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Data Visualization Concepts

Data Visualization in Python

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Get the files…

(http://bioinformatics.niaid.nih.gov)
https://github.com/burkesquires/python_biologist

Download “data_viz_files.zip” in 06_data_viz_python folder
(Click on file, then click on download)

Uncompress

Move to desktop

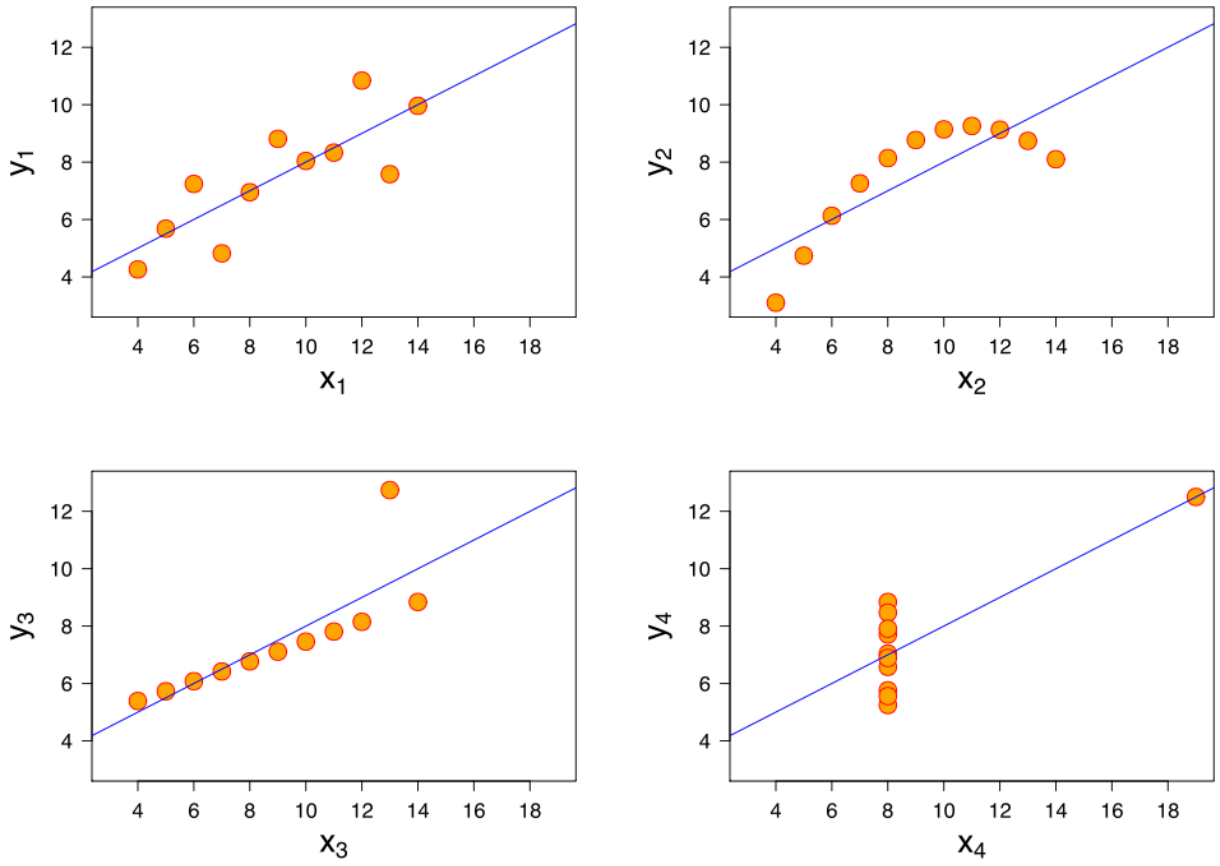
What is Data Visualization?

"The visual analysis of and communication of data"

Anscombe's Quartet

	I		II		III		IV	
	x	y	x	y	x	y	x	y
	10	8,04	10	9,14	10	7,46	8	6,58
	8	6,95	8	8,14	8	6,77	8	5,76
	13	7,58	13	8,74	13	12,74	8	7,71
	9	8,81	9	8,77	9	7,11	8	8,84
	11	8,33	11	9,26	11	7,81	8	8,47
	14	9,96	14	8,1	14	8,84	8	7,04
	6	7,24	6	6,13	6	6,08	8	5,25
	4	4,26	4	3,1	4	5,39	19	12,5
	12	10,84	12	9,13	12	8,15	8	5,56
	7	4,82	7	7,26	7	6,42	8	7,91
	5	5,68	5	4,74	5	5,73	8	6,89
SUM	99,00	82,51	99,00	82,51	99,00	82,50	99,00	82,51
AVG	9,00	7,50	9,00	7,50	9,00	7,50	9,00	7,50
STDEV	3,32	2,03	3,32	2,03	3,32	2,03	3,32	2,03

Anscombe's Quartet

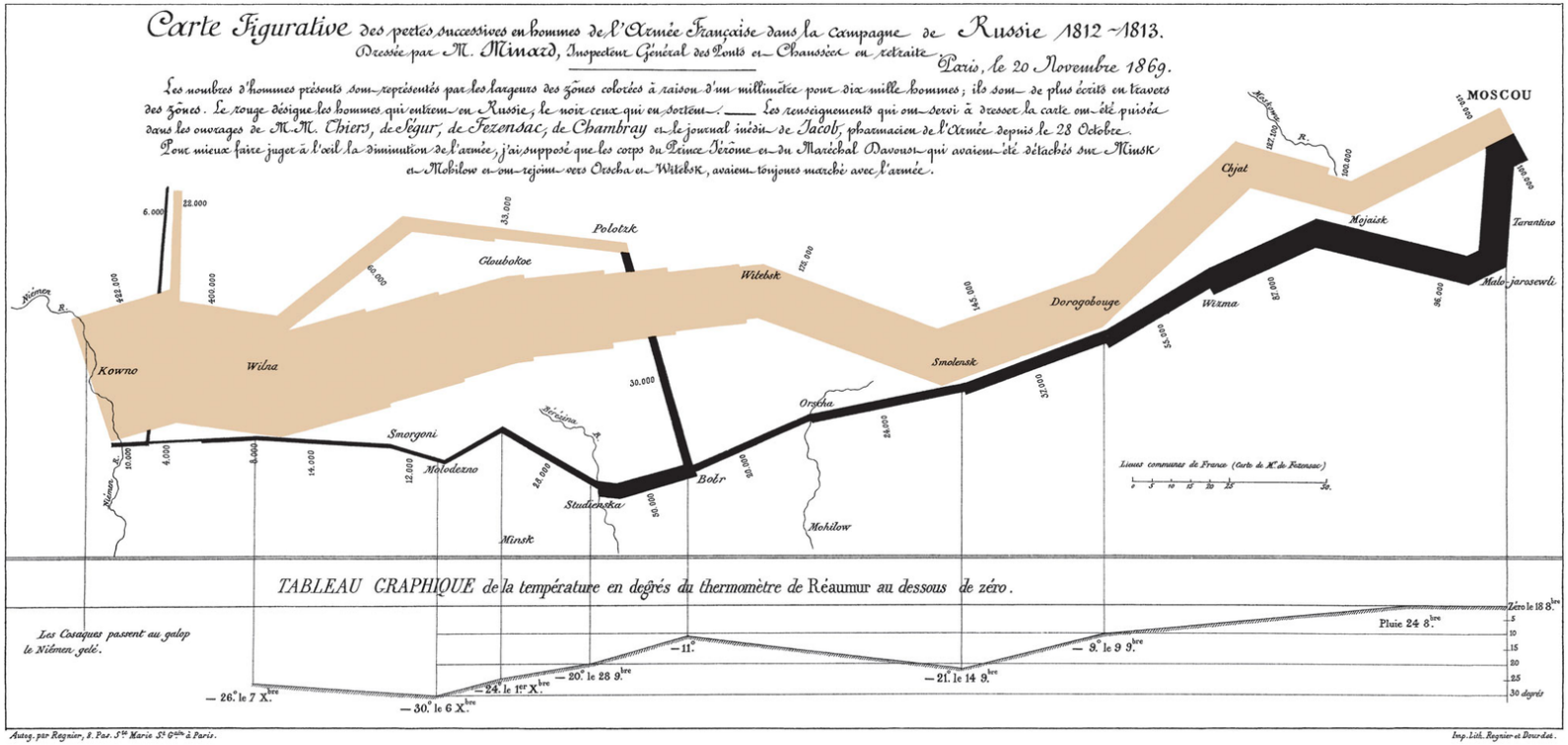


Objectives

- Data Analysis
  - Understand the data
  - Derive information from data

- Communication
  - Of information
  - Of trends
  - Involves simplification

Napoleon's March by Charles Minard



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Minard's Greatest Hit, c.1869

