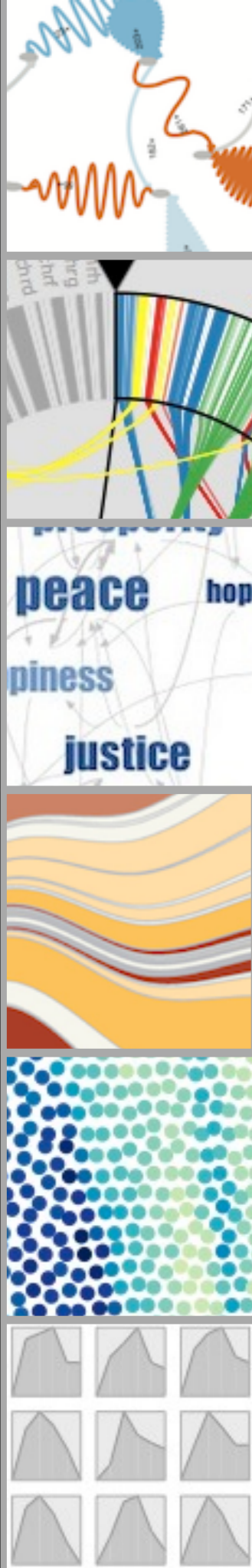


cs6964 | February 7 2012

# VISUAL REPRESENTATIONS

Miriah Meyer  
*University of Utah*

*slide acknowledgements:*  
Tamara Munzner, University of British Columbia



LAST TIME

# THE PANCAKE RECIPE CHALLENGE

*PHASE 3*

administrivia

**feb 14-23** : proposal meetings

**march 7** : presentation topics due

**march 9** : proposals due

**march 27-april 3** : project updates

**april 5-24** : paper presentations

**may 1** : final project presentations

**may 3** : process books due

this is lecture 08. next class is lecture 09.

**-spatial position**

**-visual layering**

**-glyphs**

**-scented widgets & interactive legends**

target



translate



**design**



implement



validate



comments on readings?

