Beautiful Evidence
by Edward Tufte

Harriet King, CS 5090: Data Visualization  (November 11, 2010)
[Chapter One] Mapped Pictures: Images as Evidence and Explanation
Presentation Outline

- Brief Biography
- About the Book
- About the Chapter: Mapped Pictures
- Examples of Mapped Pictures
- Conclusion
- Sources
Edward R. Tufte

- Born 1942 in Missouri
- Beverly Hills High School
- Stanford BS and MS in Statistics
- Yale PhD Political Science (1968)
- Yale Professor Emeritus of Political Science, Statistics, and Computer Science
- Landscape Sculptor
Analytical Design Theorist

- "Leonardo da Vinci of Data" (NY Times)
- “Galileo of graphics” (Business Week)
- 1975 Princeton seminars on statistics to journalists
- Self Published 1983 gave him freedom
- Statistical evidence and scientific visualization
“A big intellectual move in my work and my teaching came together in [1990 book]... It essentially opened the entire world of visual evidence up so evidence was no longer statistical graphics – it was the whole world of seeing and thinking, bringing together how seeing and therefore thinking could be intensified.” (Tufte)
Example of Book’s Variety

Edward Tufte, “Dear Leader I” and “Millstones 5 and 6”, 2003-2004
(mild steel, diameter 13"8" or 4.2 meters)
Beautiful Evidence’s Contents

1) Mapped Pictures: Images as Evidence and Explanation
2) Sparklines: Intense, Simple, Word-Sized Graphics
3) Links and Causal Arrows: Ambiguity in Action
4) Words, Numbers, Images – Together
5) The Fundamental Principles of Analytical Design
6) Corruption in Evidence Presentations: Effects Without Causes, Cherry Picking, Overreaching, Chartjunk, and the Rage to Conclude
7) The Cognitive Style of PowerPoint: Pitching Out Corrupts Within
8) Sculptural Pedestals: Meaning, Practice, Depedestalization
9) Landscape Sculptures
Valid data visualizations turn seeing into showing

For both producers and consumers

- Evidence presentation is ethical and intellectual act
- Must understand and reason about evidence
Meaning of “Beautiful Evidence”

- Beautiful beyond being proof
- Used to judge quality, relevance, integrity
- Science and art share intense observing
Mapped Pictures: Images as Evidence and Explanation
A Mapped Picture

Edward Tufte, *Spring Arcs (2004)* solid stainless steel, arc diameter 12 feet
What are “Mapped Pictures”?

- Detailed annotations on images
- Credible
- Quantified
- Contextualized
- Clear Scale
Why Mapped Pictures?

Purpose:

- To present, explain, or document
- Mappings tell why an image matters
Minimal Mapping

- Stop sign
- Street sign
- Basic relative scale

David Hockney, *Nichols Canyon* (1980) acrylic on canvas
Notations as Evidence

Galileo’s drawing (1610)

- Scaled and annotated
- “credible quantitative evidence”
Notations as Evidence

Johann Bayer, *Uranometria* (Augsburg, 1603)

Bayer’s sky drawing

- Measured star strength
- Located on the grid
- Gives context
- Unknown filled with Leo the star myth
“unscaled and dequantified”

Problem with scientific deep space photos of today
Scale and Location

Problem:
- No scale given
- Same size
- Cross section location missing

Figure 1: Marcus Bloch, *Ichthyologie, our Histoire Naturelle Generale et Particuliere des Poissons* (1795)
Problem Solved

Solution:

- Give scale bar
- Add cross section mark

Figure 1: Marcus Bloch, *Ichthyologie, ou Histoire Naturelle Generale et Particuliere des Poissons* (1795)
Evidence Because:

- Credible precision
- Engineering diagram

Proves:
Humans as a commodity (347)

Published for the Religious Society of Friends in London, *Case of The Vigilante, A Ship Employed in the Slave-Trade* (1823)
Explanatory Mappings

Various points of view

Side by side vs. overlay

Paul Cezanne, *Still Life With a Basket (Kitchen Table)* (1890-95) oil on canvas, Musée d'Orsay, Paris

Erle Loran, *Cezanne’s Composition: Analysis of His Form with Diagrams and Photographs of His Motifs* (1943)
Explanatory Mappings Annoy Artists

- Lichtenstein’s response to Loran
- Irony that the satire of the diagrammed analysis ends up museum quality art
- Response: “Pop Artists or Copy Cats”

Roy Lichtenstein, *Man with Folded Arms*, 1962, oil on canvas, Museum of Contemporary Art, Los Angeles
After the fact mappings

Ernst Mossel, *Vom Geheimnis der Form und der Urform des Seins* (Stuttgart, 1938)

- Claim of universal structure beneath all art
- Not valid as evidence
La Cuisse, *Le Repertoire des bals ou théorie-pratique des contredanses décrites d’une manière aisee avec des figures demonstratives pour les pouvoir danser facilement* (1762, Paris)
Coherent multiple viewpoint

- Investigation of bird anatomy and flight
- Goal of constructing gliders
- Quantitative scale
- Cambered airfoil cross section
- Shifting angles as flapping wings torque
- Linked and oriented (a,b,c)
- Side view flying left

Otto Lilienthal, *Der Vogelflug als Grundlage der Fliegekunst* (1889, Munich and Berlin)
Instruction

- Diagram & text overlaid on image
- Content documentation and fluent art
- Words double as horizontal line

Multiple Views

St. Kirill of Belozersk with scenes from his life, silk cloth, early 16th century
Contextualizing

Guide for Visitors to Ise Shrine (Ise, Japan, 1948-1954)

Local detail and whole country in context
Historical Documents

- Detailed diagram in parallel
- Original not disturbed
- Affiliations and names document the history
- Avoid “dreaded letter code”

Images can map other images

- Relative scale
- Easy to compare
- Lines directing attention
- Needs a universal grid or measurement scale

Conclusion:
Mappings tell why the image matters

Well designed, thoughtfully mapped images combine:

- Direct visual evidence
- Power of diagrams

Most explanatory & evidential images should be mapped

- Including scale and context
- High standards for mappings as any evidence


Sources page 2

http://www.edwardtufte.com


www.wikipedia.org/

http://www.aiga.org/content.cfm/medalist-edwardtufte

http://www.yale.edu/polisci/people/etufte.html

http://thesaurus.com/
Questions?
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