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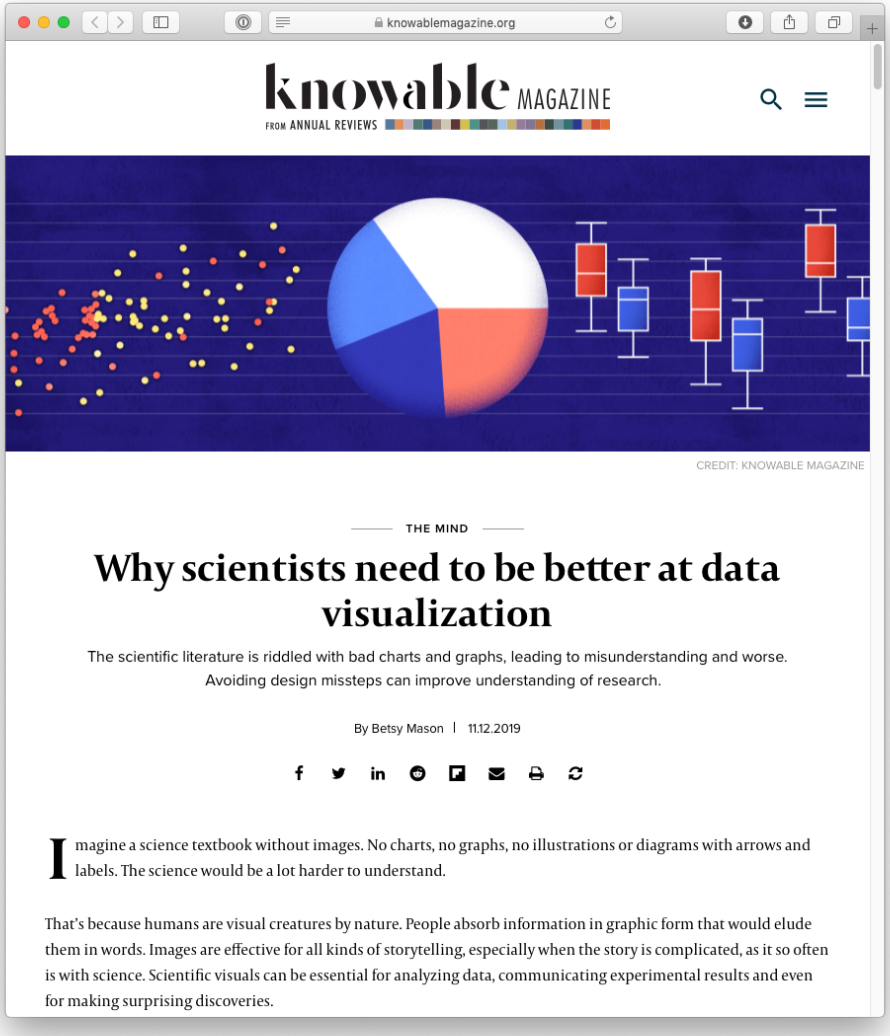
Why scientists need to be better at data visualization

The scientific literature is riddled with bad charts and graphs, leading to misunderstanding and worse. Avoiding design missteps can improve understanding of research.

By Betsy Mason

Knowable Magazine
11.12.2019



https://www.knowablemagazine.org/article/mind/2019/science-data-visualization

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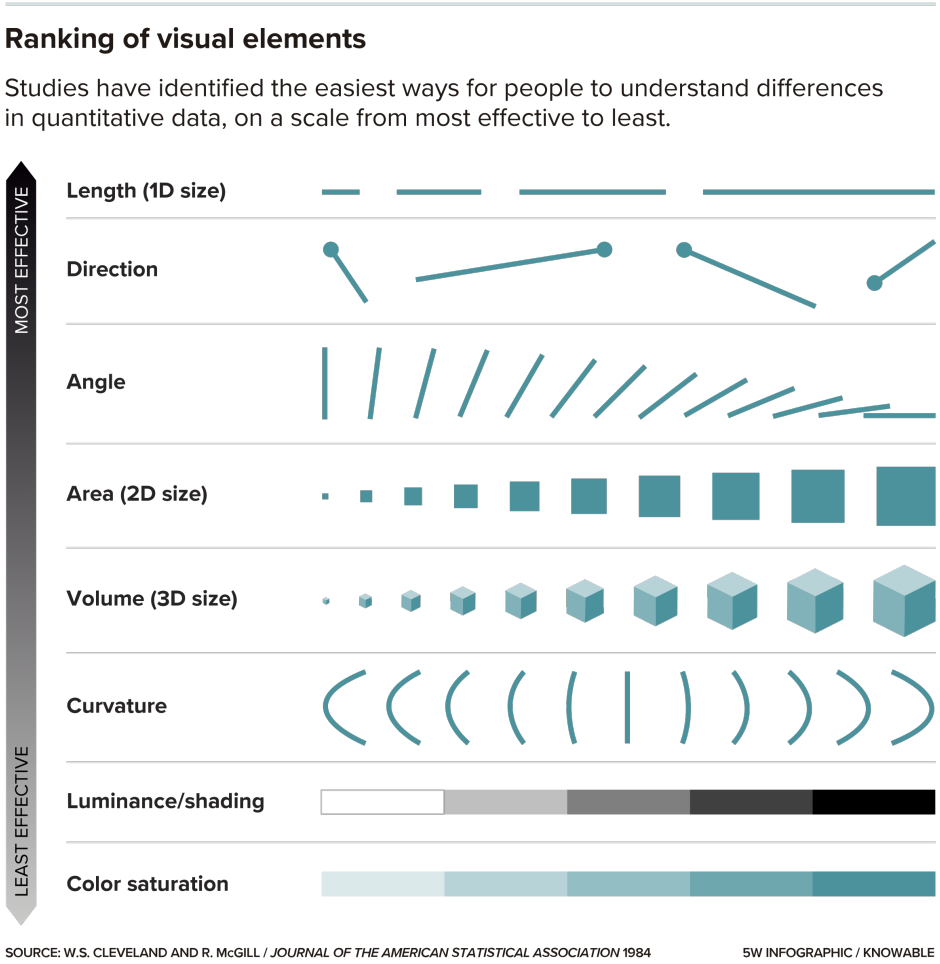
Ranking Visual Elements

People are better at discerning subtleties in some types of visuals than others — the length of two lines, for example, or the direction of a line are easier to tell apart than shades of gray or the intensity of a color. Studies show that graphs using visual elements high on this list are easier to read and more effective than those near the bottom.



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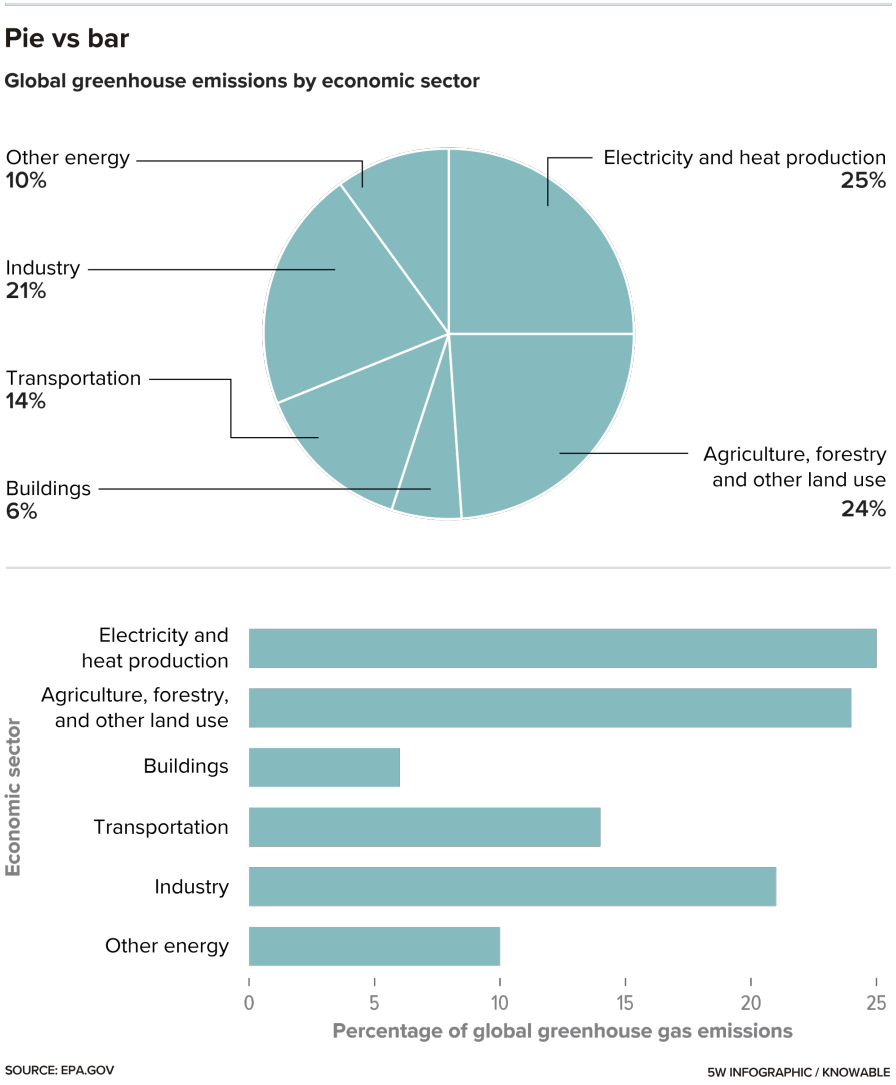
Pie vs Bar Charts

