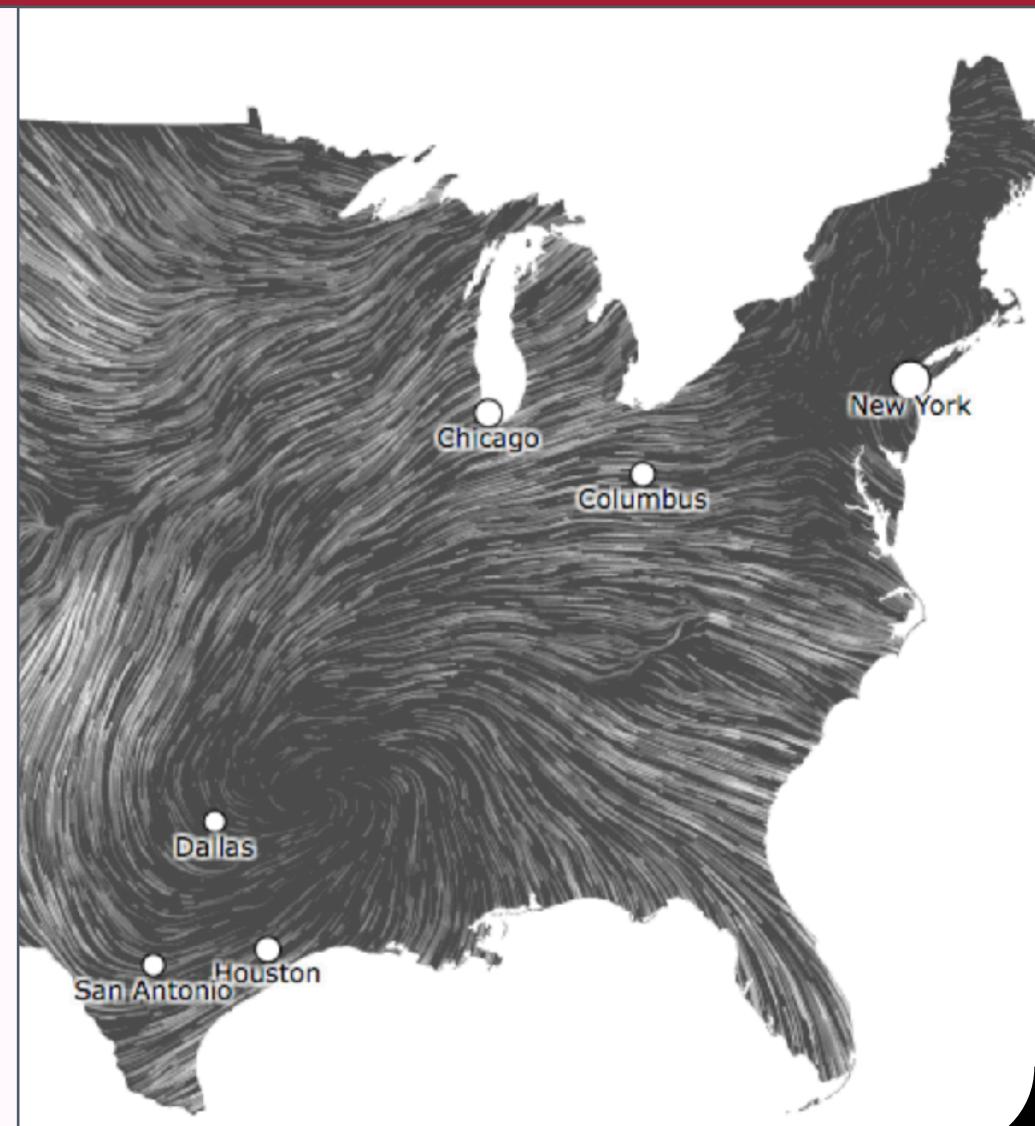
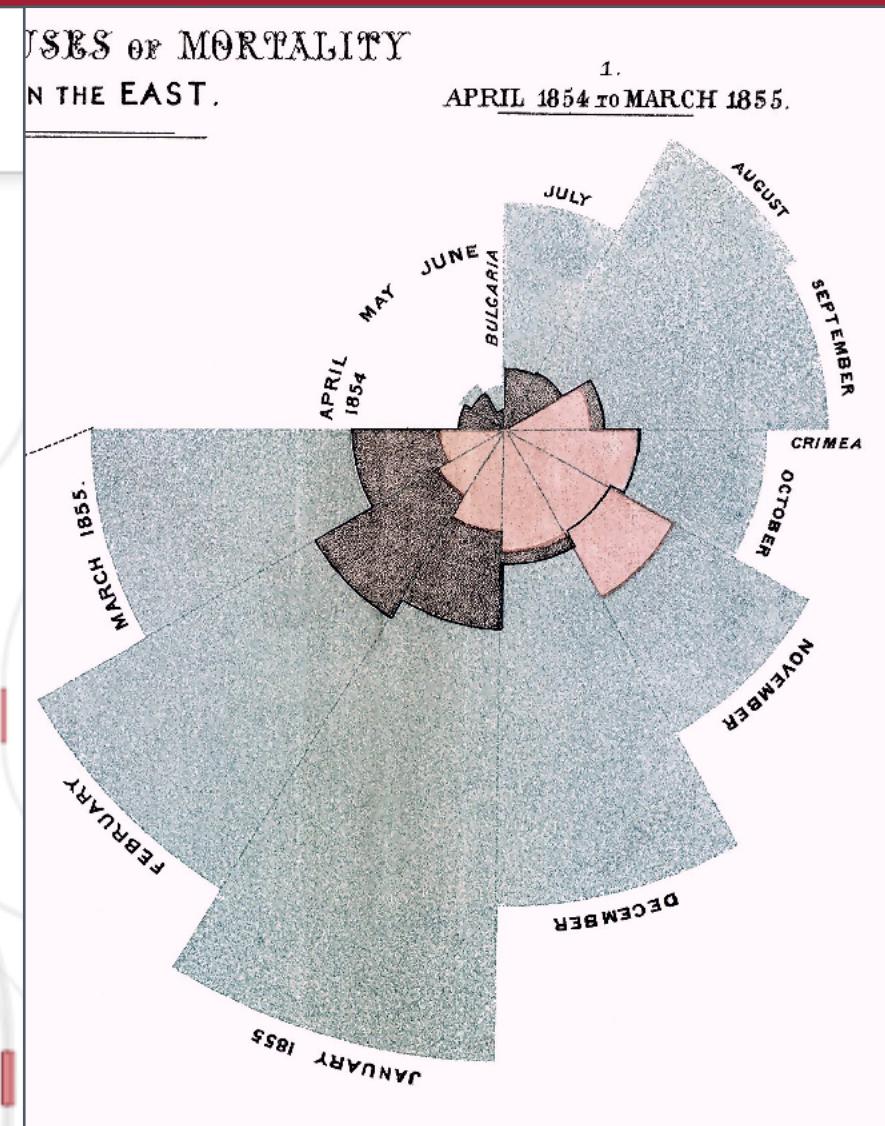
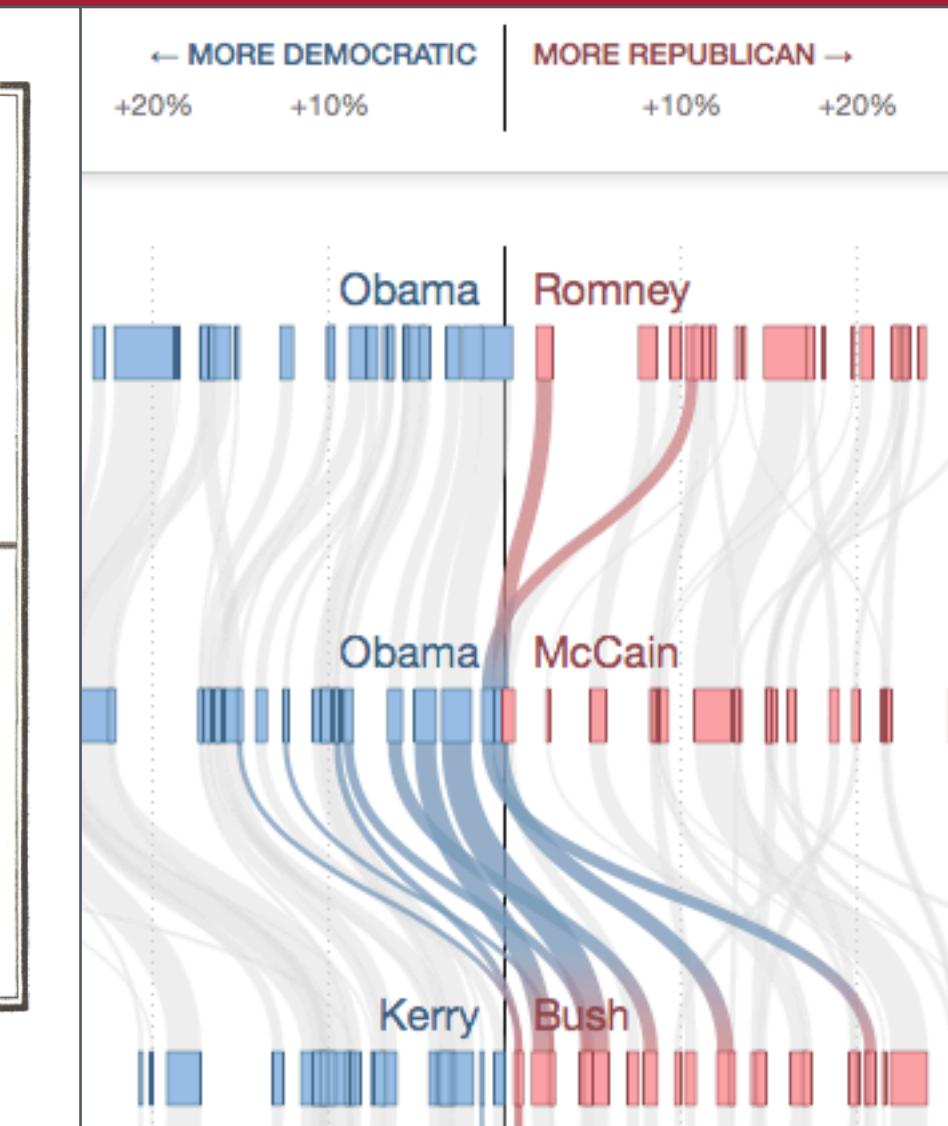
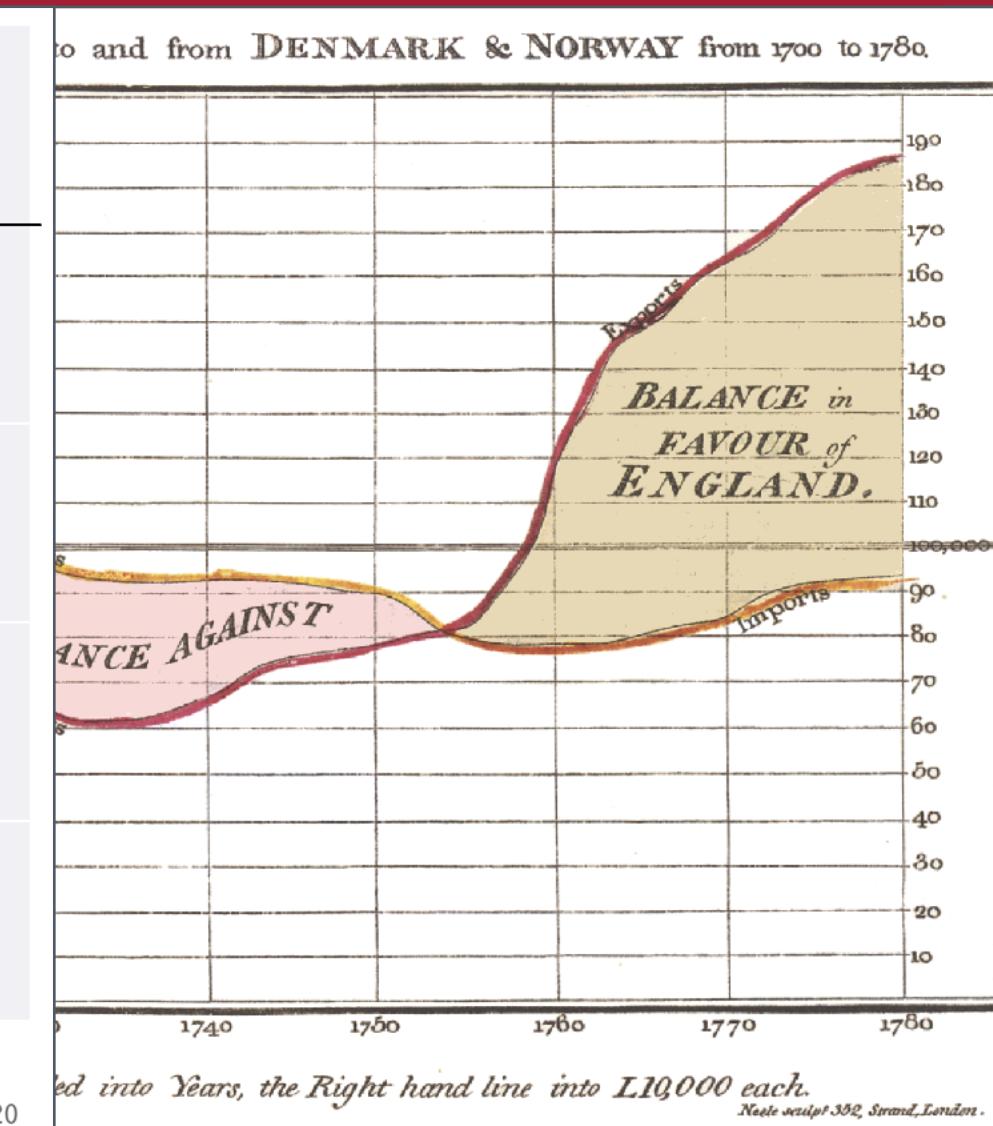
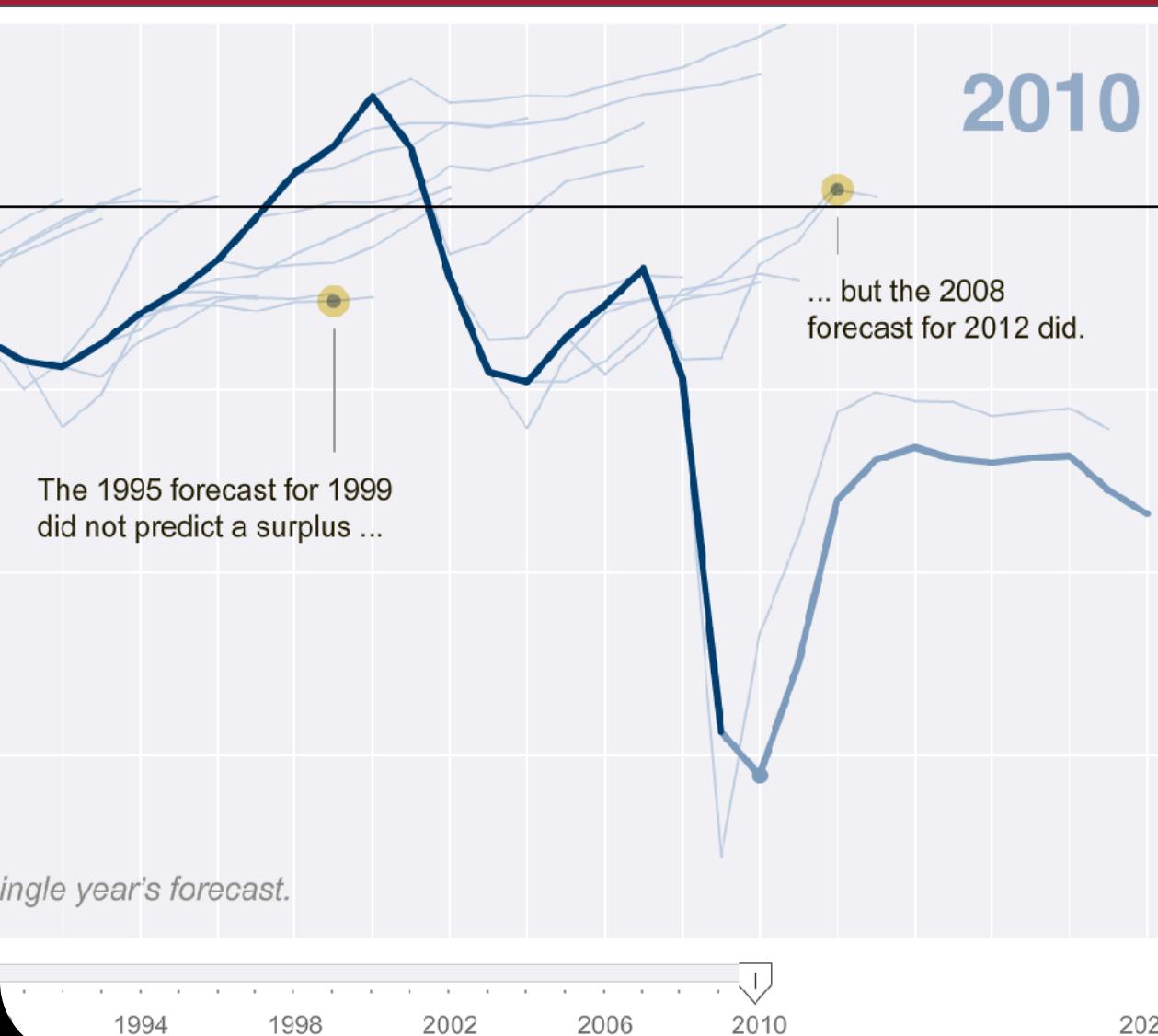


6.894: Interactive Data Visualization

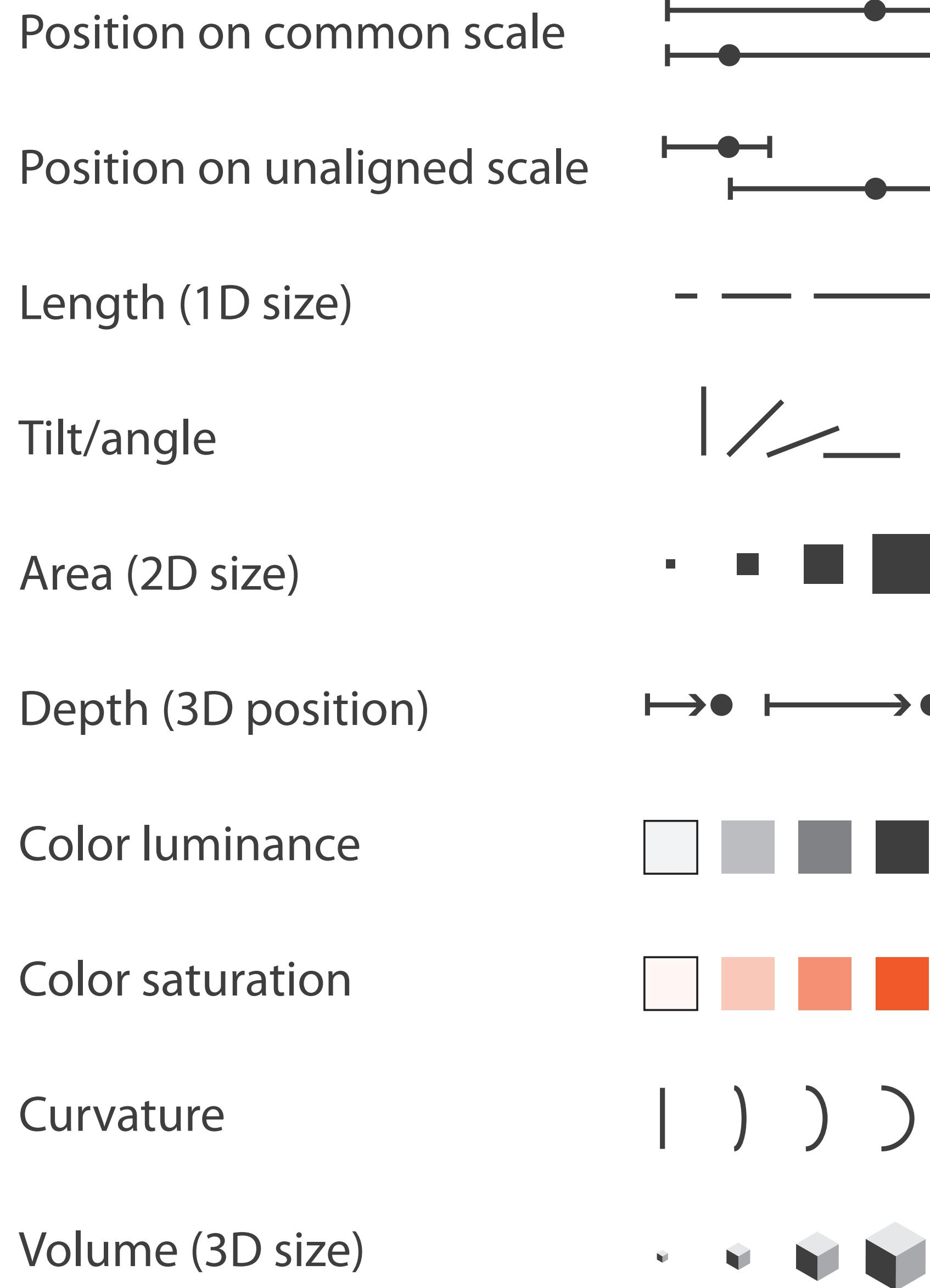
Effective Encoding & Dark Patterns

Arvind Satyanarayan



Channels: Expressiveness Types and Effectiveness Ranks

→ Magnitude Channels: O or Q attributes



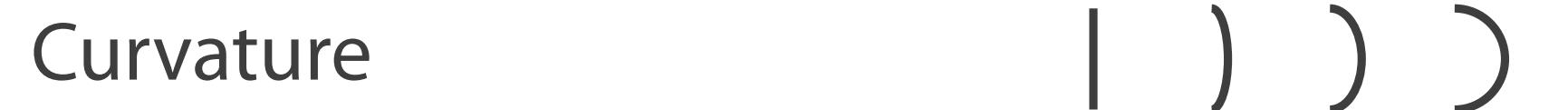
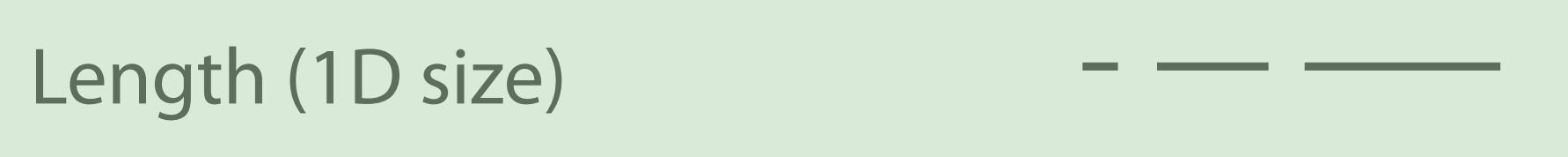
→ Identity Channels: N attributes



