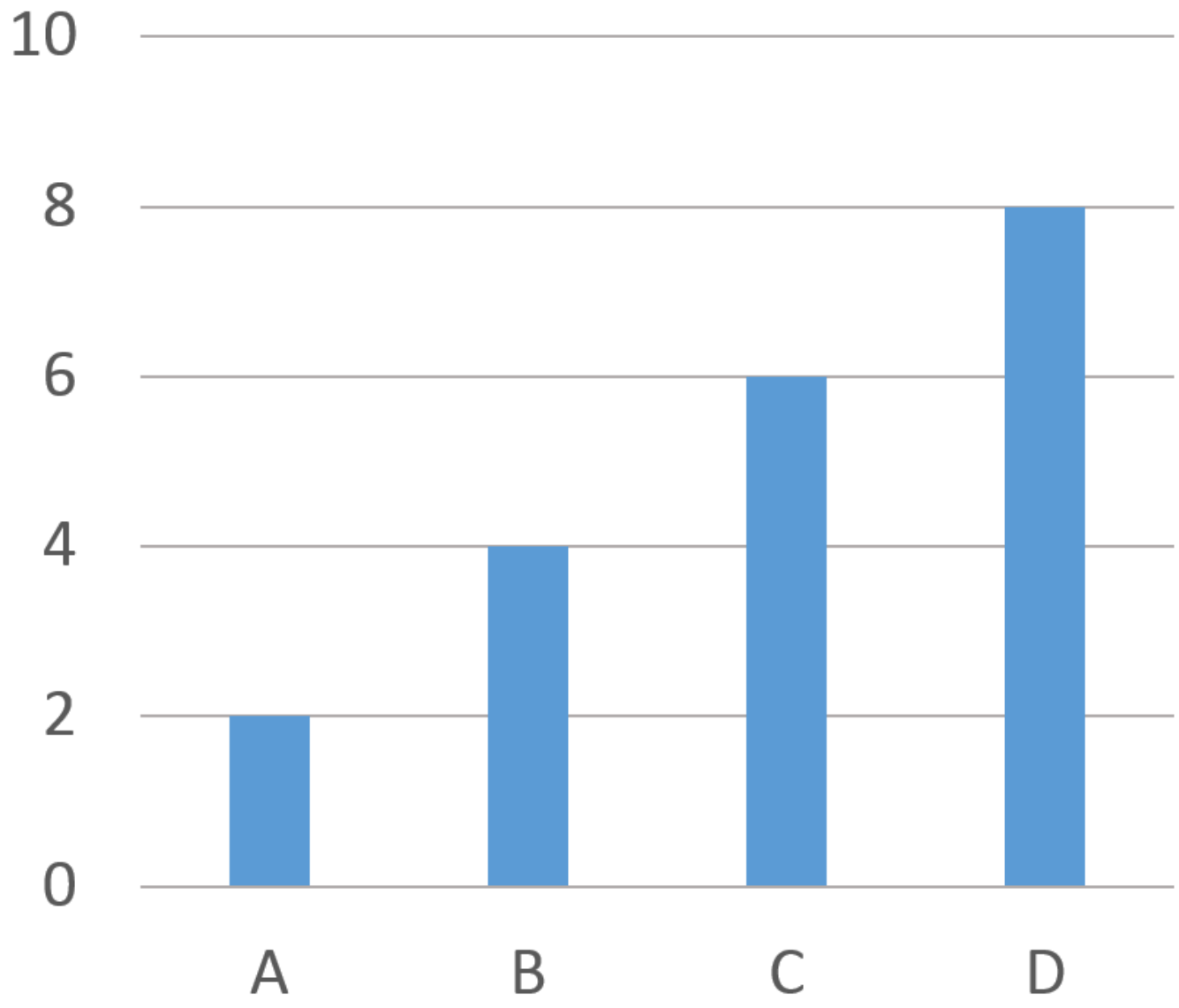
C: 6

D: 8

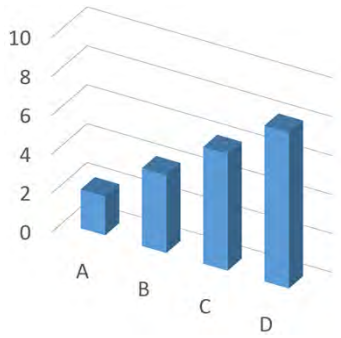
Robbins p. 22

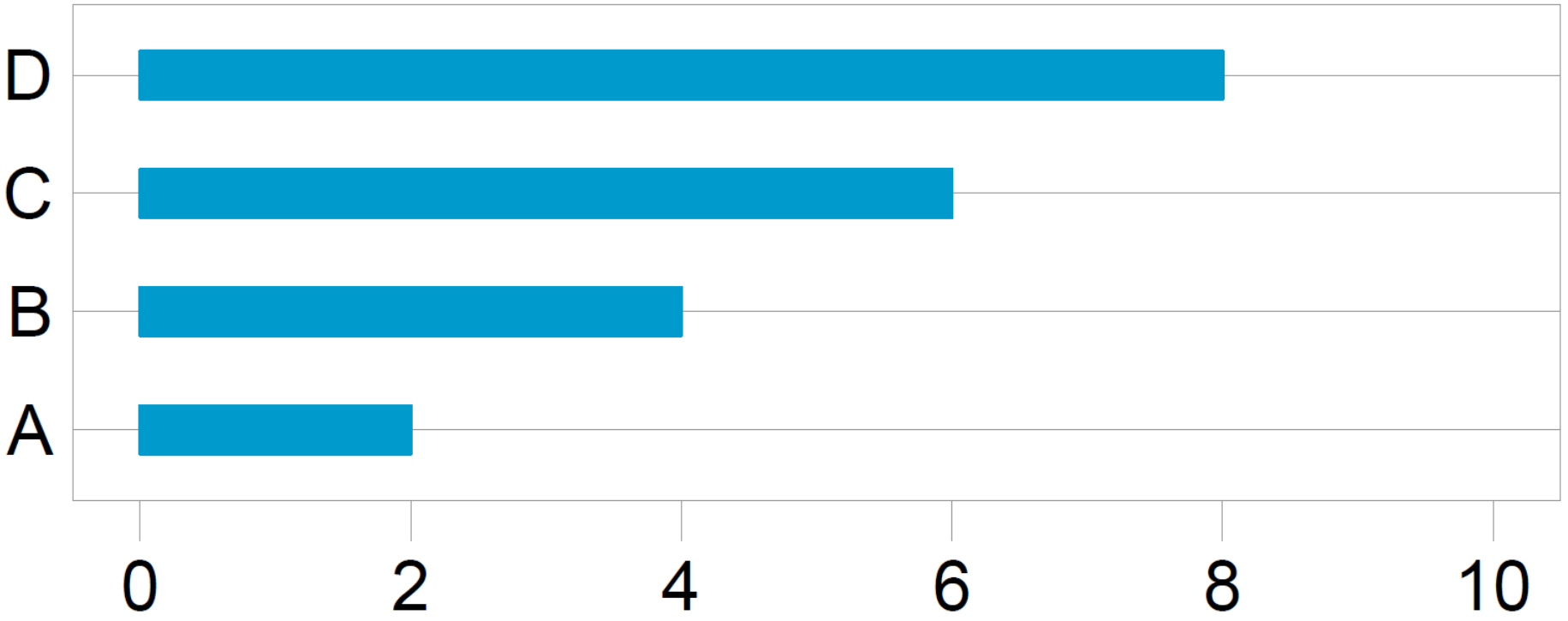
You can use bars, but avoid gratuitous 3D effects.



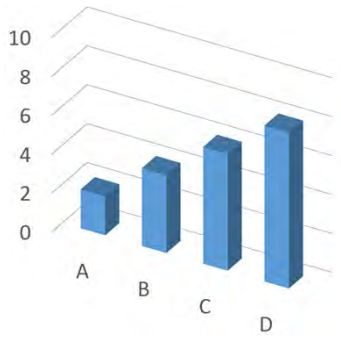


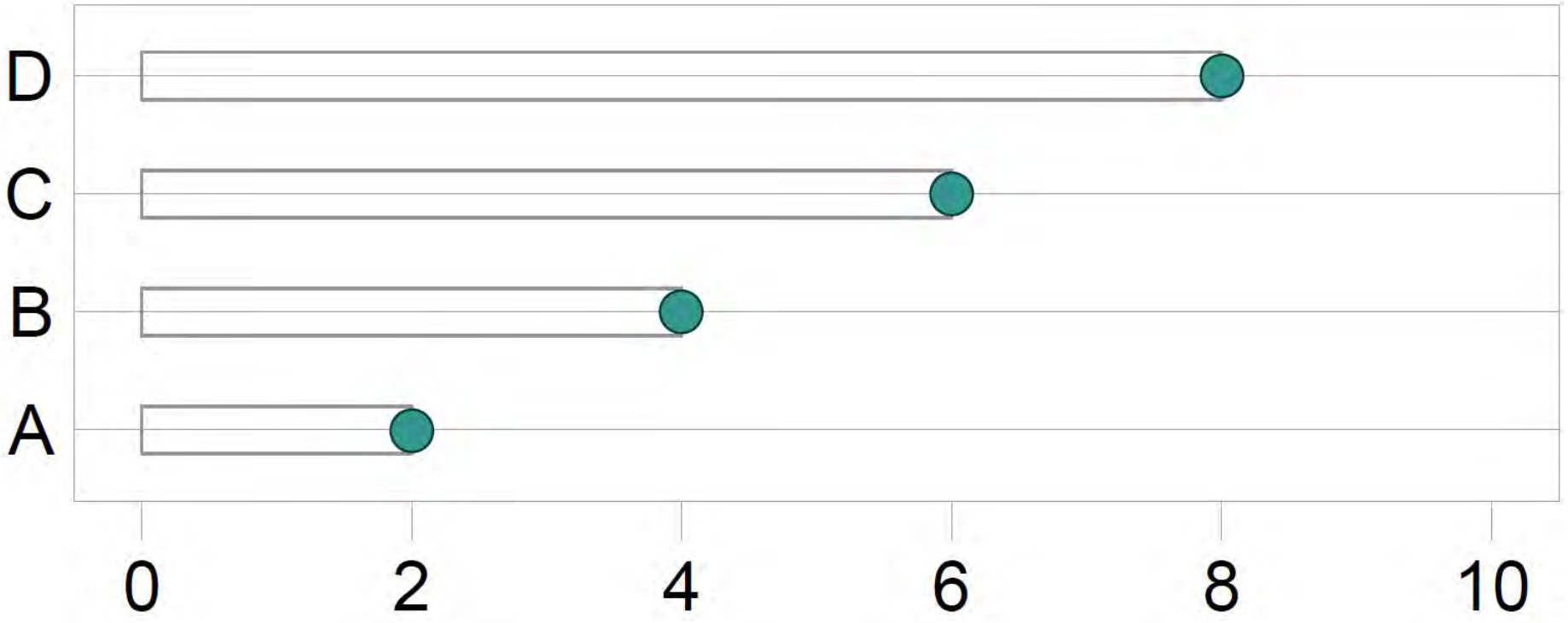
Better, use a horizontal scale, order the rows by descending magnitude…