Pie charts are best used to show the relationship of the pieces to the whole. In this graphic, the pie chart effectively shows how big or small each economic sector's contribution is to total greenhouse gas emissions, but it's difficult to compare sectors with each other. The bar chart allows for easy comparisons between sectors but doesn't convey how each one relates to the total.



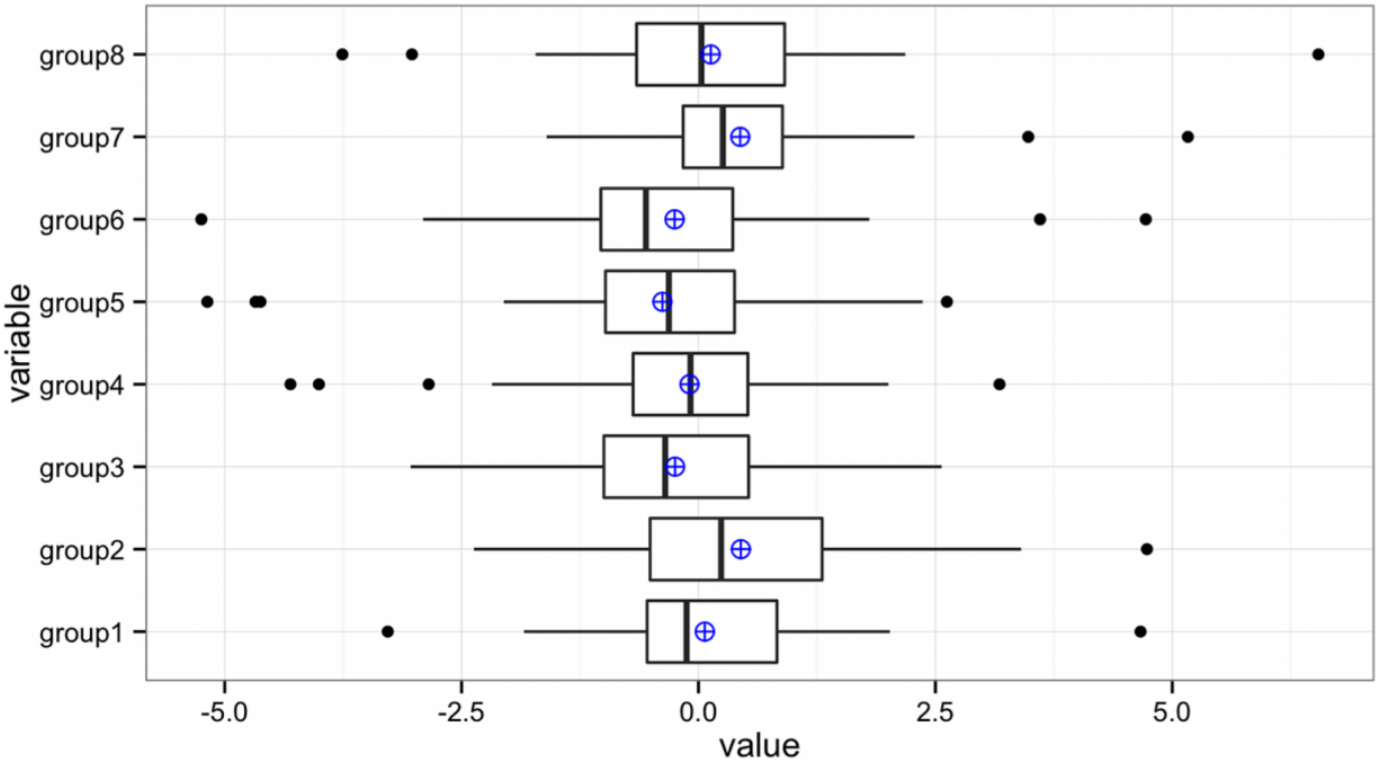
Ten-ish Simple Rules / Guidelines

- Rule 1: Know Your Audience
- Rule 2: Identify Your Message
- Rule 3: Adapt the Figure to the Support Medium
- Rule 4: Captions Are Not Optional
- Rule 5: Do Not Trust the Defaults
- Rule 6: Use Color Effectively
- Rule 7: Do Not Mislead the Reader
- Rule 8: Avoid “Chartjunk”
- Rule 9: Message Trumps Beauty
- Rule 10: Get the Right Tool

http://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1003833

Ten-ish Simple Rules / Guidelines

- Know your audience



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http://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1003833

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Ten-ish Simple Rules / Guidelines

- Identify your message

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http://upload.wikimedia.org/wikipedia/commons/9/9b/Social_Network_Analysis_Visualization.png

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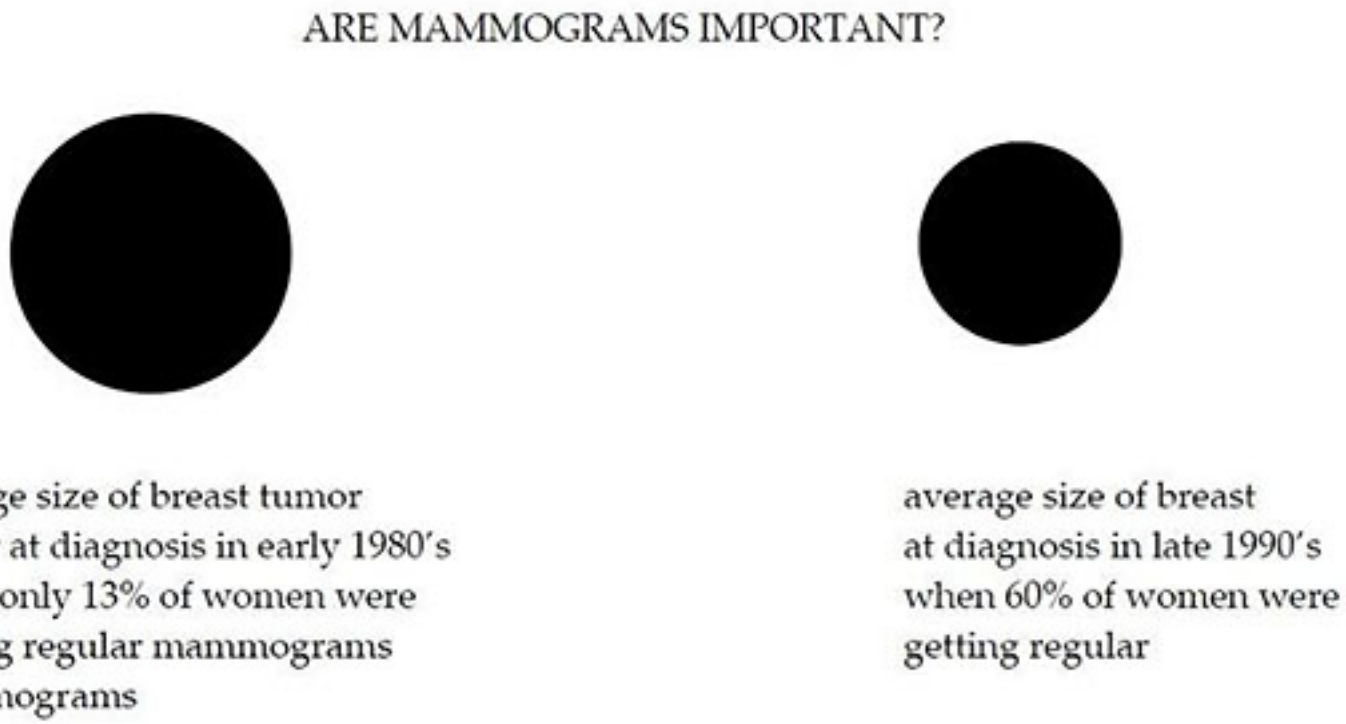
Ten-ish Simple Rules / Guidelines