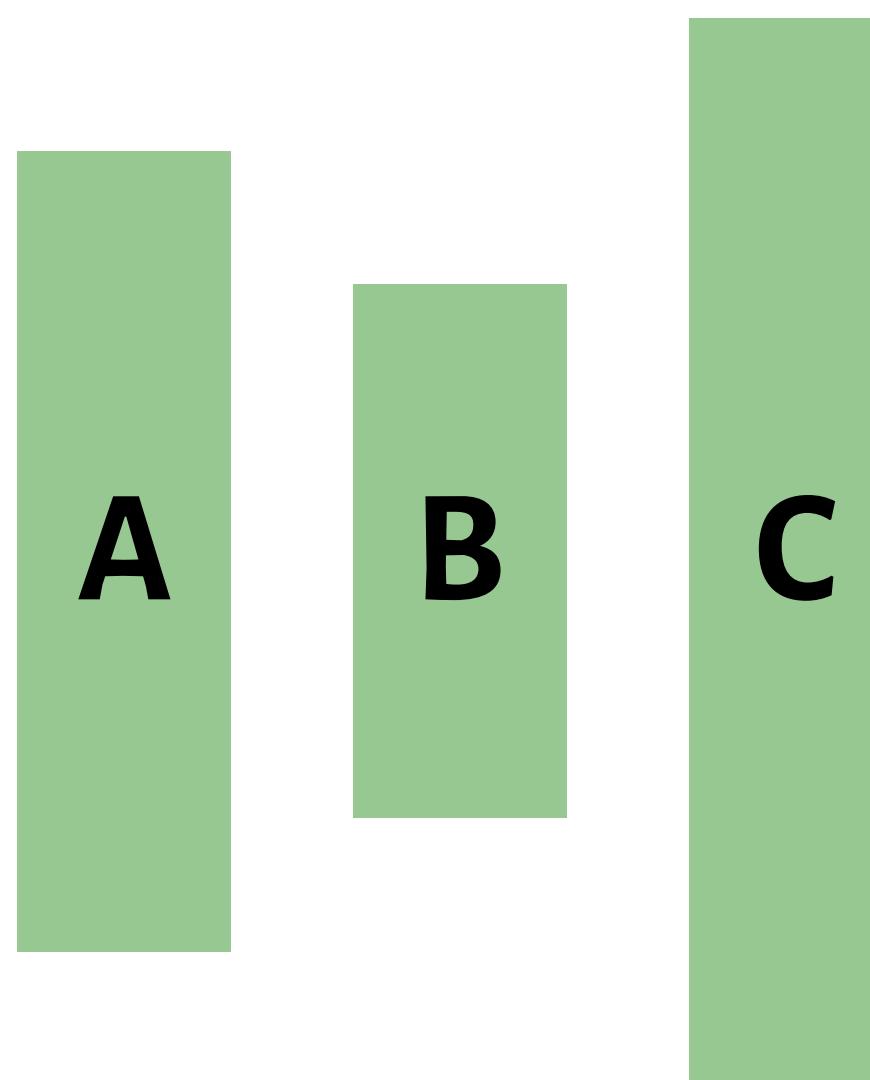
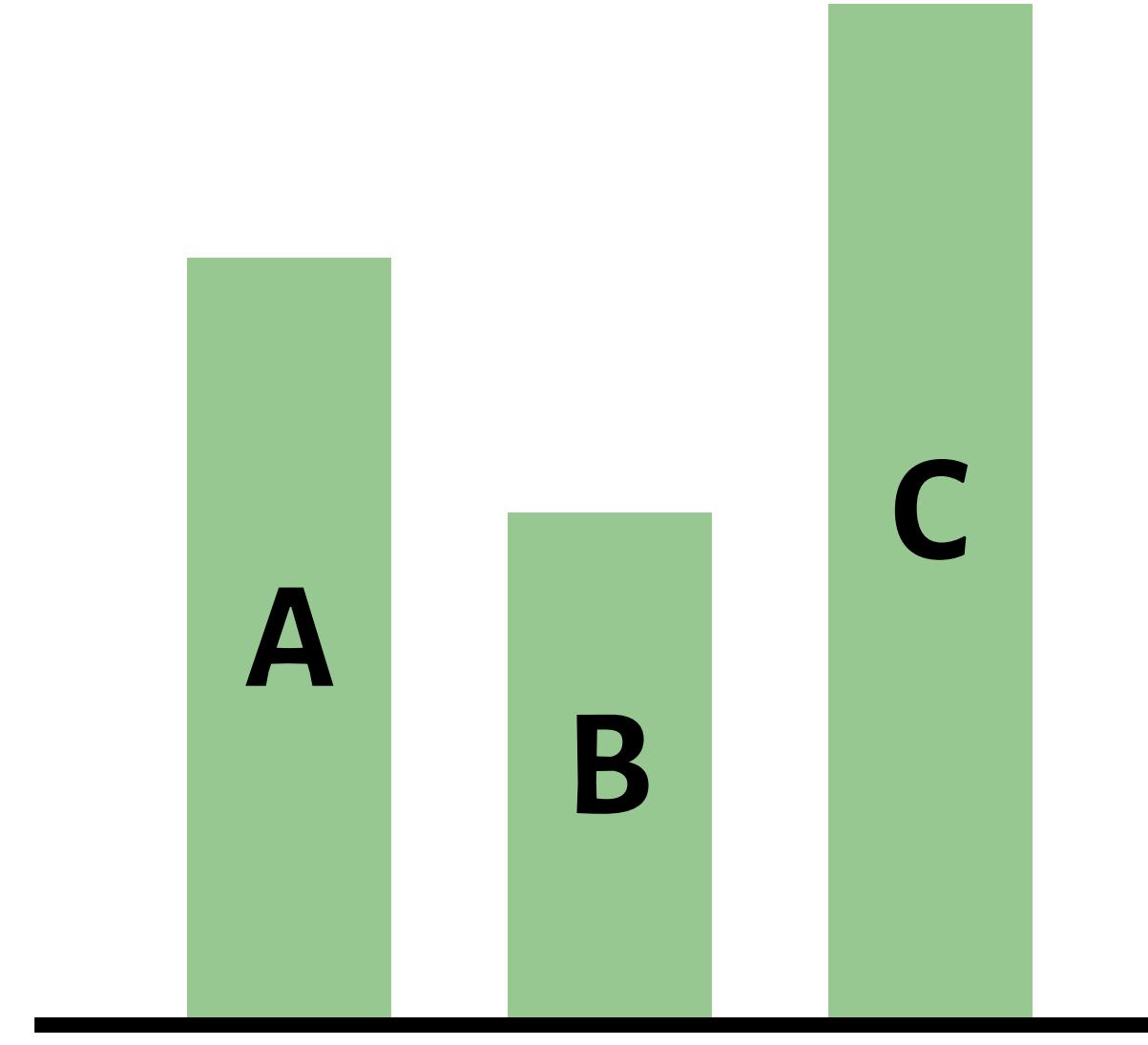
Tamara Munzner, *Visualization Analysis and Design* (2014).

Channels: Expressiveness Types and Effectiveness Ranks

→ **Magnitude** Channels: O or Q attributes



▲ Most
Effectiveness
Same
▼ Least



Channels: Expressiveness Types and Effectiveness Ranks

→ **Magnitude** Channels: **O** or **Q** attributes

Position on common scale



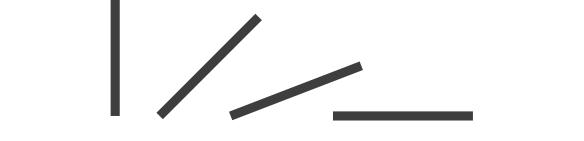
Position on unaligned scale



Length (1D size)



Tilt/angle



Area (2D size)



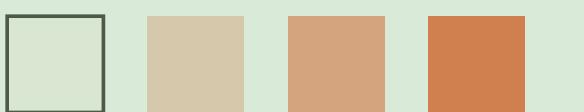
Depth (3D position)



Color luminance



Color saturation



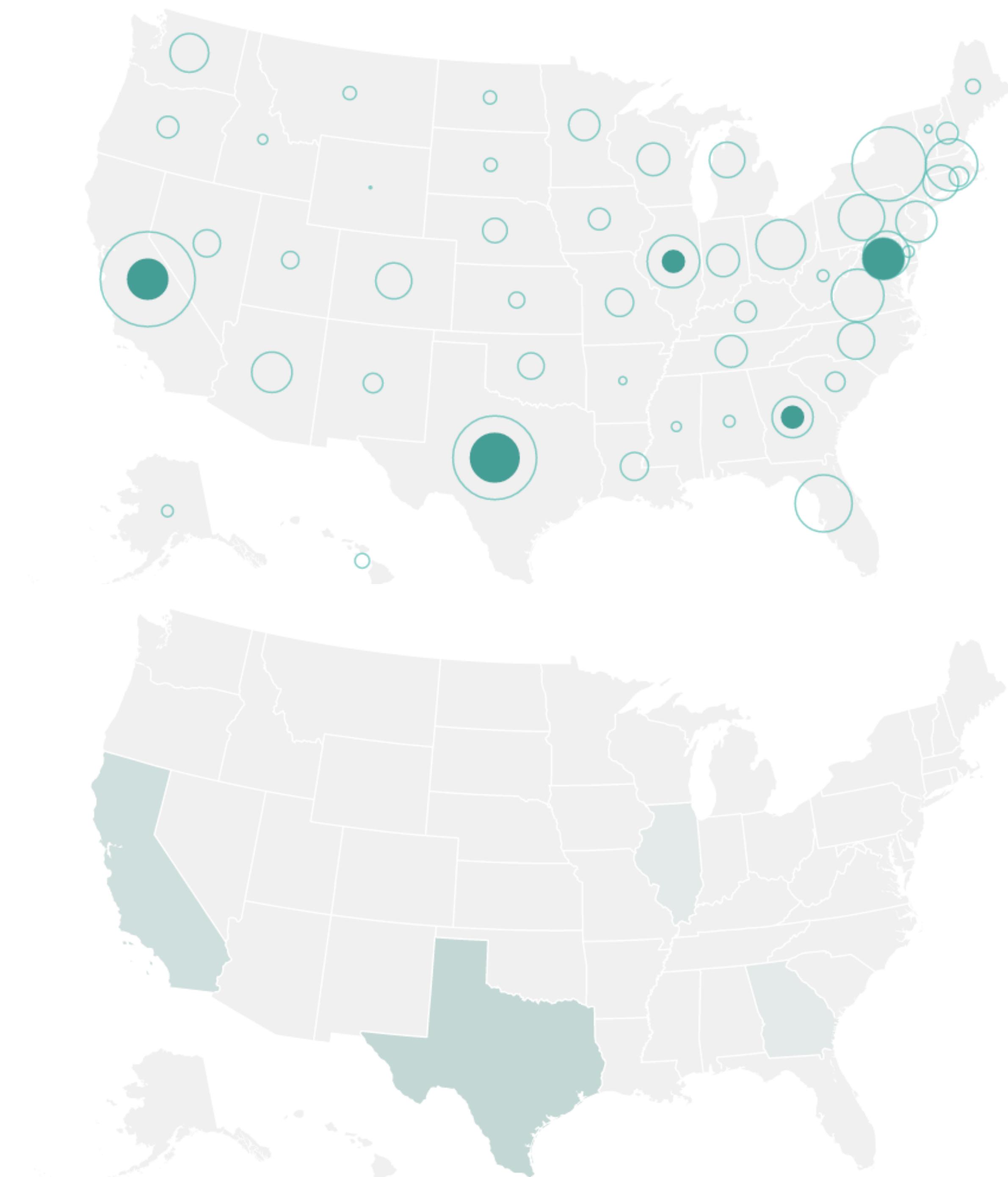
Curvature



Volume (3D size)

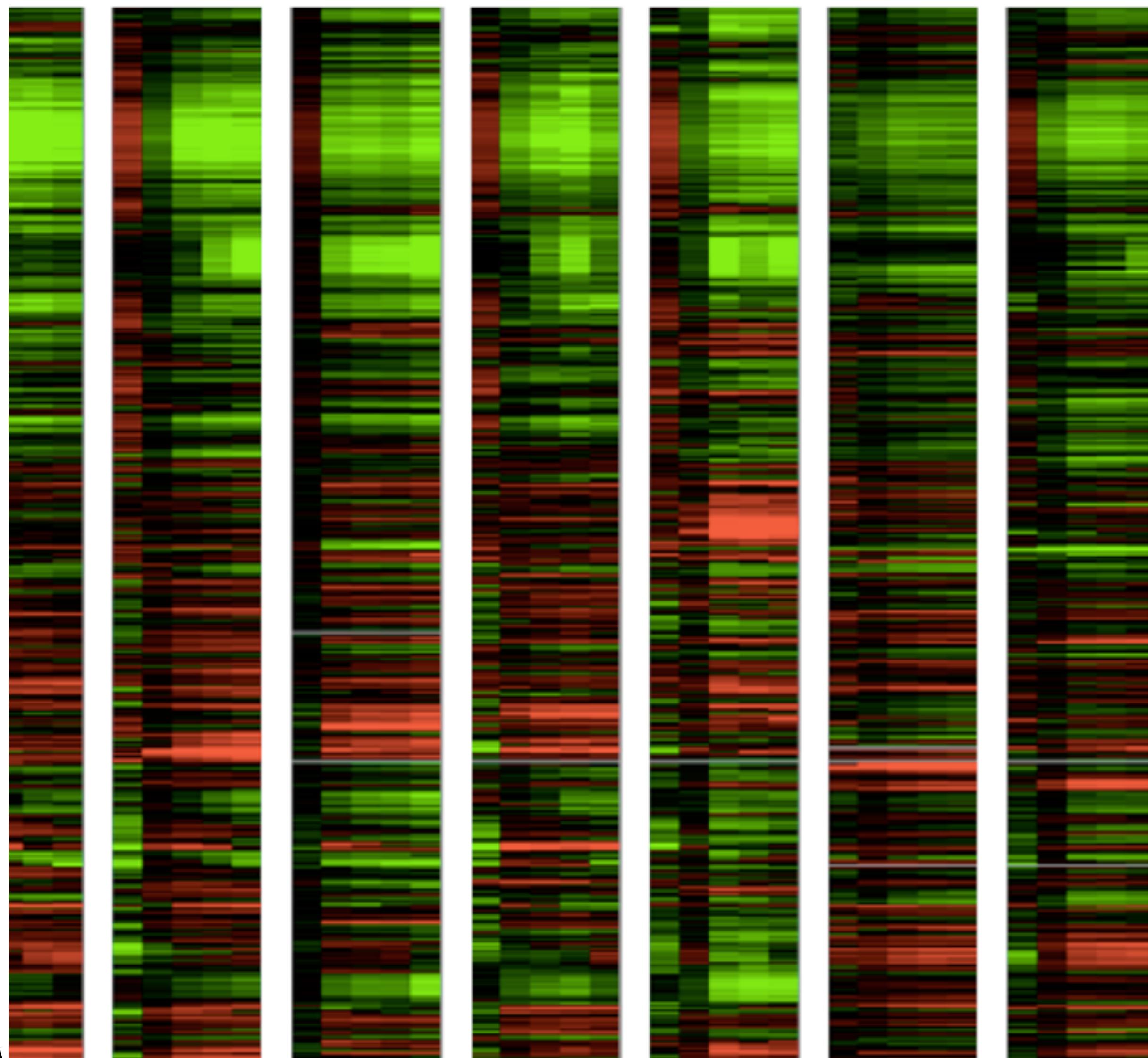


▲ Most
Effectiveness
↓ Least
Effectiveness

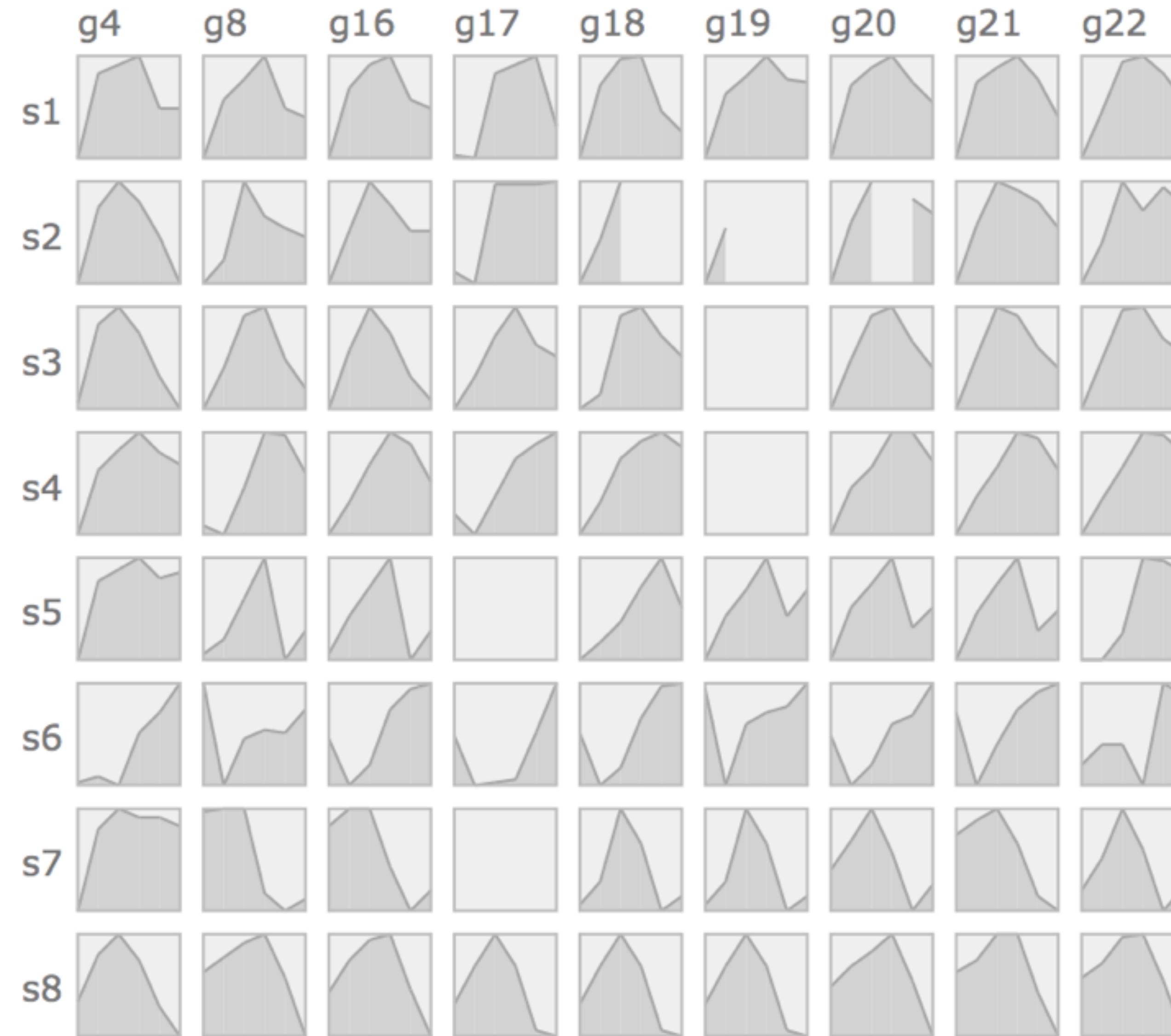


Gene Expression Time-Series [Meyer et al.'10]