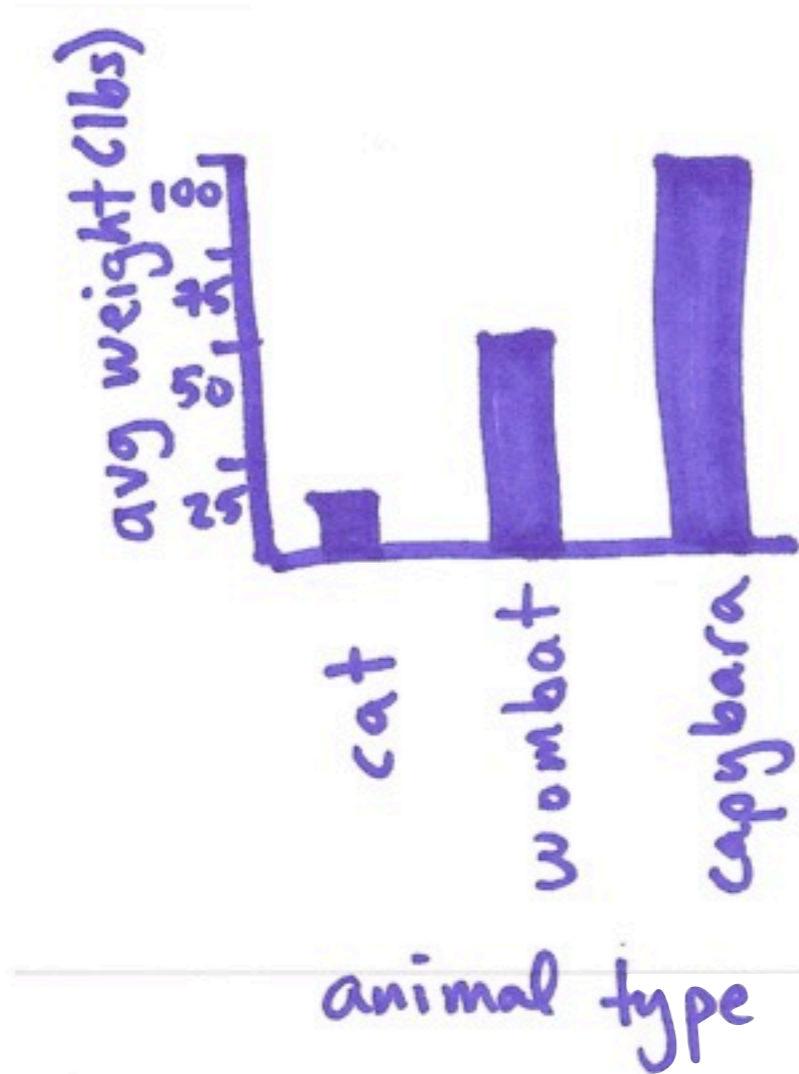
**-spatial position**

-visual layering

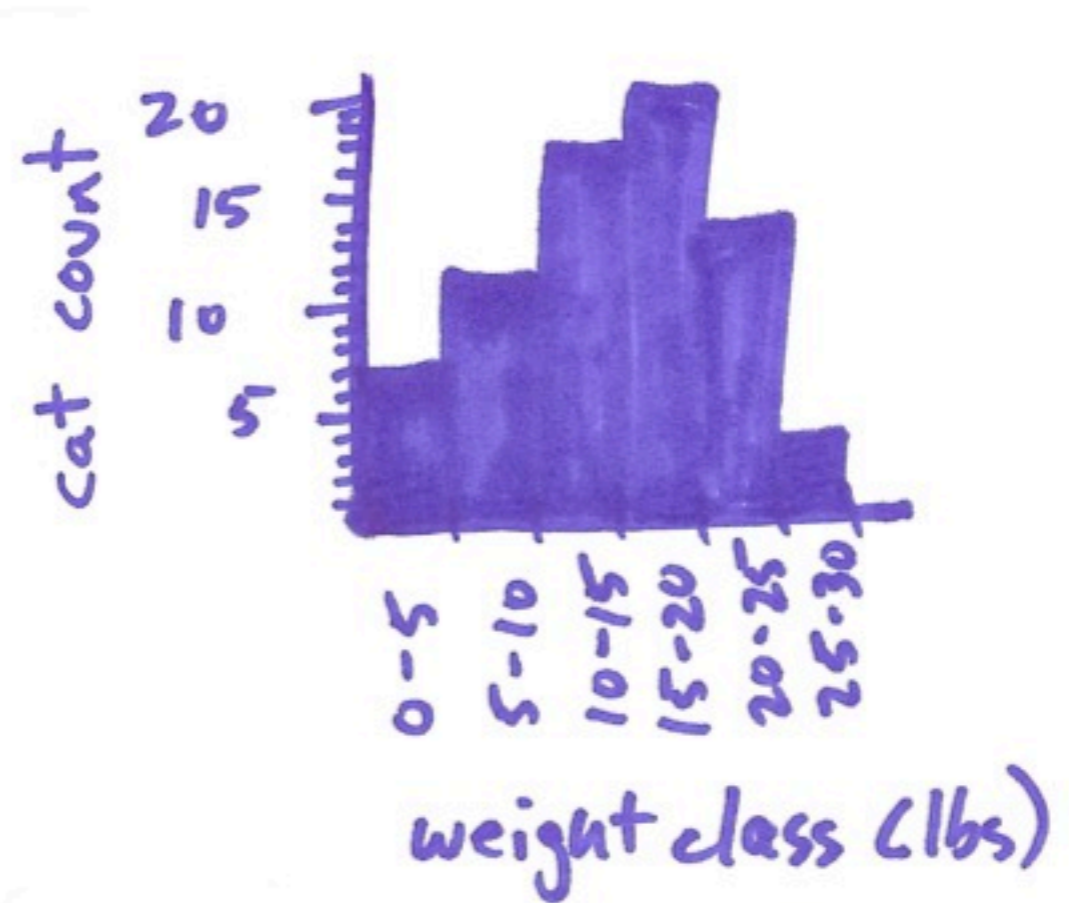
-glyphs

-scented widgets & interactive legends

# BARS

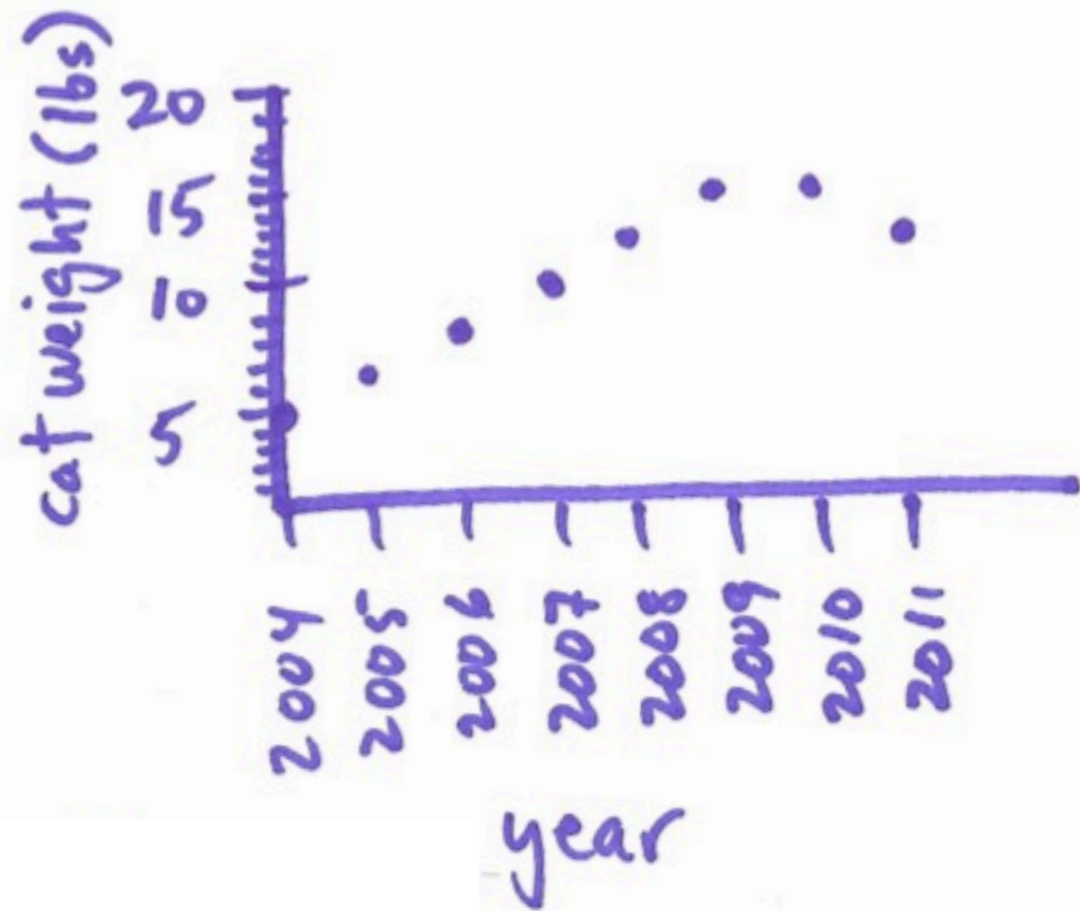


bar chart

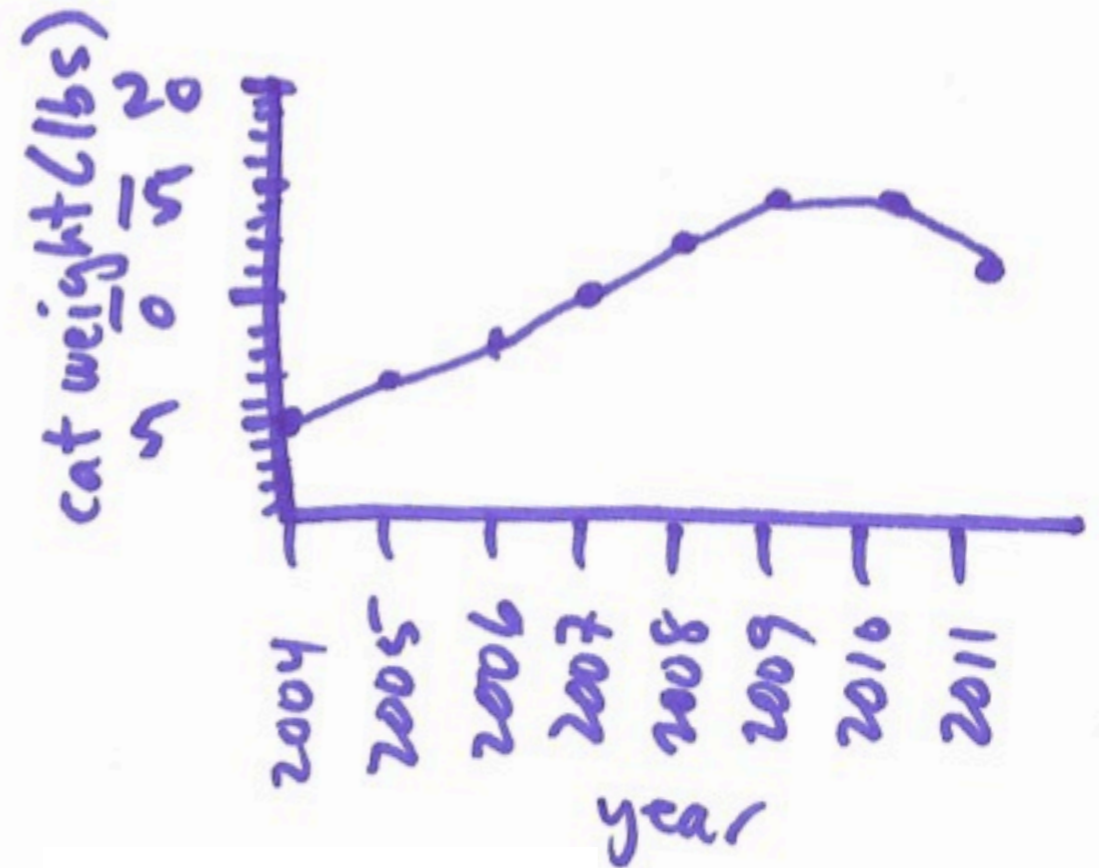


histogram

# DOTS & LINES

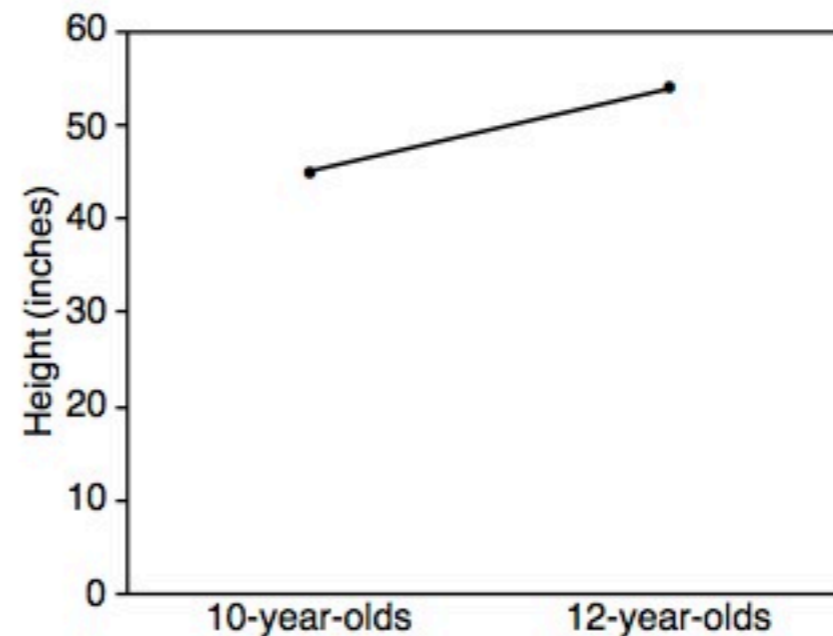
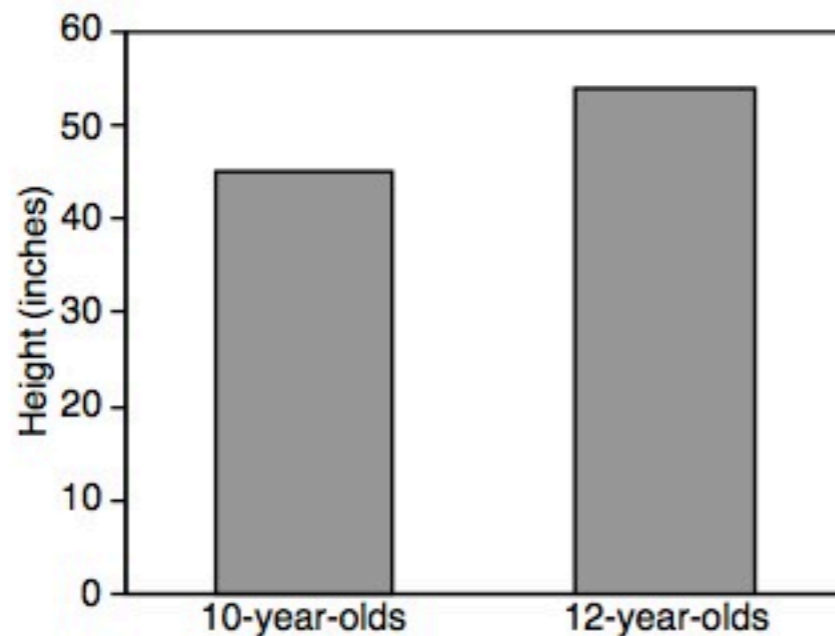
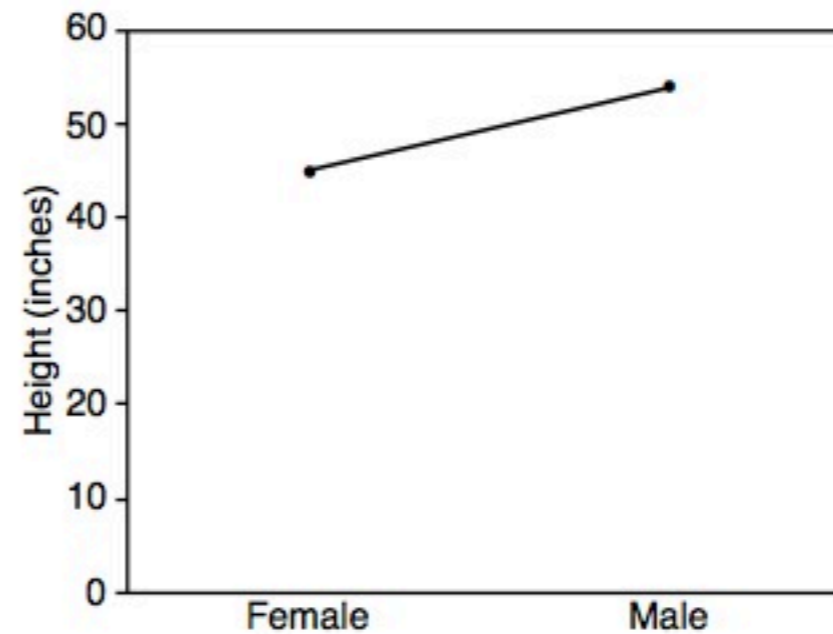
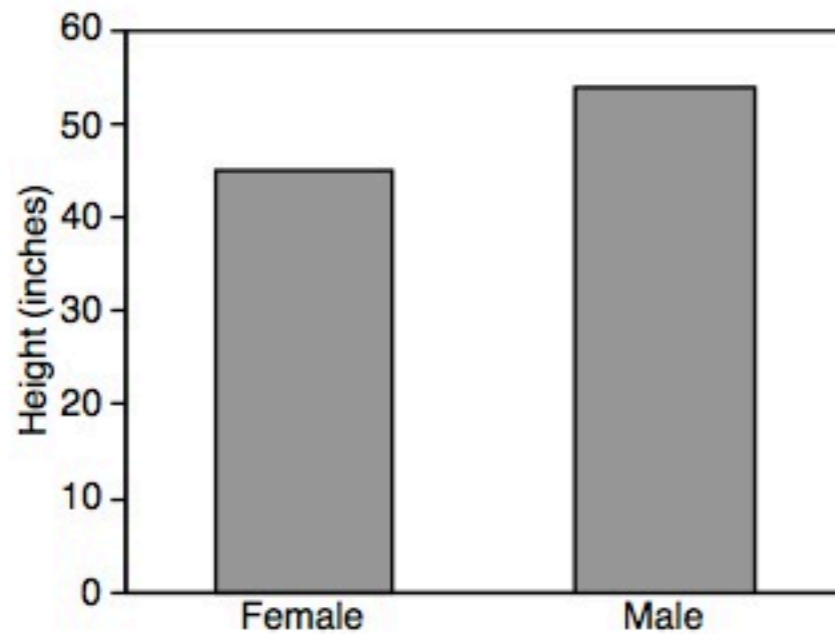


dot plot



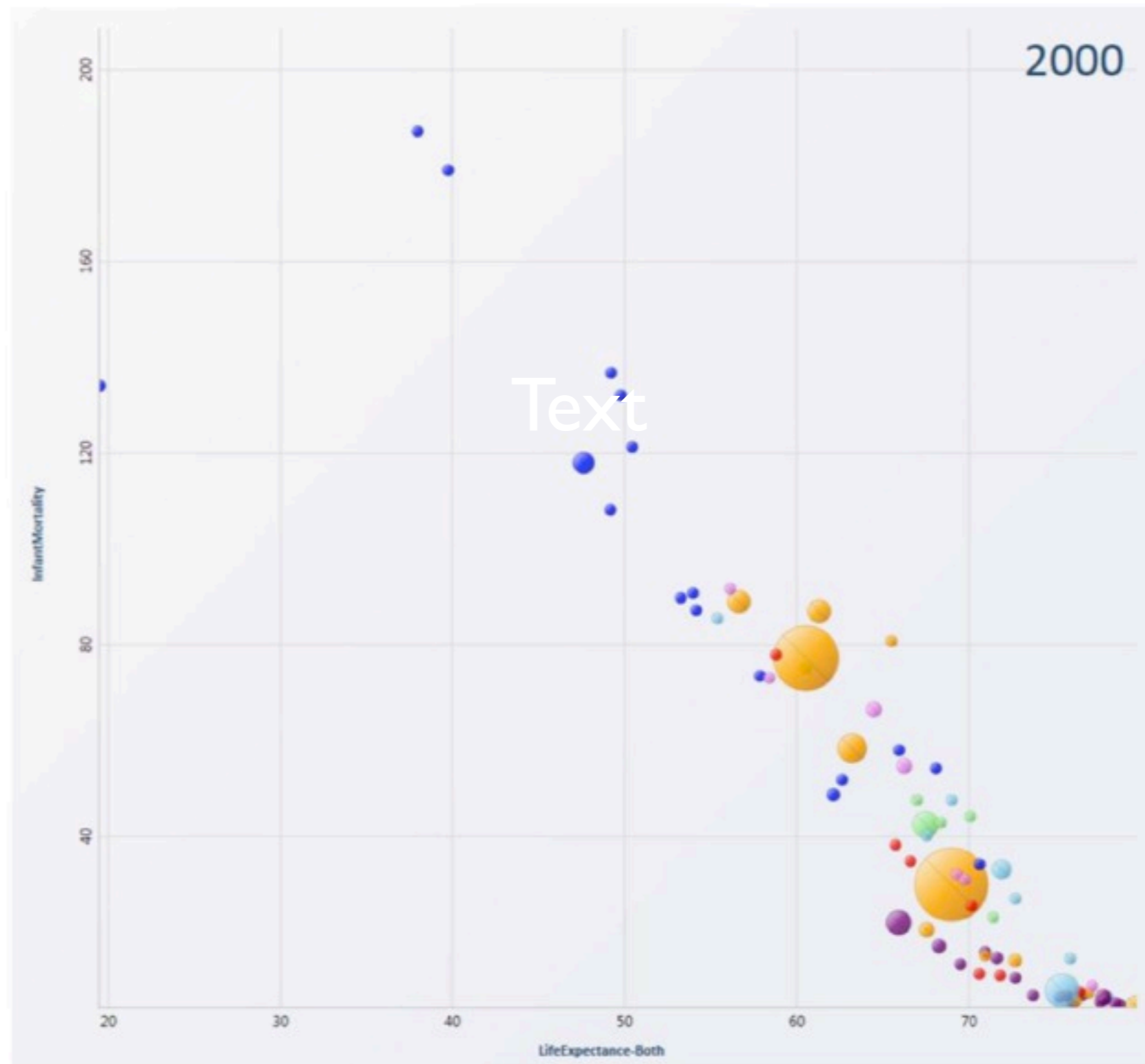
line chart

# BARS vs LINES



line implies trend. do not use for categorical data.