- Captions are not optional



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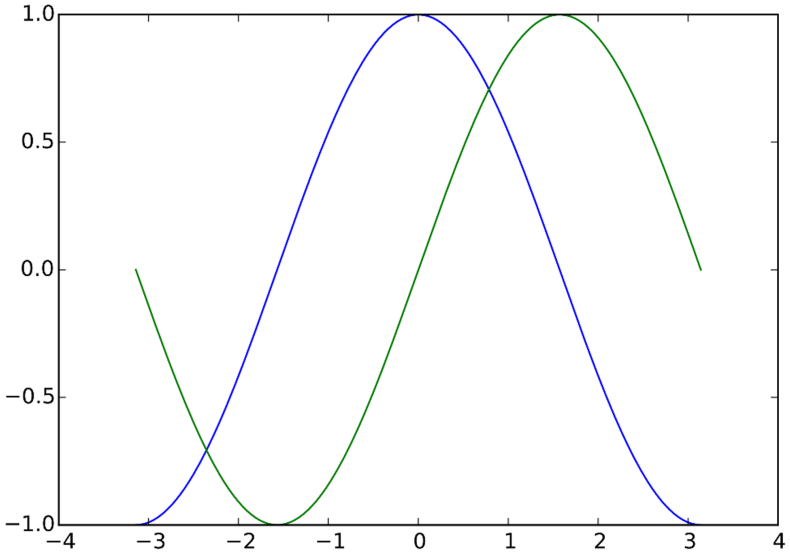
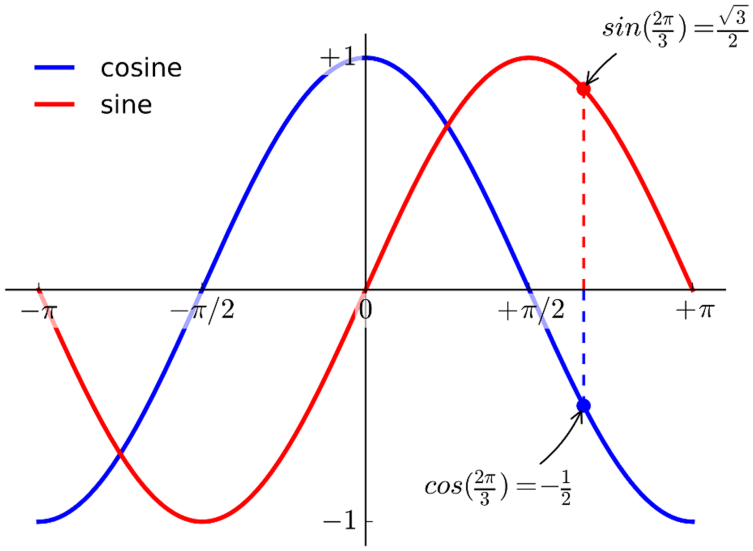
http://ksrowell.com/blog-visualizing-data/2010/12/23/data-visualization-double-take/

Ten-ish Simple Rules / Guidelines

- Do not use the defaults





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http://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1003833

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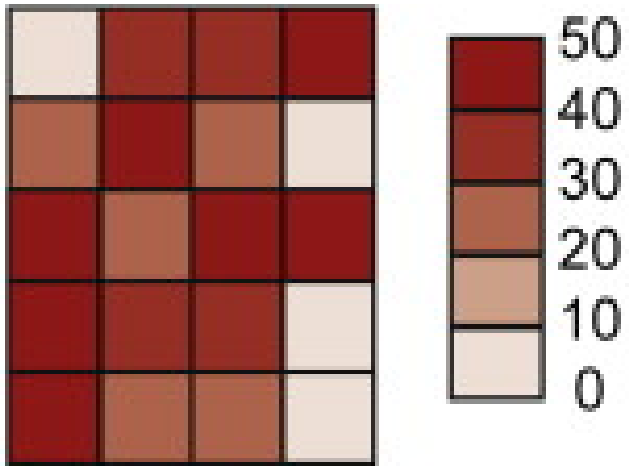
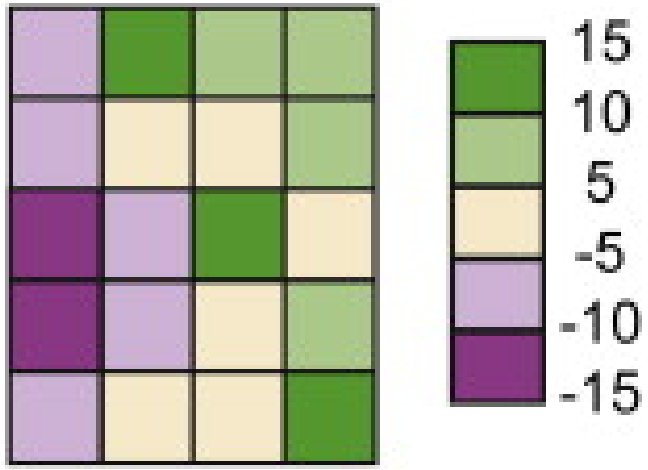
Ten-ish Simple Rules / Guidelines

- Use color effectively

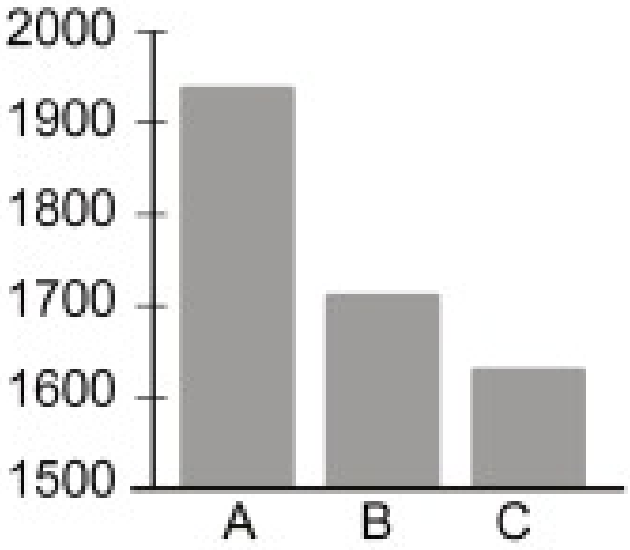


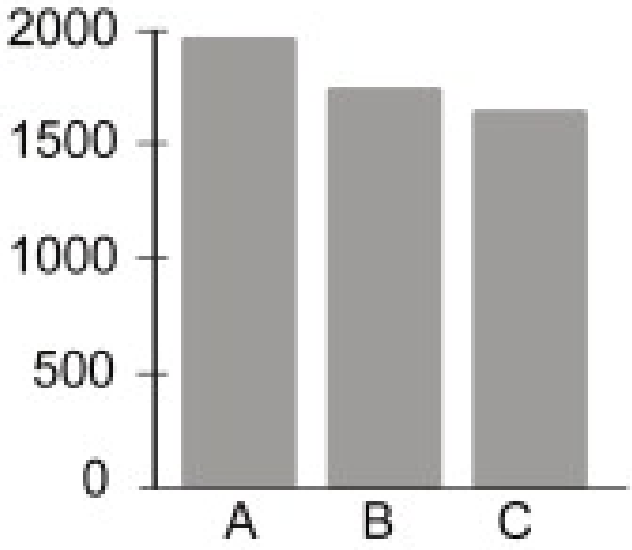


http://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1003833

Ten-ish Simple Rules / Guidelines

- Do not mislead the reader





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http://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1003833