Color Encoding

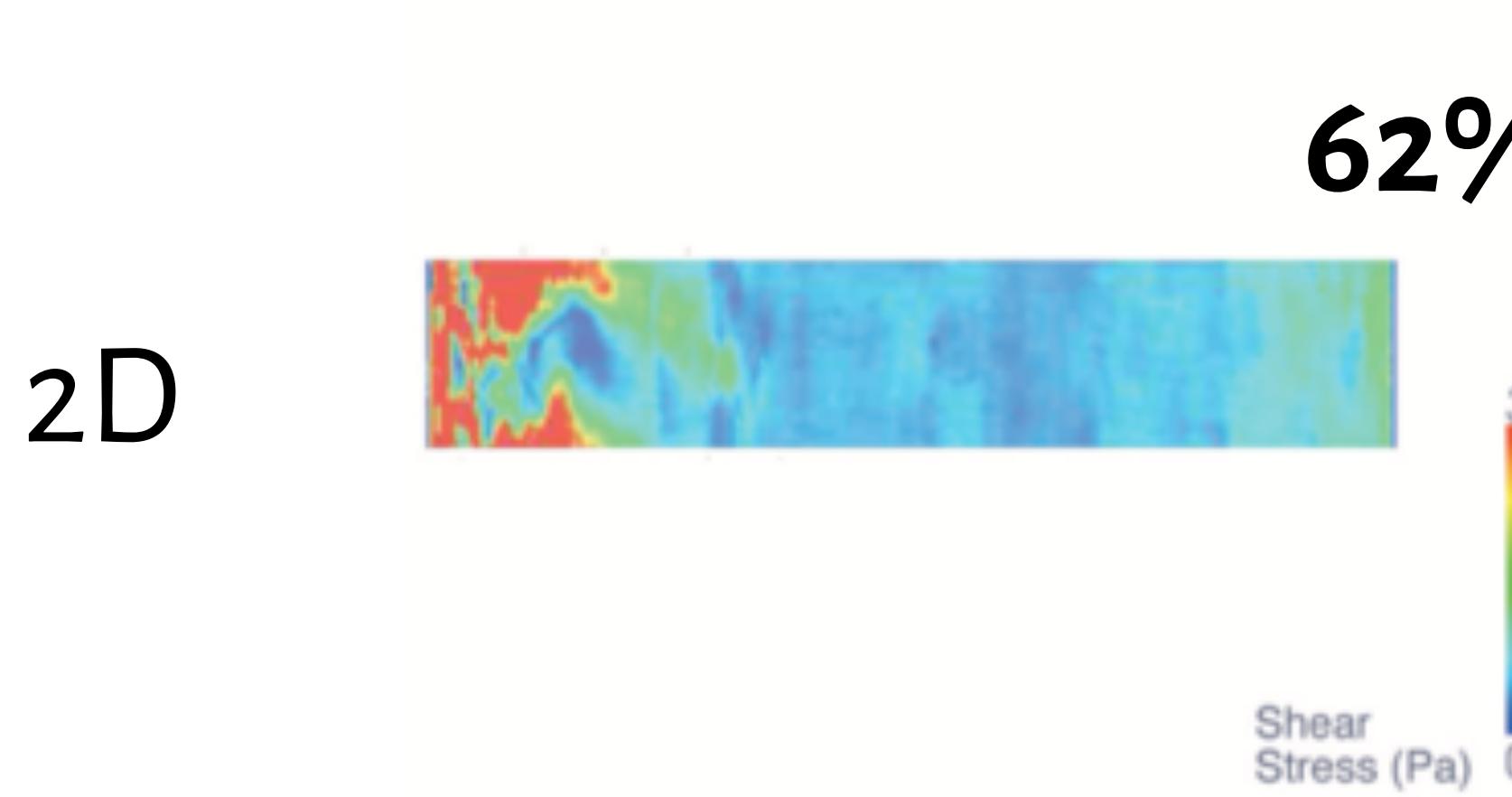


Position Encoding

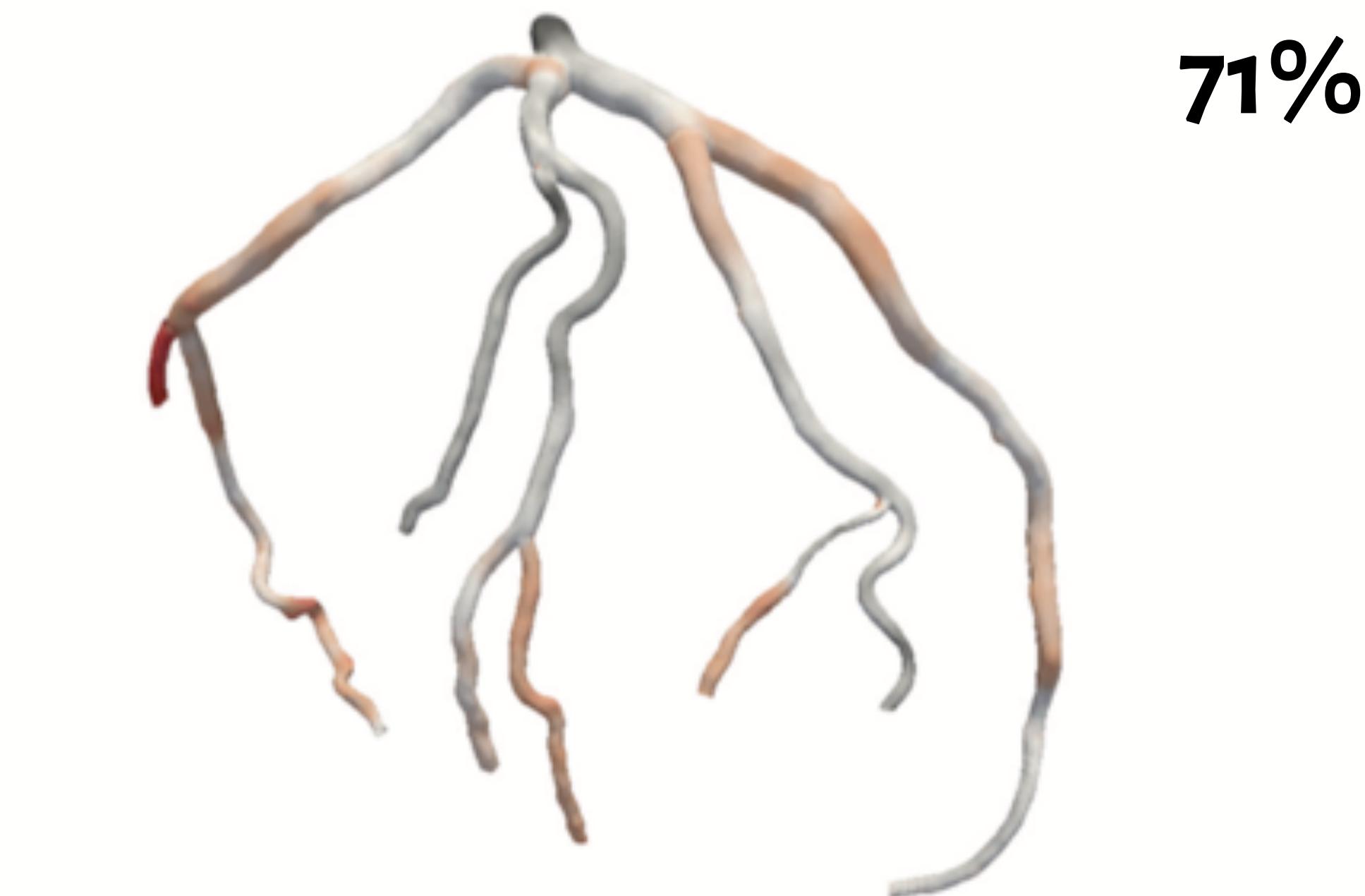
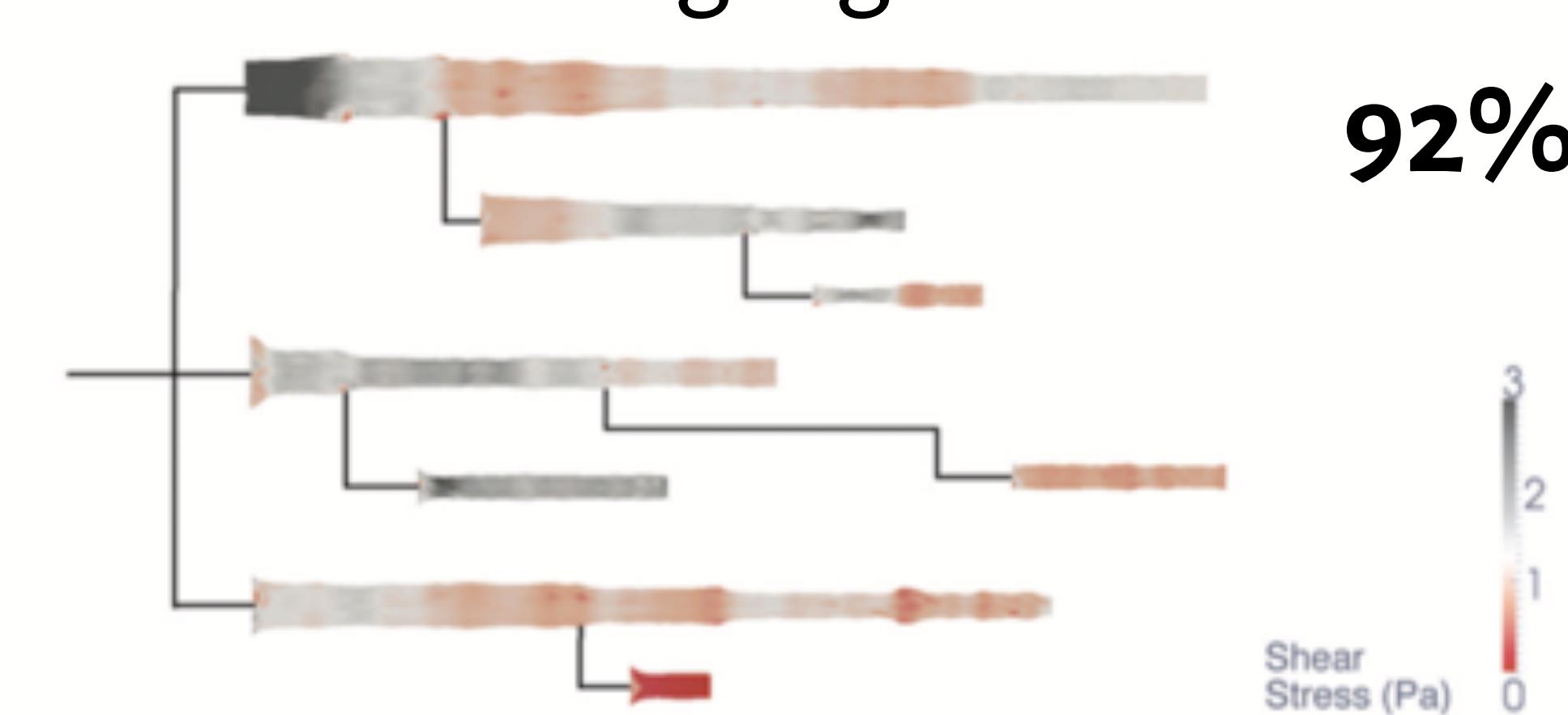


Artery Visualization [Borkin et al '11]

Rainbow Palette

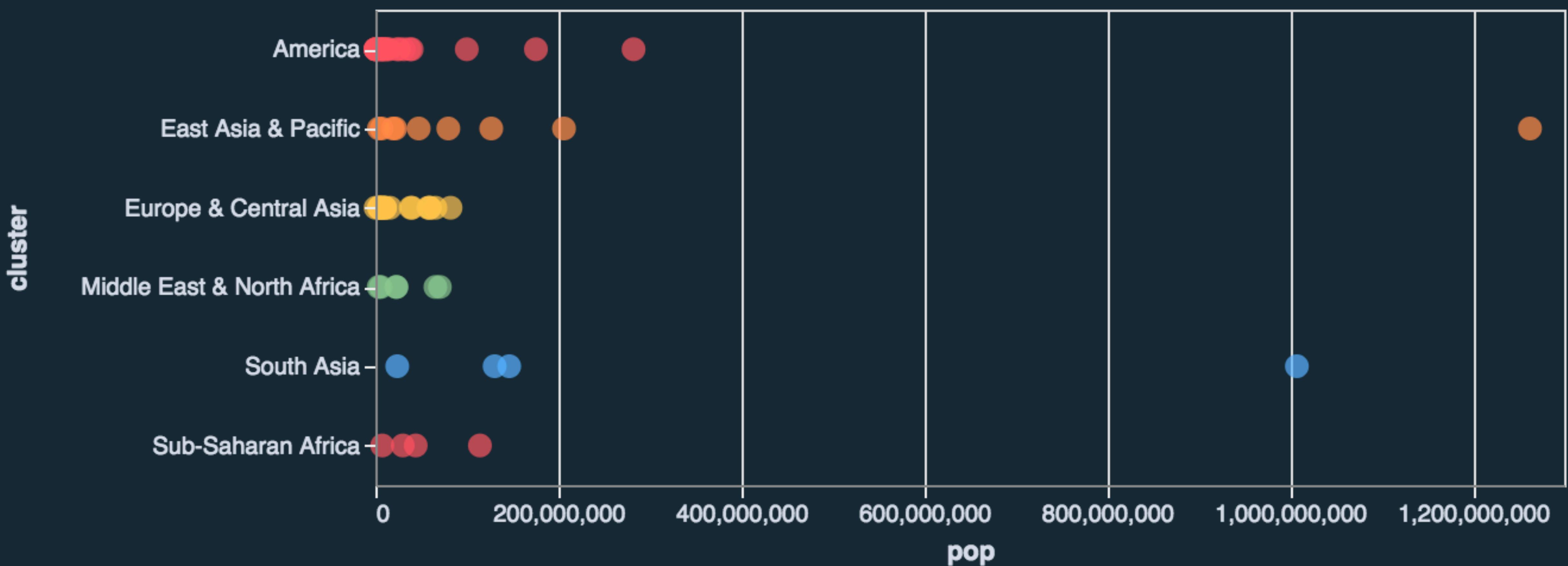


Diverging Palette



Scaling Axes

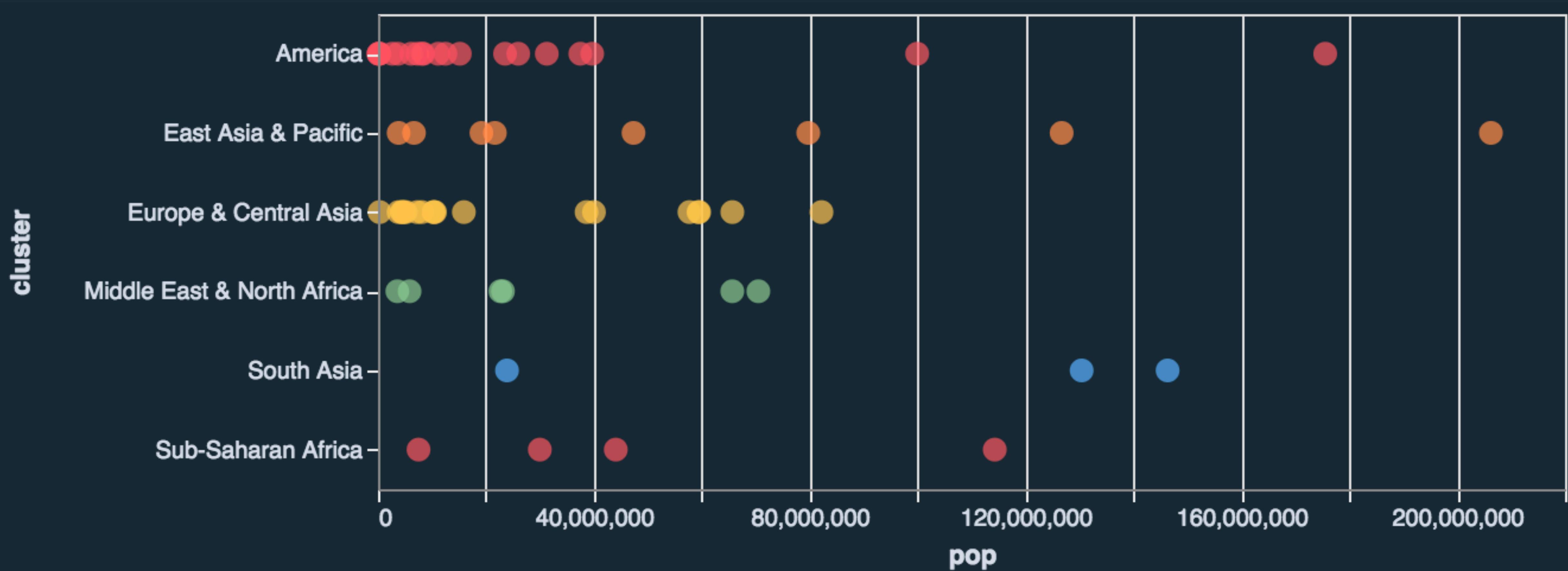
Scaling Axes: Outliers & Skew



Scaling Axes: Outliers & Skew

1. Clip them out.

Options:

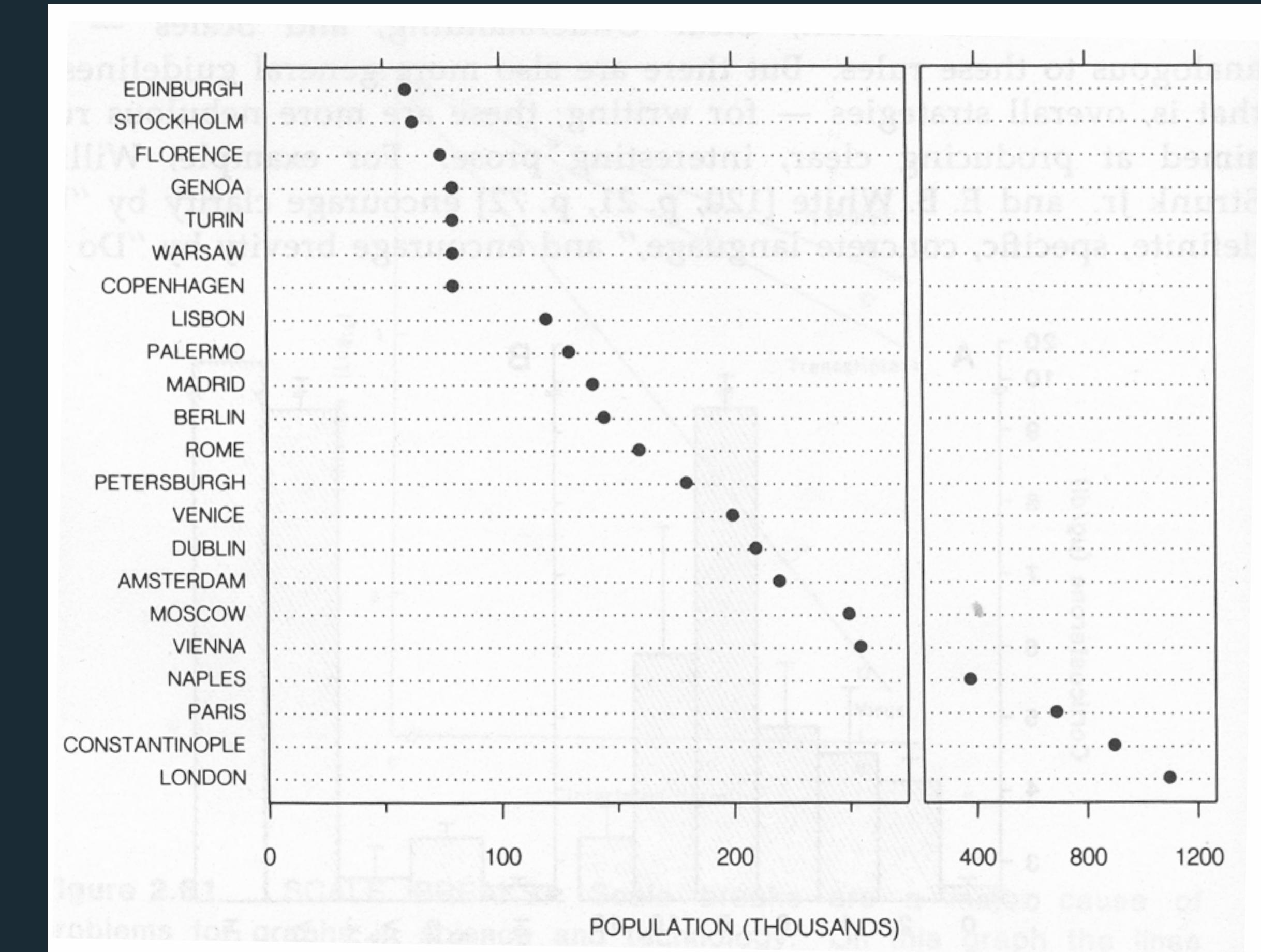
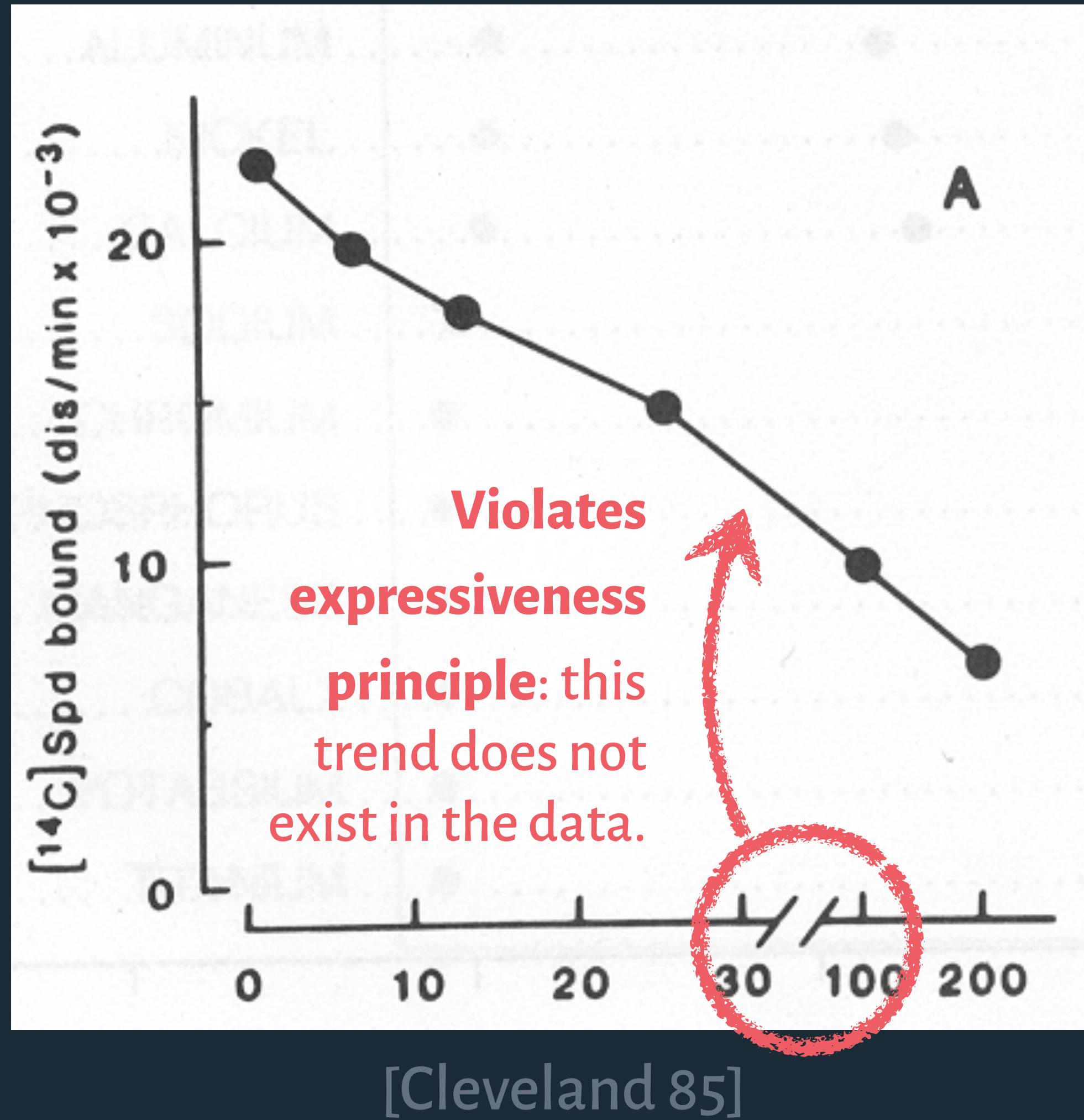


Scaling Axes: Outliers & Skew

Options:

1. Clip them out.
2. Scale Breaks

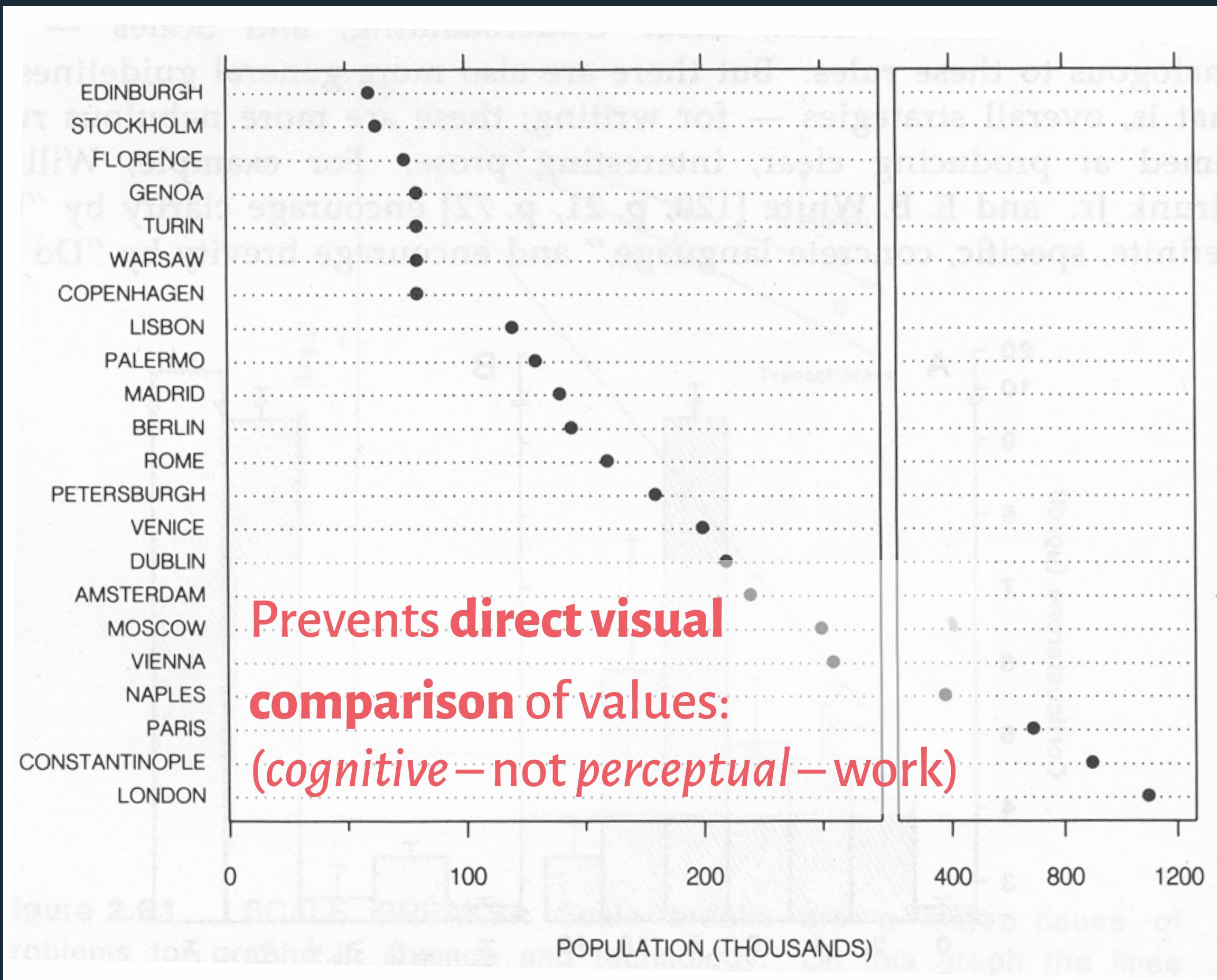
3. Log Scales



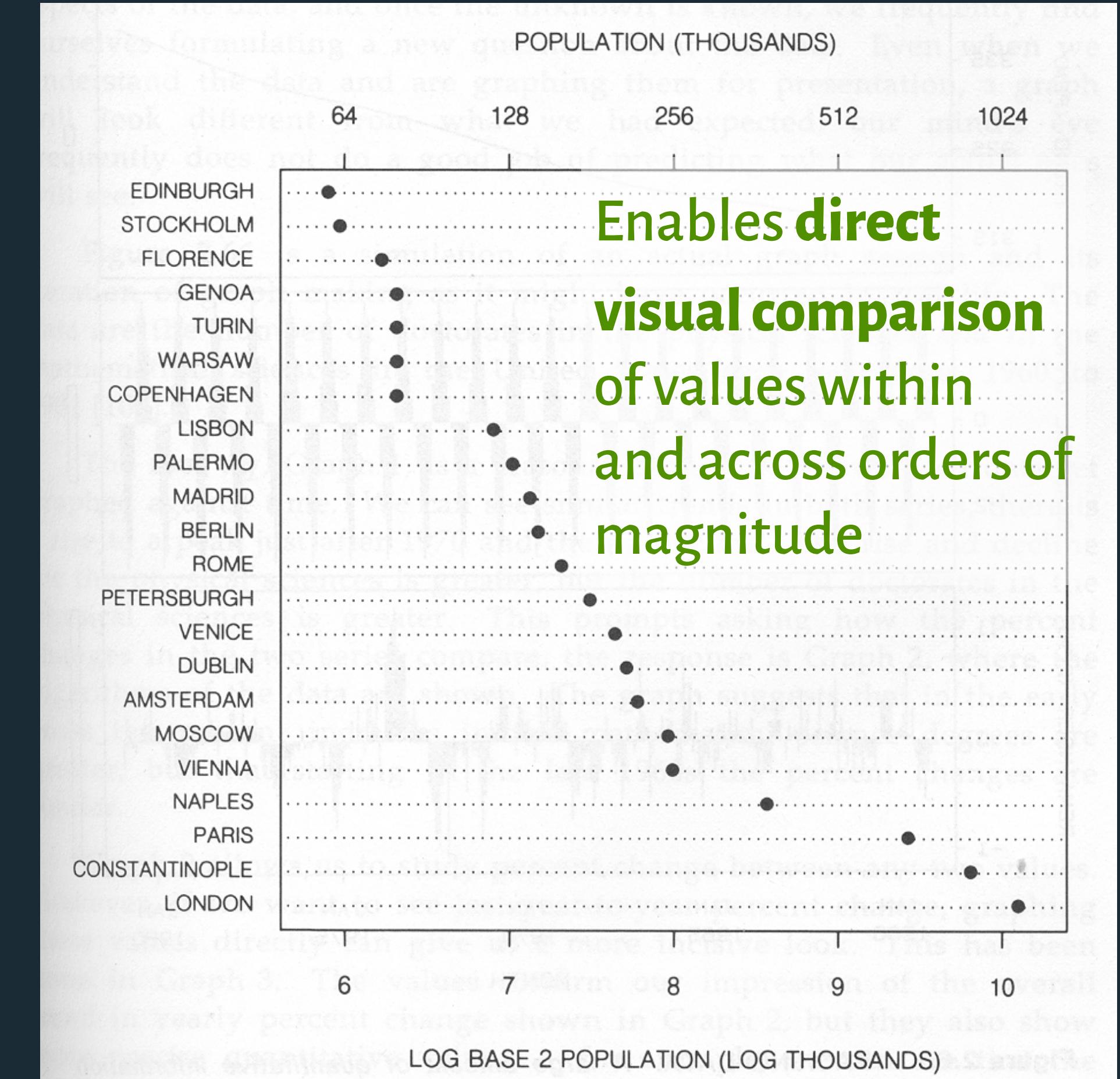
Scaling Axes: Outliers & Skew

Options:

1. Clip them out.
2. Scale Breaks
3. Log Scales



[Cleveland 85]

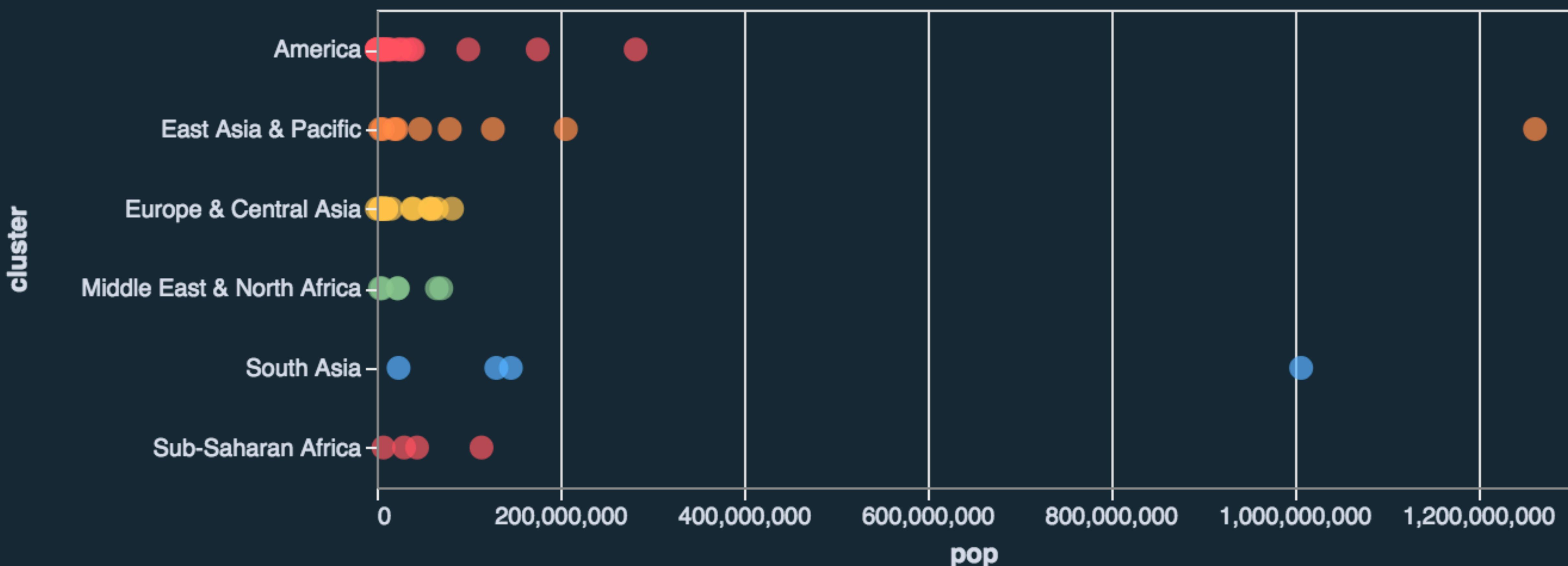


[Cleveland 85]

Scaling Axes: Outliers & Skew

Options:

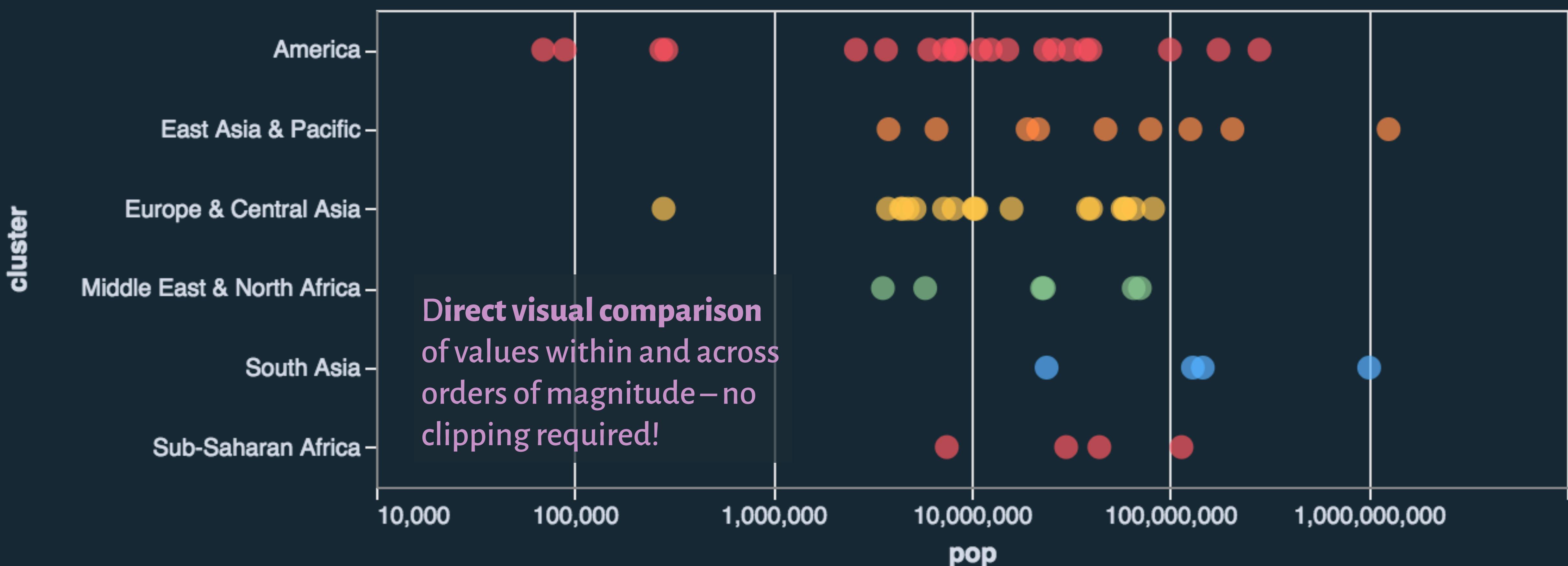
1. Clip them out.
2. Scale Breaks
3. Log Scales



Scaling Axes: Outliers & Skew

Options:

1. Clip them out.
2. Scale Breaks
3. Log Scales



Scaling Axes: Linear vs. Log

Linear Scale

Absolute change

10 visual units (pixels) = 10 additional data units



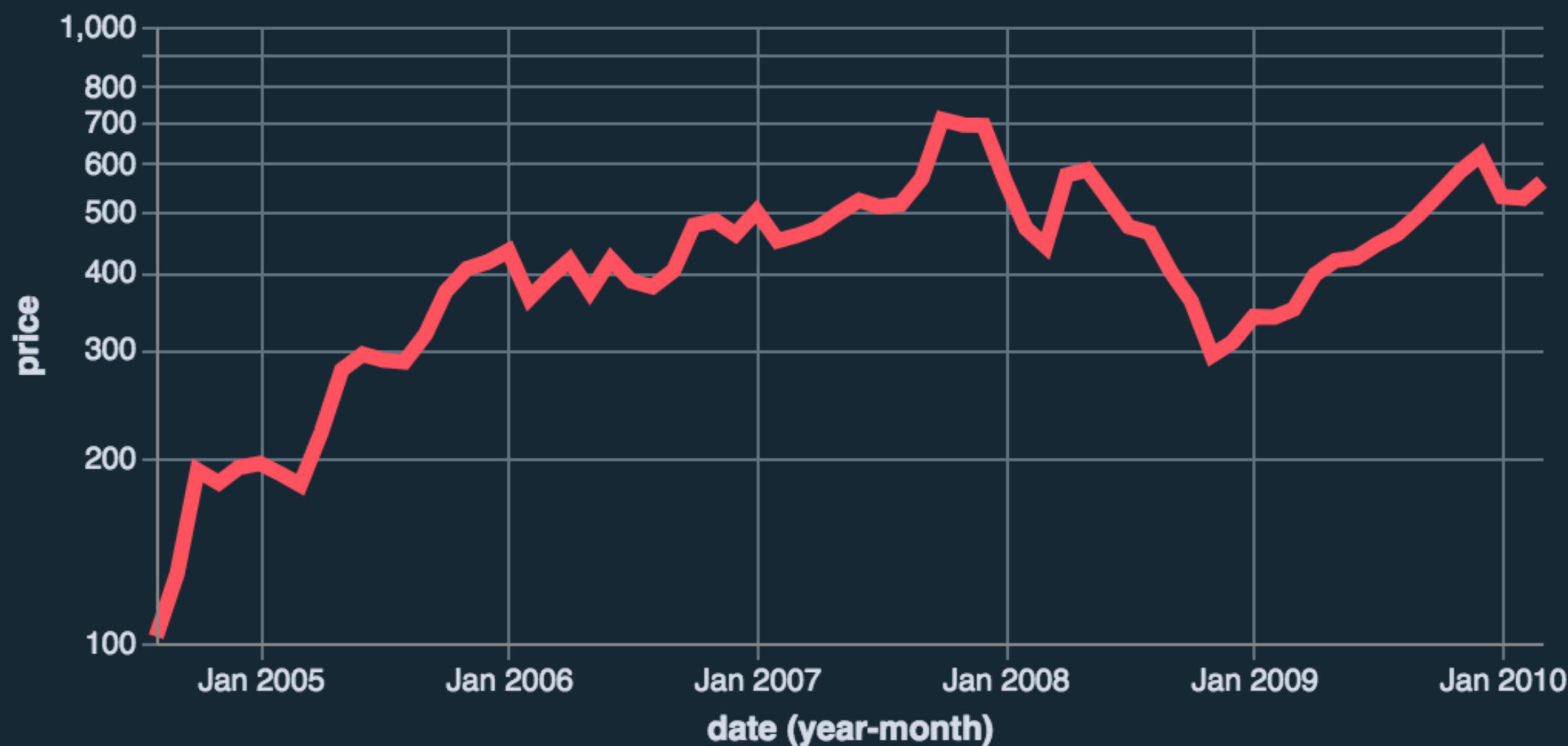
Log Scale

Percentage change

10 visual units = multiplication of 10 data units

$$\log(u) + \log(v) = \log(u*v)$$

$$d(100, 200) = d(300, 600)$$



Scaling Axes: Linear vs. Log

Log Scale

Percentage change

10 visual units = multiplication of 10 data units

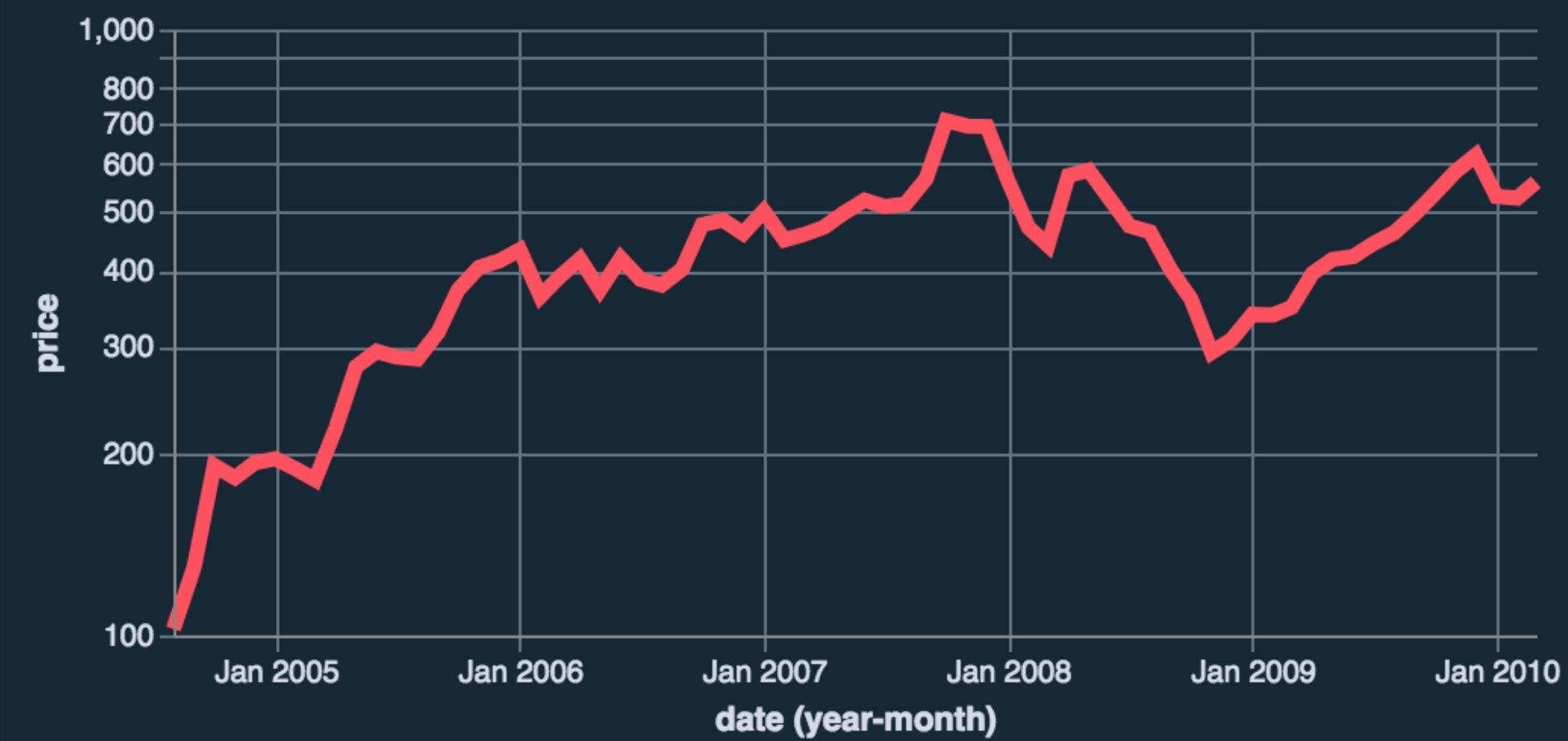
$$\log(u) + \log(v) = \log(u*v)$$

$$d(100, 200) = d(300, 600)$$

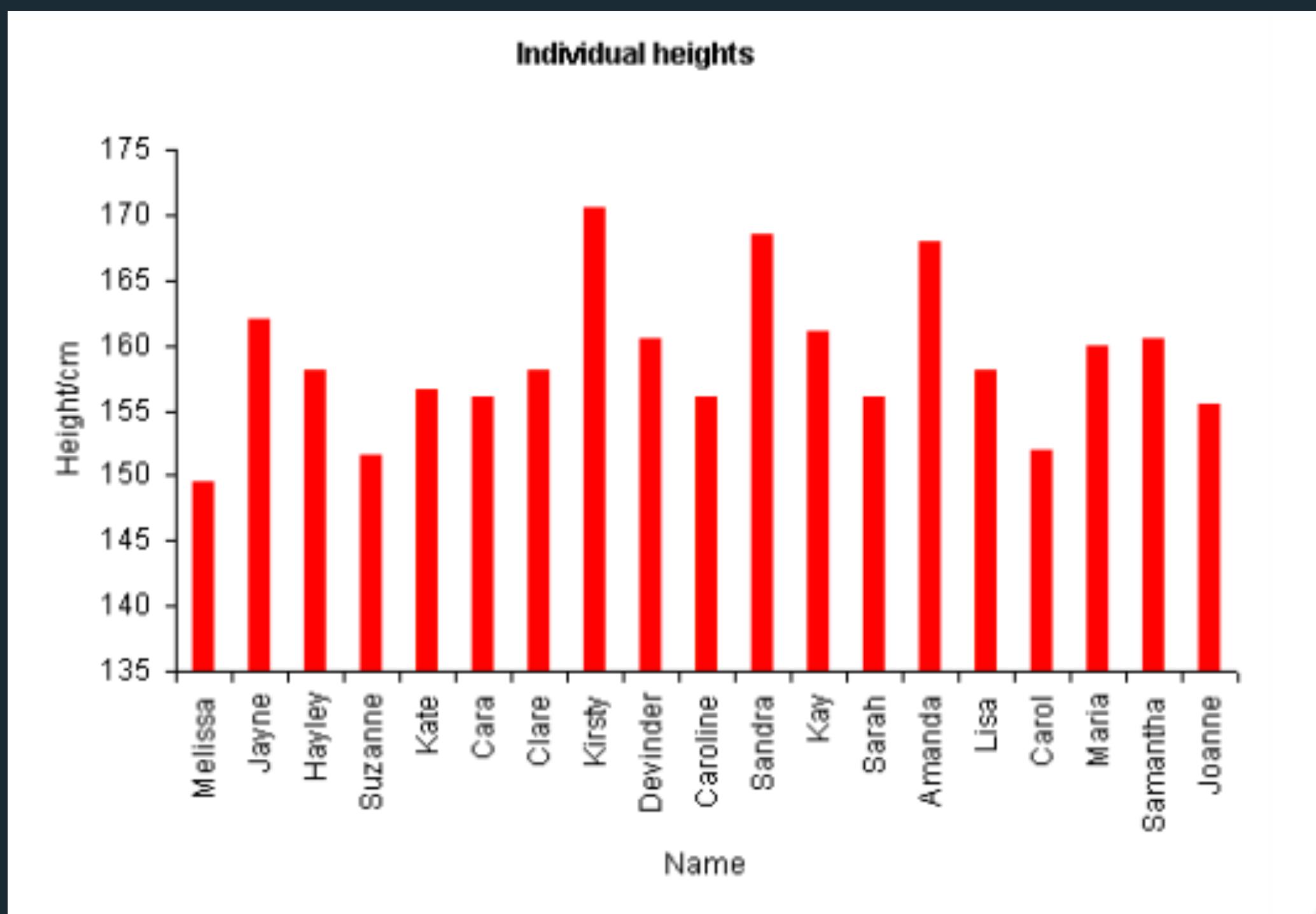
Constraints

Positive, non-zero values

Audience familiarity?

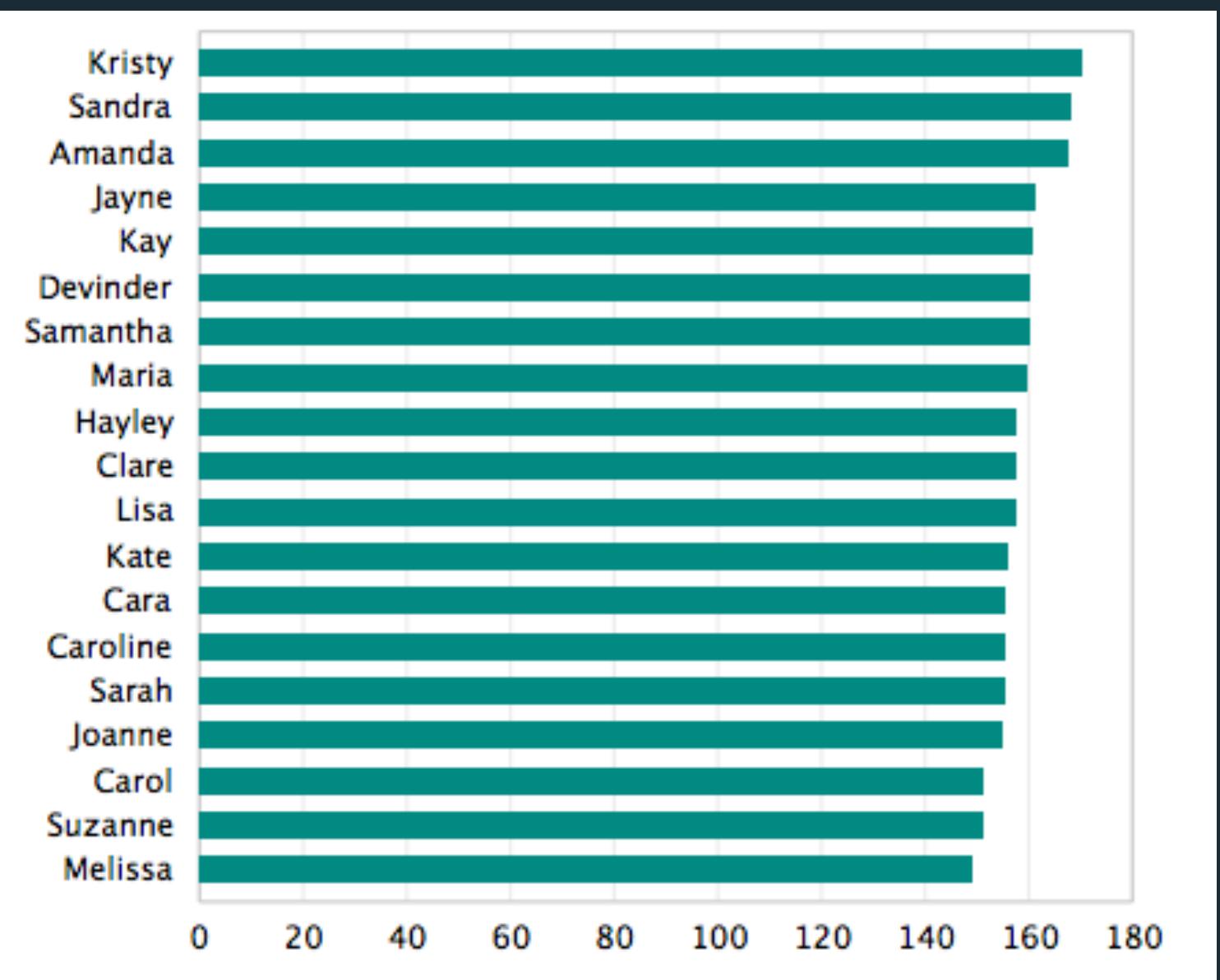


Scaling Axes: Zero Baseline?

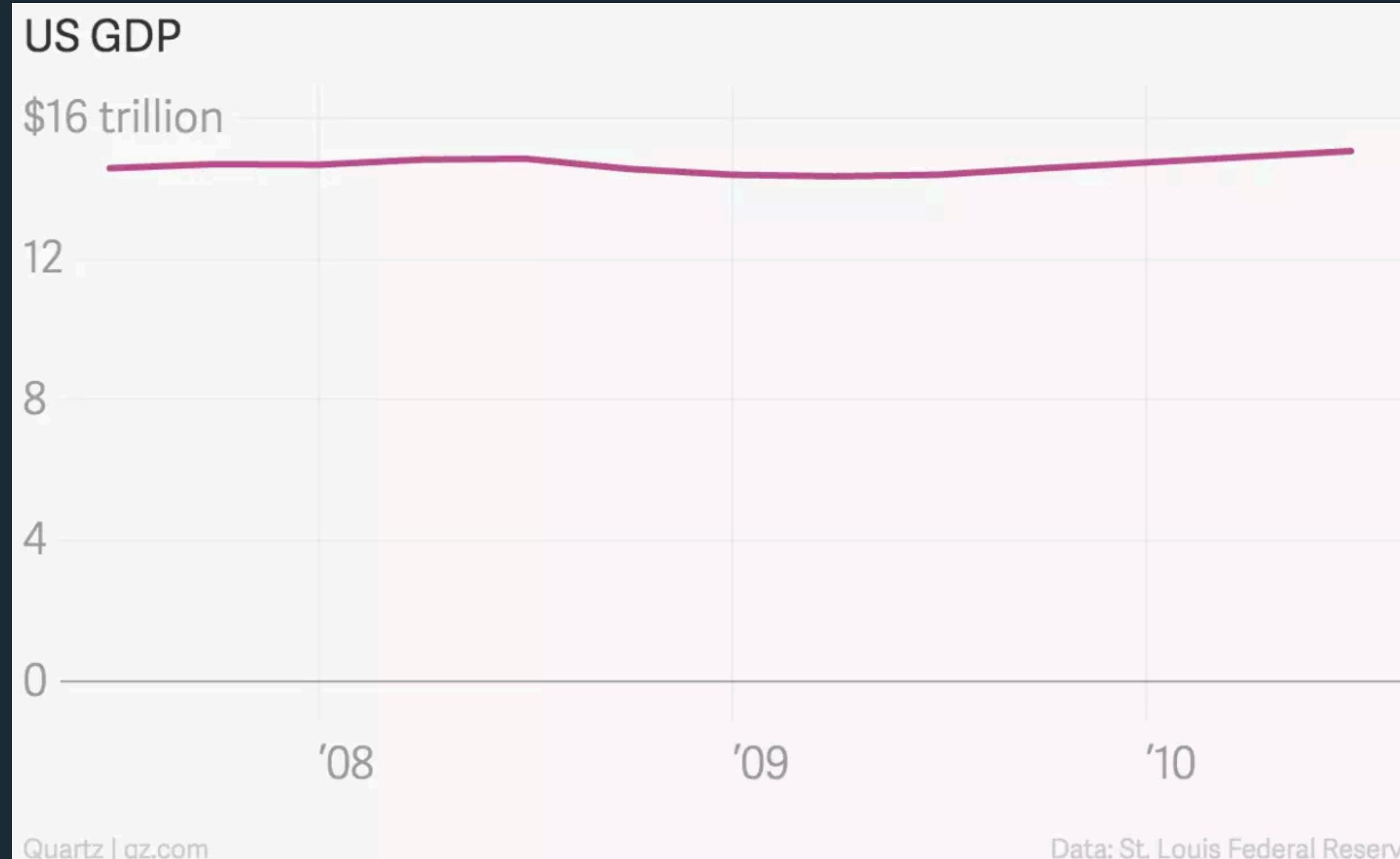


Compare proportions
(Q-Ratio)

Compare relative positions
(Q-Interval)



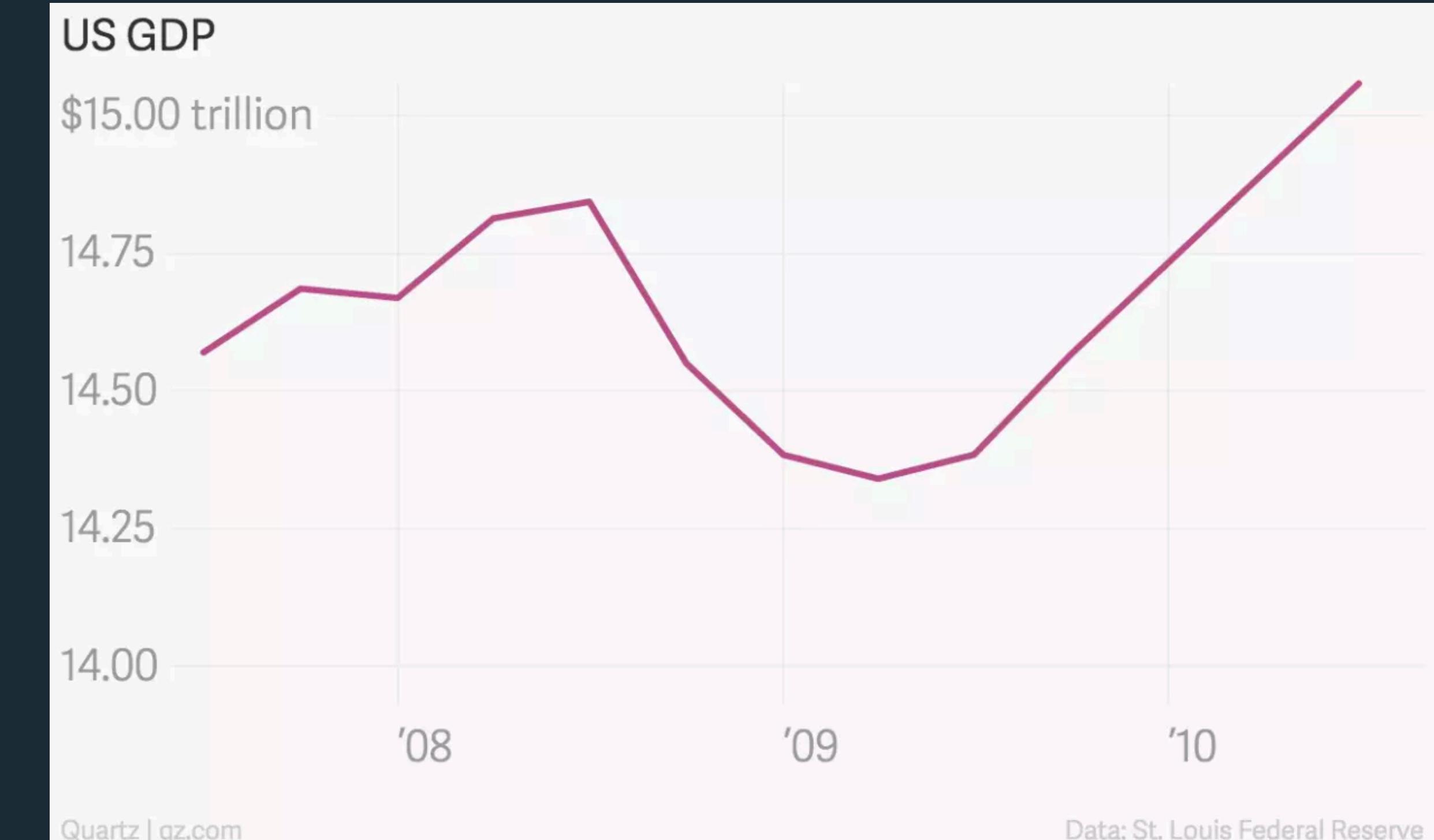
Scaling Axes: Zero Baseline?



