Introduction to visualization

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1. **Philosophy and key issues**
   (T. Kuhn, The Structure of Scientific Revolutions)

⇒ 2. **The design of visualizations**
   (Tufte, Envisioning Information)

3. **The scientific illustration tradition**

4. **Scientific visualization techniques**

5. **Visualization software and systems**

The design of visualizations

- More variables at once
- Micro/macro readings
- Small multiples
- Graphic design
- Things to avoid

More variables at once

- **parallel plots**
- **turn a table into a graph**
- **turn a table into a scatterplot**
- **drop variables**
- **combine variables**
- **use more visual cues**
- **compress scales**

– **References**
  - » NYC weather for 1980, Tufte I, p. 31
  - » Minard, Napoleon's Russian Campaign, Tufte I, p.40

Example: train schedules

1885 Marey, Paris-Lyon line

- **list reinterpreted as a continuum**

1935 Soerabaja-Djokjakarta line

- **multiple independent attributes for graph lines**
- **parallel plots and tables**
- **labels and annotations**

- **References**
  - » Marey, Tufte I, p. 31
  - » Soerabaja, Tufte II, p. 24-5

Example: sunspots

1613 Galileo

1630 Scheiner

- superimposed multiples, showing path

1904 Maunder

- horizontal extent dropped
- vertical extent displayed as scatterplot
- time axis compressed
- latitude transformed to heliocentric coordinates

1980 Hathaway

- non-linear latitude axis
- sunspot area coded using color
- time axis compressed more
- total area displayed as parallel plot

- **References**
  - » Tufte II, pp. 18-23

Micro/macro readings

- **motivations**
  - **interpretation arises directly from data**
  - **allows personal readings**
- **techniques**
  - **choose the right level of abstraction**
  - **careful handling of line weights**
  - **subtle labeling**

  - **References**
    - » Resistivity of copper, Tufte II, p. 39
    - » U.S. population distribution, Tufte I. p. 156-7

Small multiples

- **motivations**
  - used to show the "outermost" variable
  - engages human ability to find differences
- **techniques**
  - position slices within an eyespan
  - distort non-critical aspects to allow this
  - draw non-varying aspects identical

- **References**
  - » Consumer reports, Tufte I, p. 175
  - » Colton, rivers, Tufte II. p. 76

Graphic design

- **layering and separation**
  - **physical separation**
  - **variations in density**
  - **line weight**
  - **color**
- **color as a variable**
  - **pseudo-color scales**
  - **2D and 3D colorspaces**
  - **other shading parameters**

  - **References**
    - » Matterhorn, Tufte II, p. 81
    - » Sea of Japan, Tufte II, p. 91
    - » Two-variable color map, Tufte I, p. 153
    - » P.K. Robertson, TOG 4(4)

Things to avoid

- clutter
- chartjunk
- vibrating colors
- poor choice of scales
- inappropriate use of 3D
- etc.