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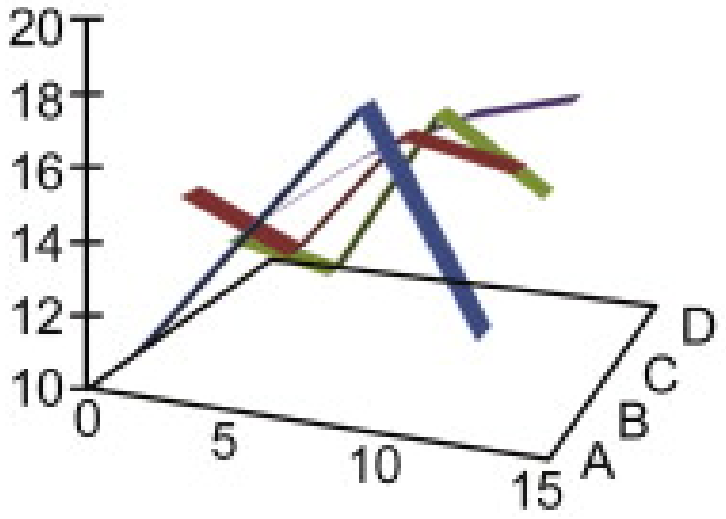
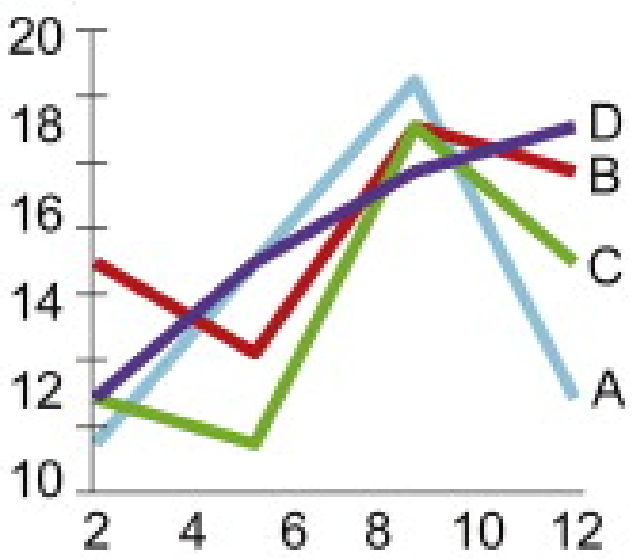
Ten-ish Simple Rules / Guidelines

- Create the simplest graph





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http://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1003833

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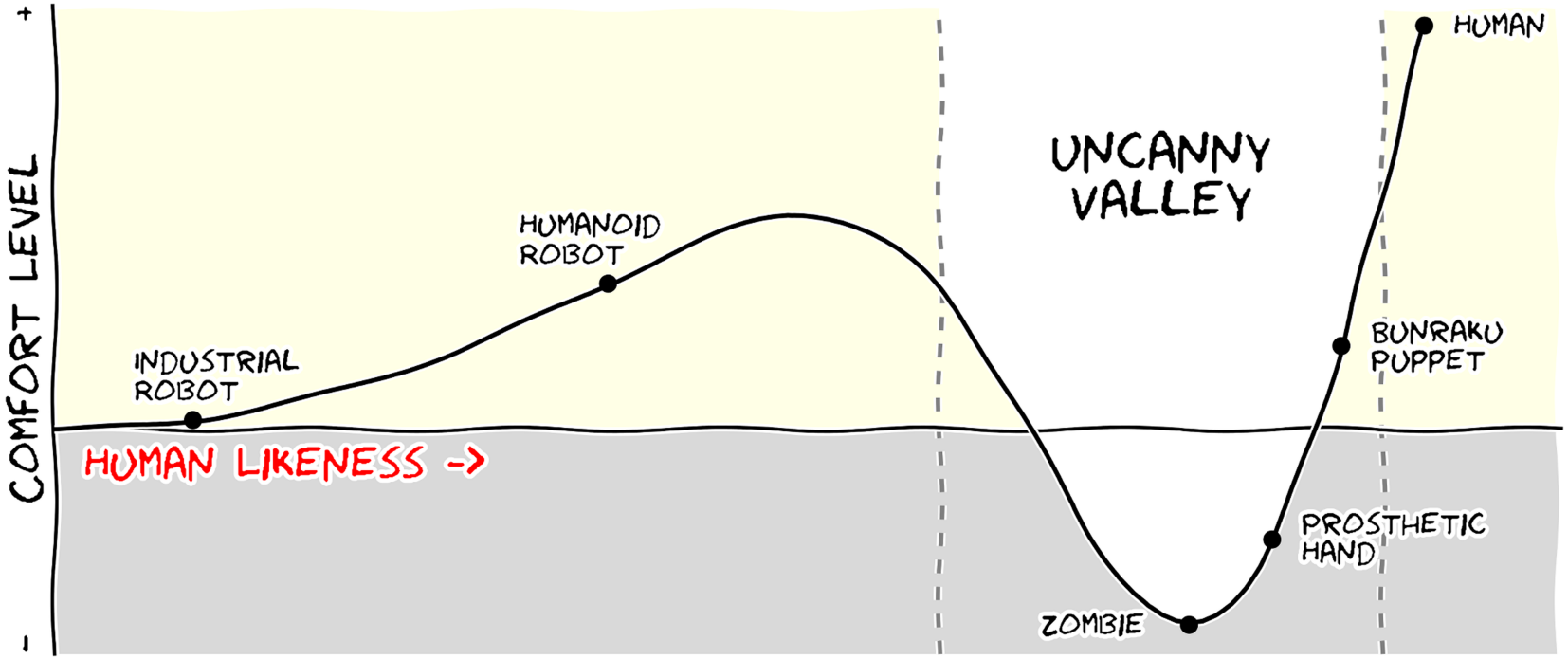
Ten-ish Simple Rules / Guidelines

- Message trumps beauty



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http://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1003833

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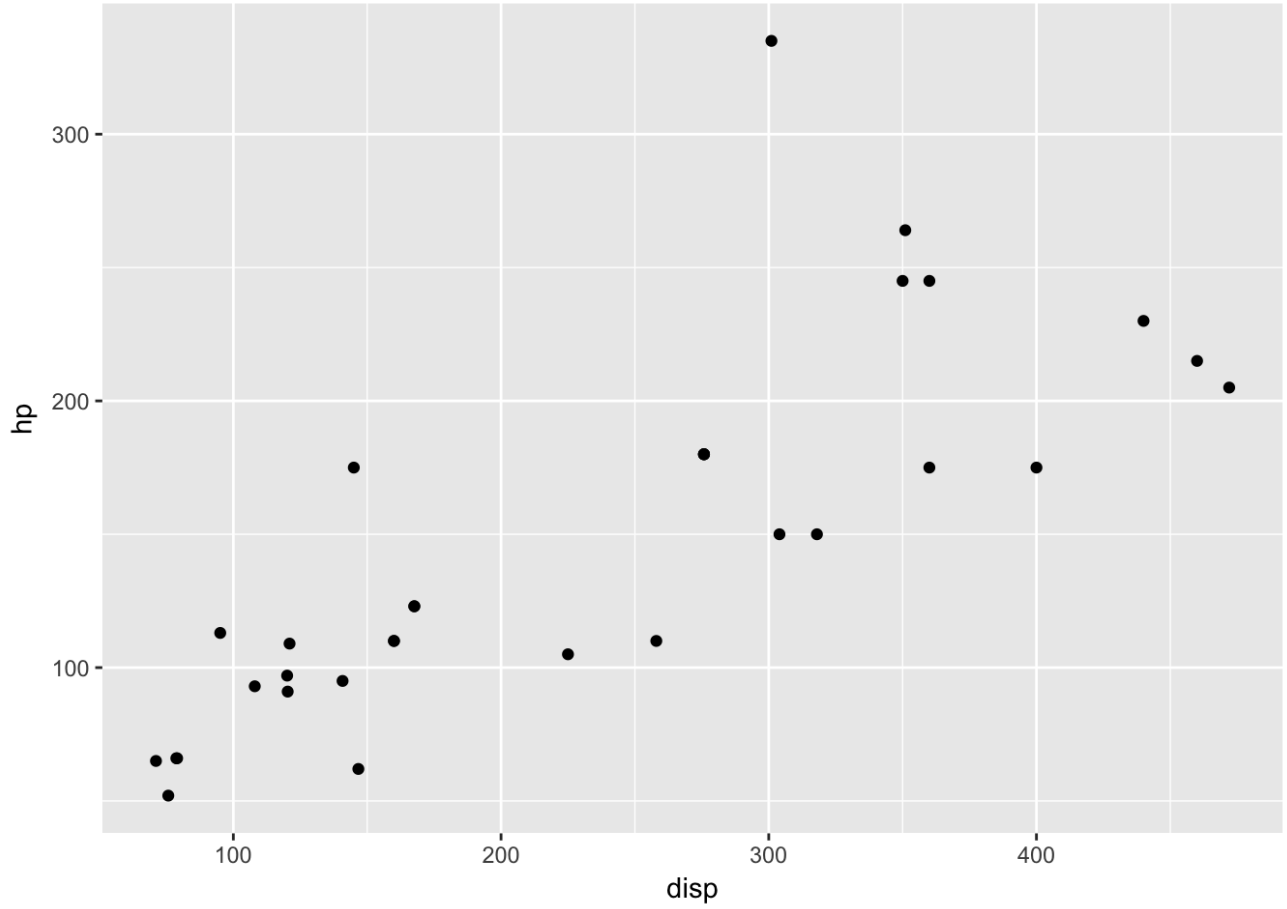
Ten-ish Simple Rules / Guidelines

- Get the right tool…

http://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1003833

How Much Data Can You Put In A Chart?

