Graphical Excellence

is the well-designed presentation of interesting data

- substance
- statistics
- design

consists of complex ideas communicated with

- clarity
- precision
- efficiency

is that which gives the viewer

- the greatest number of ideas
- in the shortest time
- with the least ink
Graphical Excellence begins with Graphical Integrity
• Graphical Integrity
  • “not lying with statistics”
  • tell the truth about data
Examples of Infographics lacking integrity

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-$4,200,000
Examples of *Infographics* lacking integrity

The Visual Display of Quantitative Information

Commission Payments To Travel Agents
In millions of dollars

New York Times, 8/8/78
Examples of Infographics lacking integrity

Commission Payments To Travel Agents
In millions of dollars

New York Times, 8/8/78
Comparative Annual Cost per Capita for care of Insane in Pittsburgh City Homes and Pennsylvania State Hospitals.

South Mountain: $147
Pittsburgh: $172
Harrisburg: $198
Norristown: $213
Warren: $214

Let’s formalize **Distortion** in Infographics
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I think I see that area B is 3.14 times bigger than area A. Is that correct?
Let’s formalize **Distortion** in Infographics

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\[ \text{Perceived} = \text{Actual}^x \]
Let’s formalize **Distortion** in Infographics

I think I see that area B is 3.14 times bigger than area A. Is that correct?

\[ \text{Perceived} = \text{Actual}^x \quad x = 0.8 \pm 0.3 \]
• Perceived Area
  • grows more slowly than measured area
  • varies between people
  • changes with experience
  • changes with context
  • changes with loading
The Visual Display of Quantitative Information

- Guidelines
  - The measurement of the graphic should be in proportion to the quantity
  - Clear, detailed labels should explain distortion and events, on the graphic.

\[ \text{LieFactor} = \frac{\text{size of effect shown in graphic}}{\text{size of effect in data}} \]
The Visual Display of Quantitative Information

- Past and Future are reversed
- Foreshortening is confusing two issues
- Y-Scale is crazy
The Visual Display of Quantitative Information

This line, representing 18 miles per gallon in 1978, is 0.6 inches long.

This line, representing 27.5 miles per gallon in 1985, is 5.3 inches long.

REQURED FUEL ECONOMY STANDARDS: NEW CARS BUILT FROM 1978 TO 1985

19.1 mpg, expected average for all cars on road, 1985

13.7 mpg, average for all cars on road, 1978
• Design vs Data Variation
  • We expect that patterns will continue
• Don’t confuse design variation and data variation
The Visual Display of Quantitative Information

Nobel Prizes Awarded in Science, for Selected Countries, 1901-1974

(Number of Prizes)

- United States
- United Kingdom
- U.S.S.R.
- Germany
- France

NSF, 1974
The Visual Display of Quantitative Information

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United States

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NSF, 1974
The Visual Display of Quantitative Information

Nobel Prizes Awarded in Science, for Selected Countries, 1901-1980

(Number of Prizes)

United States

United Kingdom

U.S.S.R.

Germany

France


NSF, 1974

Thursday, November 8, 12
The Visual Display of Quantitative Information

OPEC Oil Prices: After 18 Months of Stability, Prices Are Due to Rise Again

Dollars per barrel

'73 '74 '75 '76 '77 '78

Jan. 1, 5% increase
April 1, 3.809% increase
July 1, 2.294% increase
Oct. 1, 2.691% increase

$13.34
$14.16

Quarterly

1979

During this time
1973–1978
January–March 1979
April–June 1979
July–September 1979
October–December 1979

one vertical inch equals
$8.00
$4.73
$4.37
$4.16
$3.92

During this time
1973–1978
1979
one horizontal inch equals
3.8 years
0.57 years

• design variation

\[ \text{LieFactor} = 15.1 \]
454% in data
4280% in graphic

\[ \text{LieFactor} = 9.4 \]
• 708% in data
• 6700% in graphic

$LieFactor = 9.5$
The Visual Display of Quantitative Information

- Good examples
- Adjusted dollar amounts for inflation
The Visual Display of Quantitative Information

- Good examples
- adjusted dollar amounts for inflation

![Diagram of energy prices and GDP ratio](image)
Good examples
adjusted dollar amounts for inflation
The Visual Display of Quantitative Information

- Good examples
- adjusted dollar amounts for inflation

OPEC Oil Prices: After 18 Months of Stability, Prices Are Due to Rise Again

The real price of oil is soaring again...

Crude oil price adjusted for inflation

Dollars per bbl. (1972 dollars)
The Visual Display of Quantitative Information

• Bad example

New York State
Total Budget Expenditures and Aid to Localities
In billions of dollars
Fiscal 1966-1976

Total Budget
$4.0
$4.6
$5.5
$6.2
$6.7
$7.4
$7.8
$8.5
$9.7
$10.7
$10.8

Total Aid to Localities*

1966-67
1967-68
1968-69
1969-70
1970-71
1971-72
1972-73
1973-74
1974-75
1975-76
1976-77

*Varying from a low of 56.7 percent of the total in 1970-71 to a high of 60.7 percent in 1972-73
The Visual Display of Quantitative Information

- Bad example

New York State Total Budget Expenditures and Aid to Localities in billions of dollars
Fiscal 1966-1976

Total Budget → $4.0

Total Aid to Localities*
*Varying from a low of 56.7 percent of the total in 1970-71 to a high of 60.7 percent in 1972-73

1966-67 $4.0
1967-68 $4.6
1968-69 $5.5
1969-70 $6.2
1970-71 $6.7
1971-72 $7.4
1972-73 $7.8
1973-74 $8.5
1974-75 $9.7
1975-76 $10.7
1976-77 $10.8

Estimated
Recommended
The Visual Display of Quantitative Information

- Bad example

New York State Total Budget Expenditures and Aid to Localities  In billions of dollars
Fiscal 1966-1976

Total Budget

Total Aid to Localities*

Varying from a low of 56.7 percent of the total in 1970-71 to a high of 60.7 percent in 1972-73

Thursday, November 8, 12
The Visual Display of Quantitative Information

- Bad example

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Thursday, November 8, 12
The Visual Display of Quantitative Information

• Done well
  • Adjusted for inflation
  • Adjusted for population
  • No chart junk

Per capita budget expenditures, in constant dollars

- $400
- $380
- $360
- $340
- $320
- $300


5%
The Visual Display of Quantitative Information

- Context is essential for graphical integrity
- Graphics must not quote data out of context
The Visual Display of Quantitative Information

Connecticut Traffic Deaths, Before (1955) and After (1956) Stricter Enforcement by the Police Against Cars Exceeding Speed Limit
The Visual Display of Quantitative Information

• **Summary**
  - The size of the graphic should match the size of the quantity
  - Labels, explanations and events should be on the graph
  - Data variation should dominate, not design variation
  - Time-series with money should be inflation adjusted and standardized
  - The number of dimensions of data should match the number of dimensions in the graphic
  - Graphics should be put in context

$LieFactor = 1.0$
Explore political ad spending through creative cartography. This animated map shows where superPACs and other outside groups spent their money — over a six-month period during the general election — to air political ads aimed at influencing the presidential race.

Credit: Adam Cole / NPR