David Yanofsky. Quartz, 2015.

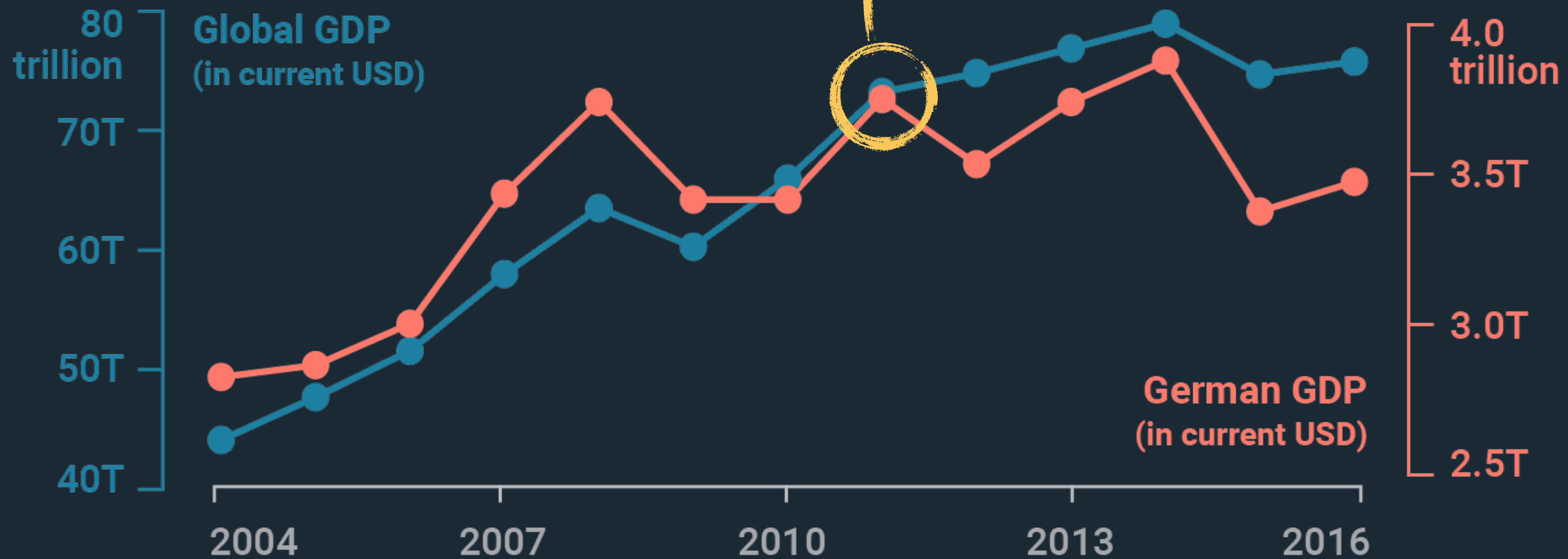
Truncate the y-axis:

- If the zero value doesn't make much sense.
- To emphasize Q-interval (vs. Q-ratio) comparisons.
- If it is the norm (e.g., stock charts).



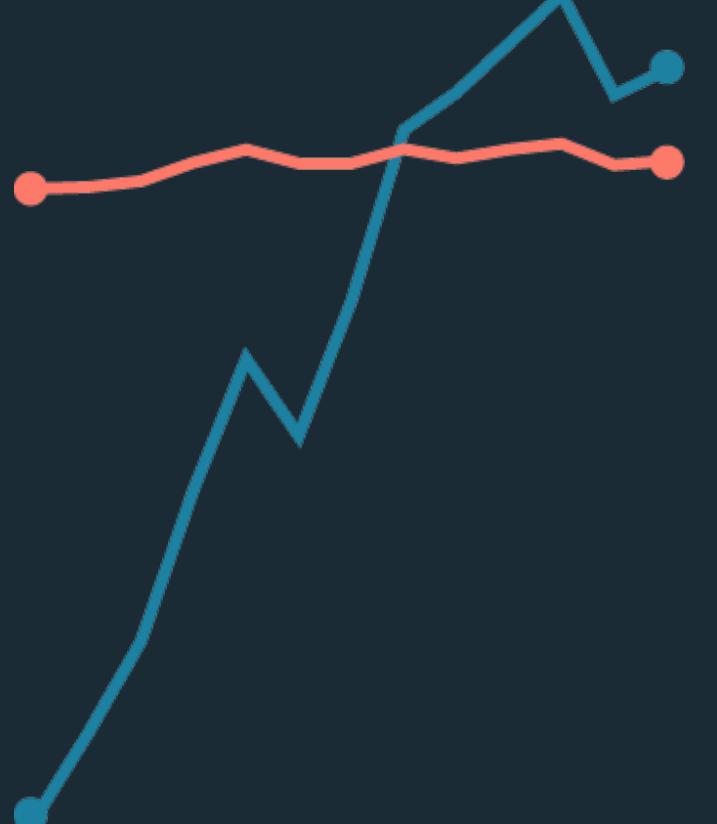
Dual Axes Charts

German and
world GDP were
equal in 2011??

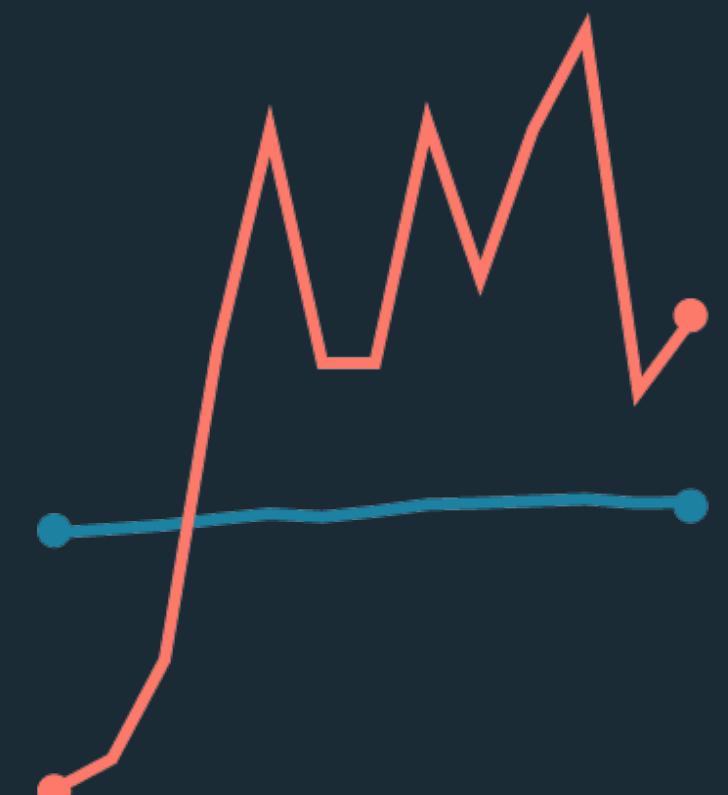


Lisa Charlotte Rost. DataWrapper, May 2018.

Dual Axes Charts



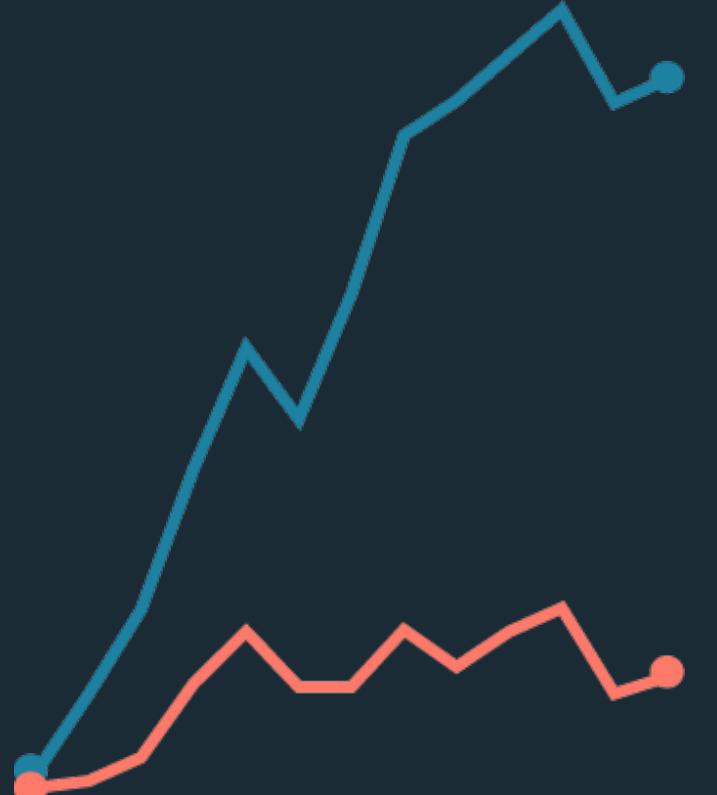
Orange steady,
Blue massively increasing.



Blue steady,
Orange increasing.



Both started at the same
level, but Orange increased
far more than Blue.



Both started at the same
level, but Blue increased far
more than Orange.

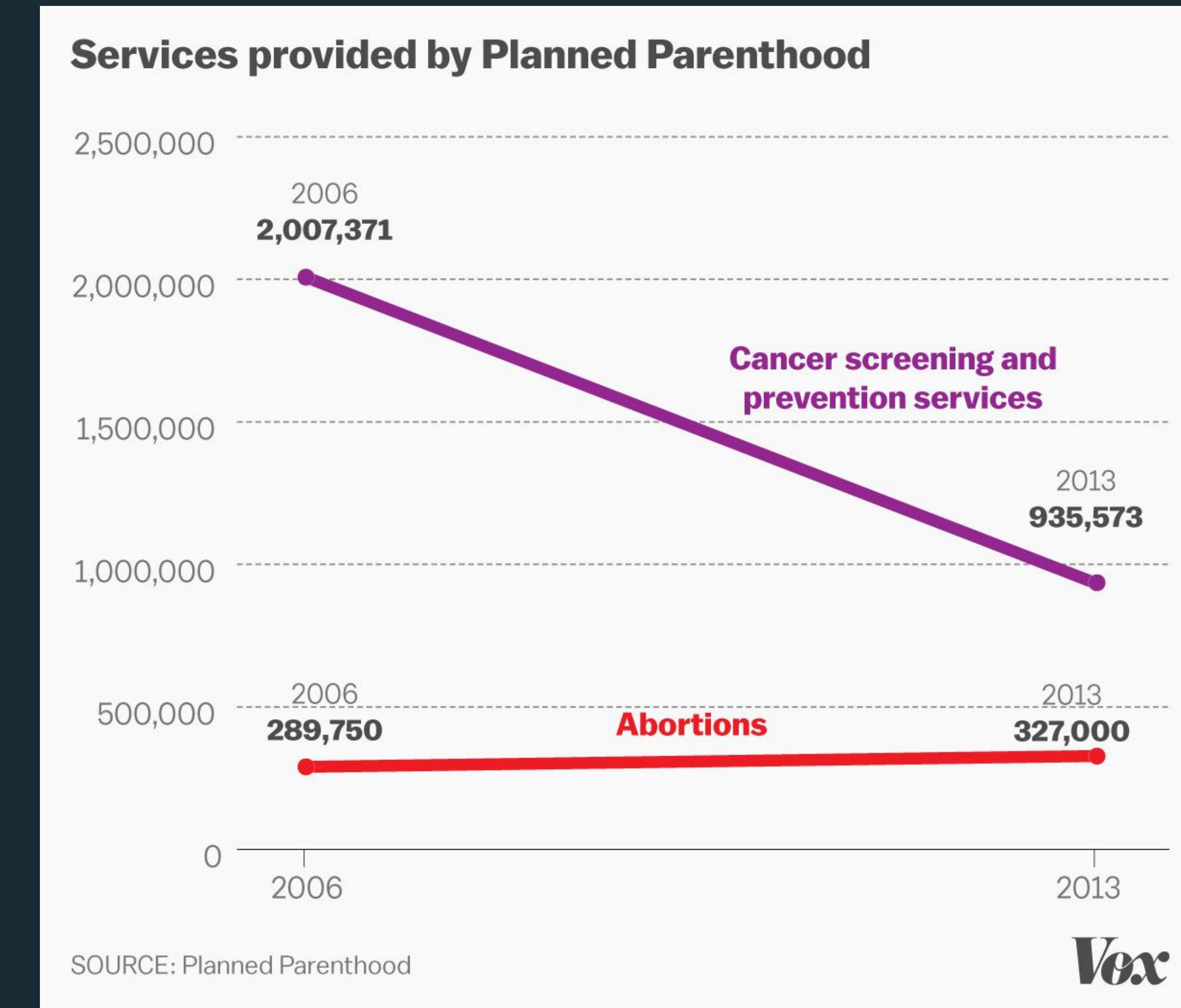
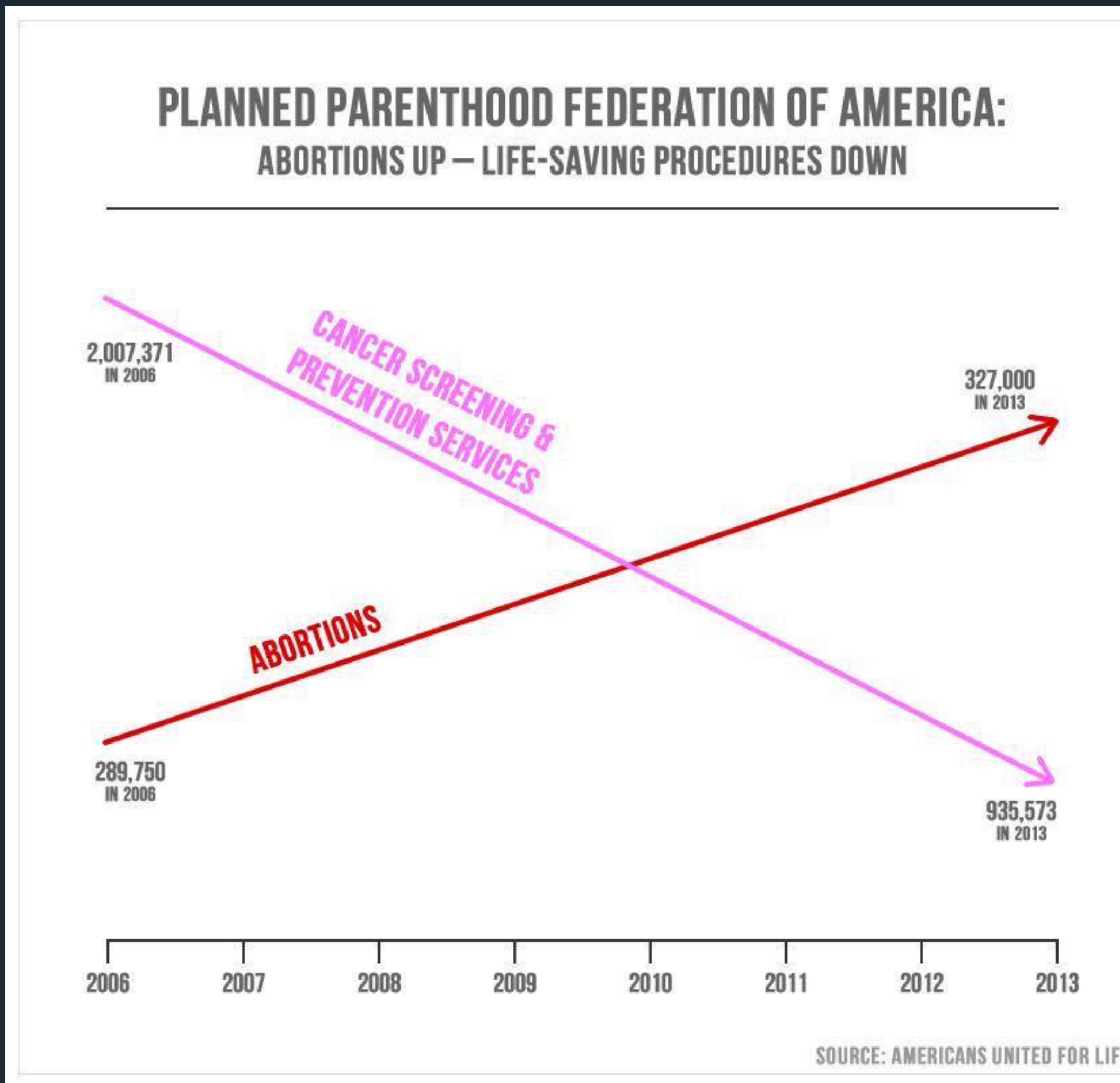


Both started with the
same increase, then Blue
raced to the top.