How Much Data Can You Present In A Single Graph? Two Dimensions?



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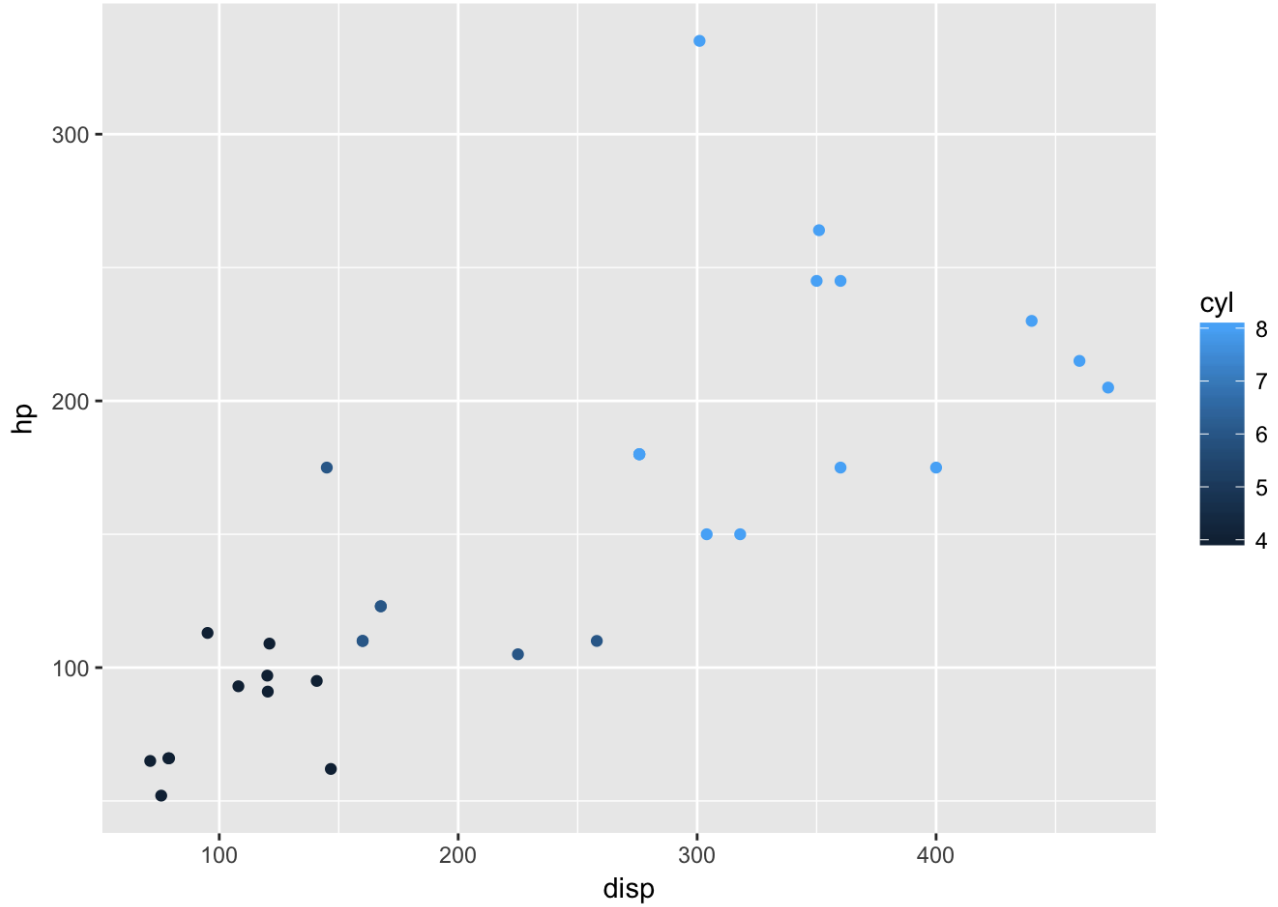
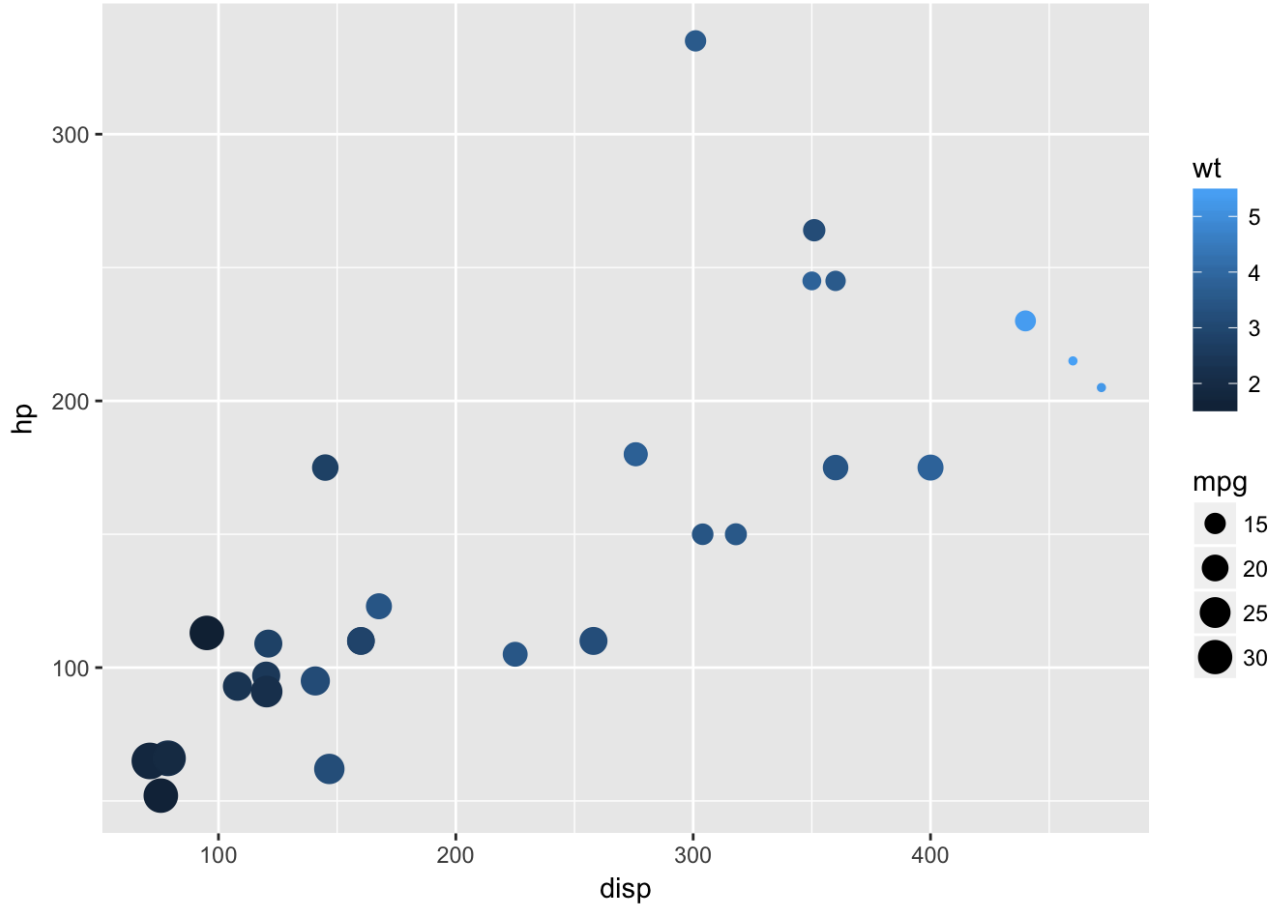
Source: Sean Davis, NCI - https://github.com/seandavi/hour_of_code; NOTE: These are "R" visualizations