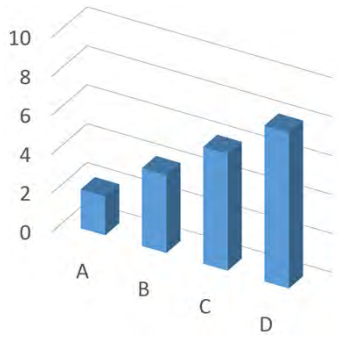


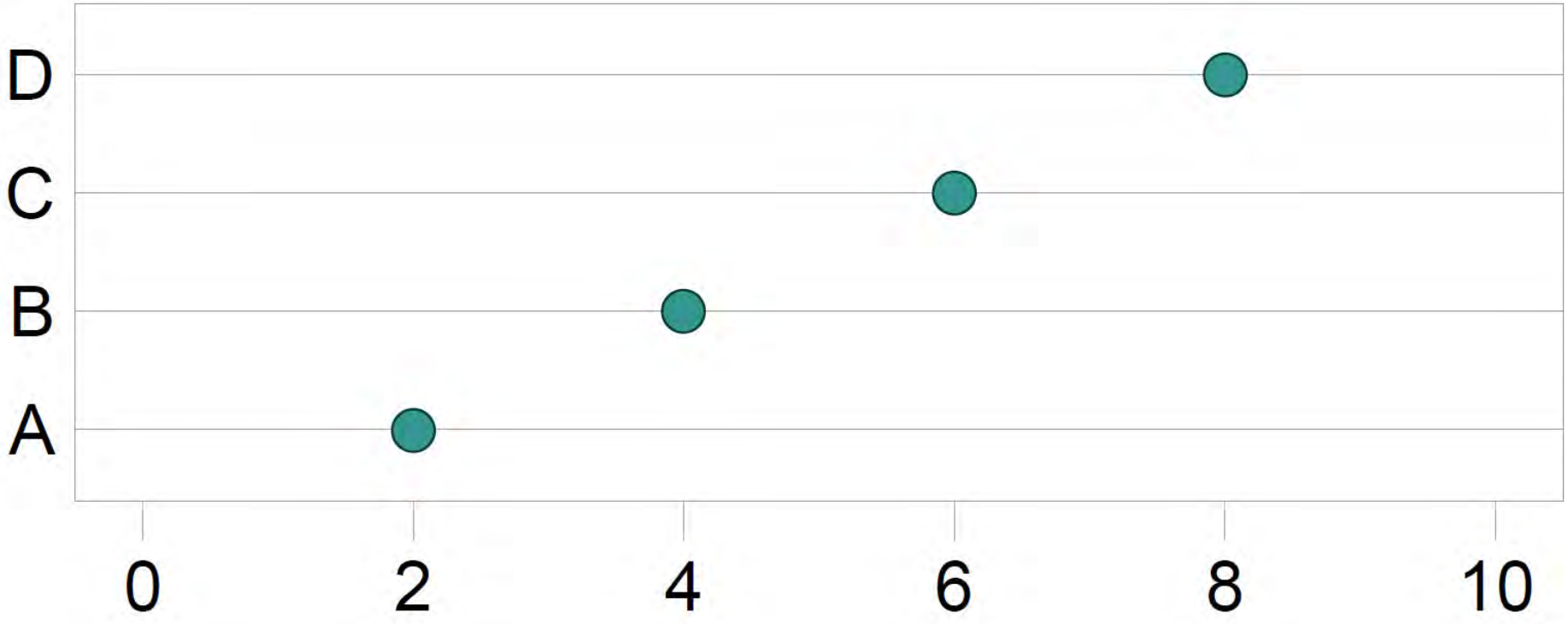
… mark the endpoints, …



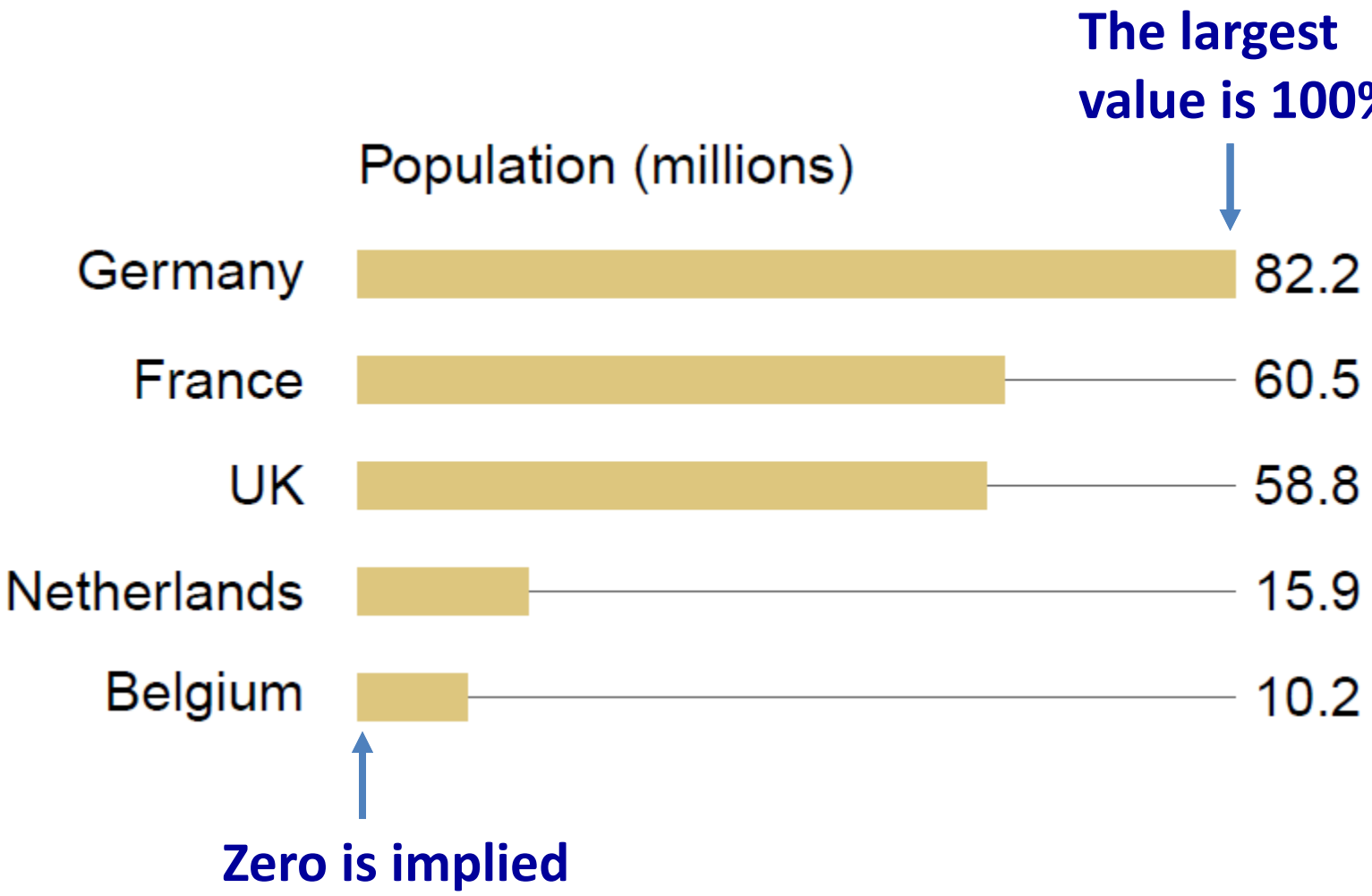


… and omit the bar. This is a dot plot.



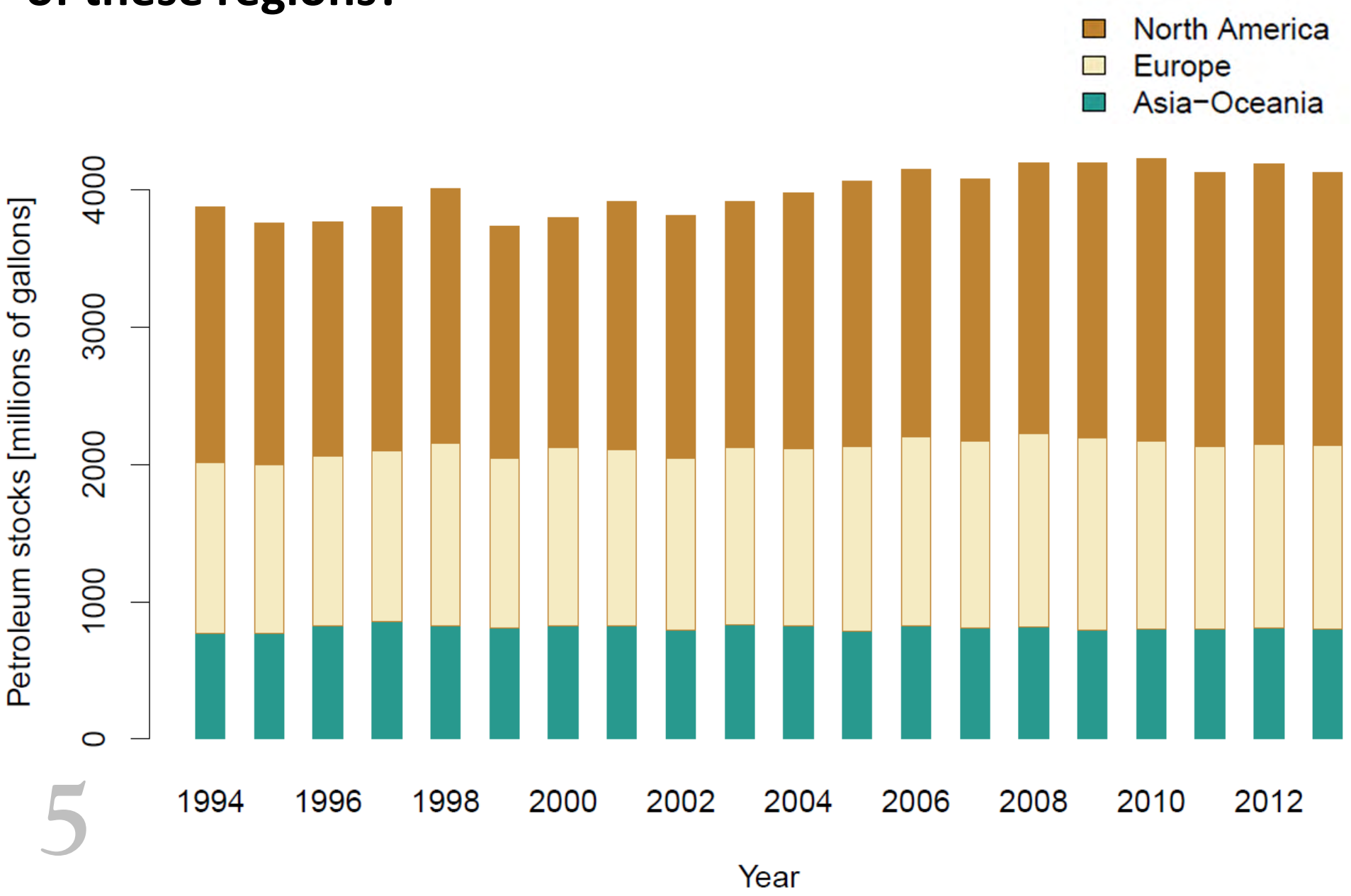


Not all bars are bad.

