Tufte’s Design Principles

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Based on slides from John Stasko, GTECH
Graphical Excellence

Principles

Graphical excellence is the well-designed presentation of interesting data---a matter of substance, of statistics, and of design. Graphical excellence consists of complex ideas communicated with clarity, precision and efficiency.
Graphical Excellence

Principles

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.

Graphical excellence is nearly always multivariate.

And graphical excellence requires telling the truth about the data.
Leveraging Human Capabilities

Data graphics should complement what humans do well

• What do we do well?

select, edit, single out, structure, highlight, group, pair merge, harmonize, compare, contrast, harmonize, synthesize, focus, organize, condense, reduce, boil down, choose, categorize/cluster, catalog, classify, list, abstract, scan, look into, idealize, isolate, discriminate, distinguish, screen, pigeonhole, pick over, sort, integrate, blend, inspect, filter, lump, skip, smooth, chunk, average, approximate, cluster, aggregate, outline, summarize, itemize, review, dip into, flip through, browse, glace over, leaf through, skim, refine, enumerate, glean, synopsize, winnow the wheat from the chaff, and separate the sheep from the goats

adapted from Tufte Vol 2, pg 50
Summary of Tufte’s Principles

1. Tell the truth
   Graphical integrity
2. Do it effectively with clarity, precision...
   Design aesthetics
1. Graphical Integrity

Your graphic should tell the truth about your data
Example

Stock market crash?
Chart Integrity: Use Proper Baseline

Vol1 Page 54
The 4G LTE Advantage

New 4G networks using LTE technology offer big improvements over their 3G and 2.5G predecessors. The average speeds were calculated based on millions of tests run on Speedtest.net, a service hosted by Ookla, throughout October 2011. U.S. averages were generated with additional data from RootMetrics.

<table>
<thead>
<tr>
<th>Country</th>
<th>4G Speed (Mb/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUSTRALIA</td>
<td>19.1</td>
</tr>
<tr>
<td>SWEDEN</td>
<td>16.1</td>
</tr>
<tr>
<td>UNITED STATES</td>
<td>14.9</td>
</tr>
<tr>
<td>GERMANY</td>
<td>8.6</td>
</tr>
<tr>
<td>SOUTH KOREA</td>
<td>8.0</td>
</tr>
<tr>
<td>JAPAN</td>
<td>6.9</td>
</tr>
</tbody>
</table>

SOURCE: OOKLA AND ROOTMETRICS
Chart Integrity: Maintain Proper Scale

The Changing General Fund/Lottery Revenue Outlook
(Quarterly Revenue Forecast Changes)

Change from March 2008 Forecast

Rep. Dennis Richardson
• 5 different vertical scales to show price

• 2 different horizontal scales to show time
  (based on comparison of image space units to value changes)
Fat Tire vs. Sunshine Wheat
Avoid Distortion

18 mpg in 1978, 0.6 inch line

27.5 mpg in 1985, 5.3 inch line
Measuring Misrepresentation

Visual attribute value should be directly proportional to data attribute value

Size of effect shown in graphic

\[
\text{Lie factor} = \frac{\text{Size of effect shown in graphic}}{\text{Size of effect in data}}
\]

Effect in data: \( 27.5 - 18.0 / 18.0 = 53\% \) increase

Effect in Image: \( 5.3 - 0.6 / 0.6 \) inches = 783% 

\[
\text{Lie} = \frac{783}{53} = 14.8
\]

Image Volume 1 Page 57
Size Encoding

Don’t use areas (or volume) to show one dimensional data

More generally, the number of information carrying dimensions $\leq$ number of data dimensions
Graphical Integrity

Additional Principles

1. Clear, detailed labels to defeat distortion and ambiguity
2. Show data variation, not design variation (avoid fancy chart tricks!)
3. Account for inflation (time & money)