Tradeoffs in Information Graphics

Andrew Gelman and Antony Unwin
Columbia University and University of Augsburg
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African Countries by GDP

TOP COUNTRIES BY GDP IN U.S. $ BILLIONS
Gross domestic product (GDP) refers to the market value of all final goods and services produced within a country in a given period (2005 - 2009).

GDP CALCULATION
private consumption + gross investment + government spending + (exports – imports)

$ 285.4 b
SOUTH AFRICA

$ 188.4 b
EGYPT

$ 173 b
NIGERIA

$ 140.6 b
ALGERIA

$ 91.4 b
MOROCCO

$ 75.5 b
ANGOLA

$ 62.3 b
LIBYA

$ 39.6 b
TUNISIA

$ 29.4 b
KENYA

$ 28.5 b
ETHIOPIA

$ 26.2 b
GHANA

$ 22.2 b
CAMEROON
The informative (but boring) stat graphic

African Countries by GDP

- South Africa
- Egypt
- Nigeria
- Algeria
- Morocco
- Angola
- Libya
- Tunisia
- Kenya
- Ethiopia
- Ghana
- Cameroon

GDP in billions of US dollars
Part 1: The Puzzle

• The “5 best data visualization projects of the year”
• We didn’t like any of them
• And we’re the kind of statisticians who *like* graphics!
Information visualization has become popular . . .

USA Today
... and parodied

The Onion
It can be done well . . .

*The Economist*
... but to what purpose?

New York Times
Advances in computer graphics . . .
From Pong and Space Invaders . . .
... to Grand Theft Auto
Statistical perspectives on graphics

• Theories of graphics:

• Graphs as alternative to statistical models
  – Tukey (1977)

• Graphs for comparisons
  – Cleveland (1985)

• Psychology research on “what works” . . .
Problems with effectiveness research

Research: Why Chart Junk is More Useful than Plain Graphs

“Yep, it has been scientifically proven: the accuracy of people in describing charts with 'chart junk' is no worse than for plain charts, and the recall after a 2-3 week gap was actually significantly better. In addition, people overwhelmingly preferred 'chart junk' diagrams . . .”

• But, before you go and slashdot this . . .
The “chartjunk” study is . . . junk!

- OK. Good chartjunk is better than crap chartjunk
Part 2: Different tools, different goals

• Can we uncover the differences between the values and priorities of infovis and statistical graphics?
5 Best Data Visualization Projects of the Year

December 19, 2008 to Featured, Visualization | Post on Twitter
Honorable mention: Wordle

Jonathan Feinberg, wordle.com
• Nathan Yau: “It's hard to say what exactly made Wordle so popular, but I [Yau] think it was a mix of randomness, aesthetics, and customization options”

• Our view: Visualization as a fun puzzle
#5. The Obama-Clinton divide


• Our view:
  – A pretty presentation of a bad model
  – Misleading picture of classification as “decision”
#3. Box office streamgraphs

Lee Byron
• Yau: “You can see Oscar contenders attract a smaller audience than the holiday and summer blockbusters and kind of slowly build an audience.”

• Our view:
  • Huh?
  • Better to display as two plots:
    (1) total sales over time, (2) trajectories for individual movies
  • Again, graph as puzzle
• Yau: “Discussion burst out across the Web . . . that I am convinced would not have come about if instead of a Streamgraph, they used say, a **stacked bar chart.**”  [emphasis added]
“5 Best Data Visualizations”: our view

- Eye-catching graphics
- State-of-the art methods in stat and comp sci
- No attempt to achieve the traditional goals of statistical graphics (communication, discovery)
Our resolution of the puzzle

• Statisticians:
  – Graphics as alternative to data tables and numerical data reductions (p-values, etc.)

• Graphic designers:
  – Information visualization as alternative to photos, cartoons, perfume, etc.

• How to get best of all worlds?
  – Shneiderman (1996):
    Overview, zoom and filter, details on demand
Winner of *Guardian* newspaper’s Visualization Contest

*Final Destination*
Density of fatal accidents 1942-2009

David McCandless
• Our view:
  – Display looks clean and efficient but isn’t!
  – Analogy to some modern architecture
Florence Nightingale’s coxcomb

http://www.Florence-Nightingale-Avenging-Angel.co.uk/Coxcomb.htm

DIAGRAM OF THE CAUSES OF MORTALITY
IN THE ARMY IN THE EAST.