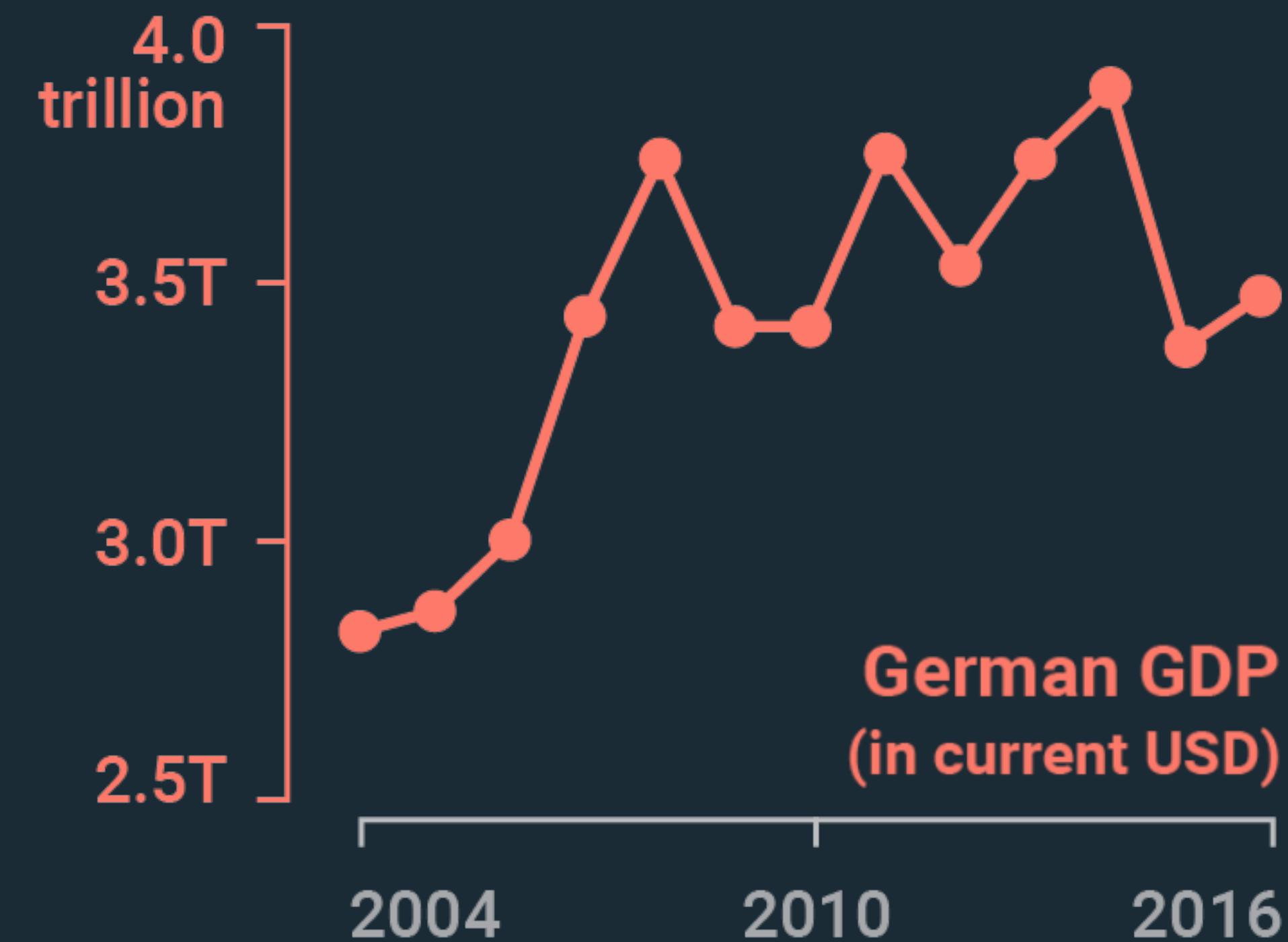
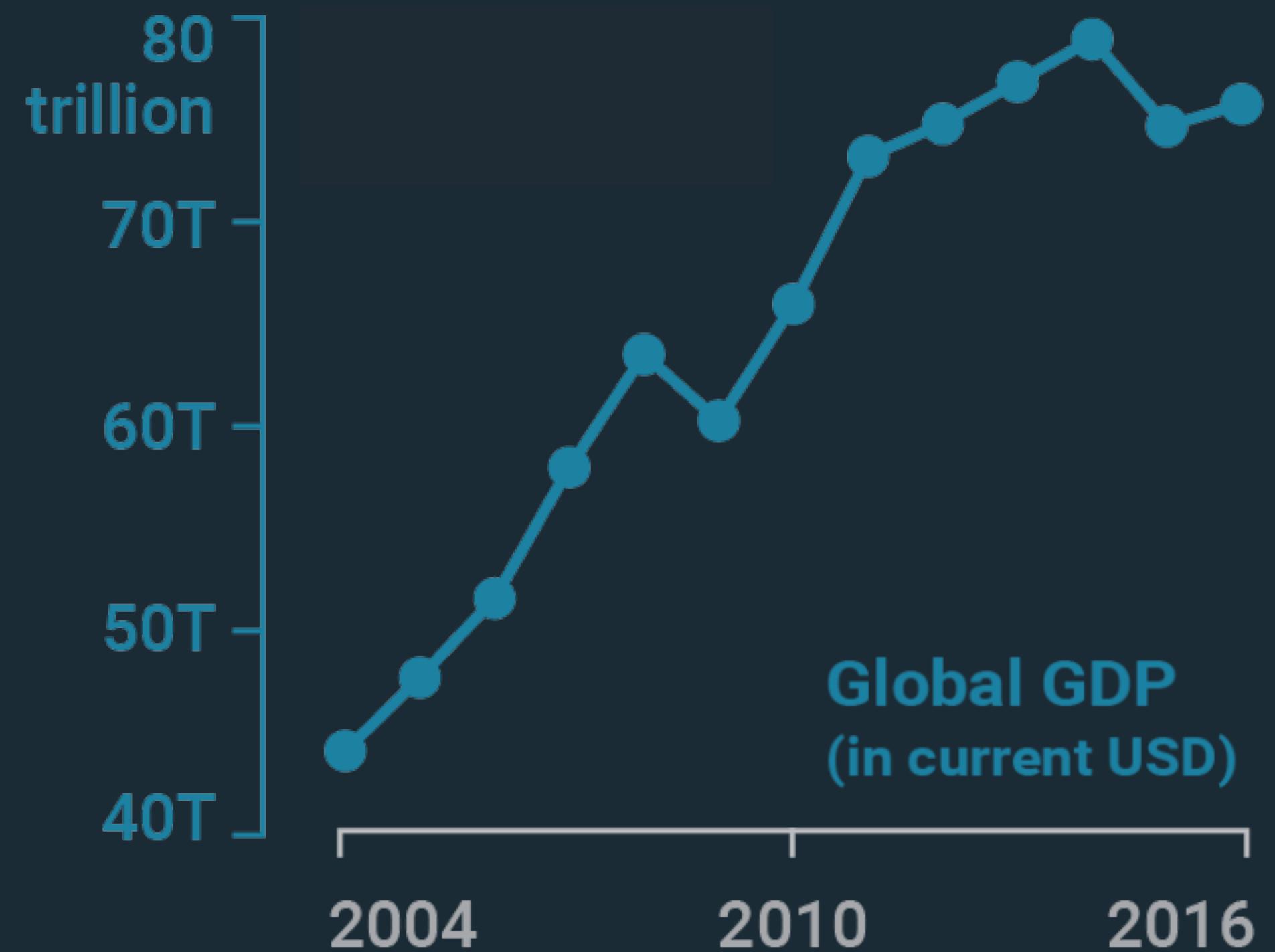


Both steady.

Dual Axes Charts

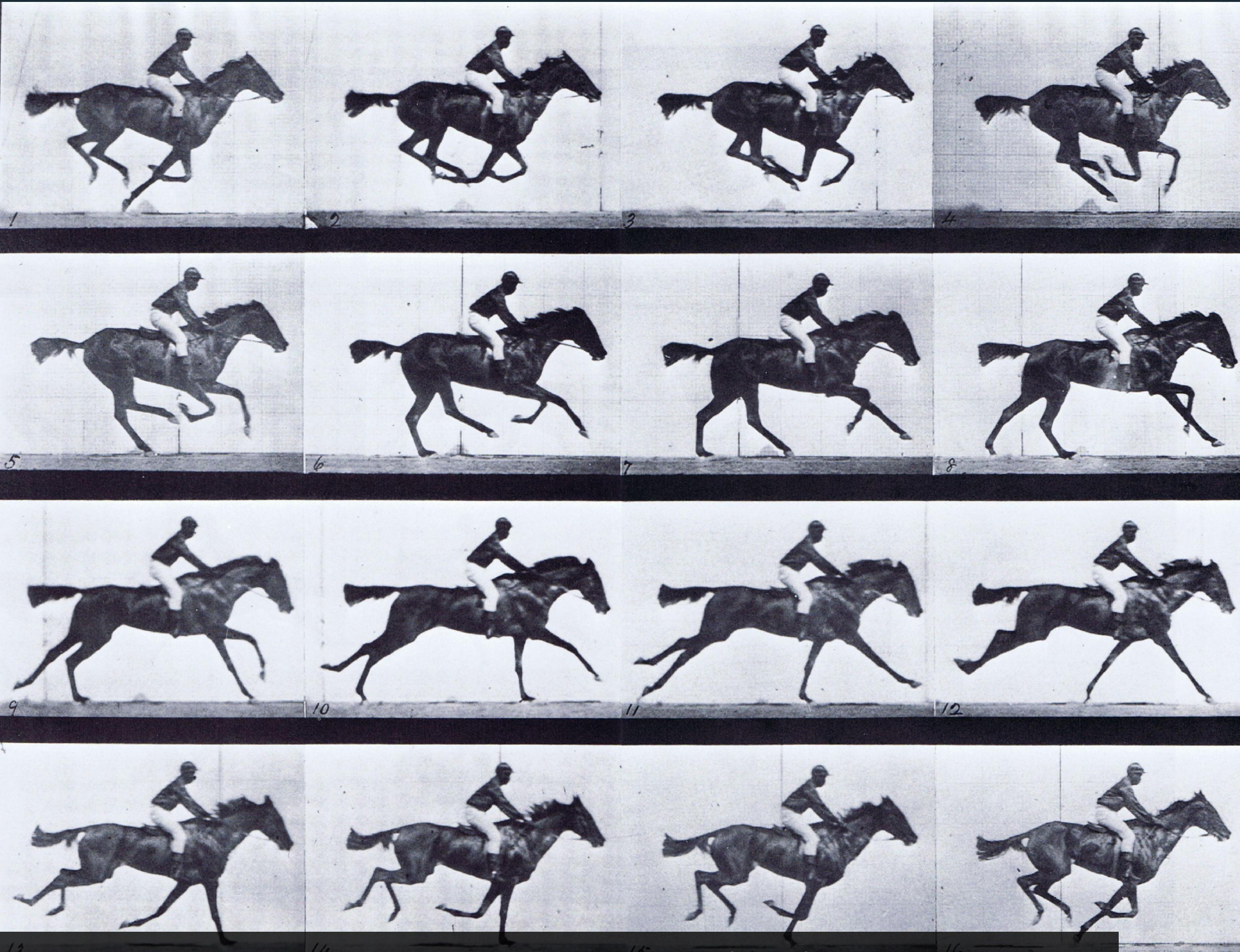


Dual Axes Charts



Lisa Charlotte Rost. *DataWrapper*, May 2018.

Small Multiples



Gallop, Bay Horse "Daisy", Muybridge. (1884-86)

Small Multiples

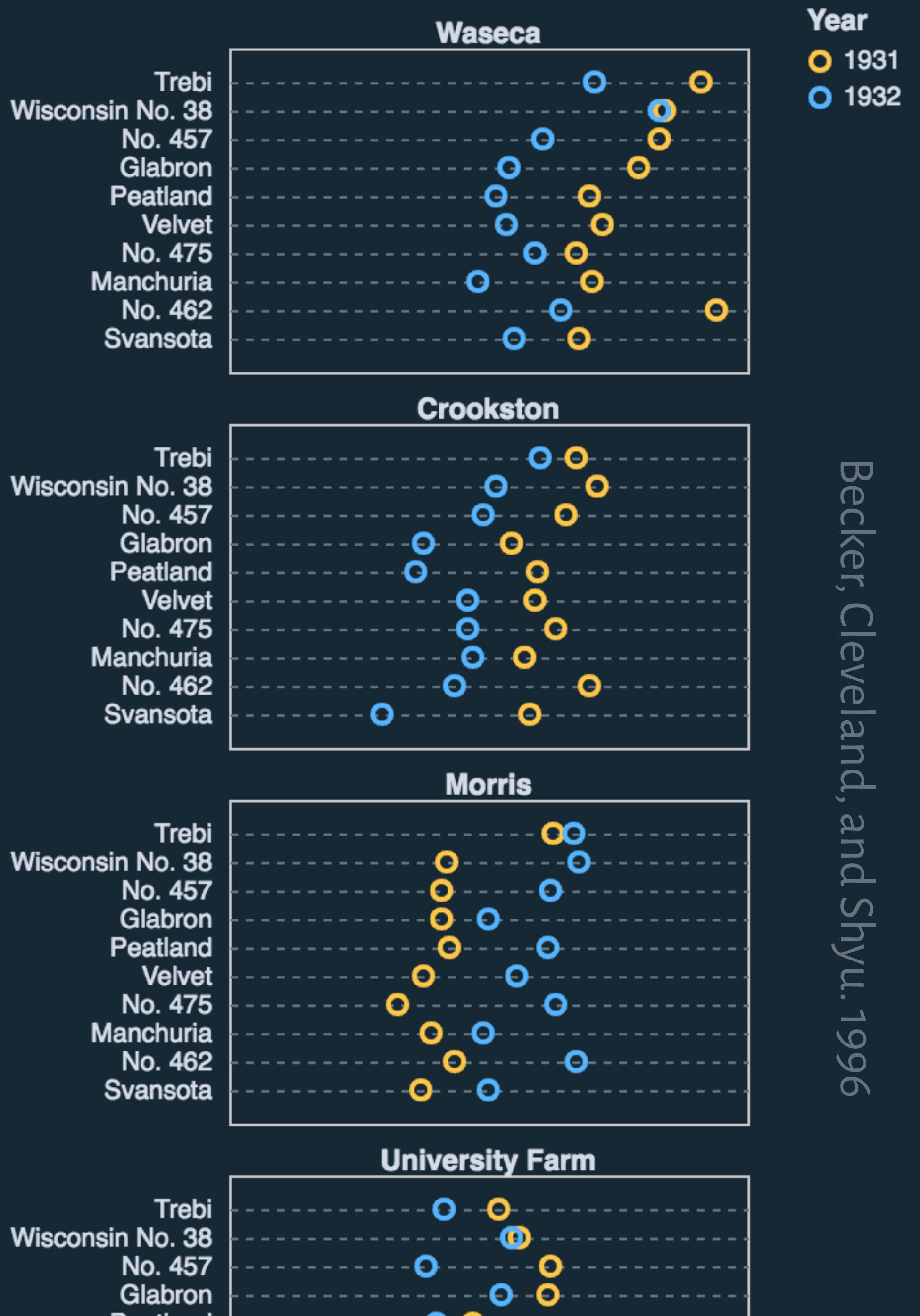


[MacEachren '95, Figure 2.11, p. 38]

Trellis Plots

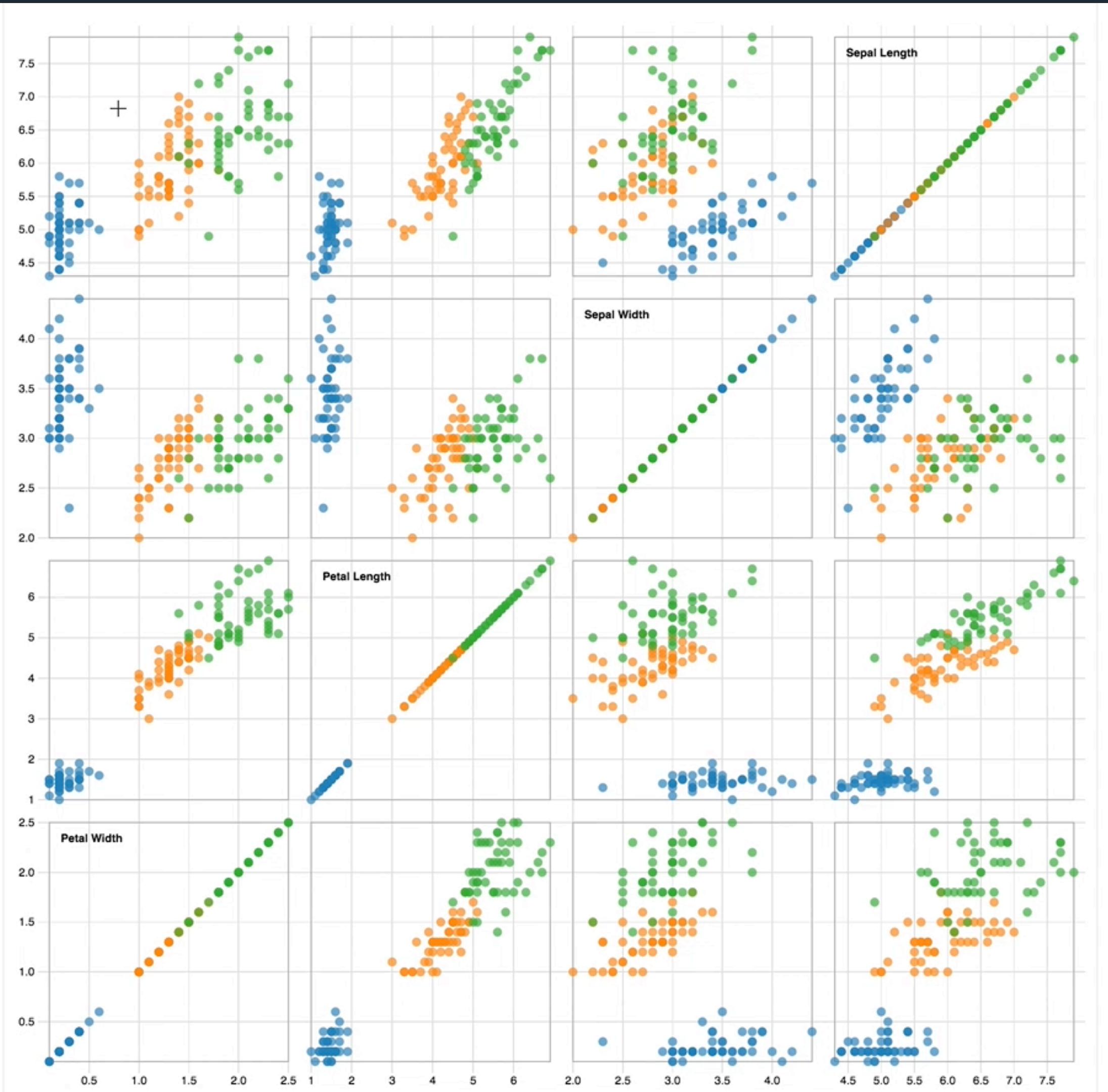
Subdivide space to enable comparison across multiple plots.

Typically nominal or ordinal variables are used as dimensions for subdivision.



Becker, Cleveland, and Shyu. 1996

Small Multiples: Scatterplot Matrix



Scatter plots for pairwise comparison of each data dimension.

Mike Bostock, November 2018.

Data-Ink Ratio

$$= \frac{\text{Data ink}}{\text{Total ink use in graphic}}$$

= Proportion of a graphic's ink devoted to non-redundant display of data.

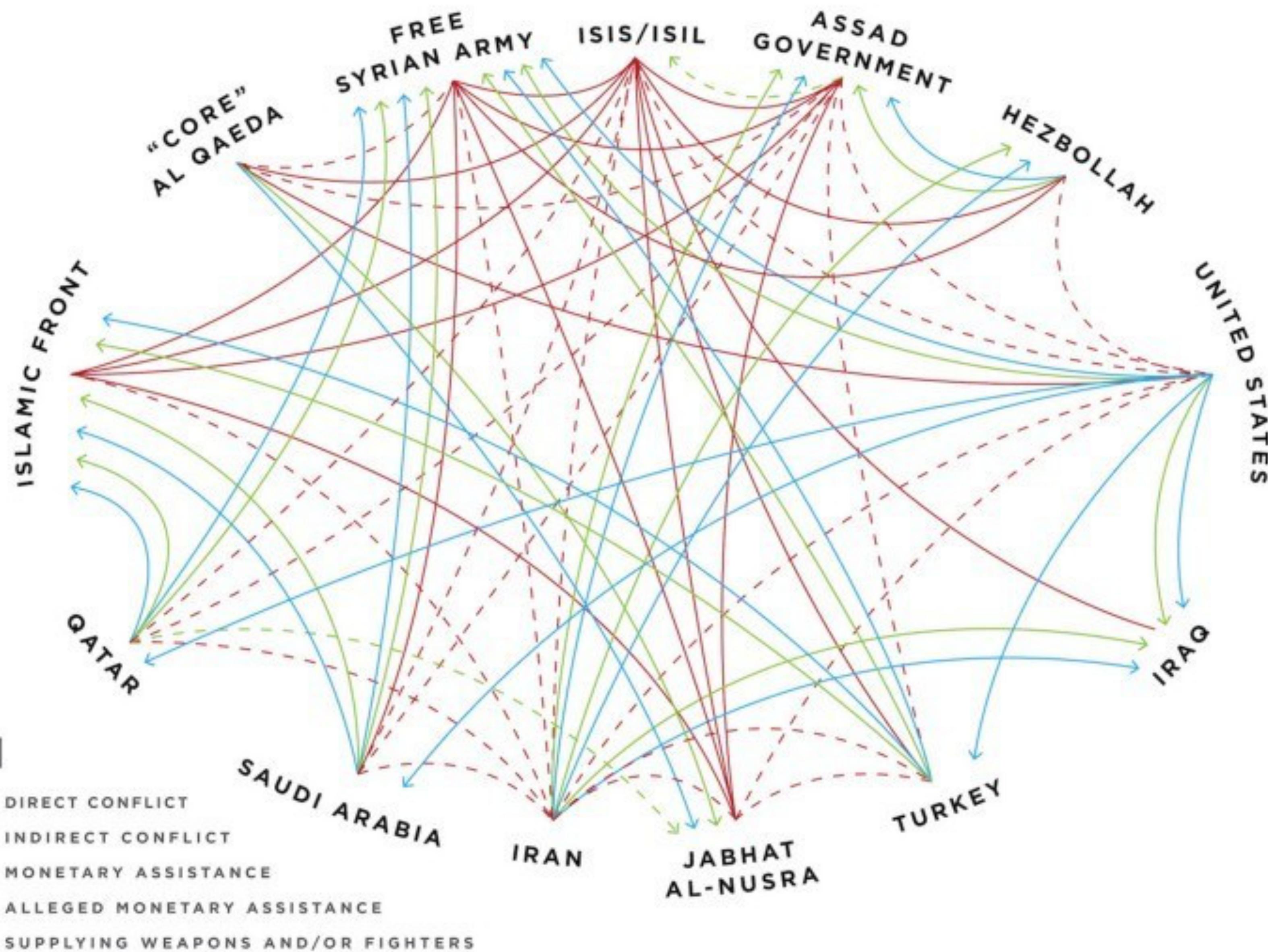
= 1.0 – proportion of graphic that can be erased.