# SCATTER PLOT



# STATISTICAL GRAPHICS

- heavy focus on spatial position**

- long history on paper**

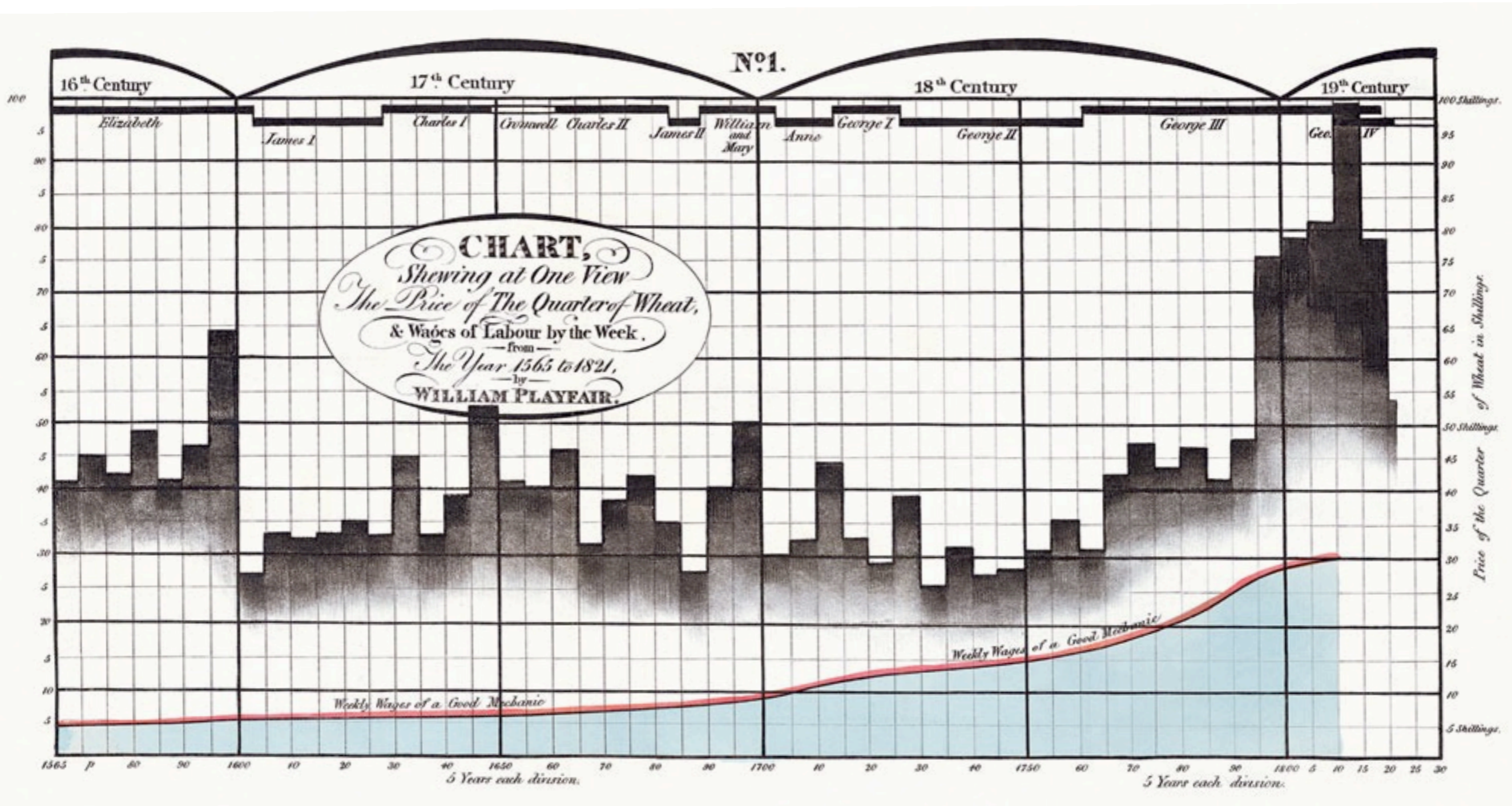
- springboard for infovis**

<http://www.datavis.ca/milestones/>



# WILLIAM PLAYFAIR

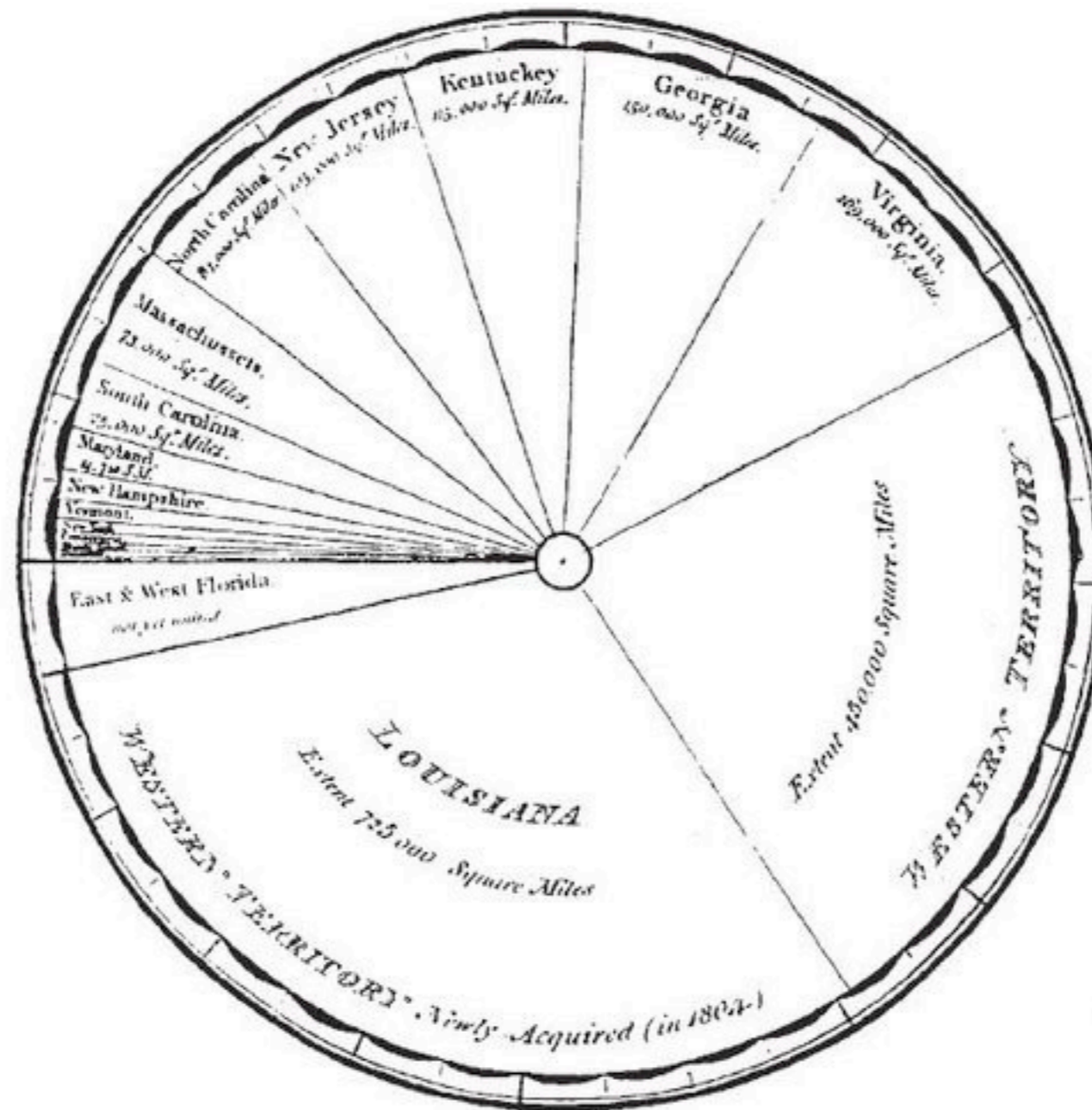
1759-1823





# WILLIAM PLAYFAIR

1759-1823



STATISTICAL REPRESENTATION of the UNITED STATES of AMERICA,

by W. PLAYFAIR

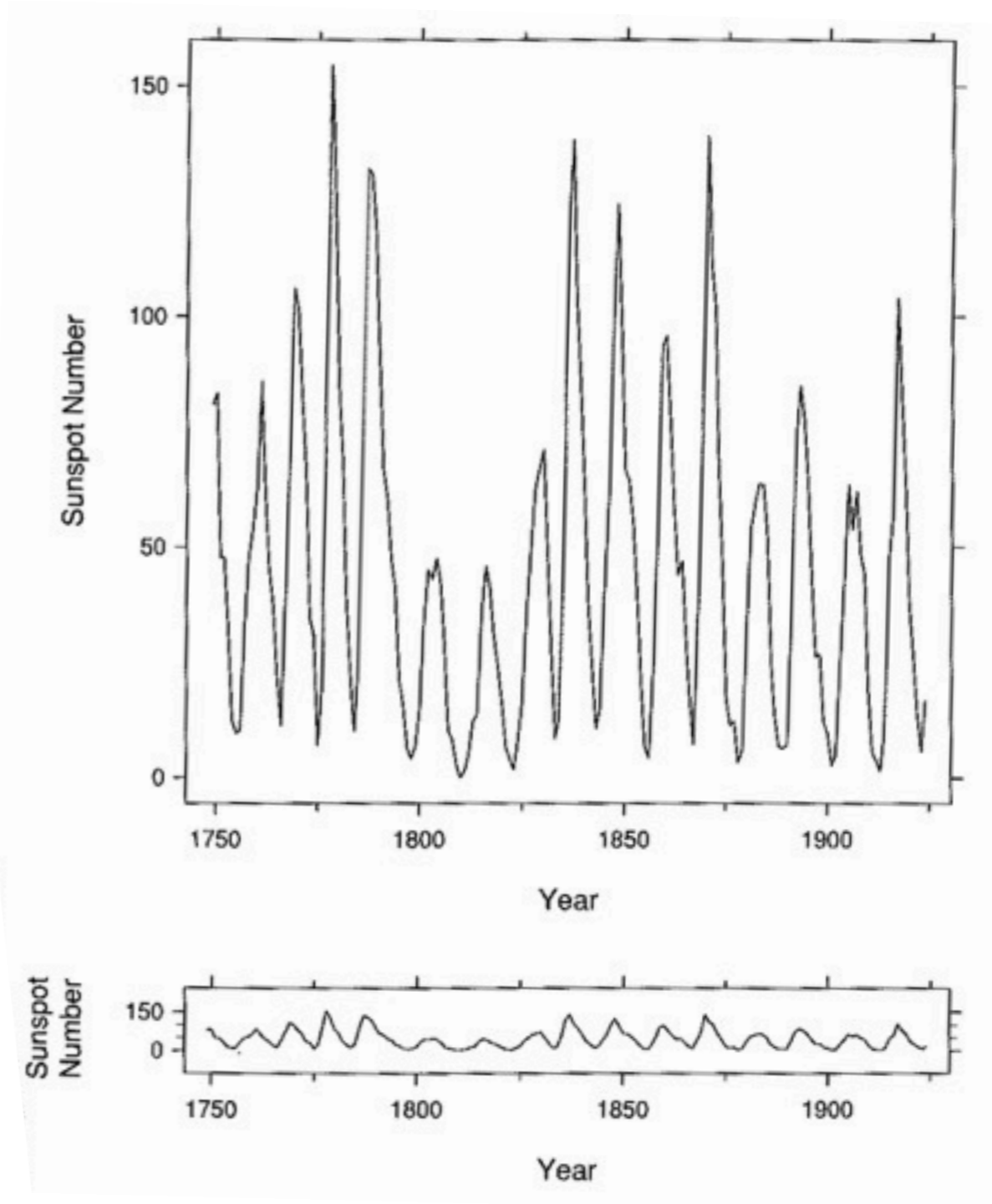
*This newly invented Method is intended to show the Proportions between the different in a striking Manner.*

*Total Extent 1,970,000 Square Miles or 1,222 Millions of Acres.*

# BANKING TO 45°

The aspect ratio of a graph is an important factor for judging rate of change.

**perceptual principle:**  
most accurate angle  
judgement is at 45

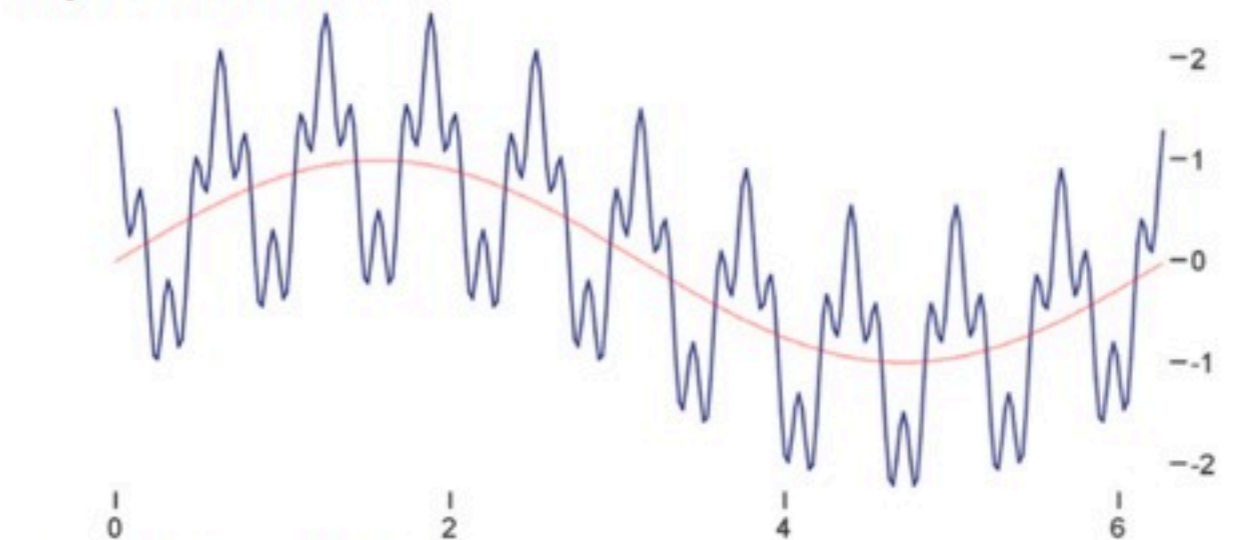


# MULTISCALE BANKING TO 45°

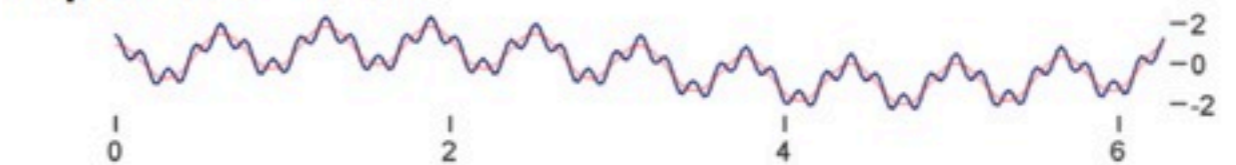
- frequency domain analysis
- find interesting regions at multiple scales
  - FFT the data and smooth by convolution with Gaussian
  - select aspect ratios as spikes in power spectrum
- create trend curves with low-pass filter
- bank all to 45°

$$\sin(x) + \cos(10x) + 0.5 \cos(40x)$$

Aspect Ratio = 2.21



Aspect Ratio = 11.34



Aspect Ratio = 14.73



Power Spectrum



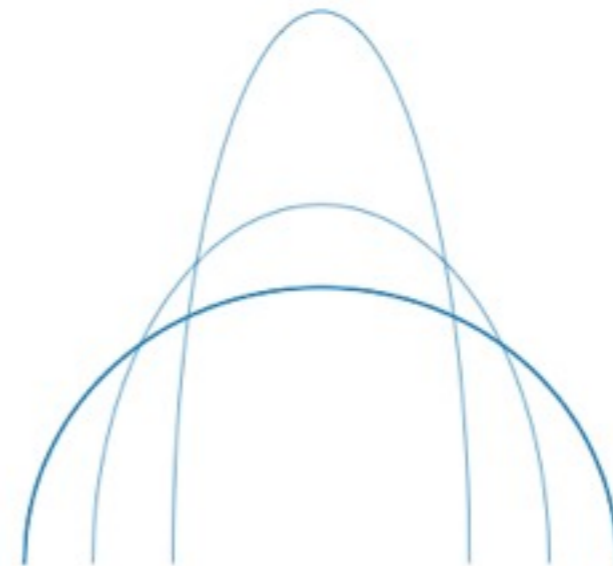
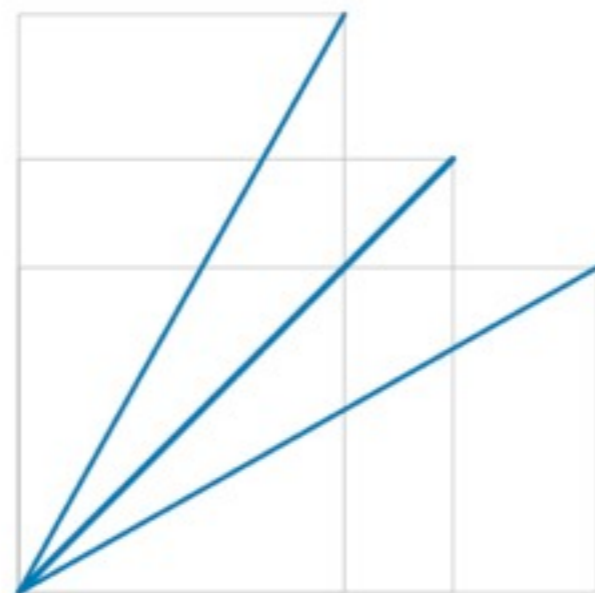
Aspect Ratios

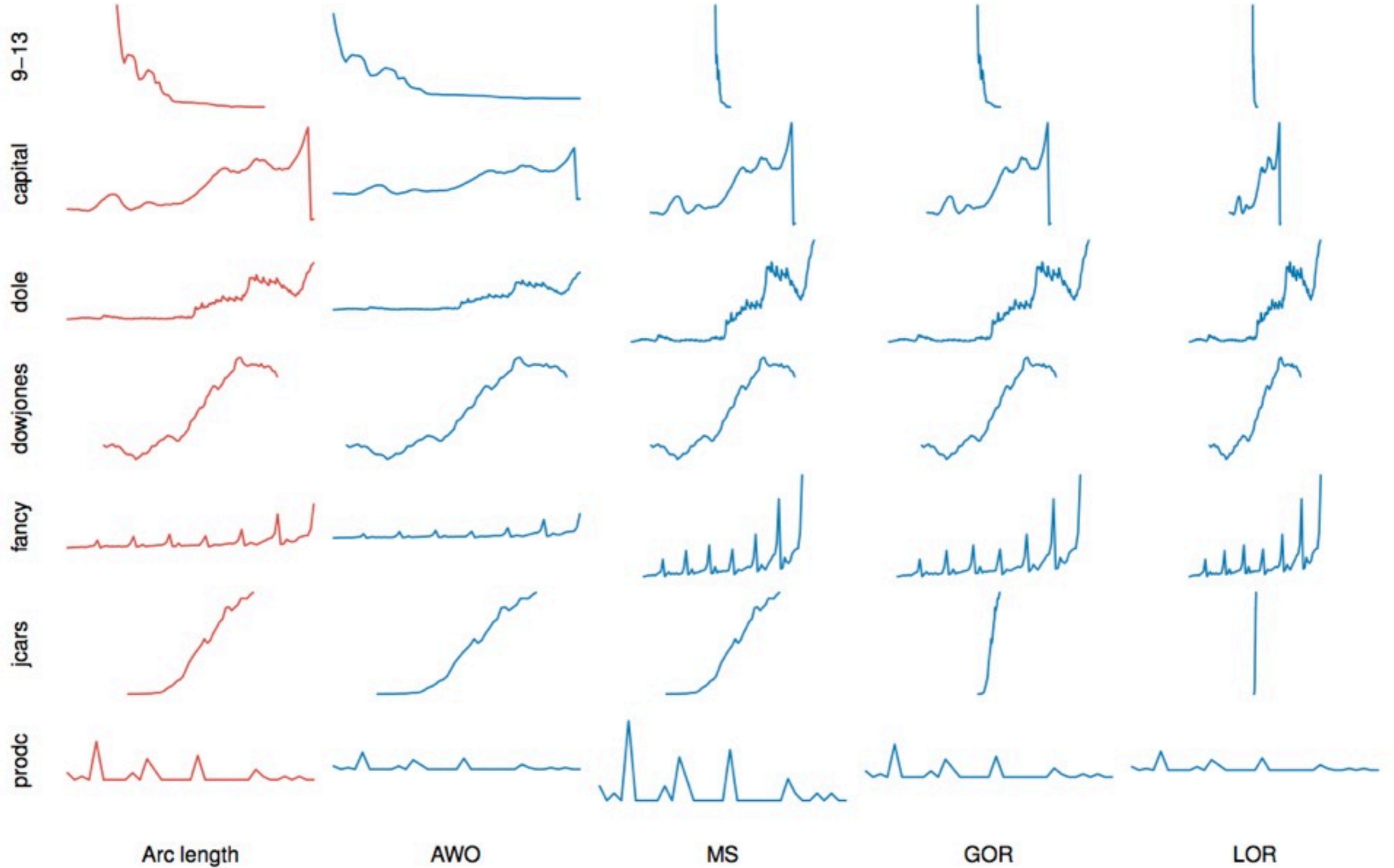


# ARC LENGTH-BASED

Minimize the arc length of the data curve while keeping the area under the plot constant.