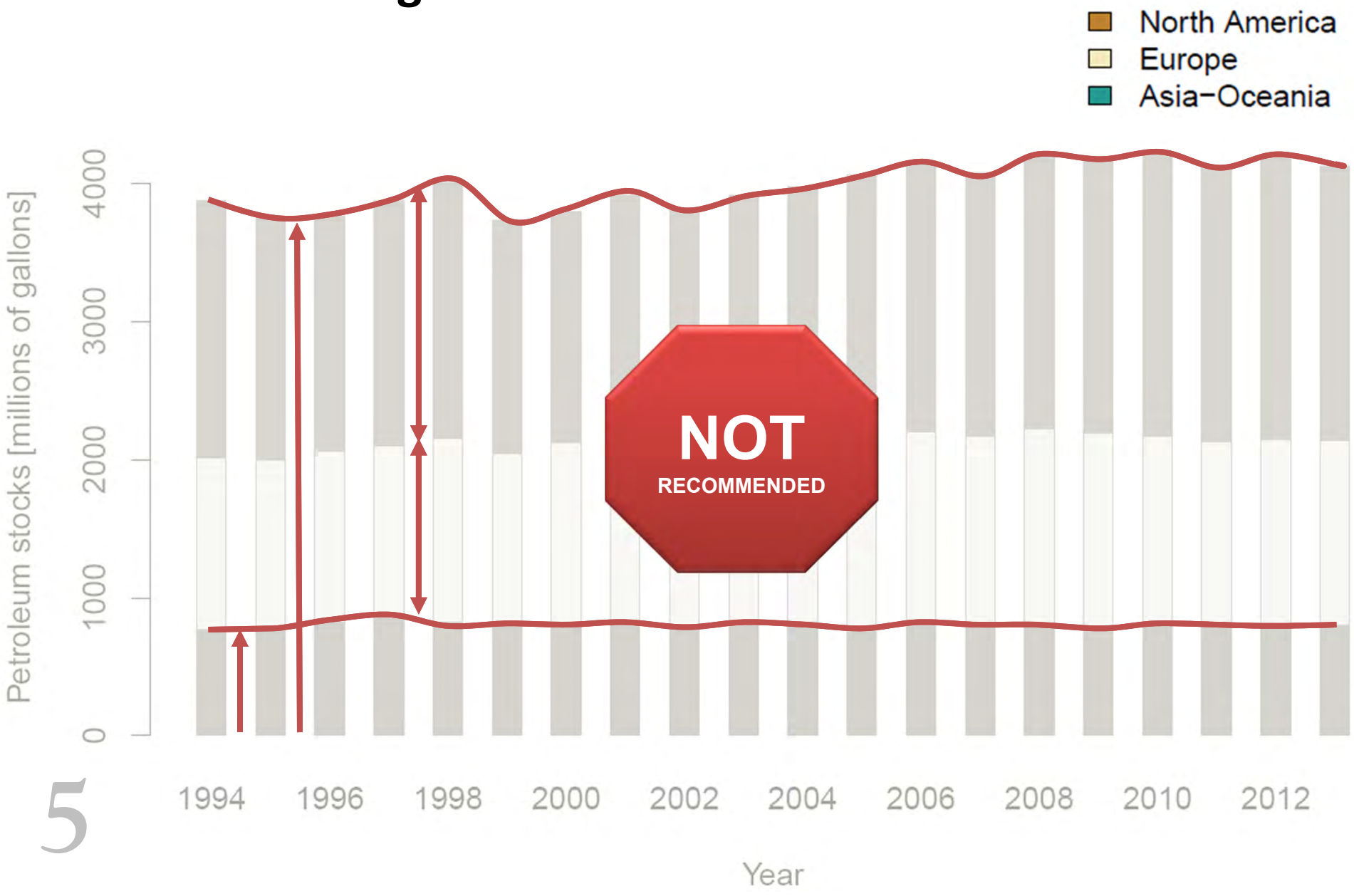


Jean-luc Doumont (2009) Trees, maps, and theorems, Principiae, pp.135

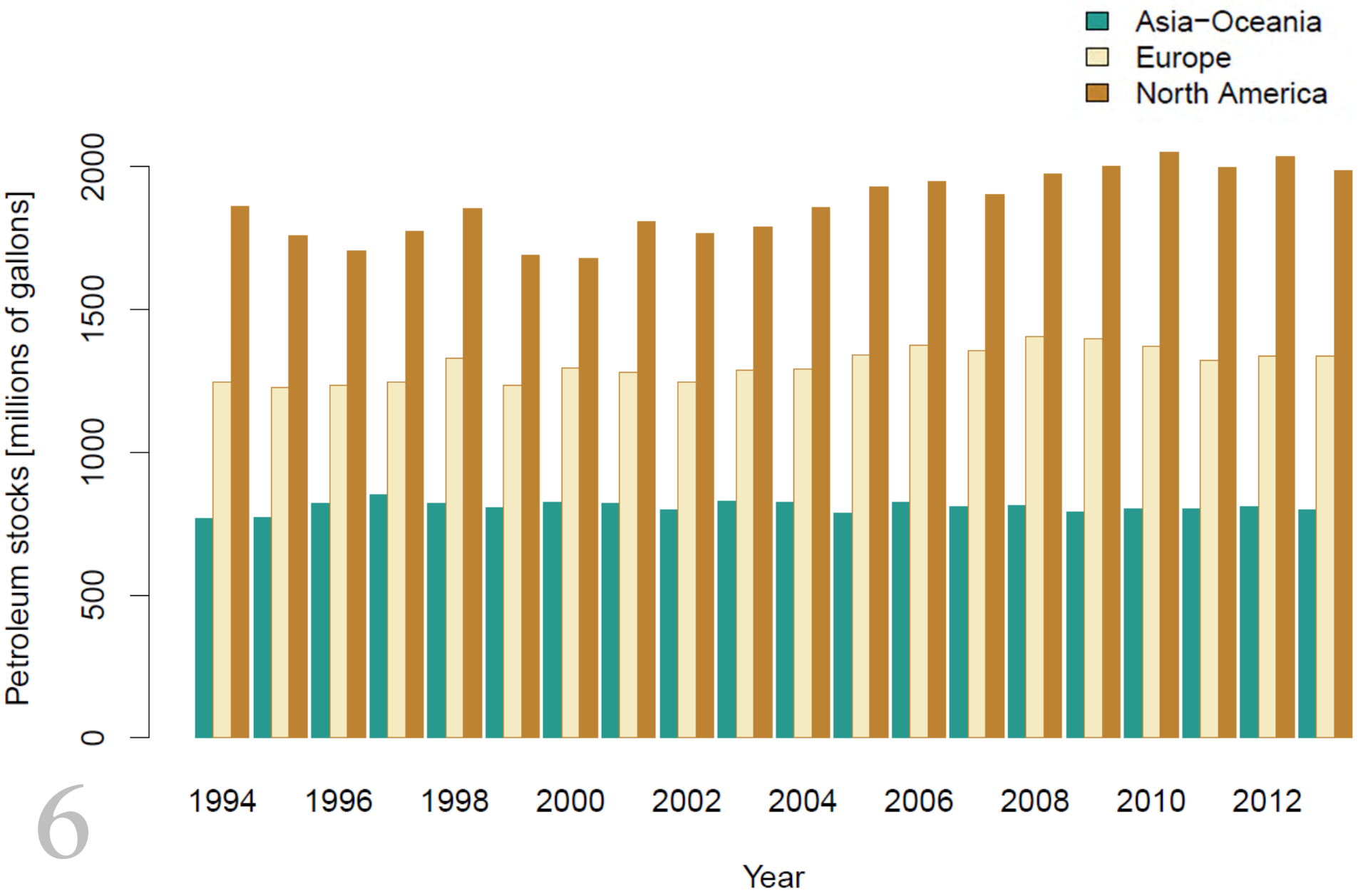
What story do you see in the petroleum stocks of these regions?



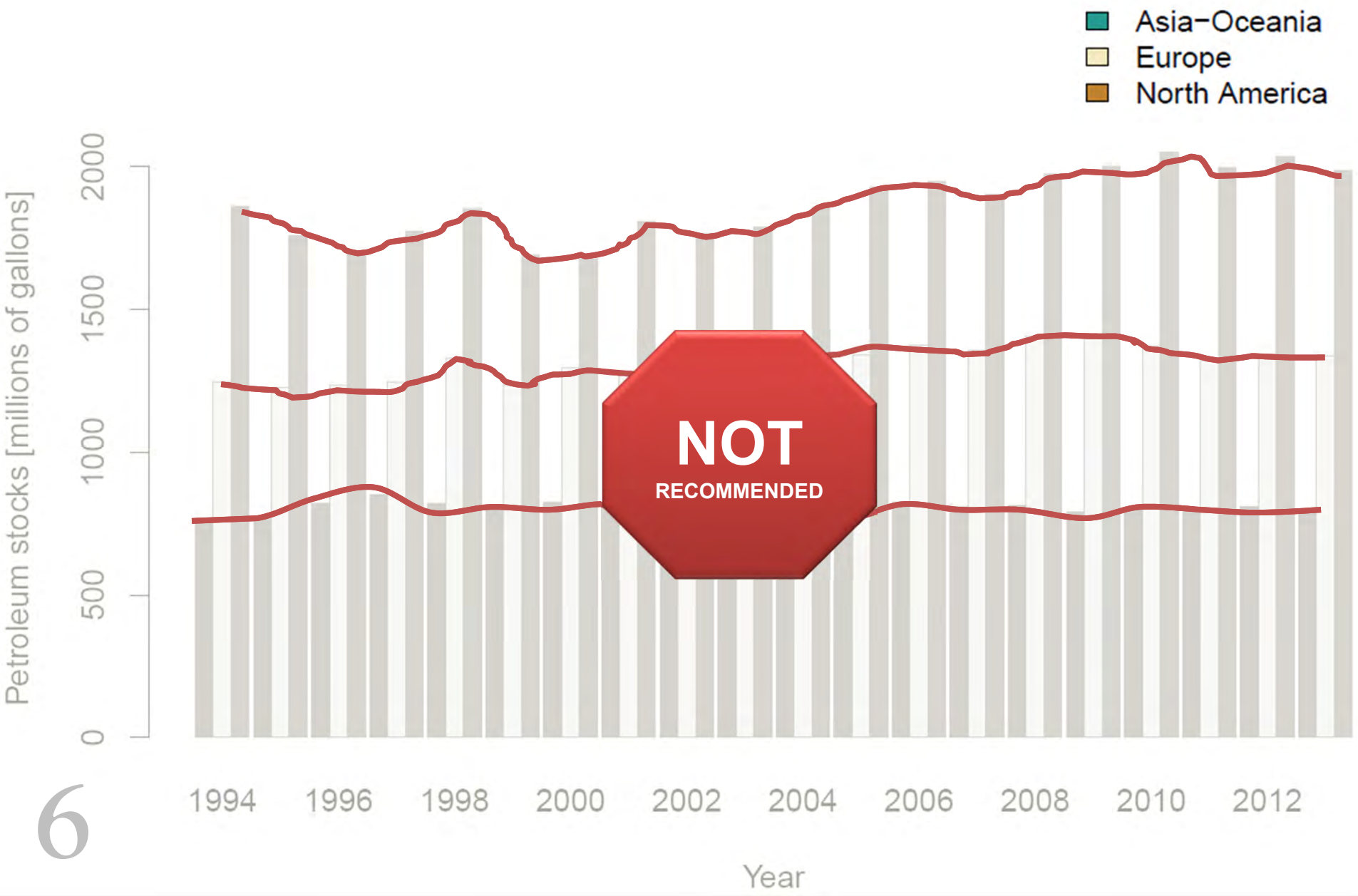
What story do you see in the petroleum stocks of these OECD regions?