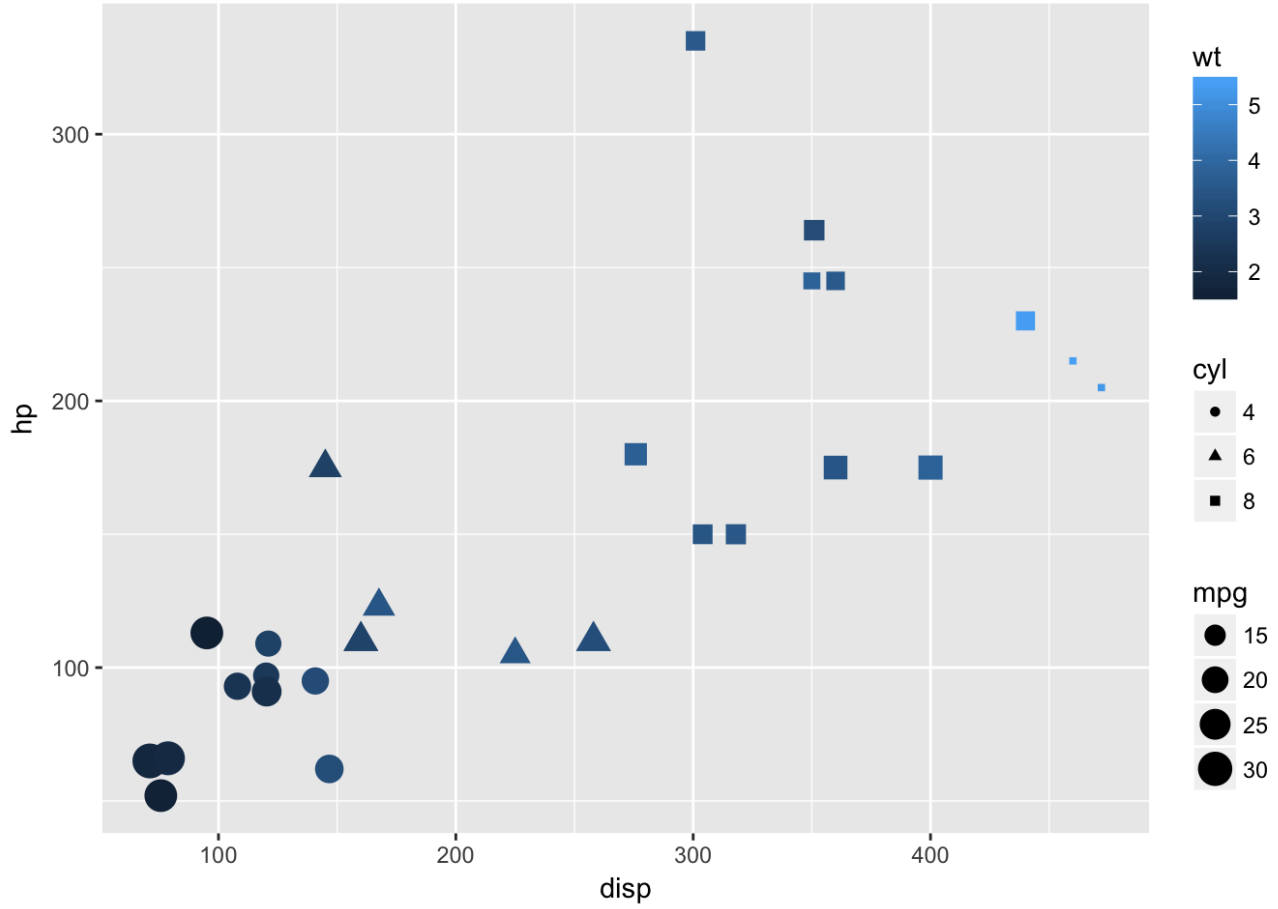
How Much Data Can You Present In A Single Graph? Three Dimensions?



How Much Data Can You Present In A Single Graph? Four Dimensions?

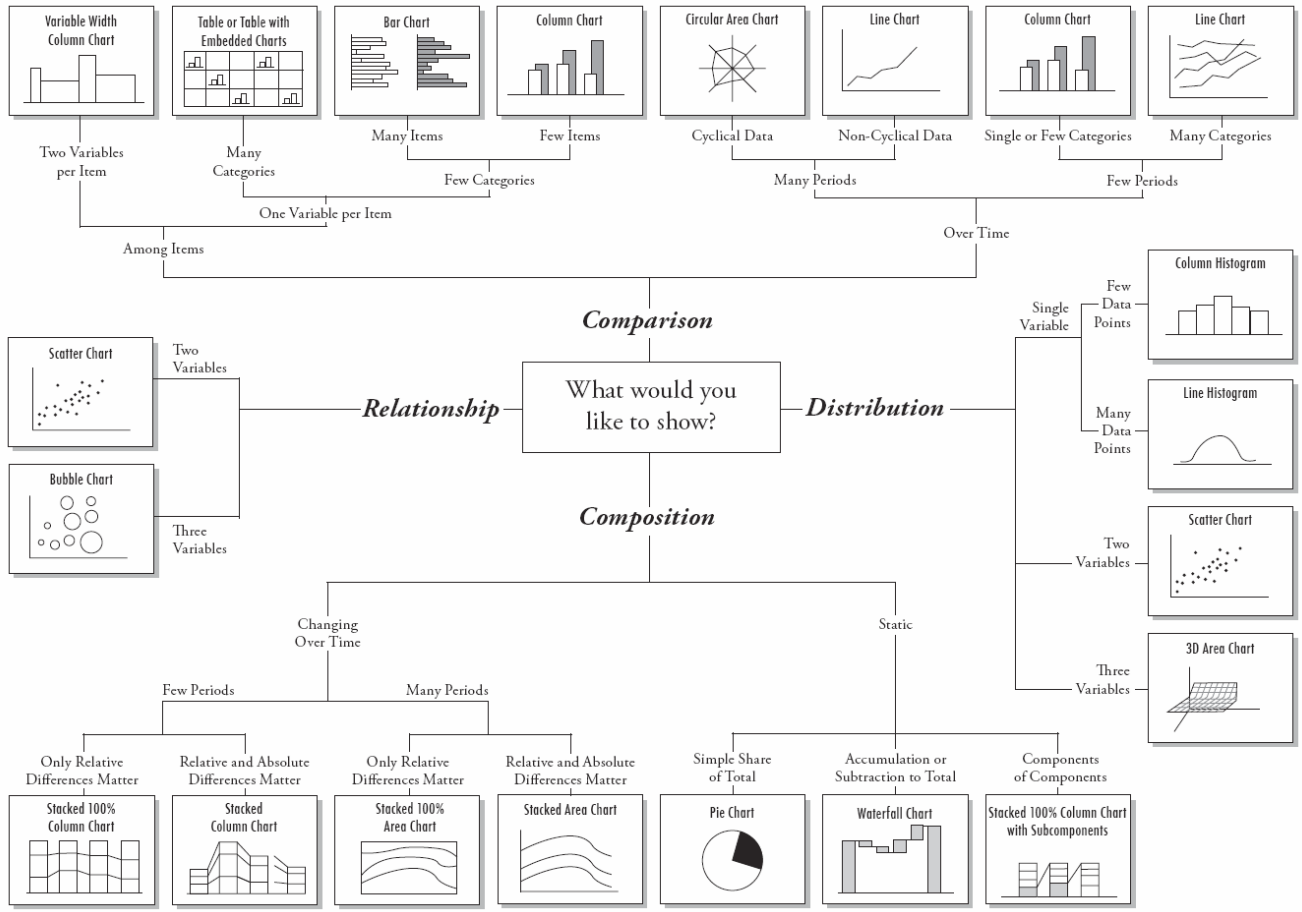


How Much Data Can You Present In A Single Graph? Five Dimensions?



How Do I Know Which Chart To Use?