- scale and parameterization invariant
- preserves symmetries
- robust on a wide range of inputs
- fast

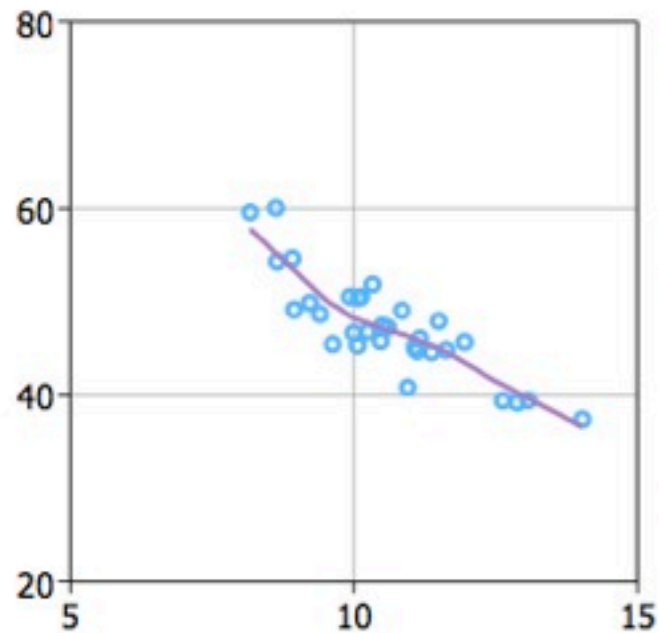
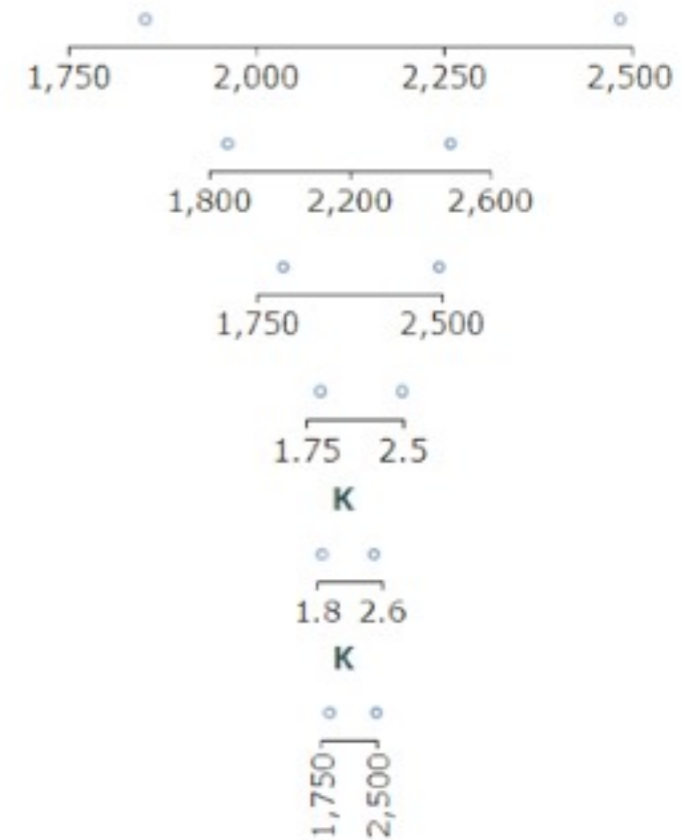




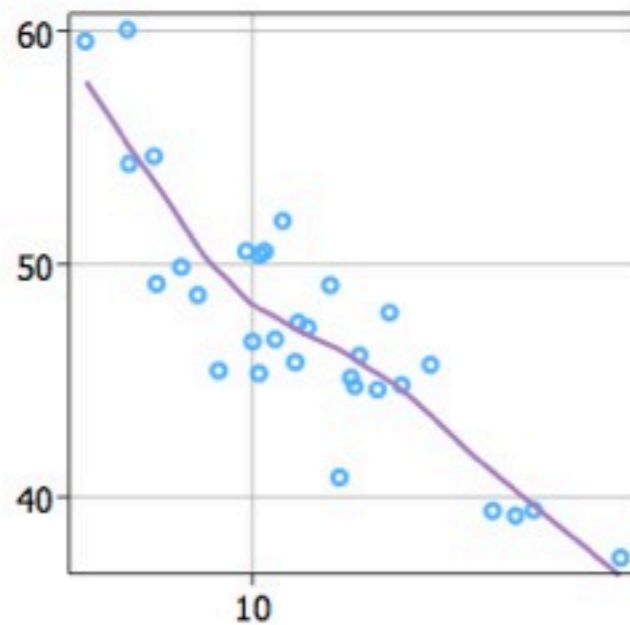


# AUTOMATIC TICKS

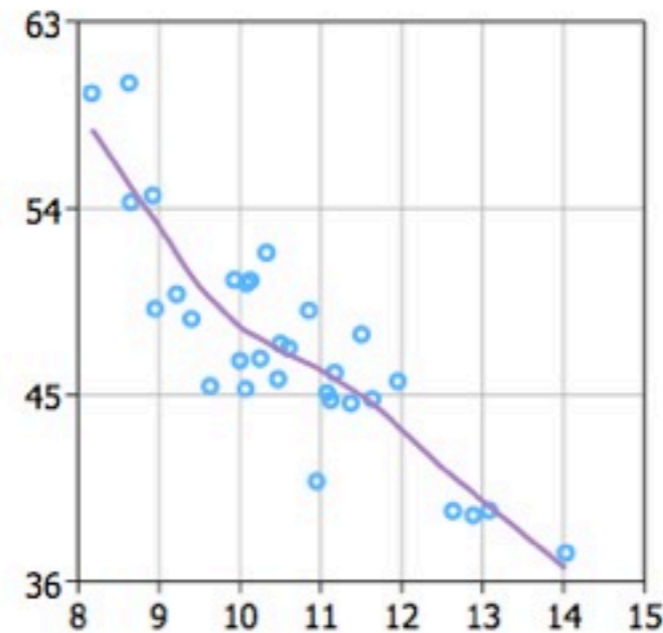
- optimization of tick placement
- optimization of label formatting, font size, and orientation



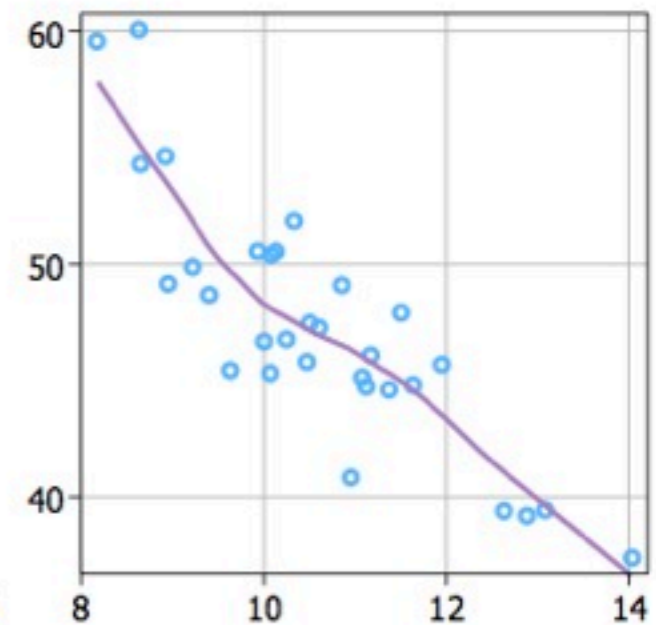
(a) Heckbert



(b) R's pretty



(c) Wilkinson



(d) Extended

-spatial position

**-visual layering**

-glyphs

-scented widgets & interactive legends

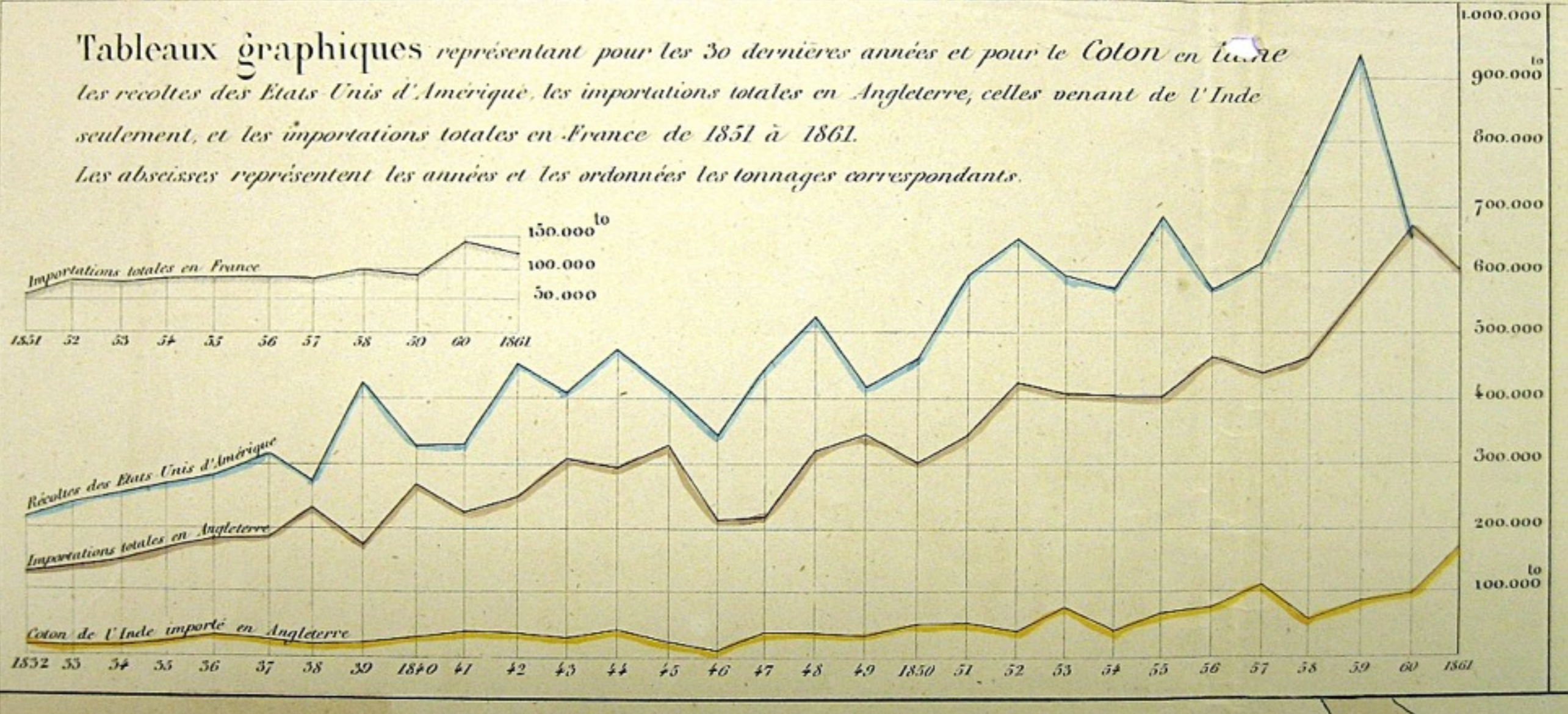
# GLOBAL COMPOSITING



# JOSEPH MINARD

1781-1870

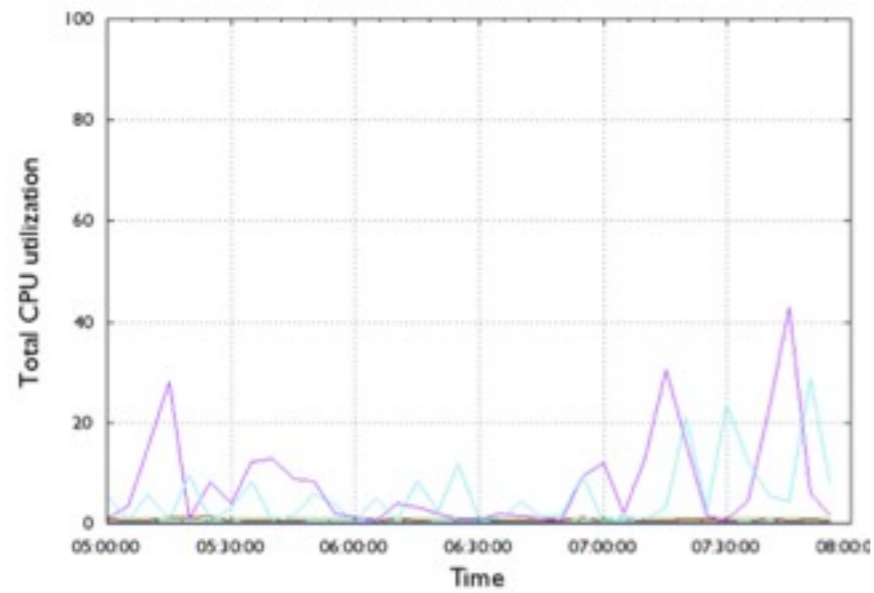
Tableaux graphiques représentant pour les 30 dernières années et pour le Coton en laine  
les récoltes des Etats-Unis d'Amérique, les importations totales en Angleterre, celles venant de l'Inde  
seulement, et les importations totales en France de 1851 à 1861.  
Les abscisses représentent les années et les ordonnées les tonnages correspondants.