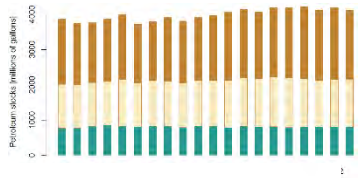
What stories do you see now?

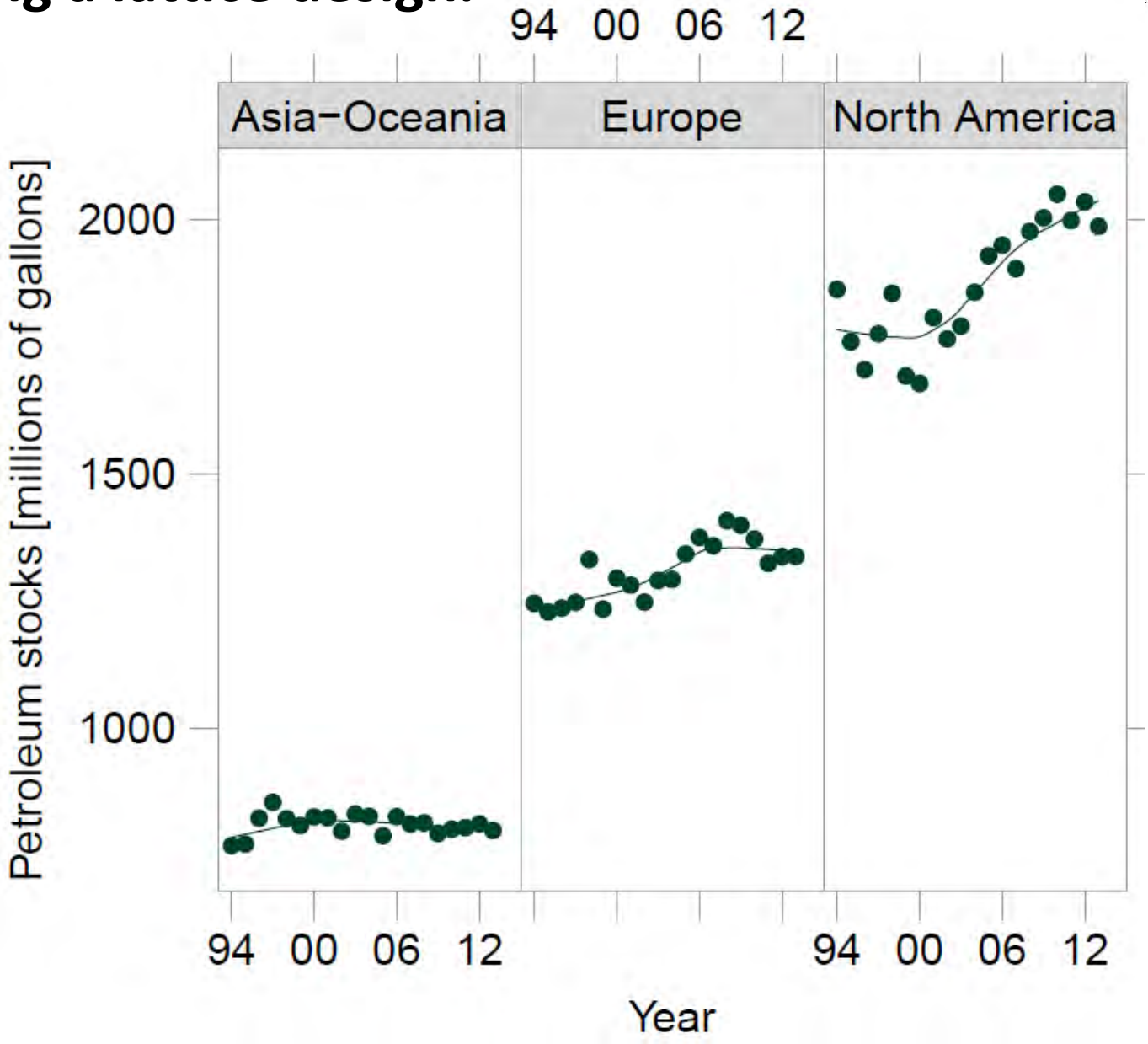


What stories do you see now?

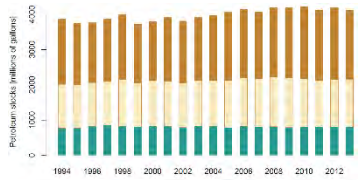


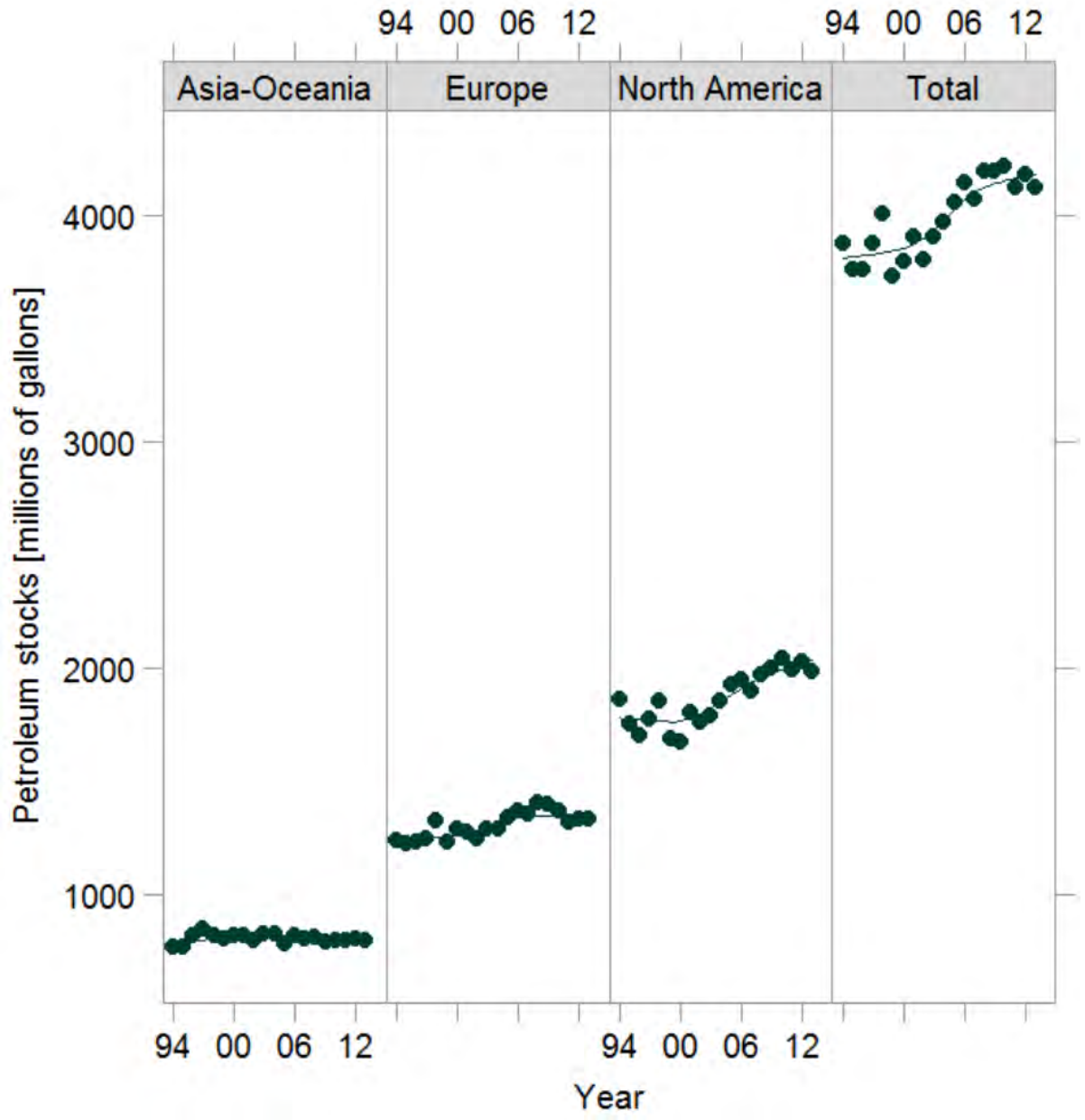
Time-series comparisons are more readily seen using a lattice design.