Remove
to improve
(the **data-ink** ratio)

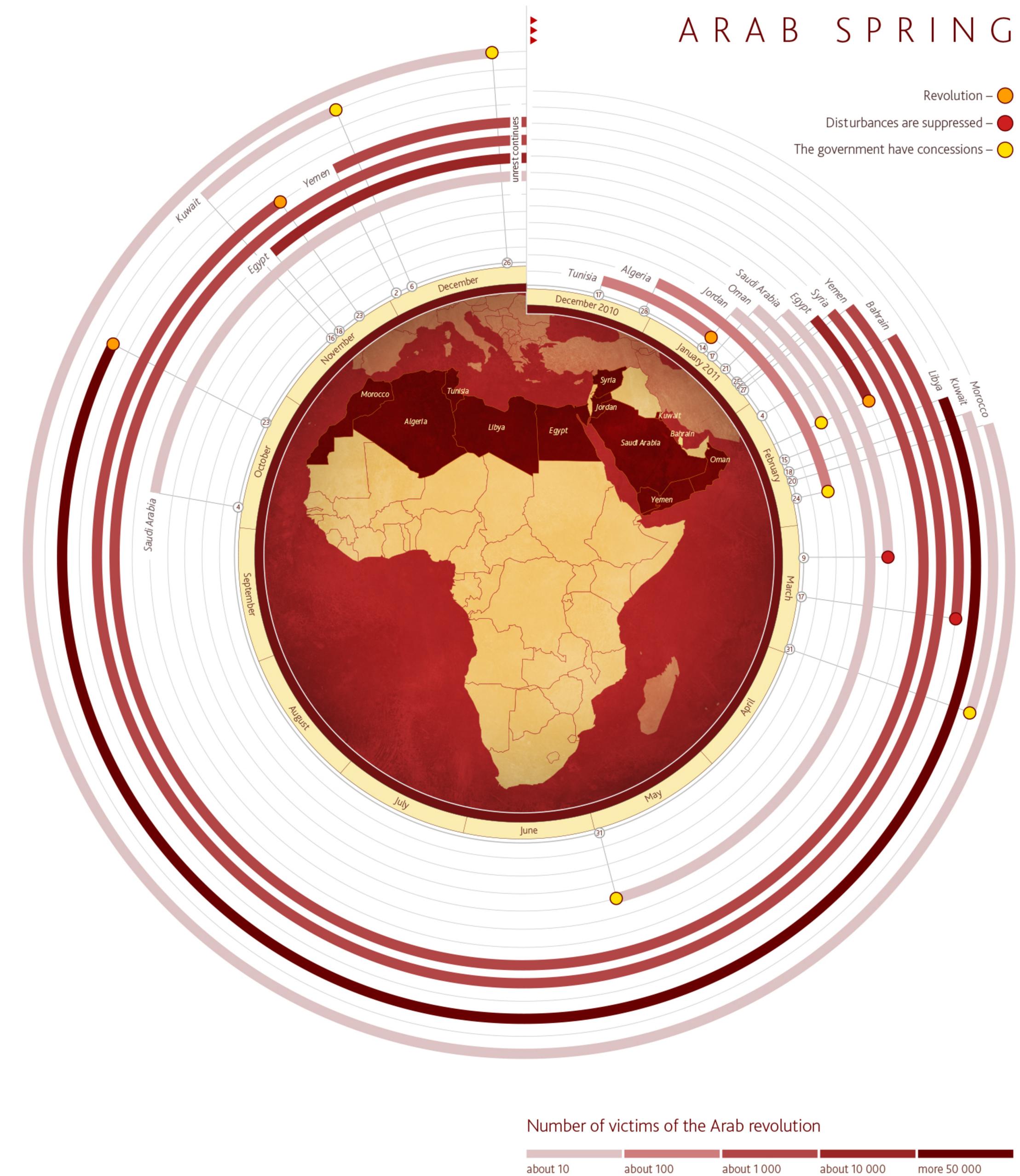
Remove
to improve
(the **data-ink** ratio)

Redesign Exercise

THE TANGLED WEB IN THE FIGHT FOR SYRIA'S FUTURE



ARAB SPRING

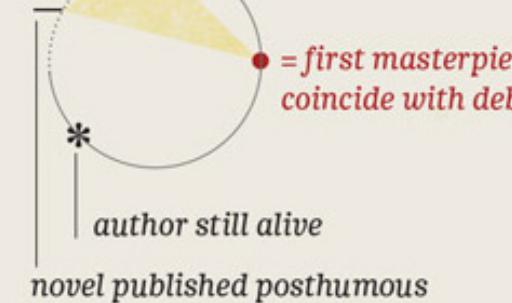
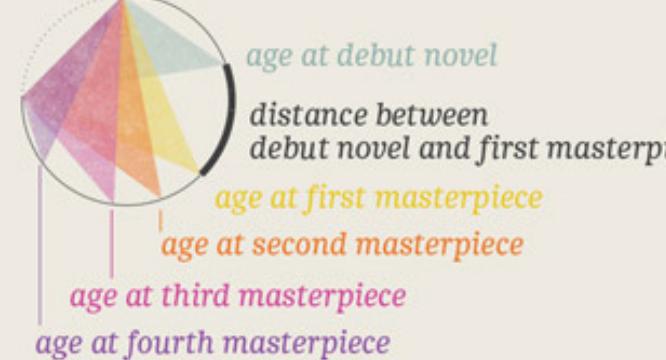
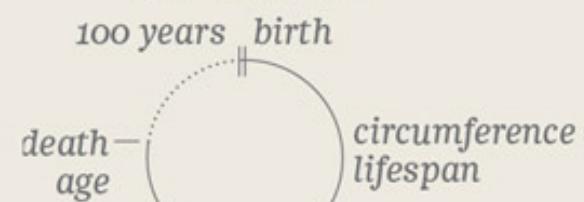


How to read it

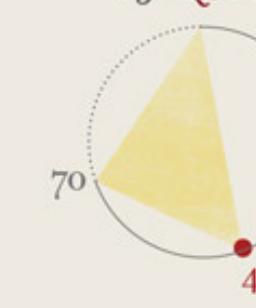
Authors are ordered from the earliest success to the last one.

colour:
Asia, North America,
Europe, South America

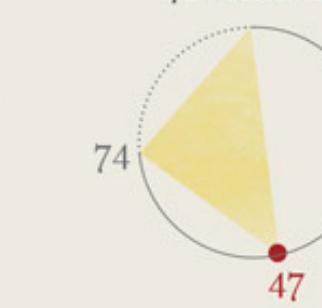
Author name
85 - Hometown
100 years birth



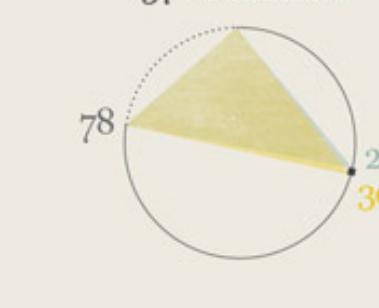
John Cheever
63 - Quincy



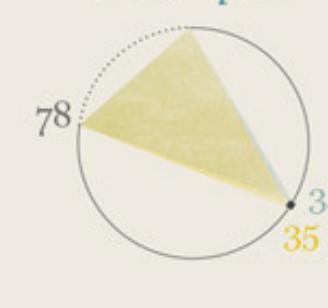
James Dickey
42 - Atlanta



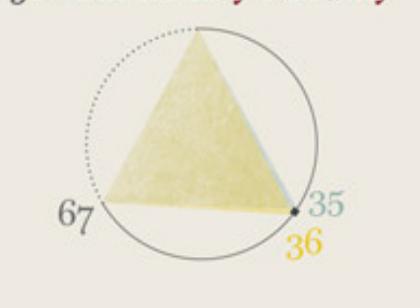
Thornton Wilder
37 - Madison



Arthur Koestler
8 - Budapest



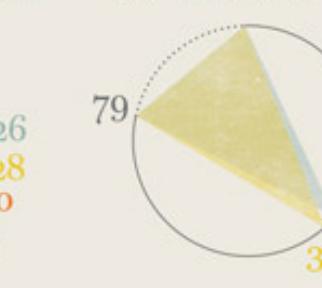
Dashiell Hammett
56 - Saint Mary's County



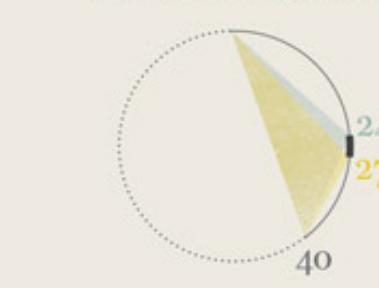
David H. Lawrence
9, 48, 49 - Eastwood



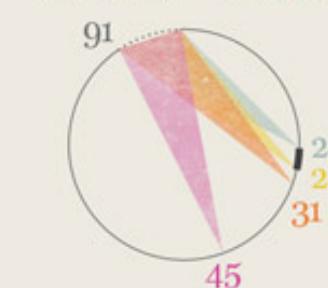
John Fowles
93 - Leigh-on-sea



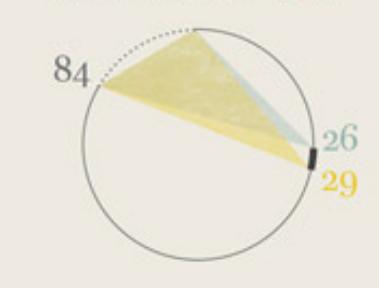
Jack London
88 - San Francisco



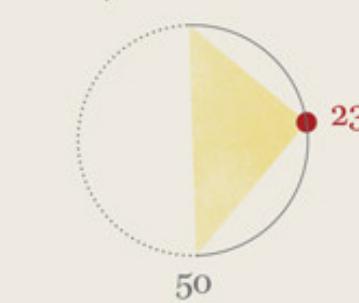
Edward M. Forster
79, 38, 25 - London



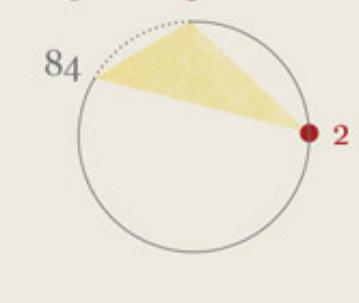
Erskine Caldwell
91 - Coweta County



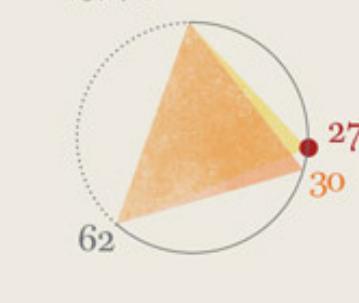
Carson McCullers
17 - Columbus



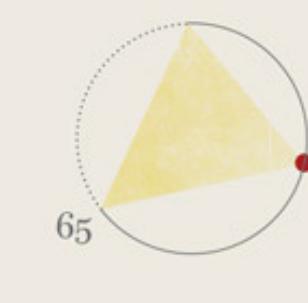
Norman Mailer
51 - Long Branch



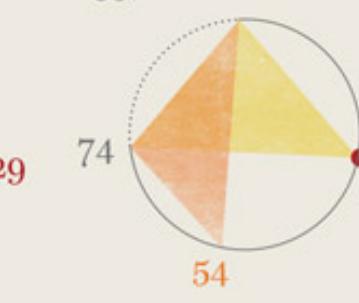
Ernest Hemingway
45, 74 - Oak Park



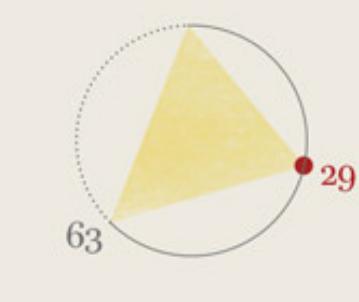
John O'Hara
22 - Princeton



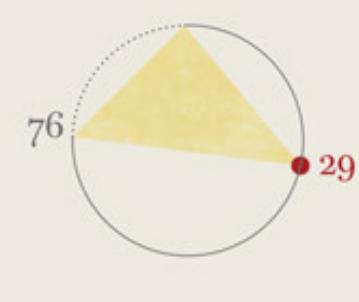
Theodore Dreiser
33, 16 - Terre Haute



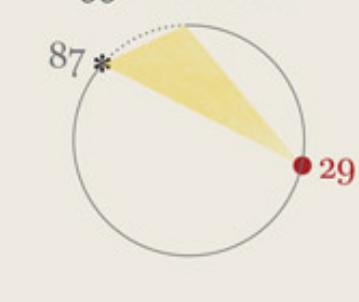
James Baldwin
20 - New York



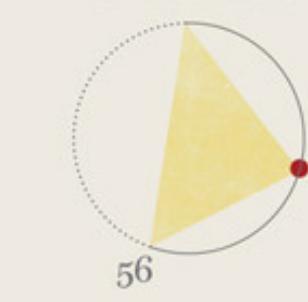
Richard Hughes
71 - Wenvrider



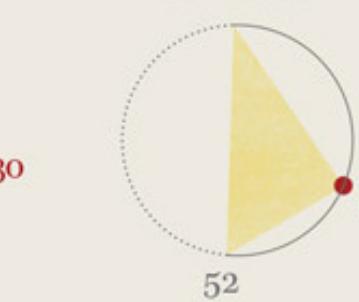
nes P. Donleavy
99 - New York



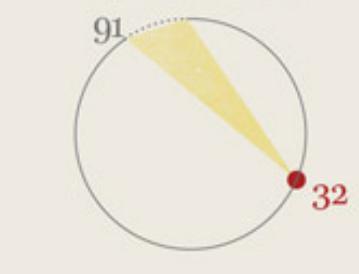
James Jones
62 - Robinson



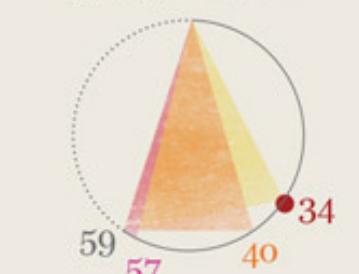
Richard Wright
20 - Roxie



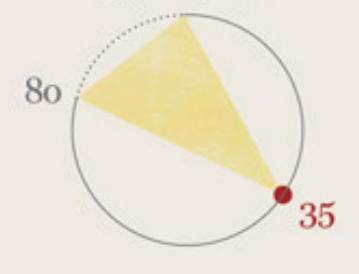
Jerome D. Salinger
64 - New York



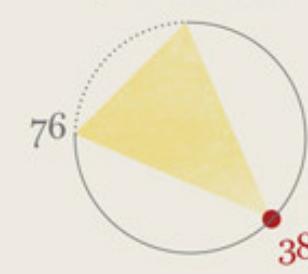
James Joyce
3, 1, 77 - Dublin



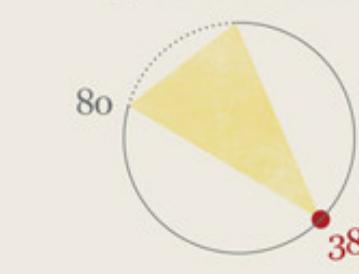
Iris Murdoch
95 - Dublin



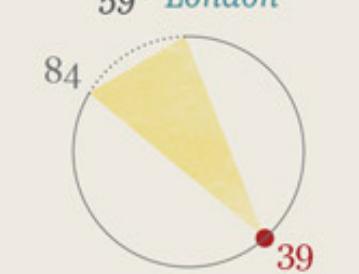
Joseph Heller
7 - New York



Ralph Ellison
19 - Oklahoma City



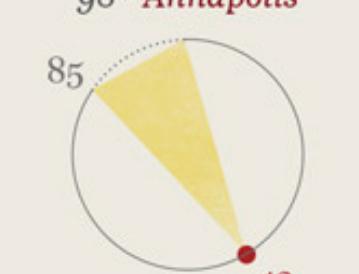
Max Beerbohm
59 - London



Paul Bowles
97 - New York



James M. Cain
98 - Annapolis



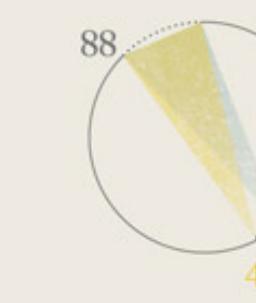
William Golding
41 - Newquay



Walker Percy
60 - Birmingham



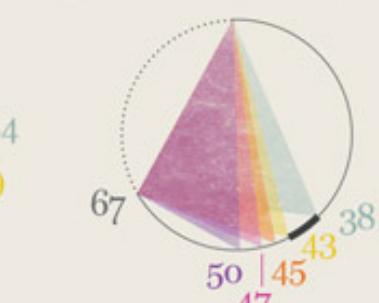
Muriel Spark
76 - Edinburgh



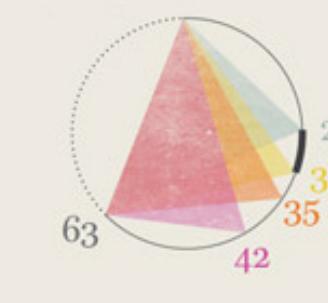
Francis S. Fitzgerald
2, 28 - Saint Paul



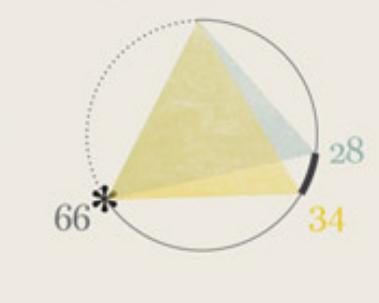
Joseph Conrad
85, 67, 47, 46 - Berdychiv



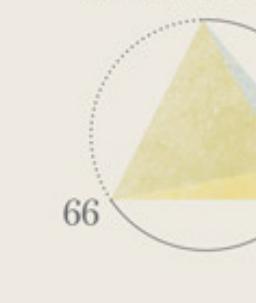
Evelyn Waugh
34, 75, 80 - London



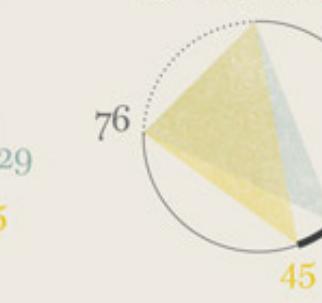
Salman Rushdie
90 - Bombay



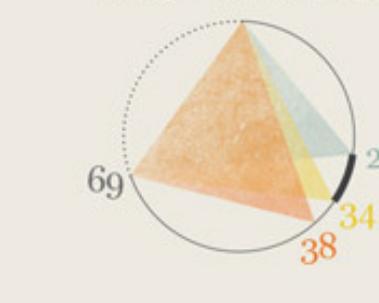
Sinclair Lewis
68 - Sauk Centre



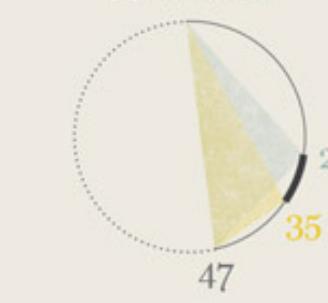
Anthony Burgess
65 - Manchester



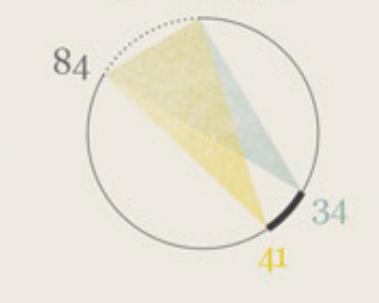
Aldous Huxley
44, 5 - Godalming



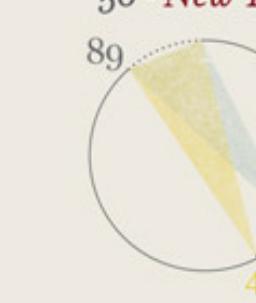
Jack Kerouac
55 - Lowell



Robert P. Warren
36 - Guthrie



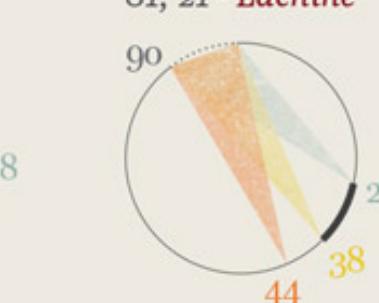
Henry Miller
50 - New York



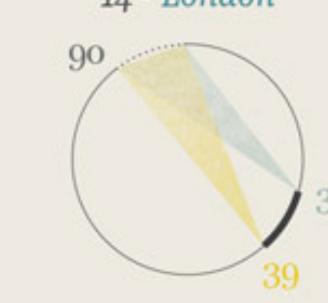
Nathanael West
73 - New York



Saul Bellow
81, 21 - Lachine



Robert Graves
14 - London



Philip Roth
52 - Newark