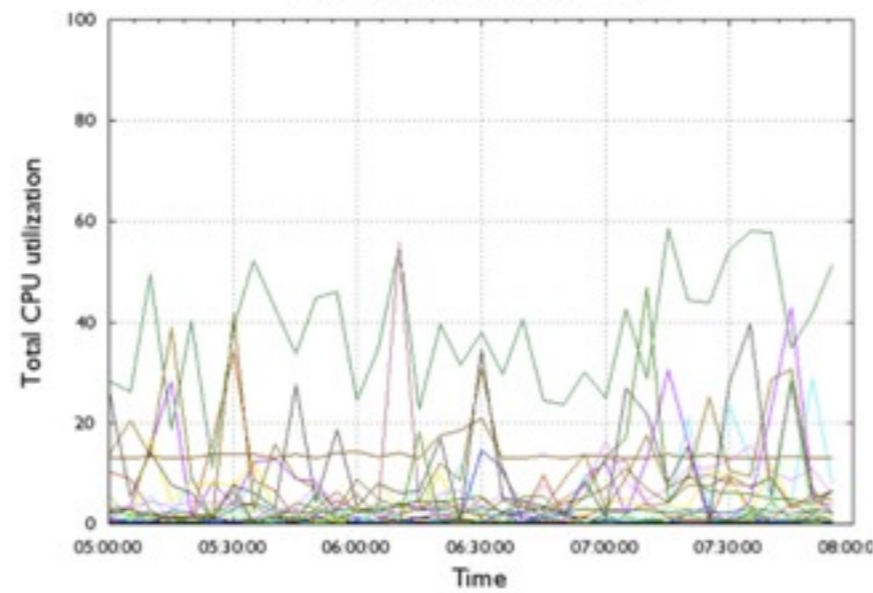


# overlays

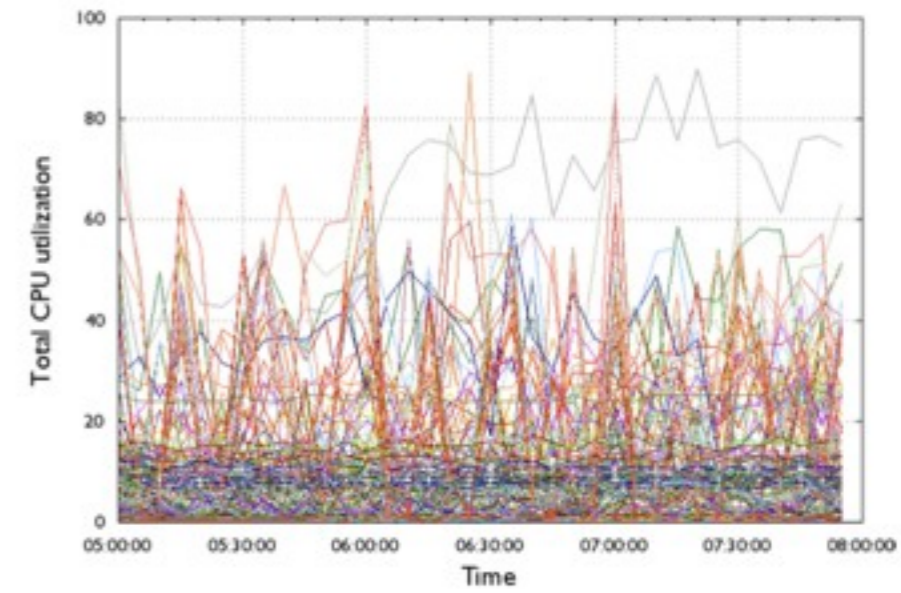
CPU utilization over time



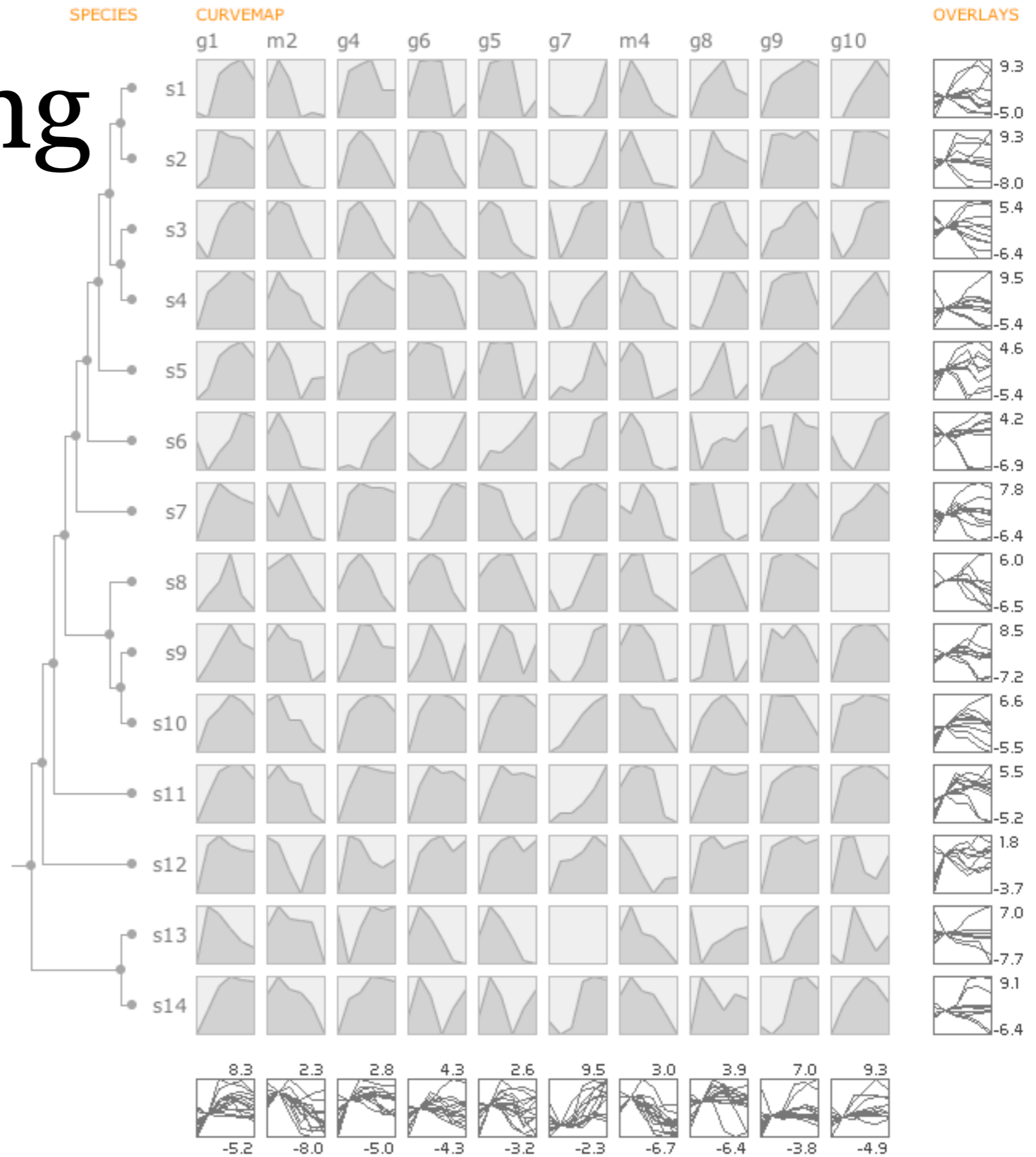
CPU utilization over time



CPU utilization over time

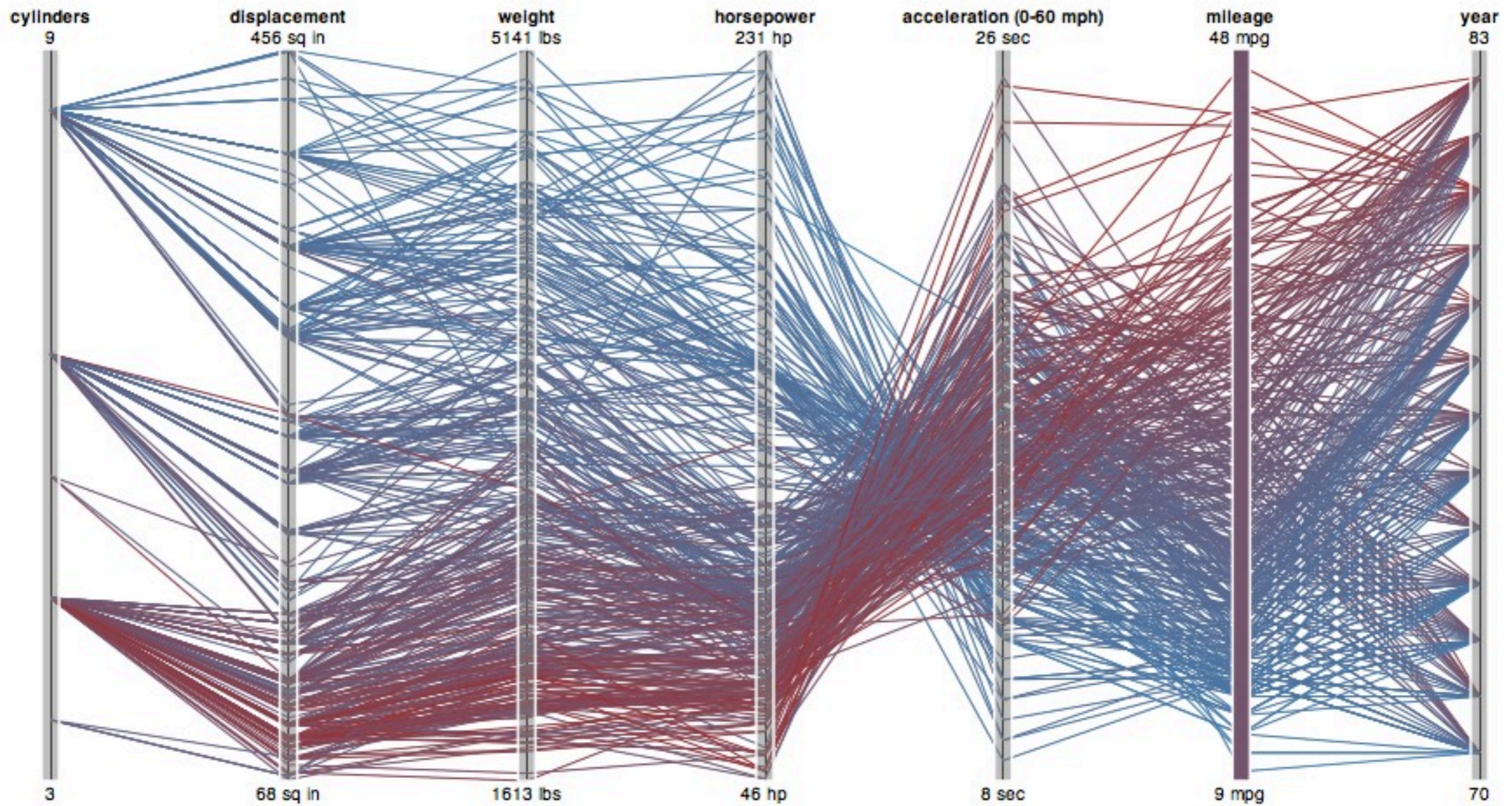


# highlighting



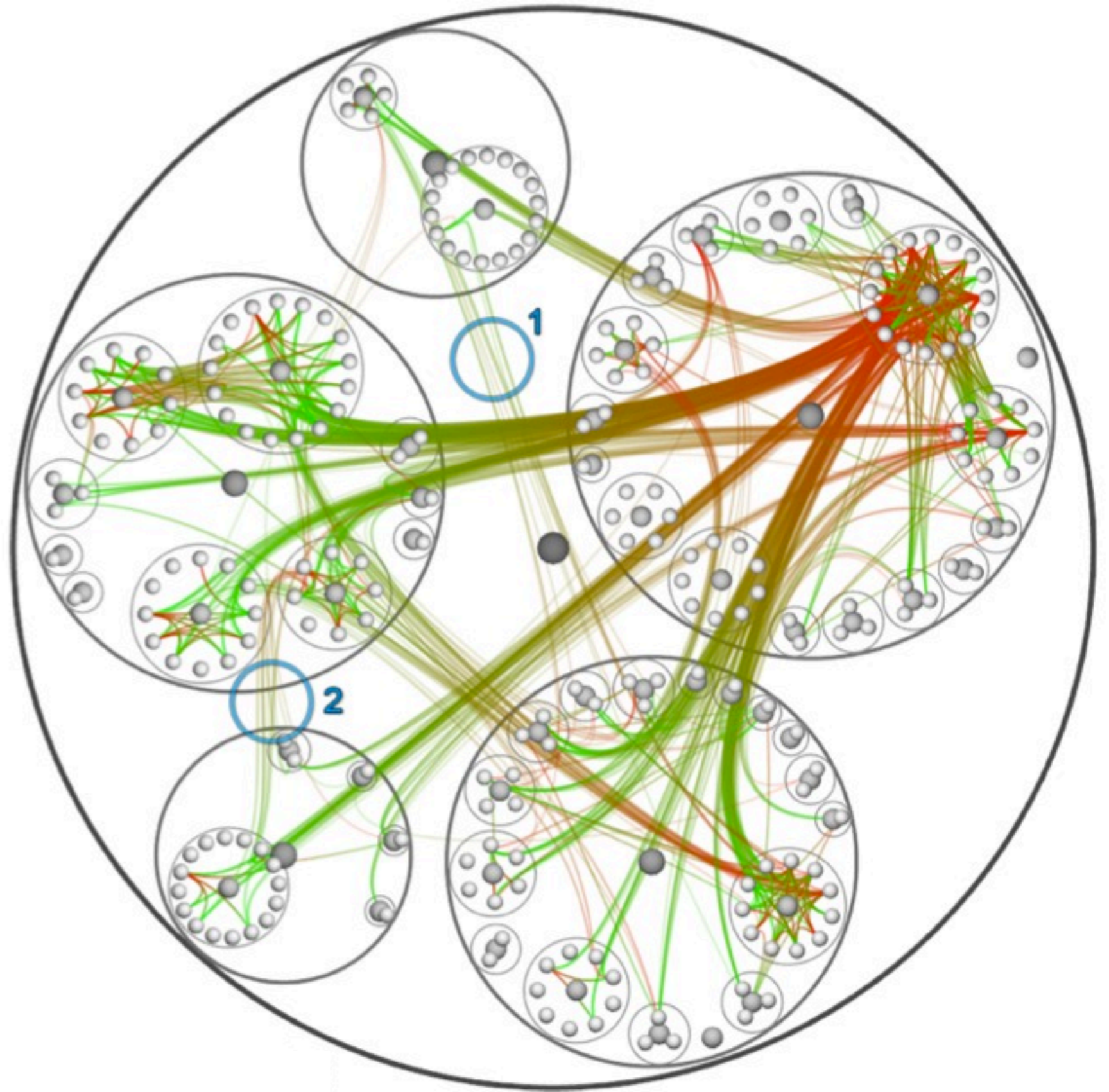


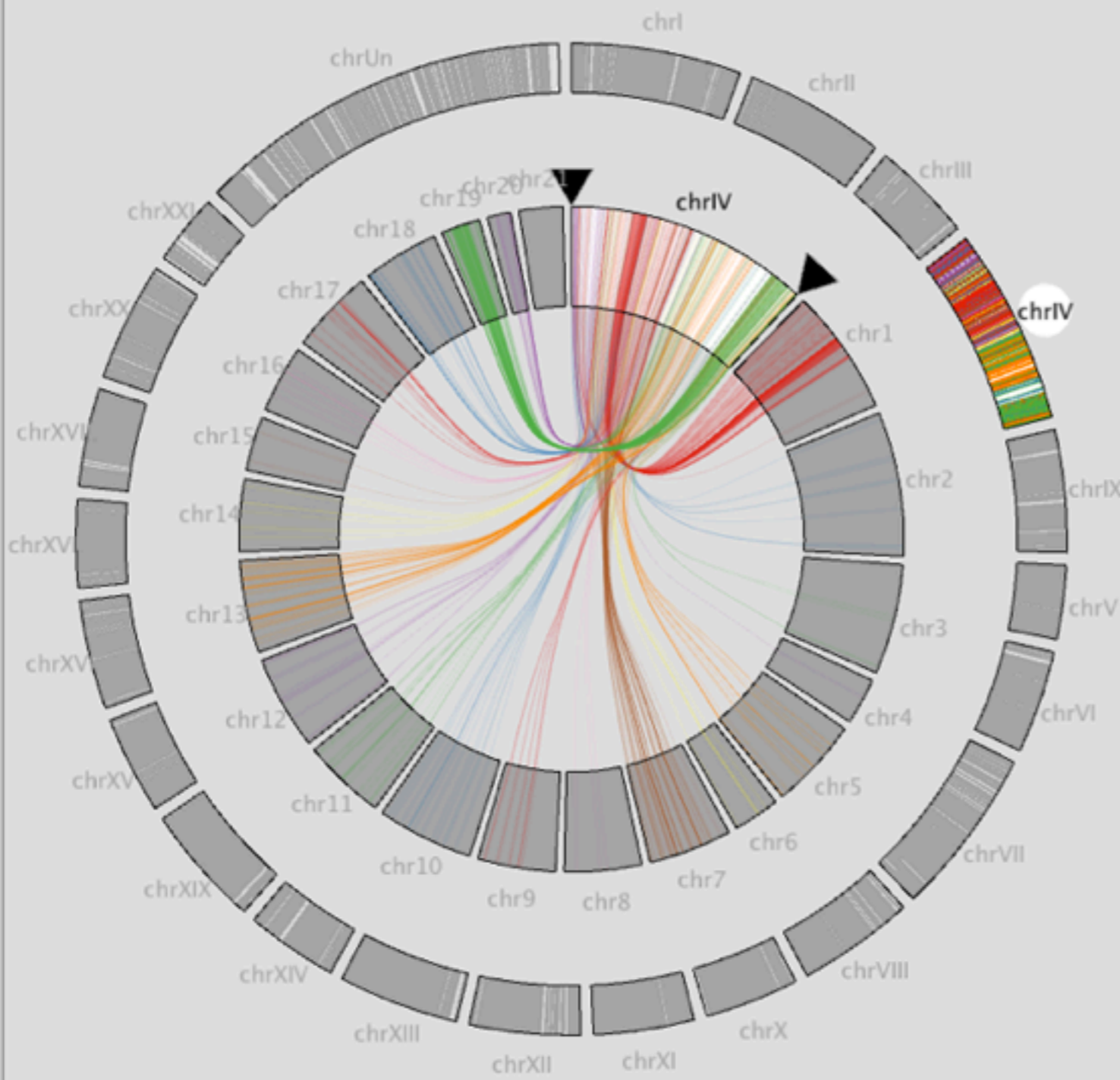
# parallel coordinates



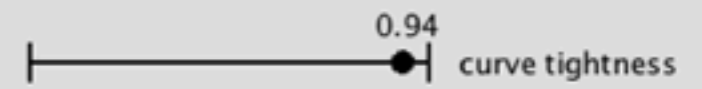


# edge bundling

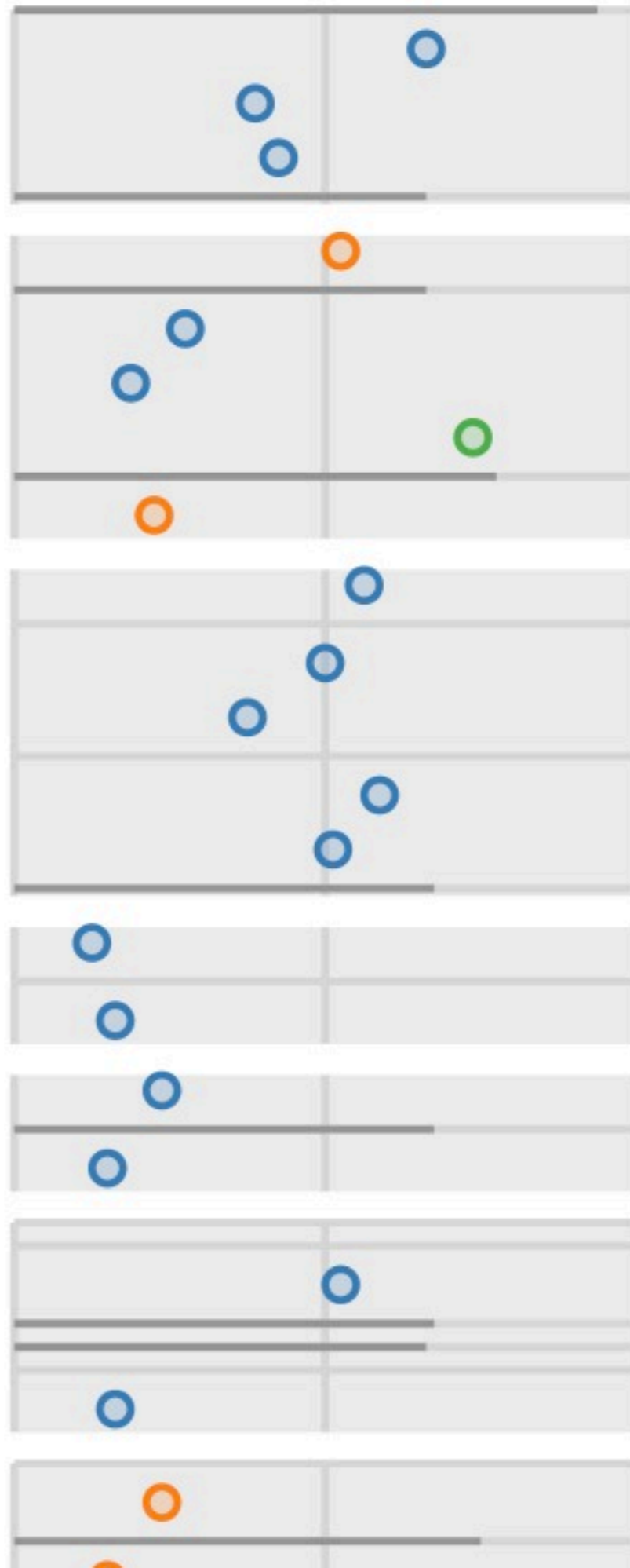




Indie 2



# multiple encodings



# ITEM-LEVEL STACKING

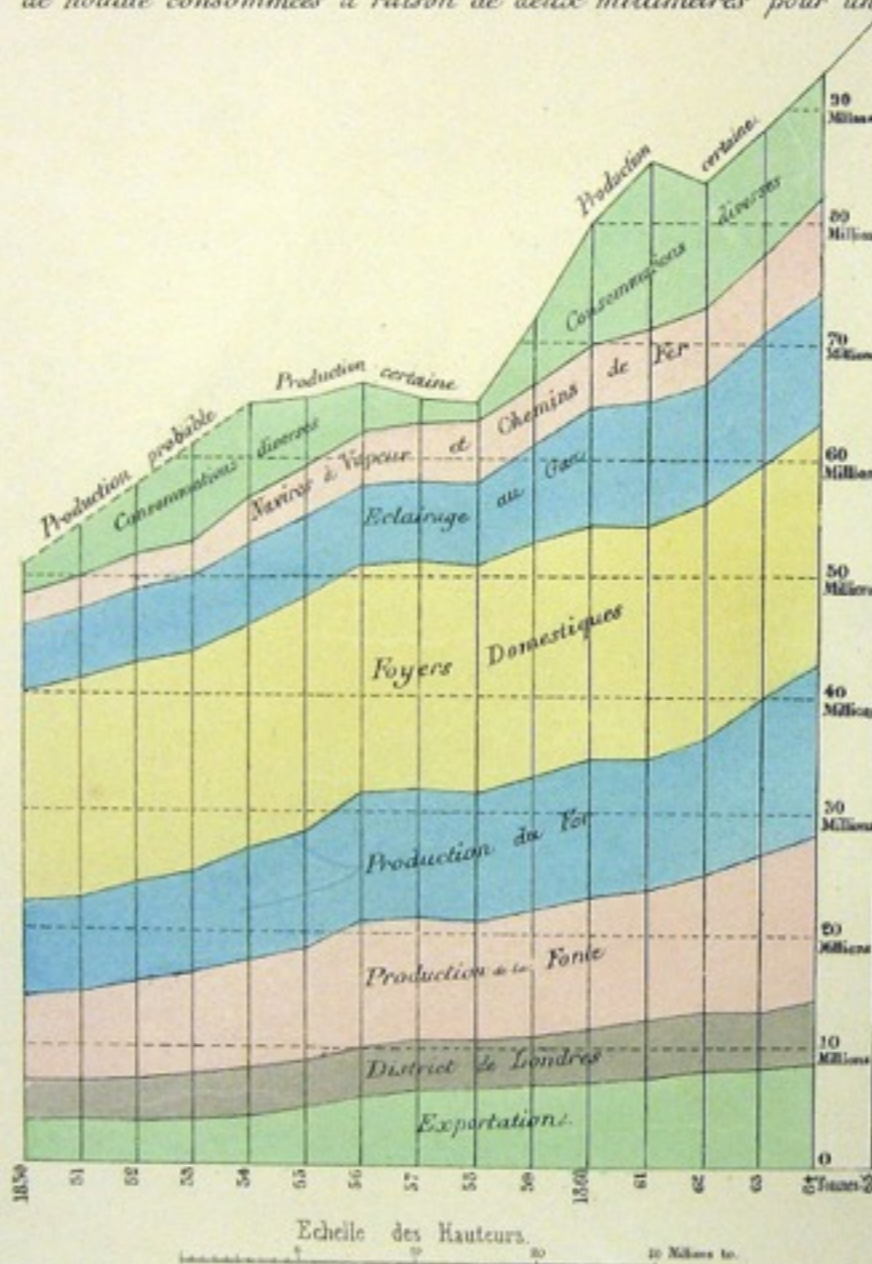


# JOSEPH MINARD

1781-1870

## Consommations approximatives de la Houille dans la Grande Bretagne de 1850 à 1864.

Les abscisses représentent les années et les ordonnées les quantités annuelles de houille consommée.  
Les couleurs indiquent les espèces de consommations. Les longueurs d'ordonnées comprises dans une couleur sont les quantités de houille consommées à raison de deux millimètres pour un million de tonnes.



### Données admises pour former le Tableau ci-contre.

Consommations. — Sources des Renseignements.

Exportations. — *Mineral statistics 1865 page 214 et Renseignements Parlementaires.*

District de Londres. — *id.* — page 213