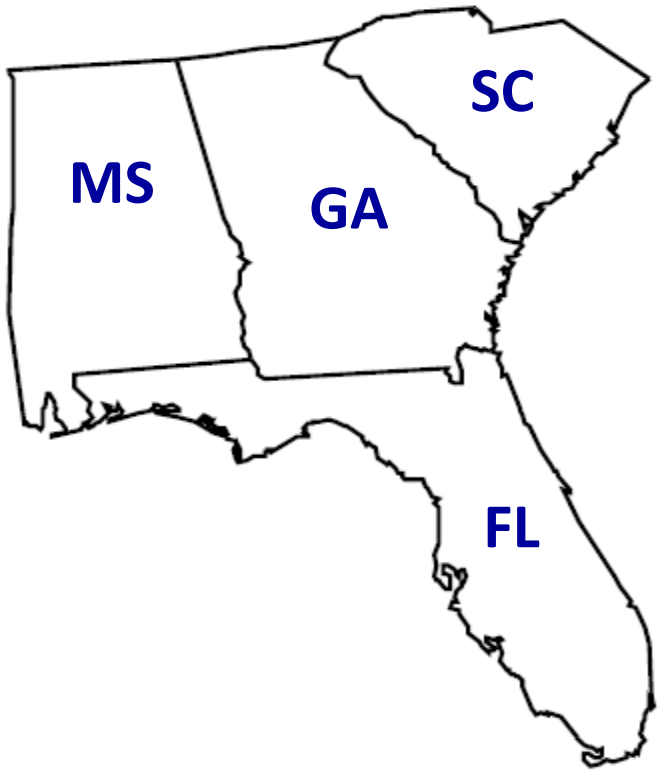


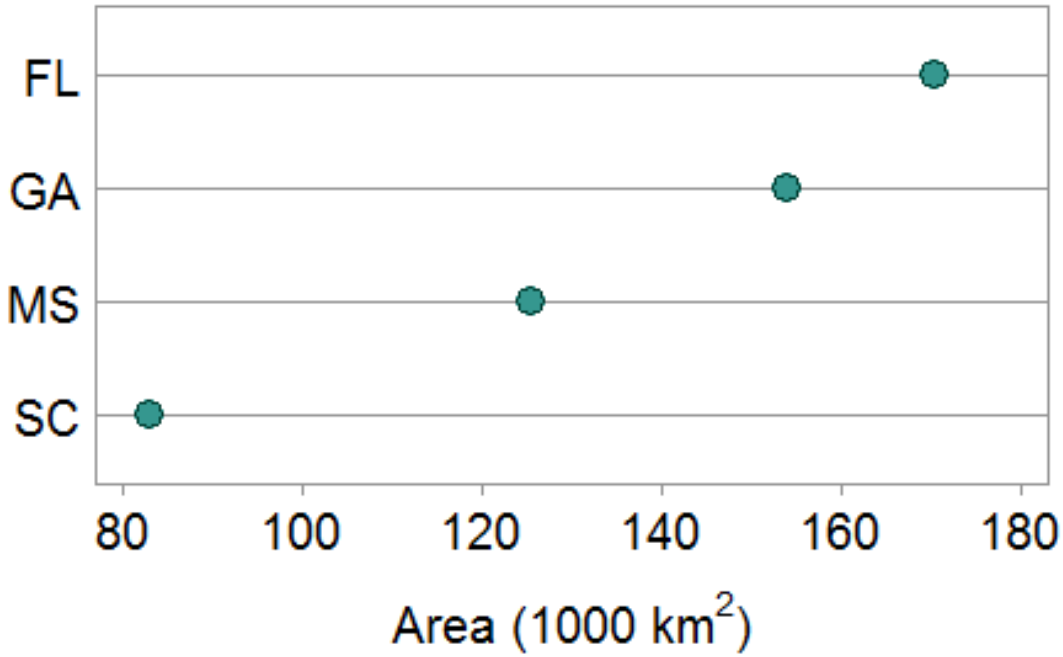
If the total is important, we can add a panel.





Area. List the states from largest to smallest.



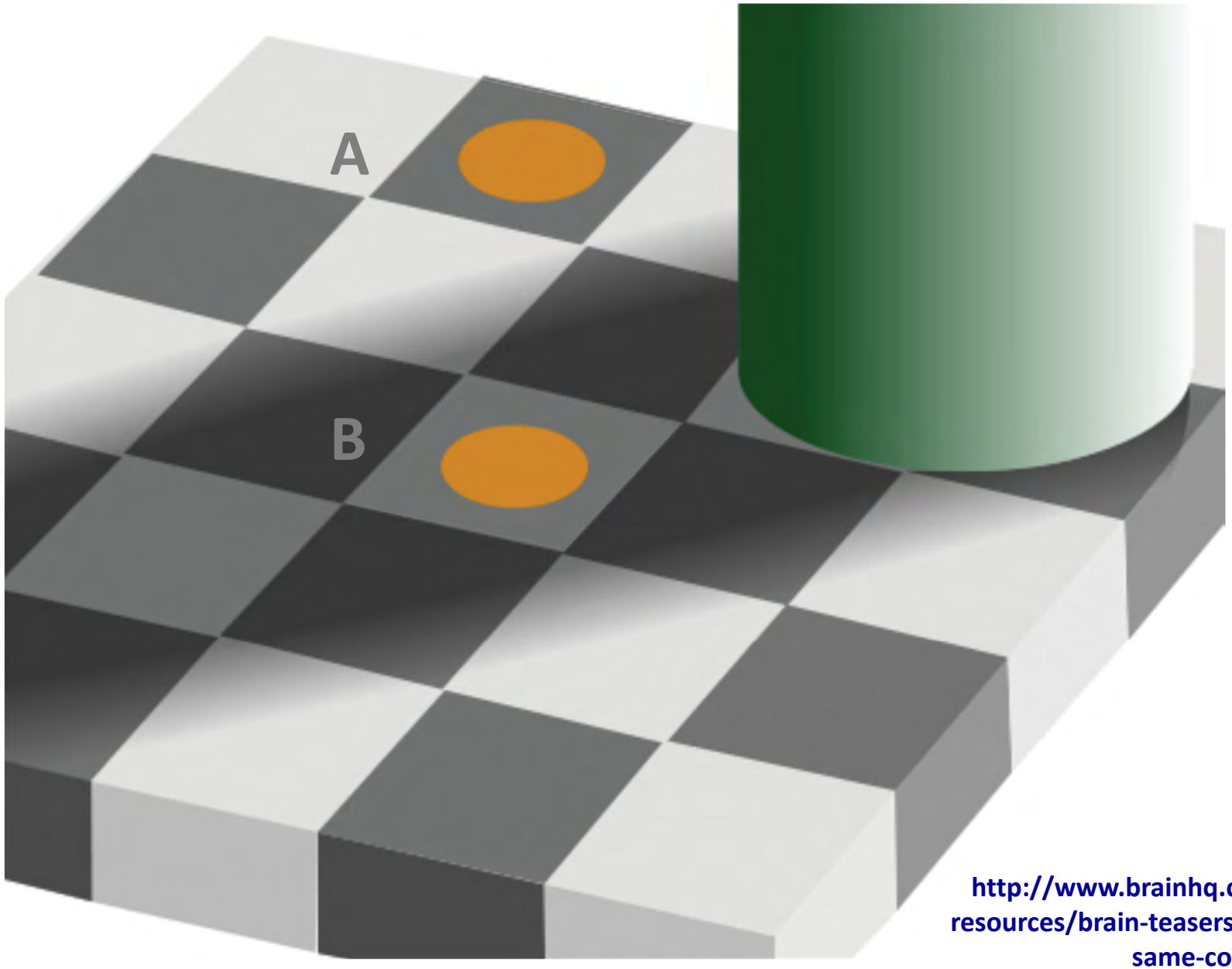


Rows ordered by the data values.

(Not alphabetical on purpose.)

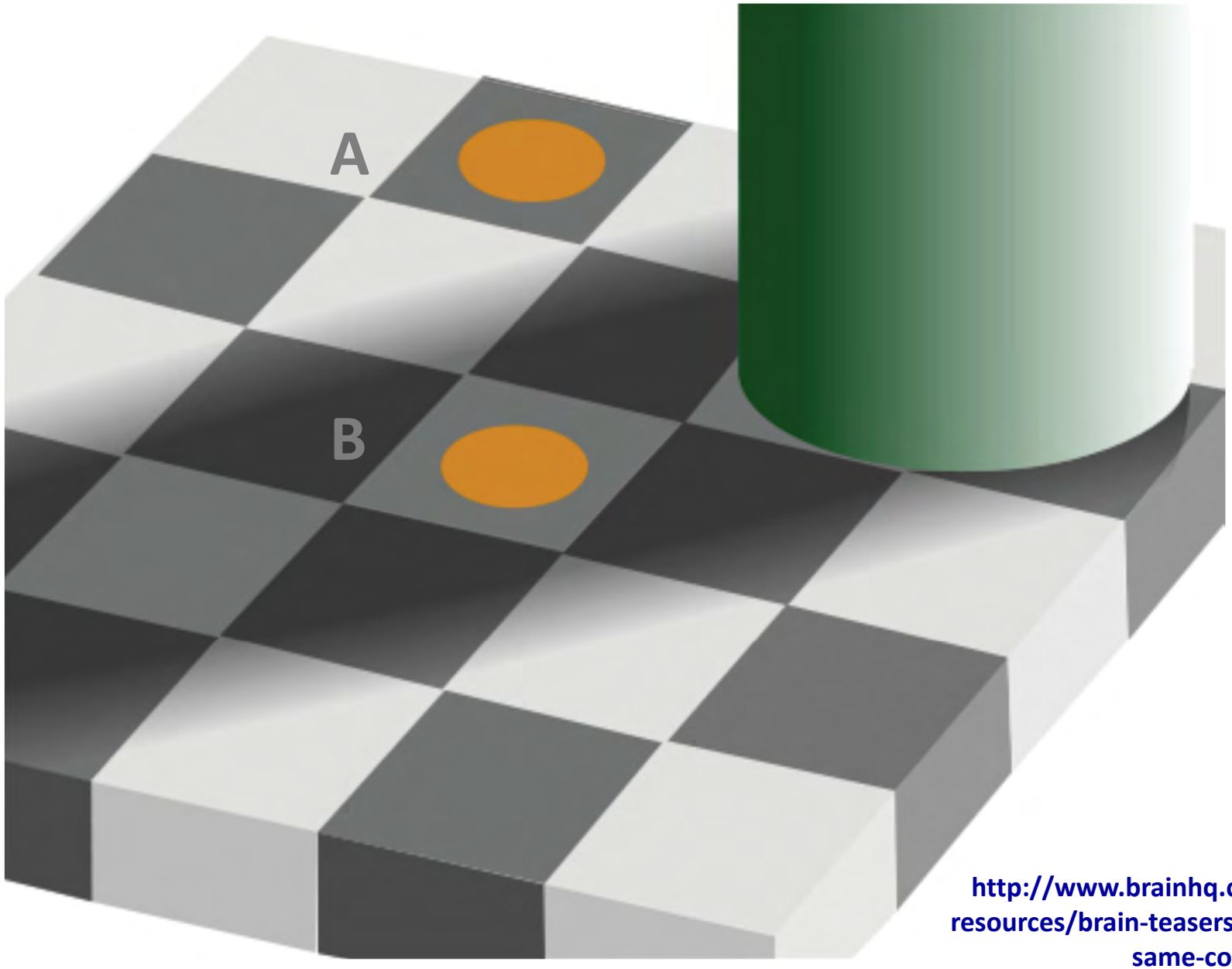
common visual illusions

Color. Perception of color occurs in your brain.



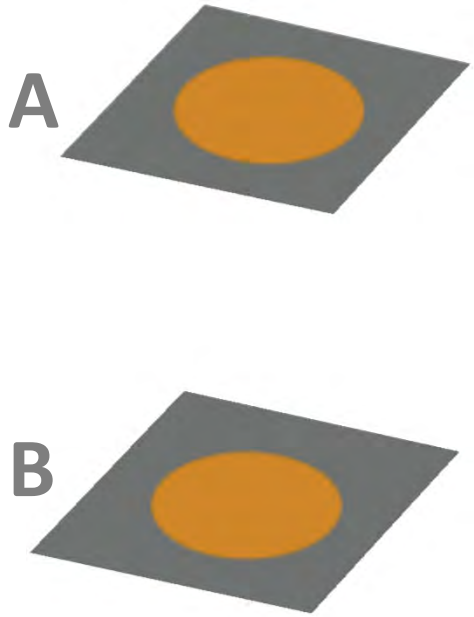
http://www.brainhq.com/brain-resources/brain-teasers/adelsons-same-color-illusion

Color. Perception of color occurs in your brain.