The Areas of the blue, red, & black wedges are each measured from
the centre as the common vertex.
The blue wedges measured from the centre of the circle represent area
for area the deaths from Preventible or Mitigable Zymotic Diseases, the
red wedges measured from the centre the deaths from wounds, & the
black wedges measured from the centre the deaths from all other causes.
The black line across the red triangle in Nov. 1854 marks the boundary
of the deaths from all other causes during the month.
In October 1854, & April 1855, the black area coincides with the red,
in January & February 1856, the blue coincides with the black.
The entire areas may be compared by following the blue, the red & the
black lines enclosing them.
• Our view:
  – Excellent *infographic*—it’s attractive, grabby, thought-provoking
  – Graph as puzzle
  – Not a good *statistical graphic* does not push to deeper understanding
  – “Clock plot” as dead end
Mortality rates in the Crimean War from April 1854 to March 1856

Sanitary commission arrives

British Army Size in the Crimean War from April 1854 to March 1856
Health spending

(Oliver Uberti, National Geographic)

• Our view:
  – Image is dramatic but doesn’t convey data well
  – Arbitrary scaling
  – Try a scatterplot
Part 3: Software as friend or enemy

• Beautiful possibilities . . .
• But defaults can kill
  – Bar graphs and pie charts as standards
  – And it can get much worse . . .
Guess her height and weight

From blog of Kate Harding
Distribution of the guesses

Actual Stats
5'3.5" • 314 #
• Kate Harding: “To be honest, I’m not even sure how you're supposed to read this graph, and I'm the one who made it.”

• Our view:
  – We blame the software!
• Our point is not to mock
• We must communicate with authors of software as well as creators of graphs
• To paraphrase Keynes:

  Practical researchers, who believe themselves quite exempt from any graphical influence, are usually the slaves of some defunct software design

4) Which two countries give their patients the most time?
5) Which two countries give their patients the least time?
6) What colour is the UK slice?
7) Which country gives their patients about the same amount of time as the UK?

1) Now check your answers with those on the answer sheet.
Part 4: A positive example

Laura and Martin Wattenberg,
babynamewizard.com
• Excellent as infovis *and* as statistical graphics
  – Colors are informative rather than decorative
  – Axes go to zero and are labeled clearly but gently
  – Melding of static and interactive
John, James, George, Charles, Edward, . . .
Last letter of boys' names in 1950

Michael, David, Thomas, Larry, . . .
Ethan (#2), Jayden (4), Aiden (9), Mason (12), Logan (17), Benjamin (22), Ryan (23), Jackson (25), John (26), also 27, 28, 29, 31, 32, 36, 37, 40, ...
The trend in last letters of boys’ names

- The long tail . . . and the paradox of freedom
Part 5: Some practical tips

- Line plots and small multiples
- But not just “sparklines”
- Avoid the graphical equivalent of the data dump
- Don’t try to cram everything into one plot
- Combine graphics with text
  - A picture plus 1000 words is worth more than two pictures or 2000 words
Cleveland’s principle

• Always ask: What is the comparison?
• Example: an analysis from marketing

Sharad Goel,
Yahoo Research
Improvement?
Parallel coordinate plot is better

- Consider the **comparisons** you can make
Who do you want to be?

• George Orwell
• Martin Amis
• Pieter Breughel
• Scott Adams
• Chris Ware
• ?
Summary (1): Statistical graphics

• Displaying patterns clearly (Expected and unexpected)
• Alternative to tables and numerical summaries
• Comparisons
Summary (2): Infovis

- Engages the viewer
- Puzzles and the joy of recognition
- Data vis instead of photo or cartoon
- One single display
- The correspondence principle
Conclusions

• Infovis and stat graphics can work together
• But we should respect different goals and be open about tradeoffs
  – Puzzles vs. clarity
  – Originality vs. focus on comparisons
  ...
• Multiple displays