Design World

Graphical Excellence

largely from Edward Tufte,

Graphical Excellence

Fundamental graphic designs include:

• Data maps: these involve placement of additional information spatially situated on a spatially explicit diagram.
• Time series: these involve plotting some data as it changes across time.
• Space-time narrative: plotting changes across both space and time.
• Relational graphics: designed to show the relationship between two or more data aspects.
Graphical Excellence

Start with reasonable data

A. New York stock prices
B. Solar radiation inverted,
C. London stock prices
For all months 1929

Data Maps

Age-adjusted death rates by cancer type for USA
(each some 21,000 numbers)

Can be considered at many levels from overall pattern to county by county detail

• High death rates in north east and around great lakes
• Low rates in band down middle
• Higher rates for men than women in south
• Hot spots; in Minnesota, Iowa, Nebraska, along the Missouri River
• Differences in cancer types by regions

Data Map

Grid map - Carved in stone in China

1137 – probably created 1100

Precision of coast and rivers remarkable

About 3 feet square

Nothing like it in Europe until the 1500s


Data Maps

1st data maps

Edmond Halley's 1686 map shows trade winds and monsoons

Data Maps

1686

Detail of trade winds map shows encoding—“the sharp end of each little stroke pointing out ... from whence the wind continually comes.”


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Data Map

Deaths by Cholera

Dr John Snow

1854


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Beyond Simple Screen Design
Data Maps

- 1.3 million galaxies
- North galactic pole in centre
- Number of galaxies counted in each of 2.27 million rectangles
- Clusters are evident
- Filaments maybe spurious

**Times Series**

Plot of radio emissions from Jupiter

Based on Voyager 2’s data 1979

Maximum intensity occurs when the north magnetic pole is tipped towards the spacecraft – indicating a northern hemisphere source.

Dual labels on horizontal axis indicate both date and distance from Jupiter (in terms of Jupiter’s radius)


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**Time Series**

New York Weather History- 1980

• Data density - 181 numbers/sq inch

Time Series

E. J. Marey. 1885. Train schedules from Paris to Lyon
Stations spaced according to distances, time from left to right

E.J. Marey, “La Methode Graphique,” (Paris 1885), p.20. This method is attributed to the French engineer, Irby (Tufte, 1983, p.31)

1981 – new express train – trip now 3 hours instead of 9
Time Series

*W. Playfair. 1759-1823.* 3 time series – prices, wages and reigns of Kings and Queens

Time Series

*E. Marey. 1885.*

Shows the lives, the reigns, and the state of war or peace.
Time Series

Diagrams of motion

Using white tape and black velvet, Marey created time series images.

E. J. Marey, (1830 – 1904)


Time Series

Small multiples

Outgoing mail from the US House of representatives – peaks every 2 years just before elections
Time Series

Adjusted data

This time series shows all

• the raw data
• the holiday and seasonal etc variations
• The adjusted date

However the vertical bars hide the December peaks


Space-time story

C. J. Minard, French engineer, 1851
Telling a story: Napoleon's march to Moscow – combines statistical diagrams and maps
Space-time story
Small multiples
Learn once
Invite comparisons

Los Angeles Times, July 22, 1979; based on work of G. McRae, California Institute of Technology. (Tufte, 1983, p.42)

E. Tufte: Visual Display of Quantitative Information

Space-time story
The life cycle of the Japanese beetle
Small multiples
Mixes space and time on the horizontal axis
Location relative to the ground surface on the vertical axis


E. Tufte: Visual Display of Quantitative Information
Slides by: Sheelagh Carpendale
Relational Graphics

More abstract designs

Circles represent area of country, line on left population in millions, line on the right taxes in millions (both measured on vertical scale). Slope direction positive or negative is significant but not slope magnitude due to the size of country affecting it.

In general 2 variables x and y related in some way so that we can determine the value of y for each value of x. Lambert drew a graphical derivation of the evaporation of water (figure on left):

- Starting with data for curve DEF – height of water in the capillary tube
- And curve ABC – the temperature

Slope of curve DEF is then taken at several places to derive the rate of evaporation

Measured rate is then plotted against the corresponding temperature.
Relational Graphics

Relationship of lung cancer to smoking


Relational Graphics

Small multiples for different countries.

Shows the lack of relationship between inflation and unemployment

Relational Graphics

Relationship between temperature and thermal conductivity of copper

Gathers data from several laboratories

Makes a clearer and stronger point by the collection

Connected points are from one publication

Different answers result from different impurities levels


Relational Graphics

Relationship between fear and rage on a dog’s facial expression

(Tufte 1983, p.50)
Relational Graphics

The varying sizes of white pine seedlings after growing for one season in sand containing different amounts of calcium, in parts per million in nutrient sand cultures.

Graphical Excellence - Summary

Designed for the presentation of interesting data – matter of substance, of statistics, and of design.

Graphical excellence consists of complex ideas communicated with clarity, precision and efficiency.

Graphical excellence is that which gives to the viewer the greatest number of ideas in the shortest time with the least ink in the smallest space.

- > ideas
- < time
- < ink
- < space

Graphical excellence is nearly always multivariate.

And is all about truth and integrity.