Produits de la Fonte. — *id.* — page 215 et pour les années avant 1855 calculée à raison de 3<sup>tes</sup> de houille pour 1<sup>re</sup> de fonte, en admettant les quantités annuelles de fonte du Coal question page 192.

Production du fer. — *Mineral statistics* — page 215 et pour les années avant 1855 — calculée à raison de 3<sup>tes</sup> 35 de houille pour 1 tonne de fonte convertie en fer, et admettant  $\frac{1}{3}$  de la fonte produite convertie en fer.

Foyers domestiques. — En y comprenant les petites manufactures. On l'estimait en 1848 à 19 millions de tonnes, (A) qu'on peut réduire à 18 millions to. pour les foyers seuls, mais qu'on peut porter à 20 millions pour la population de 1864.

Eclairage au Gaz. — Consommation estimée généralement de  $\frac{1}{3}$  au  $\frac{1}{2}$  de la production totale.

Exploitation des Chemins de Fer. — En supposant pour consommation totale 10<sup>tes</sup> par Kilomètre parcouru par les trains d'après les renseignements parlementaires.

Navigation à vapeur. — Calculée à raison de 5<sup>tes</sup> houille par cheval vapeur et par heure, le nombre de chevaux étant celui du Steam Vessels pour 1864, et les steamers étant supposés marcher la moitié de l'année;

Avant 1864 j'ai supposé les consommations proportionnelles aux tonnages annuels des steamers du statistical abstract et du Board of trade.

(A) Voir l'excellent article houille de M. Lamé Fleury, Dictionnaire du Commerce Page III.