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

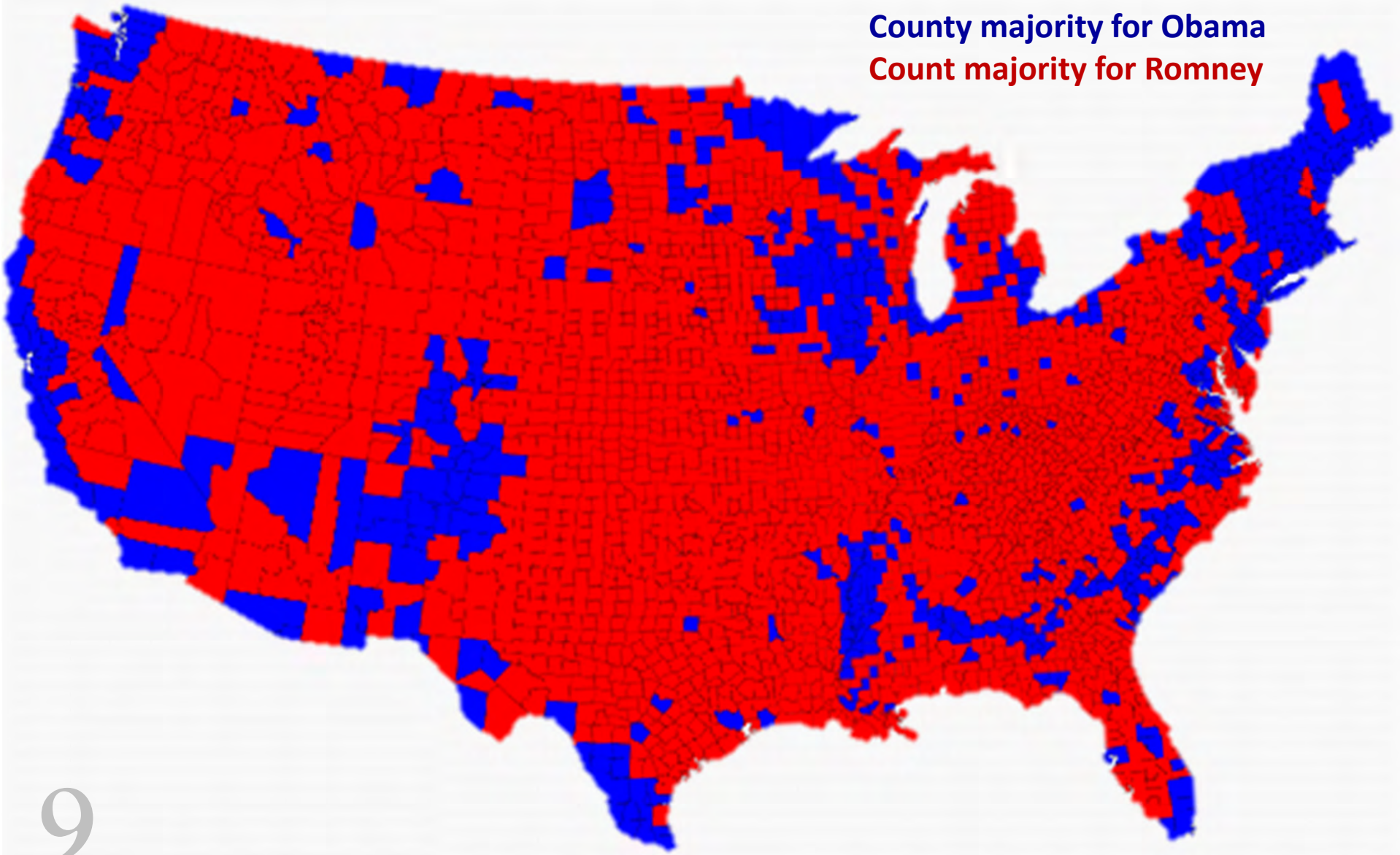
Color. Perception of color occurs in your brain.



Differences in color are easily misperceived.

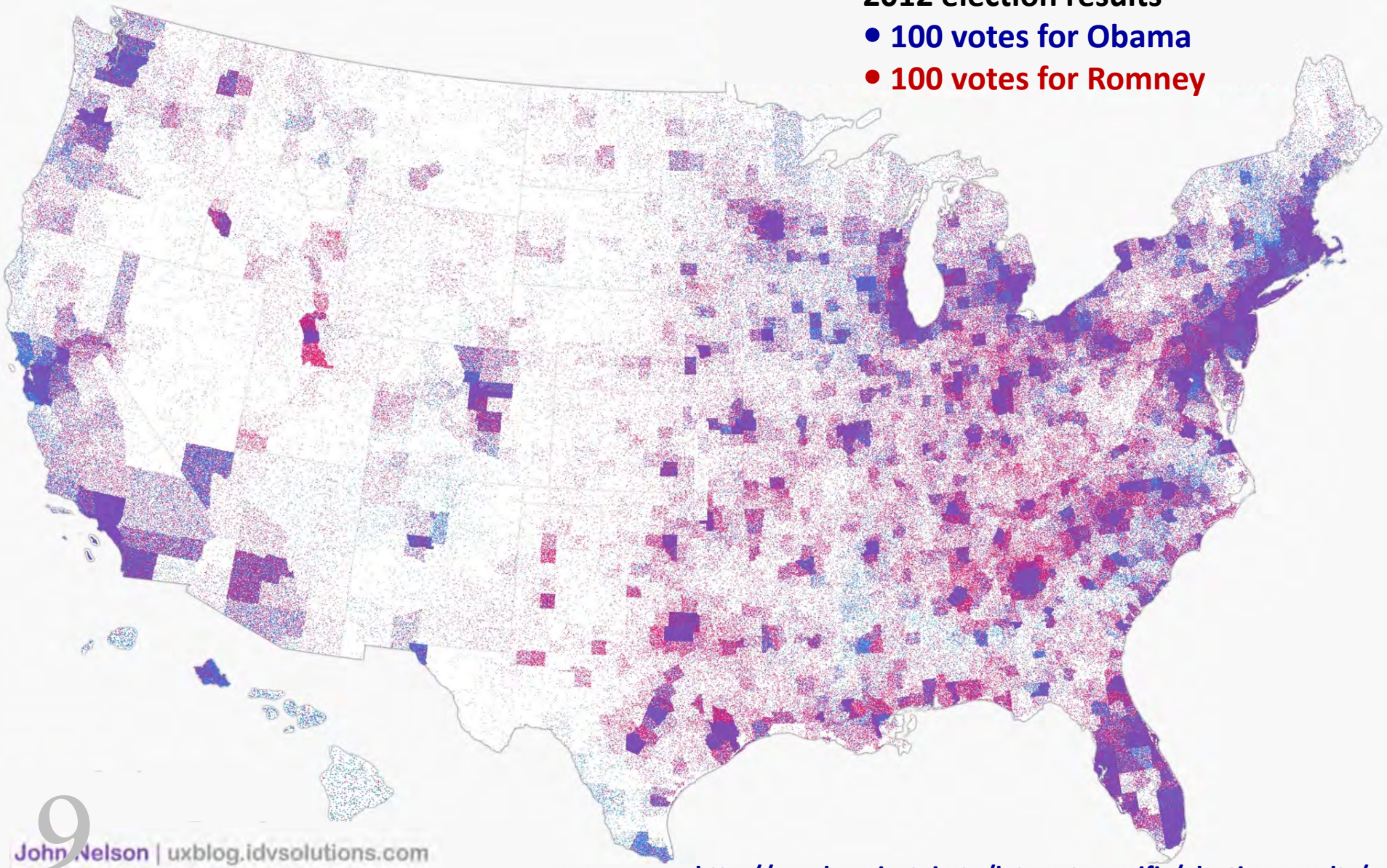
http://www.brainhq.com/brain-resources/brain-teasers/adelsons-same-color-illusion

Color represents area. What story do you see?



http://www-personal.umich.edu/~mejn/election/2012/

Color represents votes. What story do you see?



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?

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

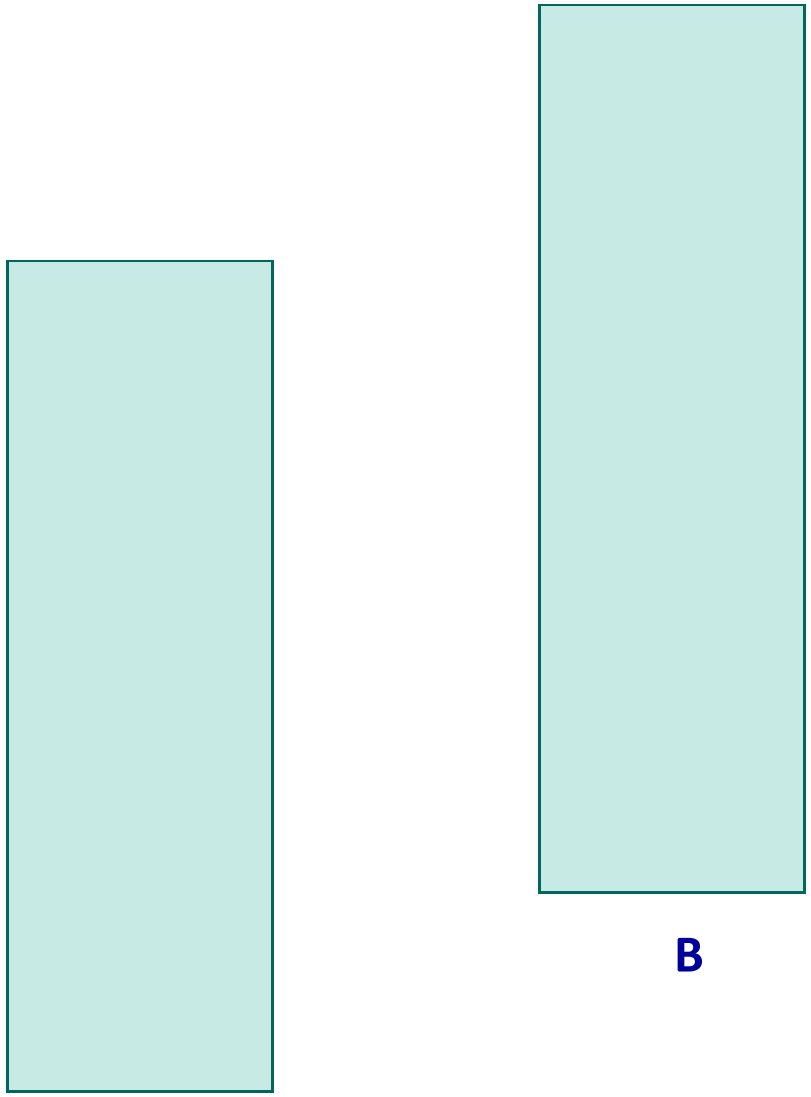
Perspective illusion. Are the SUVs different sizes?

Beware of perspective illusions.

