The Visual Display of Quantitative Information
Envisioning Information
Visual Explanations

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Good graphics exemplify the principle of analytical design
The Story

• Charles Joseph Minard (1869) described the successive losses of lives in the French army during the invasion of Russia in 1812

• The best statistical graphic ever
  – Vivid historical content
  – Brilliant design
Let’s look at it closely

• First, a title announces the design method (figurative map), the subject (French army), and the author (Minard)
And …

- The color code, the scales of measurement, and data sources

Red: enter Russia
Black: leave Russia

1 mm/10K men

Data sources
Then the history begins
June 1812
The Nieman River

• On the Polish-Russian border near the Nieman River, the Grand Army had 422,000 men

• When the army arrived at Moscow in September, only 100,000 survived
Principle 1: Comparison

• Show comparisons, contrasts, and differences

Surviving Troops: 50,000 -> 28,000
Principle 2: Causality, Mechanism, Structure, Explanation

- Why nearly everyone in the Grand Army died?
  - The map only shows the locations of bad news, not the cause
  - Minard depicted a possible cause
Principle 3: Multivariate Analysis

- Minard’s Map depicted the war by 6 variables: size of army, 2D location, direction of army movement, temperature, and dates.
- Nearly all interesting worlds we seek to understand are multivariate in nature
- The only thing that is truly two dimensional is our display screen
  - Need to escape flatland
Principle 4: Integration of Evidence

• Minard’s Map contains words, numbers, images, and diagrams, all integrated together
  – The number of troops, invasion flow-lines in 2D space, temperatures and dates, and description by words

• Use transparency overlays

• What matters is the evidence, not a particular mode of evidence
Principle 5: Documentation

What is the display about? Losses in men of the French Army in the Russian Campaign 1812-1813.

Who did the work? Drawn up by M. Minard.


Where and when was the work done? Paris, November 20, 1869.

What are the data sources? The information which has served to draw up the map has been extracted from the orders of M. M. Thiers, of Segur, of Fizesac, of Chambray and the unpublished diary of Jacob, the surgeon of the Army since October 28th.

Any assumptions? In order to better judge with the eye the diminution of the army, I have assumed that the king of Prince Jerome and of Marshal Davoust, who had been detached at Minsk and Mogilev and have rejoined at Ockha and Vitebsk, had always marched with the army.

What are the scales of measurement?

- for invasion and retreat flow-lines: one millimeter for every ten thousand men
- for the underlying map: Common leagues of France (Map of Fizesac)
  
<table>
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<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
</tr>
</thead>
</table>
- for the temperature: degrees of the Réaumur thermometer below zero

Principle 6: Content Counts Most of All

• What matters the most: A good knowledge of the content and a deep caring about the substance
• The first question to ask: what are the content-reasoning tasks that this display is supposed to help with?
Principle 6: Content Counts Most of All

- What matters the most: A good knowledge of the content and a deep caring about the substance

- The most effective way to improve a presentation is to get better content!!
Recap of the principles

- Show comparisons
- Show causality
- Show multivariate data
- Integrating relevant evidence
- Documentation
- Contents count most of all
The General Principle

The principles of analytical design are derived from the principles of analytical thinking.