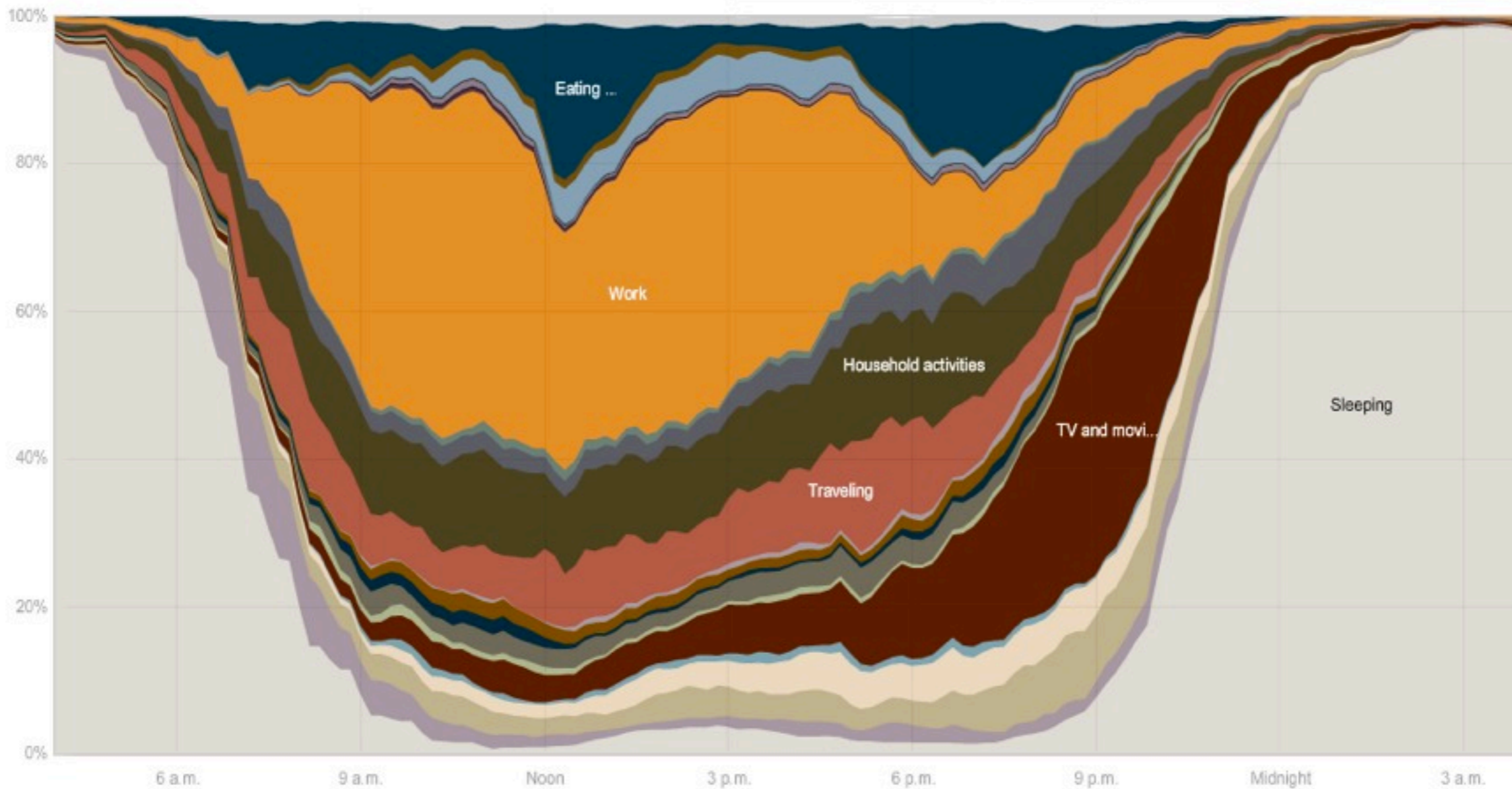


# stacked area chart

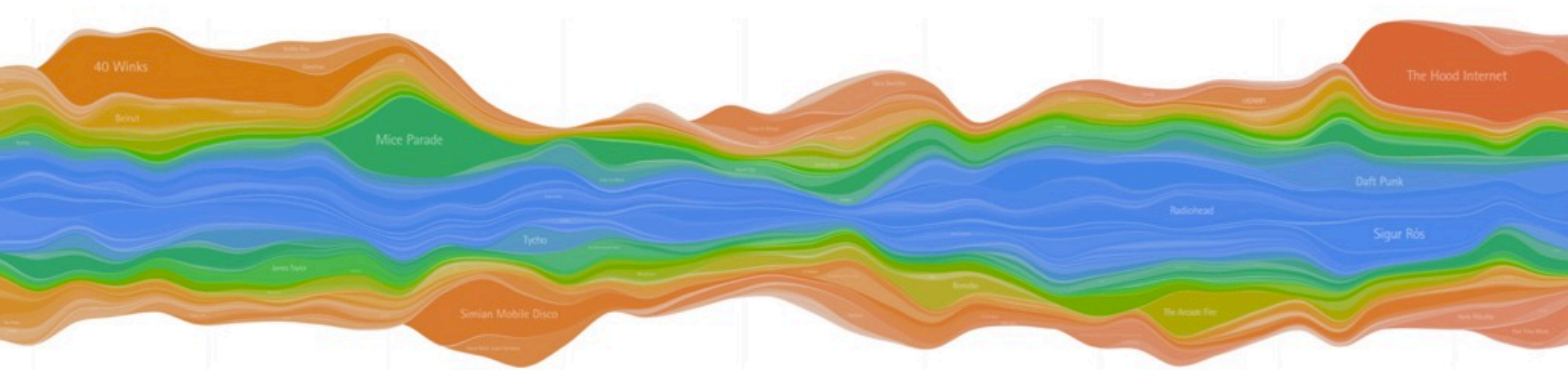
## People with advanced degrees

Those with advanced degrees spend the most time volunteering: 14 minutes a day (or more than an hour and a half a week), on average.

Everyone	Employed	White	Age 15-24	H.S. grads	No children
Men	Unemployed	Black	Age 25-64	Bachelor's	One child
Women	Not in lab...	Hispanic	Age 65+	<b>Advanced</b>	Two+ children



# streamgraph

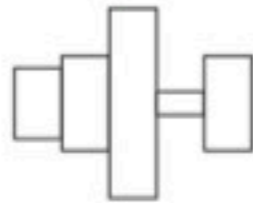
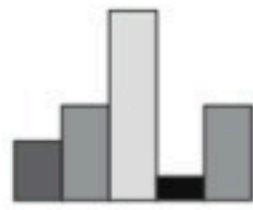
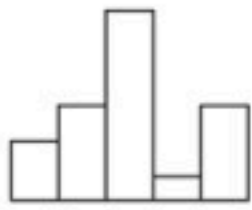