Choose the Right Chart Type for your Data



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Source: http://img.labnol.org/di/choosing_a_good_chart2.pdf

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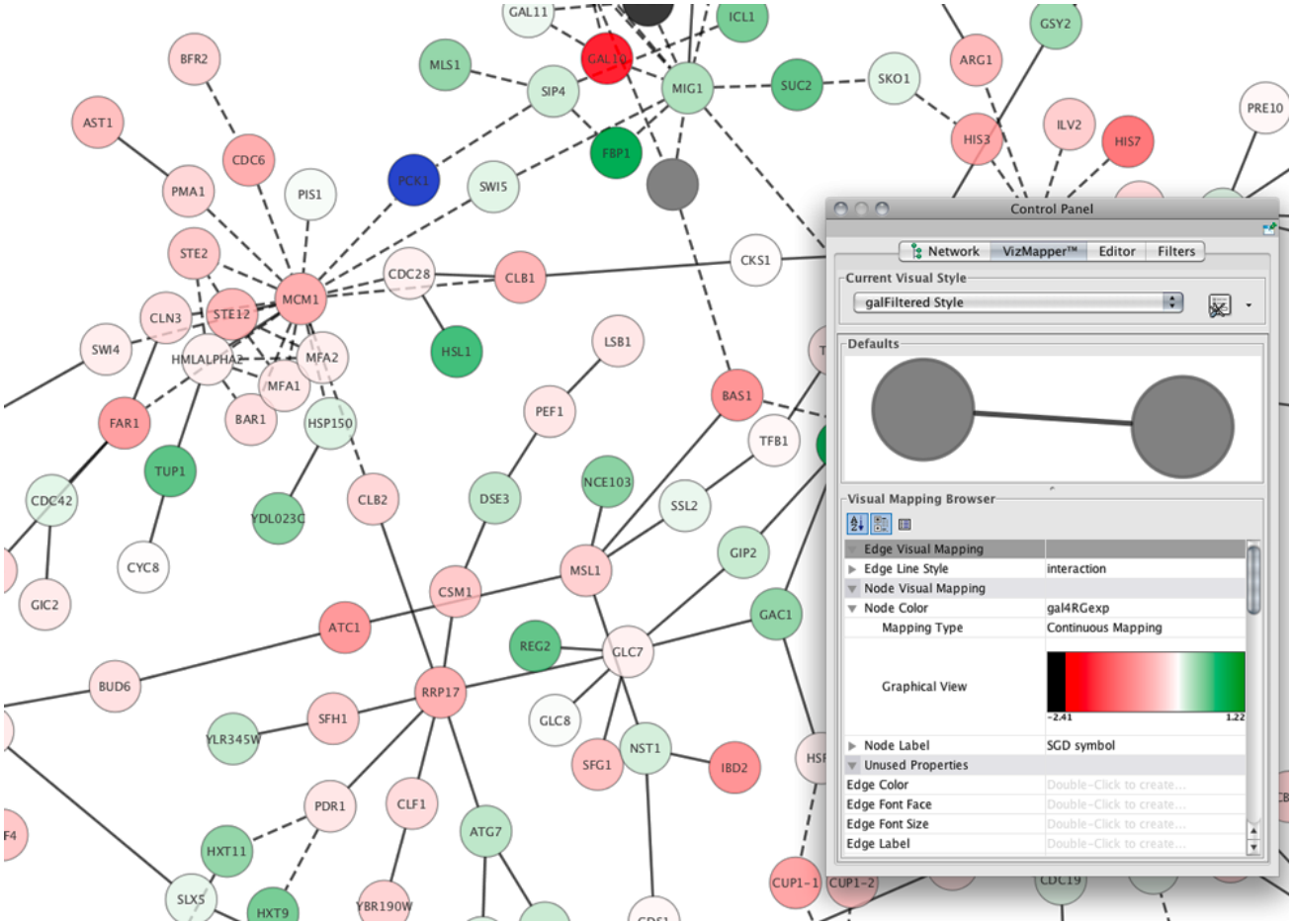
Data Visualization

- Static data visualization
  - matplotlib, seaborn, ggpy (ggplot)
- Dynamic visualization
  - Bokeh
- Declarative Visualization
  - Altair
- Specialized visualizations
  - Mapping of geographical data, timelines
  - 3D visualization – Vispy

Additional (non-python) Data Visualization Techniques:

Network Visualization: Cytoscape



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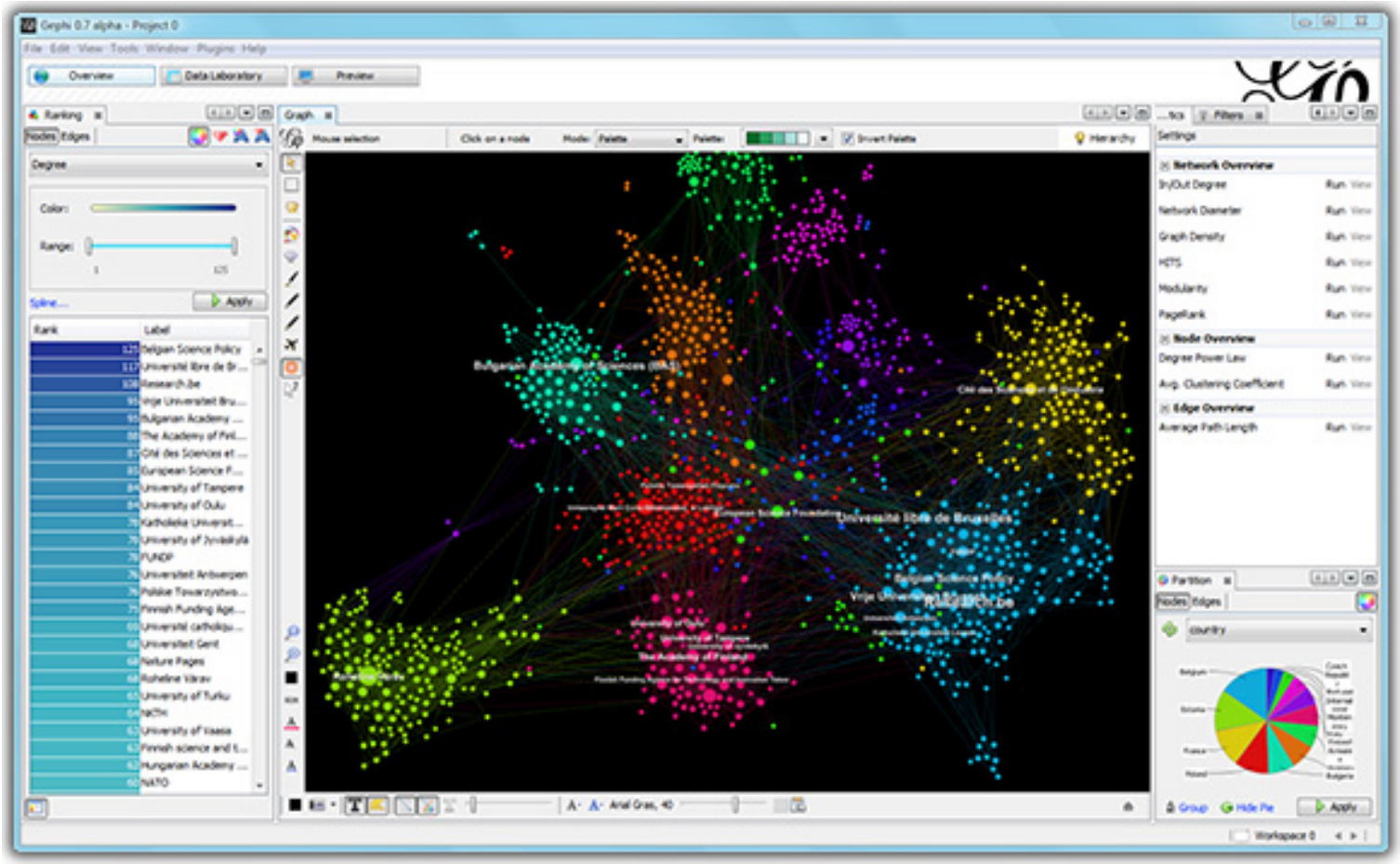
Network Visualization: Gelphi



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References

- **Ten Simple Rules for Better Figures**. Nicolas P. Rougier , Michael Droettboom, Philip E. Bourne. PLOS Computational Biology. September 11, 2014

Resources

- one-dataset-visualized-25-ways
  - http://flowingdata.com/2017/01/24/one-dataset-visualized-25-ways/

Resources

- Nature Methods: Point of View column
  - http://blogs.nature.com/methagora/2013/07/data-visualization-points-of-view.html
  - http://mkweb.bcgsc.ca/pointsofview/
- Publications
  - https://www.knowablemagazine.org/article/mind/2019/science-data-visualization
  - https://www.annualreviews.org/doi/pdf/10.1146/annurev-biodatasci-080917-013424

- http://www.vanseodesign.com/web-design/gestalt-principles-of-perception/
- Course
  - http://enrico.bertini.io/teaching/
- Chart Chooser
  - http://labs.juiceanalytics.com/chartchooser/