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

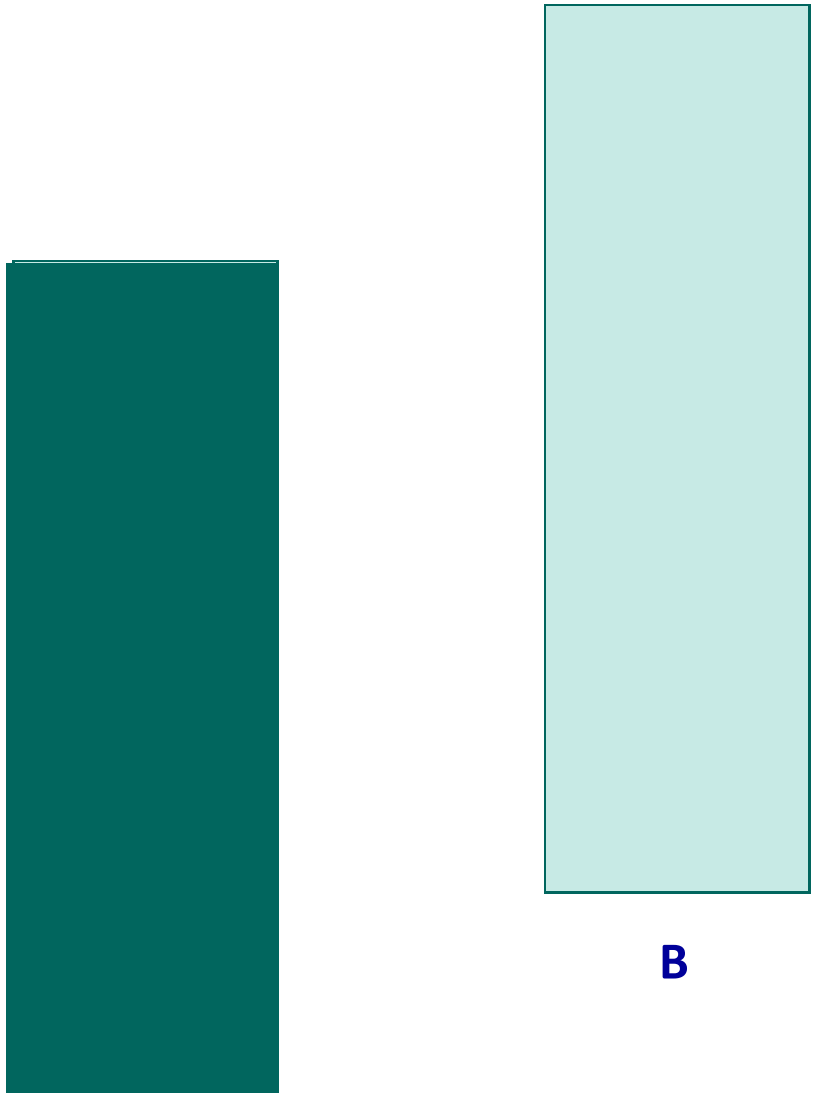
Length

Which bar is longer, A or B?



Length

Which bar is longer, A or B?

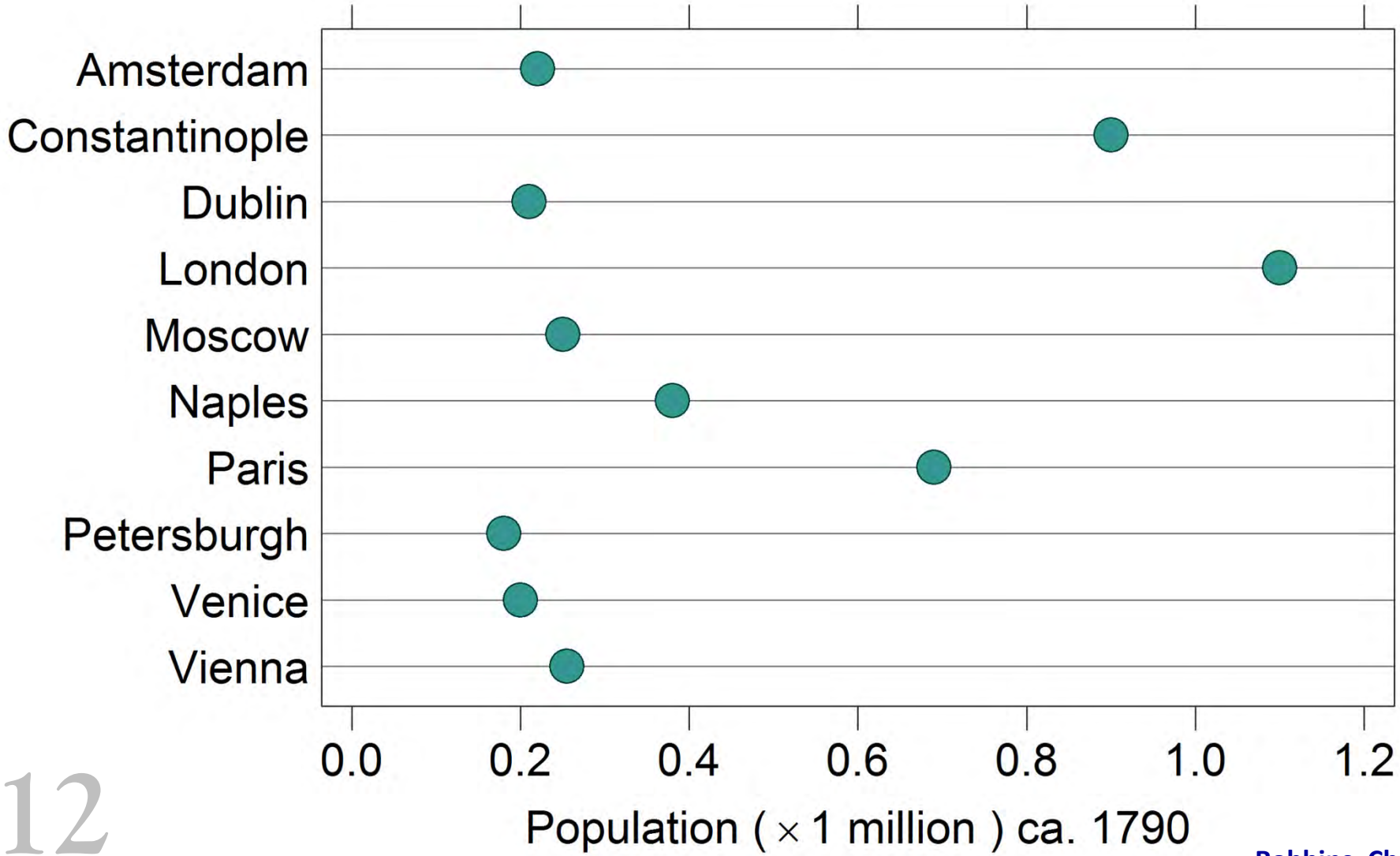


A

B

Position along a common scale

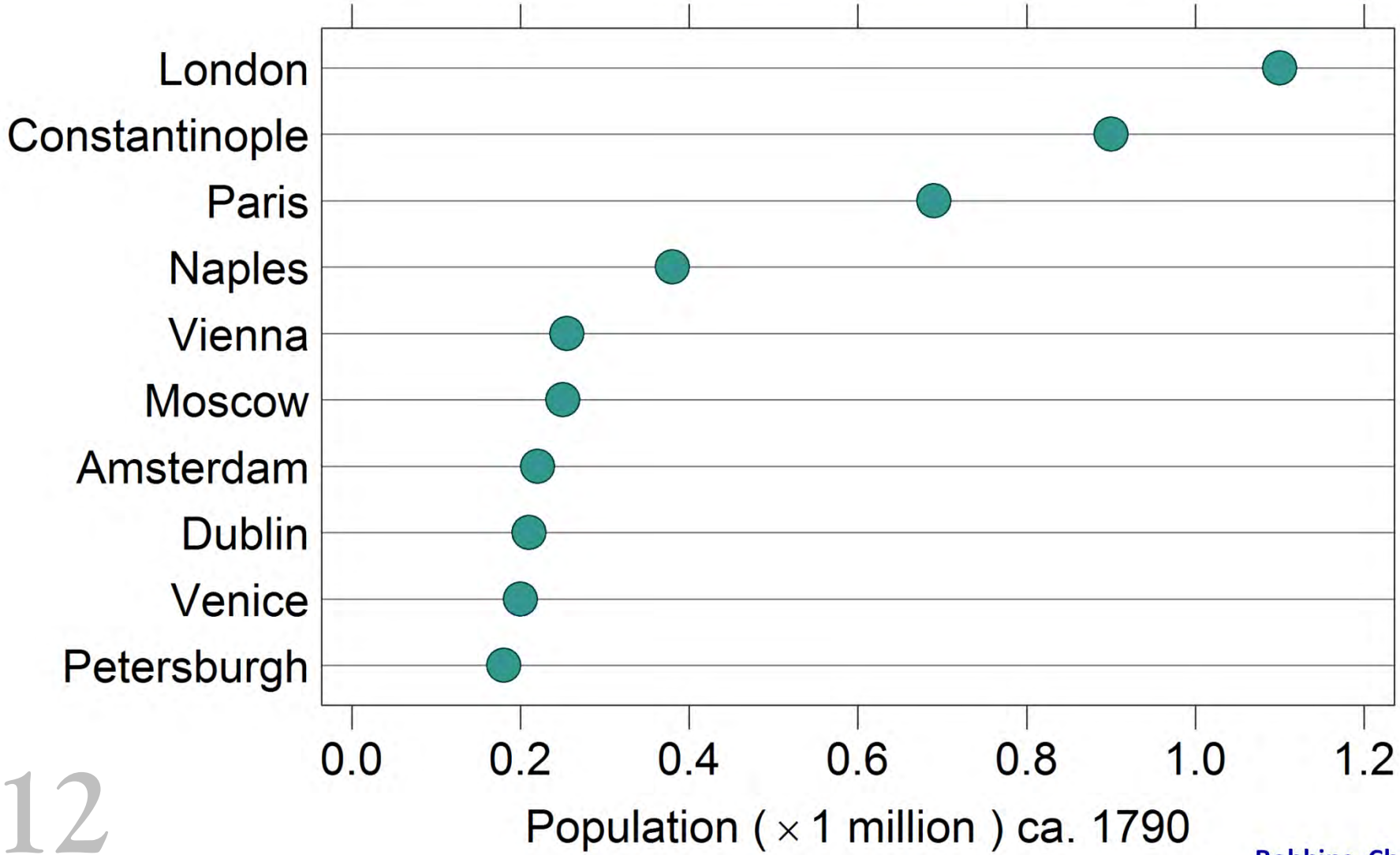
What conclusion do you draw from these data?



Robbins, Ch. 8.

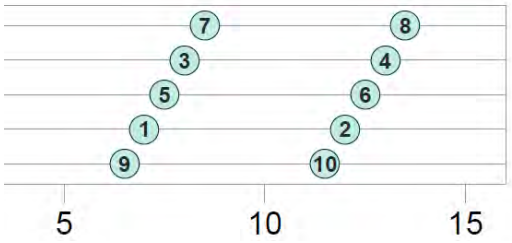
Position along a common scale, with ordered rows

Do you see anything now you did not see before?