-spatial position

-visual layering

**-glyphs**

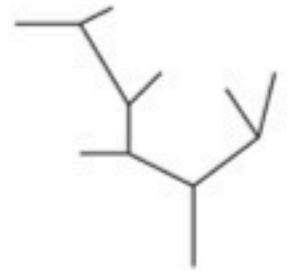
-scented widgets & interactive legends



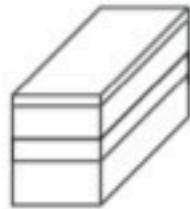
Variations on Profile glyphs



Stars and Anderson/metroglyphs



Sticks and Trees



Autoglyph and box glyph

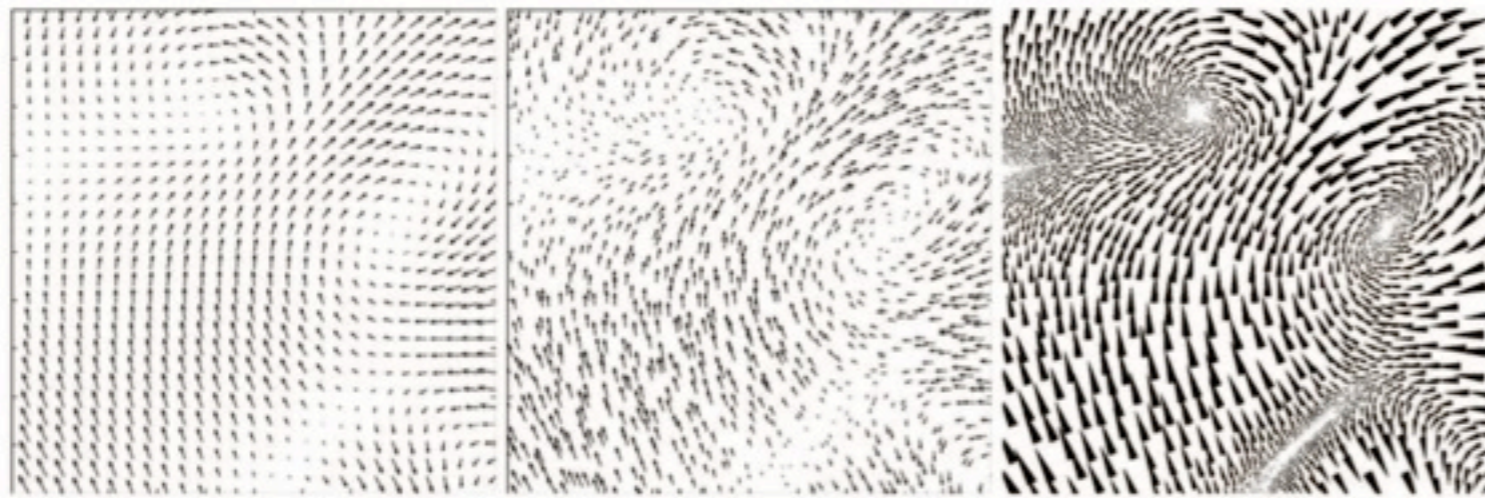


Face glyphs



Arrows and Weathervanes





GRID

JIT

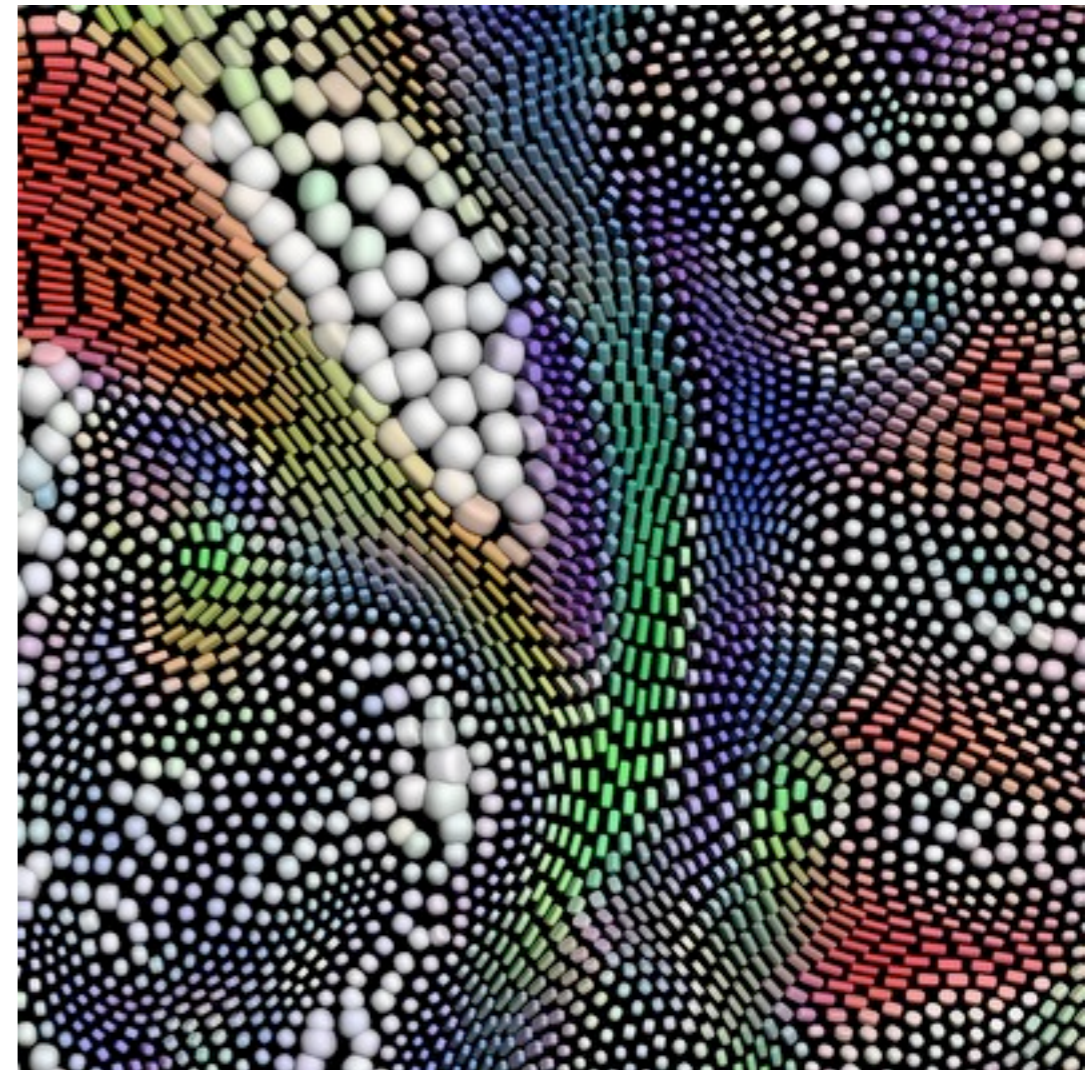
LIT



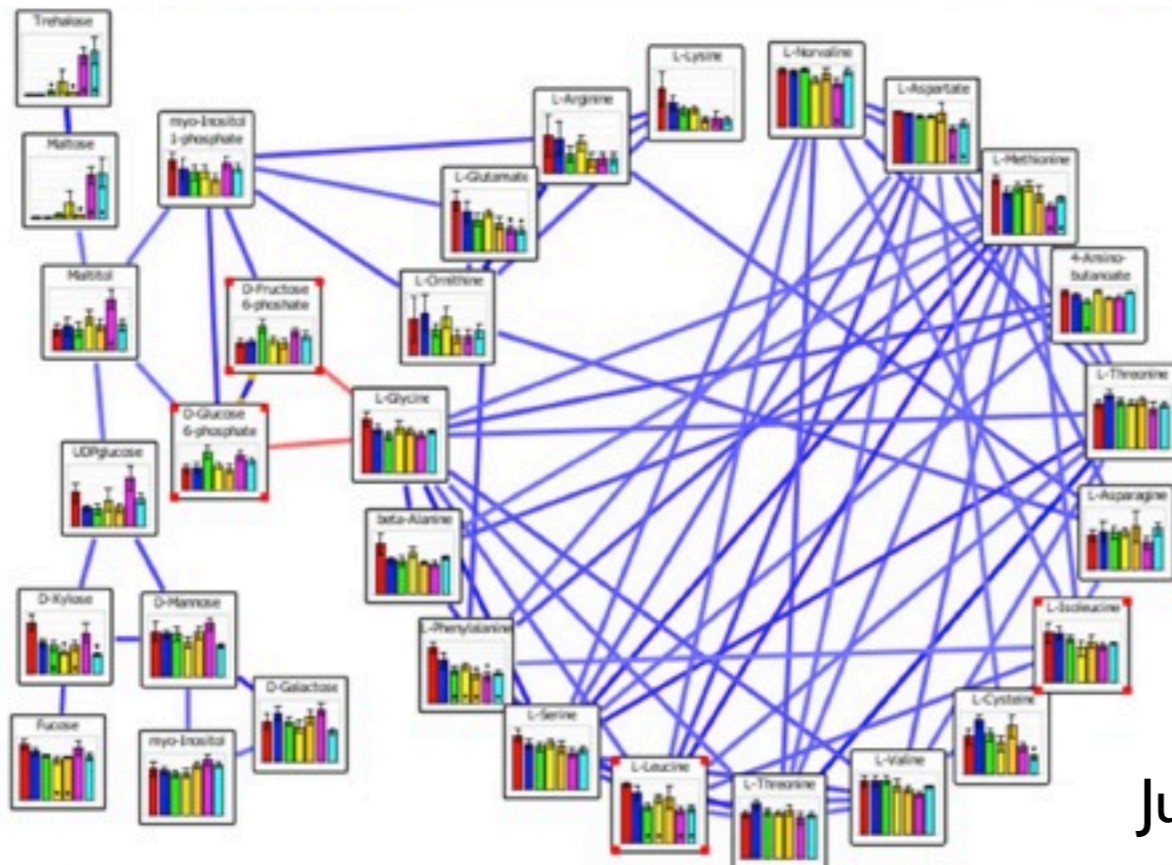
LIC

OSTR

GSTR



Kindlmann 2006



Junker 2006



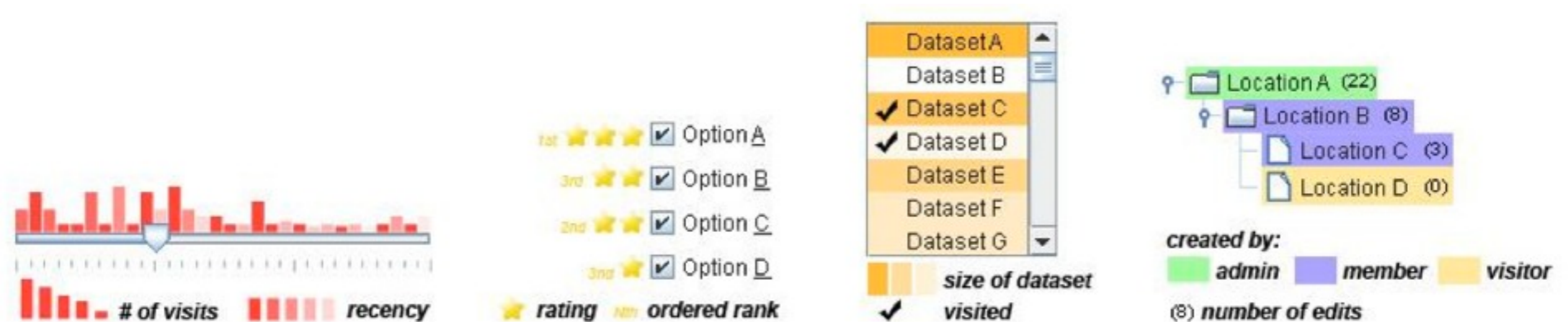
-spatial position

-visual layering

-glyphs

**-scented widgets & interactive legends**

# scented widgets

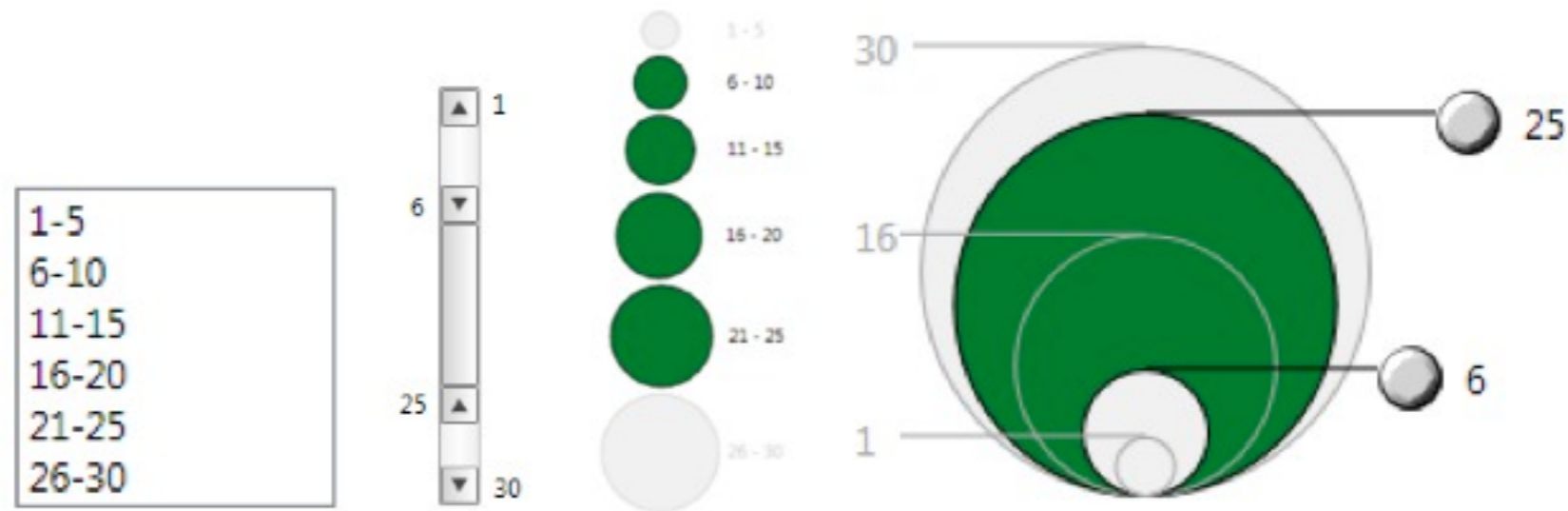


**information scent:** user's (imperfect) perception of data

**GOAL: lower the cost of information forging through better cues**



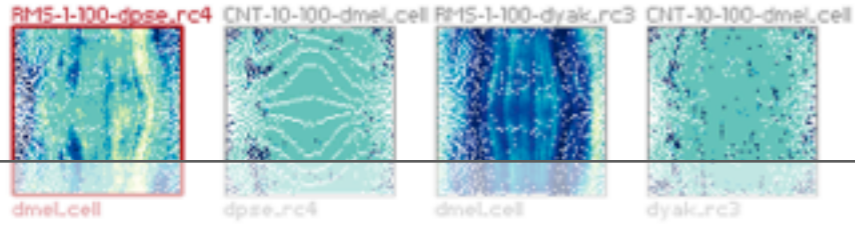
# interactive legends



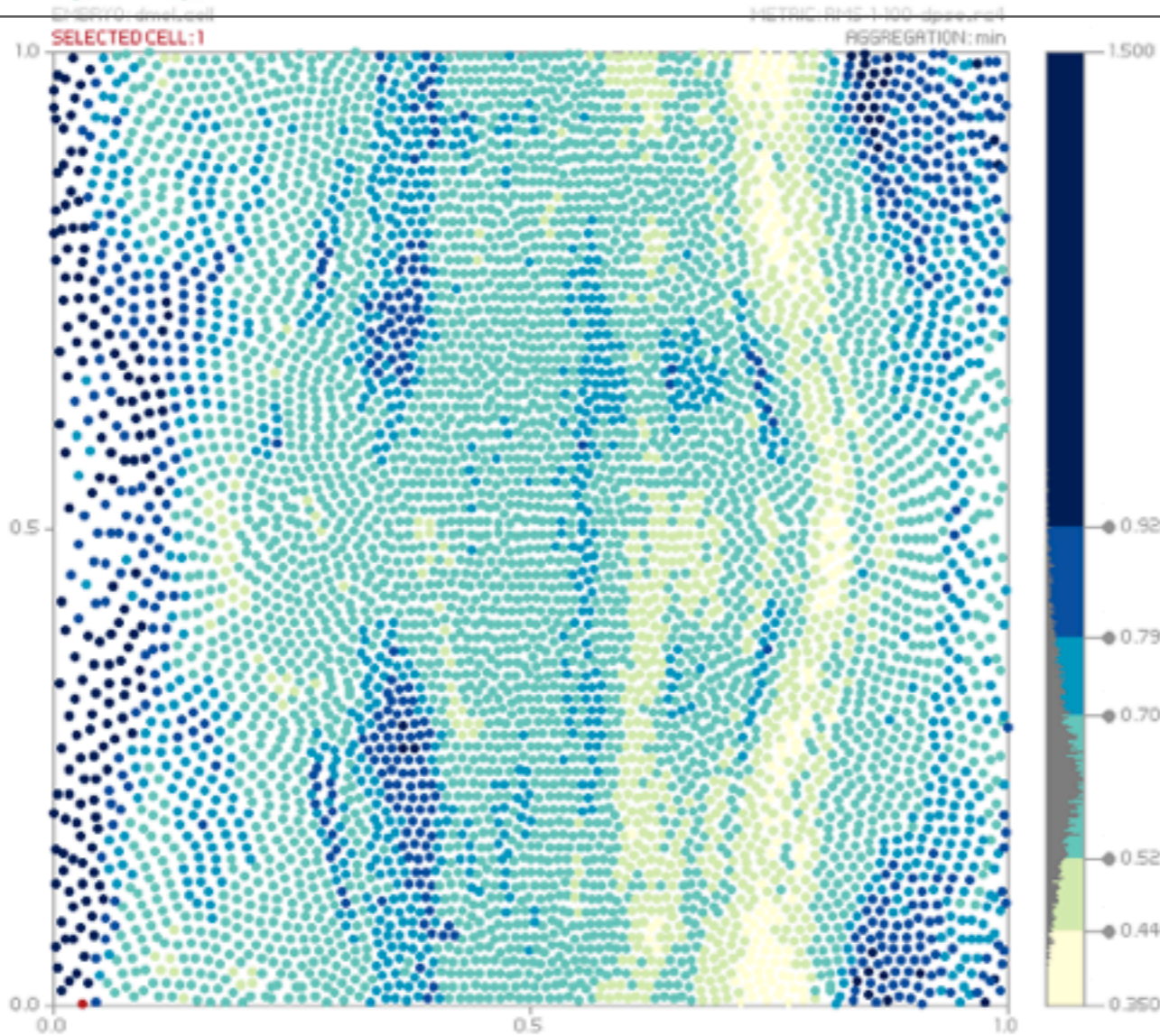
controls combining the visual representation of static legends with interaction mechanisms of widgets

**define and control visual display together**

### Summaries

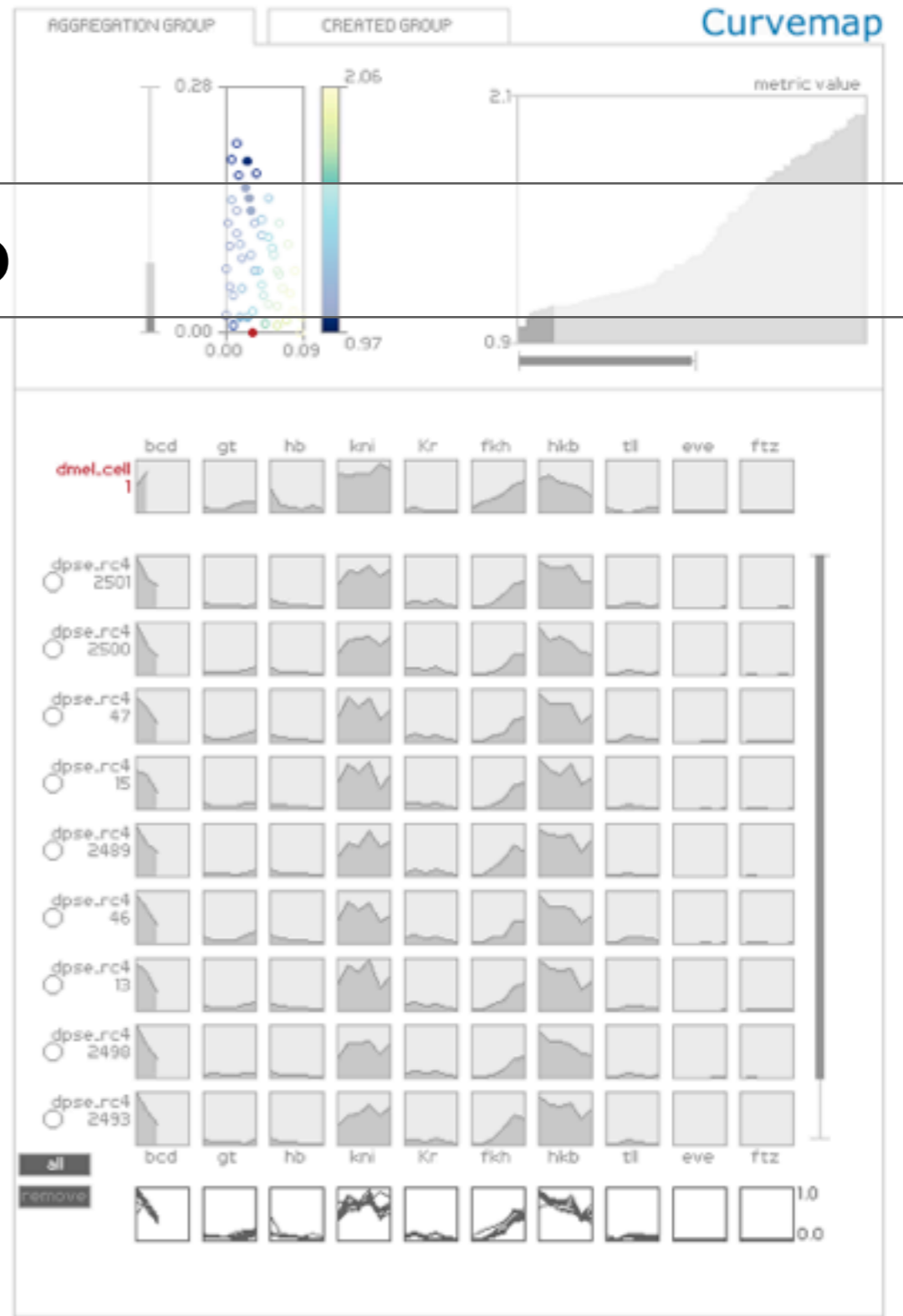


### Embryo Map



Colormaps ▲

# Demo



L9: Multiple Views

**REQUIRED READING**



# Multiple View Methods

This chapter moves on from methods that use only a single view, turning to those that use multiple adjacent views, which are usually linked together. Linked highlighting is by far the most common approach, and other linkages including navigation are also possible. The chapter continues with a taxonomy of multiple views depending on what changes between them. They could use the same visual encoding or a different one; they could show the same dataset or a different one; they could show all of the data or a different subset of it, for example a change of viewpoint. The final point is how to order the views themselves.

## 6.1 Linked Views

One of the most common and powerful methods of incorporating interactivity into visualization is **linked views**: multiple views that are simultaneously visible and linked together so that actions in one view affect the others<sup>1</sup>. That is, rather than combining all information into a single

# The Visual Design and Control of Trellis Display

Richard A. Becker  
William S. Cleveland  
Ming-Jen Shyu