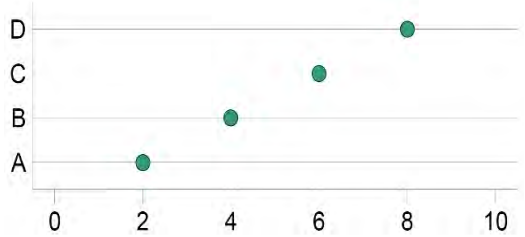


Robbins, Ch. 8.

Implications for the designer.



Explore, revise, and edit until a story emerges.

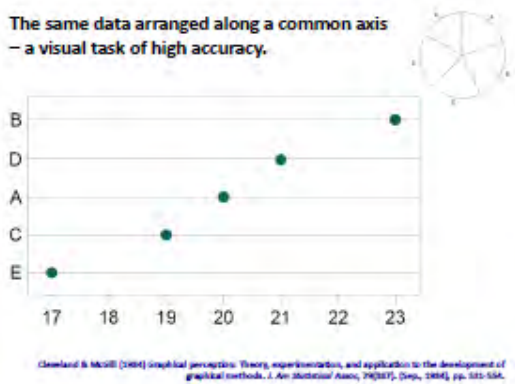


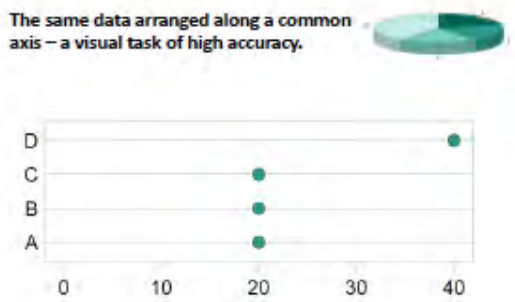
Use effective visual coding.

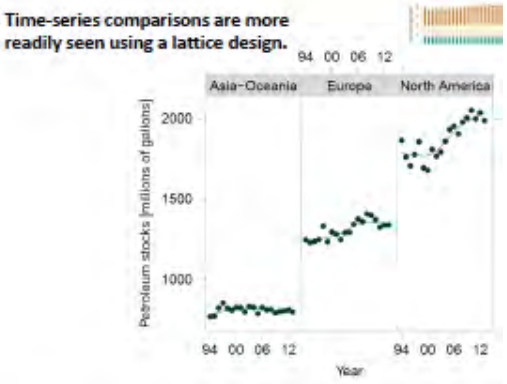
Avoid quantitative encoding using color or area.

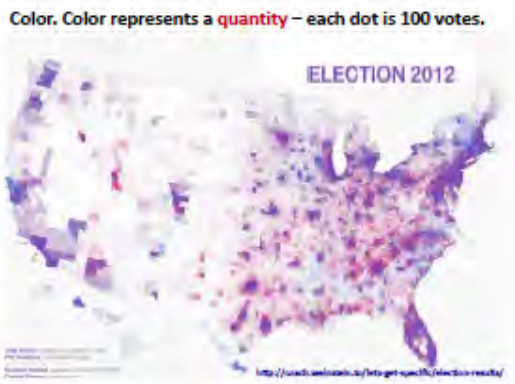
Avoid illusions and 3D effects.

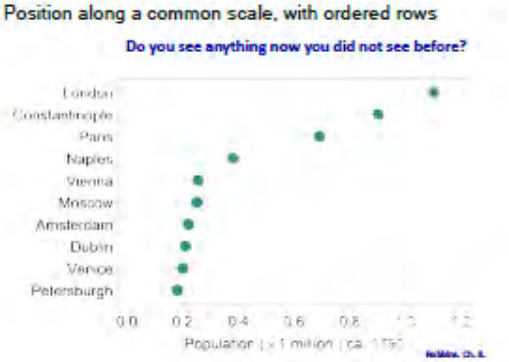
I've provided a page of the "more effective" versions of the example graphs.











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

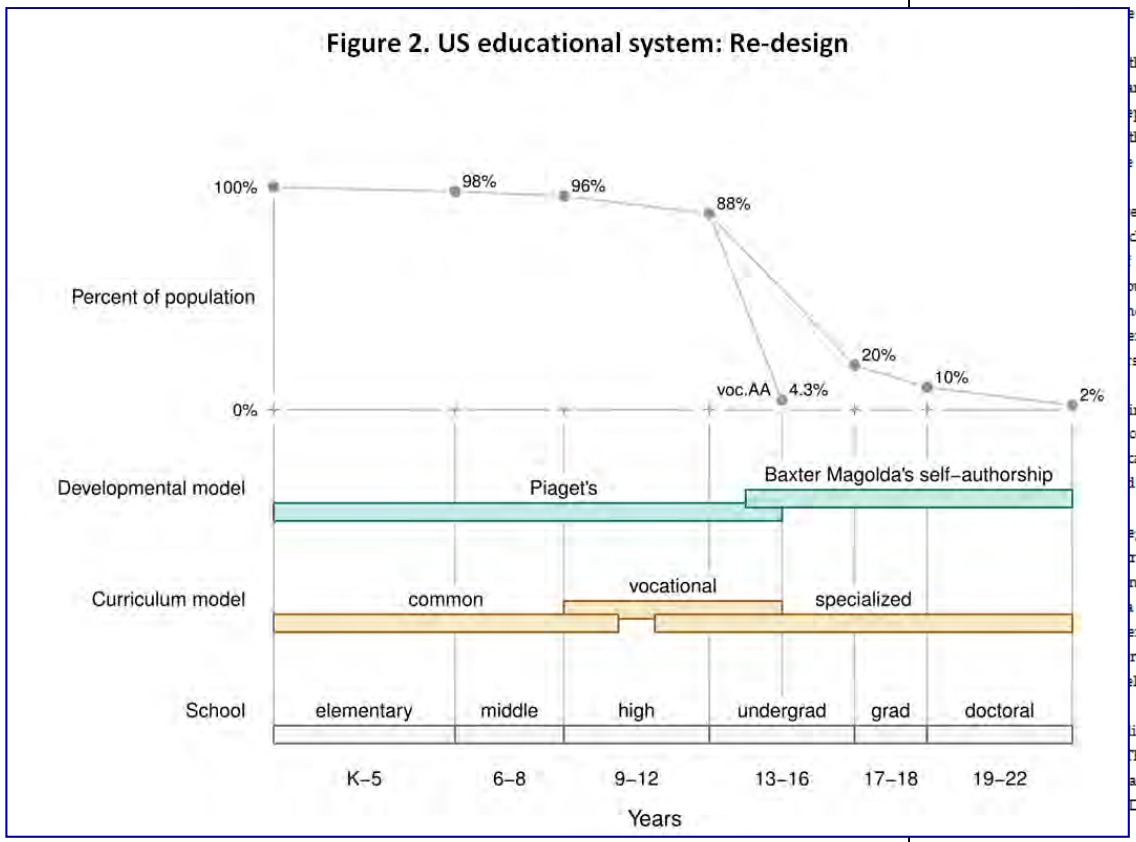
- Media
- Preparation
- Organize the README file
- Importing images
- Start a report
- Data tables
- Create the bib file
- BiBTeX entry types
- YAML bibliography argument
- Add a citation
- Add a references heading
- Format the citations and references
- Presentation prompts
- Reading prompts

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 unnecessary.

th types of data in one graph, the data rectangle is divided into upper and lower rated by a horizontal line. Vertical grid lines span the lower portion only, enhancing paration 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 time series, subtly emphasizing that the upper region is a conventional scatter plot.

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

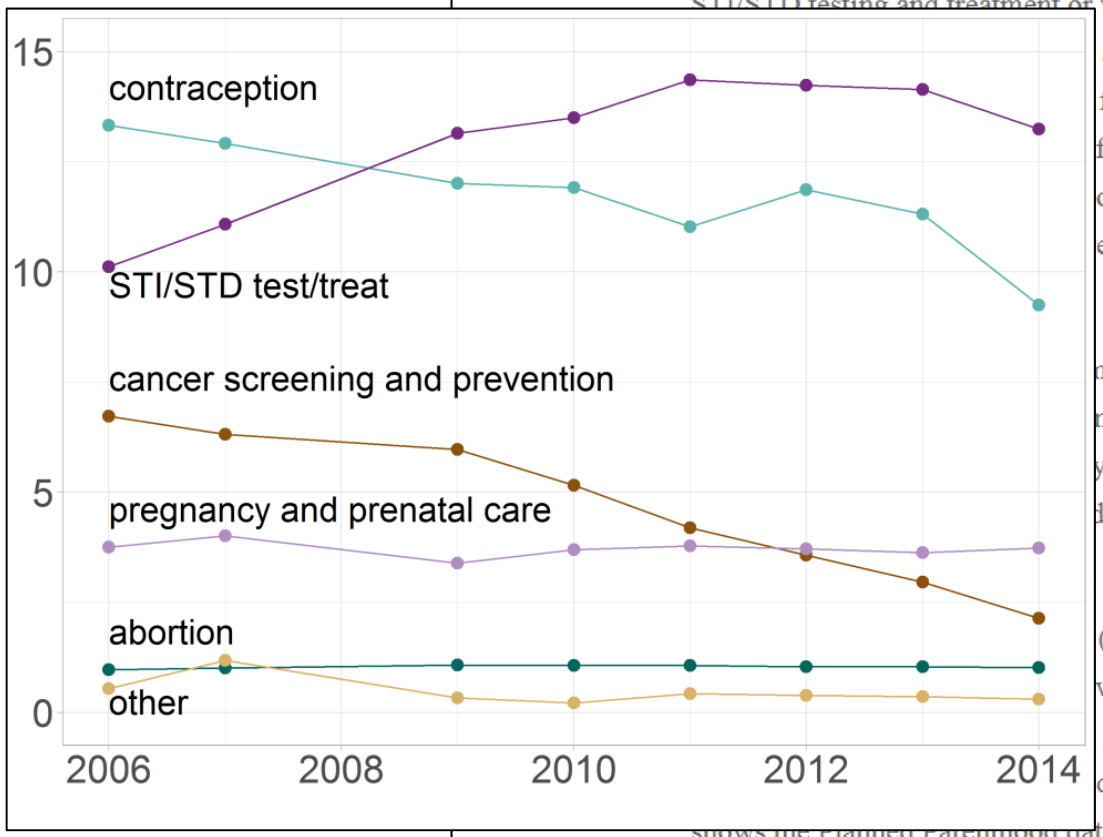
ines between data markers help dramatize the sharp decline in the percent of the completing post-secondary education. A separate line indicates those completing a tational associates degree. This observation was not in the original concept but was d once the new design was established.

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

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

See my blog for additional samples of critiques and redesigns.

http://www.graphdoctor.com



This graph suggests we might want to find out what caused the increase in STI/STD testing and treatment or what's behind the gradual decline in
also shows that compared to the number of
four times as many STI/STD services were
for cancer services compared to
ommon scale, abortion services appear to be
ed to the dramatic changes seen in other

npare abortion to cancer screening only?
nient data): the decline in cancer screening
y trend in these data that supports AUL's
l is abandoning "life-saving" services.

account for population increase. To avoid a
(especially over long time periods, which is
vices should be studied on a per capita basis
for inflation when studying dollar amounts
data from the US Census, the graph below
shows the Planned Parenthood data on the basis of the number of services per
1000 people.