

Visualization Design

ID 413: Information Graphics and Data Visualization
Spring 2016

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<http://info-design-lab.github.io/ID413-DataViz/>

Tufte's design principles for graphical excellence

- Show the data
- Induce the viewer to think about the substance, rather than about methodology, graphic design, [or] the technology of graphic production
- Avoid distorting what the data have to say
- Present many numbers in a small space
- Make large data sets coherent
- Encourage the eye to compare different pieces of data
- Reveal the data at several levels of detail
- Serve a reasonably clear purpose
- Be closely integrated with the statistical and verbal descriptions

1. Organise

// PROGRAMM

MITTWOCH 21.04.2004

| | 12:00 | 13:00 | 14:00 | 15:00 | 16:00 | 17:00 |
|---------------------------------|-------|-------|-------|-------|-------|-------|
| LAGERHALLE | | | | | | |
| KUNSTHALLE DOMINIKANERKIRCHE | | | | | | |

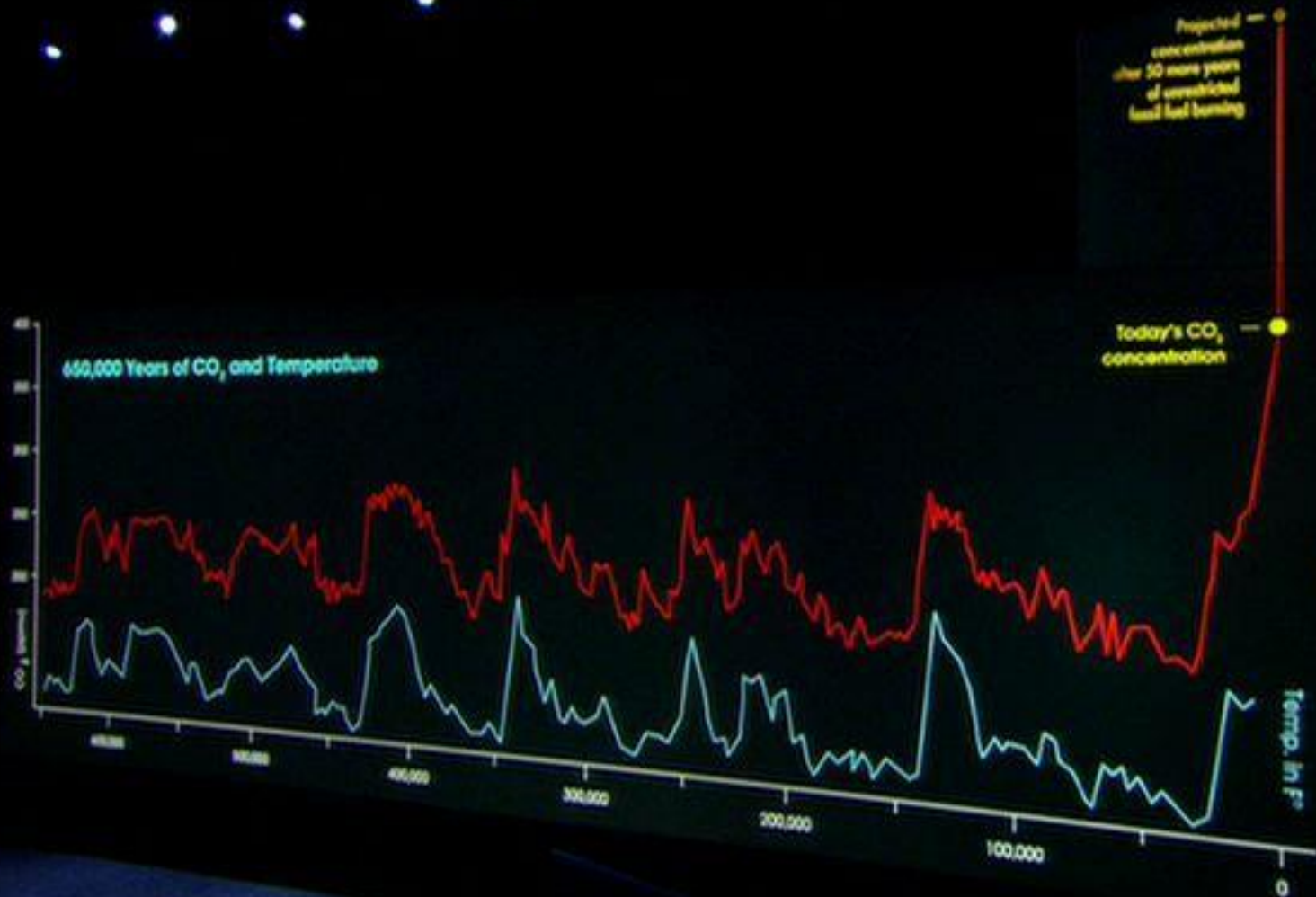
DONNERSTAG 22.04.2004

| | 12:00 | 13:00 | 14:00 | 15:00 | 16:00 | 17:00 |
|--------------------------|--|-------|--|---|--|--------------------------------|
| LAGERHALLE | BRAVE NEW WORLD 12:00 // 58 min | | ELSEWHERE 13:30 Le Gout du Escapisme // 66 min | MEMORIES ARE MADE OF THIS 14:00 // 64 min | JONAS AT THE OCEAN 15:00 // Peter Scupelli / Klaus / 2002 // 84 min | |
| ARTHOUSE 4 | | | | | DIE PERLE IN DER KACKE 16:30 // Dirk BBE / 82 min | EWIG 17:30 // -Artis |
| ARTHOUSE 5 | | | | | MIWATORI WA HADASHI DA 16:30 // Atsuna Marisaki / Japan 2003 // 114 min / 0 mD | ARAO 17:30 // Farb |
| HAUS DER JUGEND (HDJ) | STUDENT FORUM: MEDIA ACADEMIES / PART I 12:00 TAMAS Kyoto Christa Sommerer (A/JP) 13:00 Academy of Fine Arts, Prague Anetta Mona Chlosta (SE/CZ) | | | STUDENT FORUM: MEDIA ACADEMIES / PART II 14:00 HFG Offenbach Reinard Fapo (D) 15:00 AKI Tanabata Rie Sychawan (NL) 16:00 KRM Köln Karin Peters (D) | | |

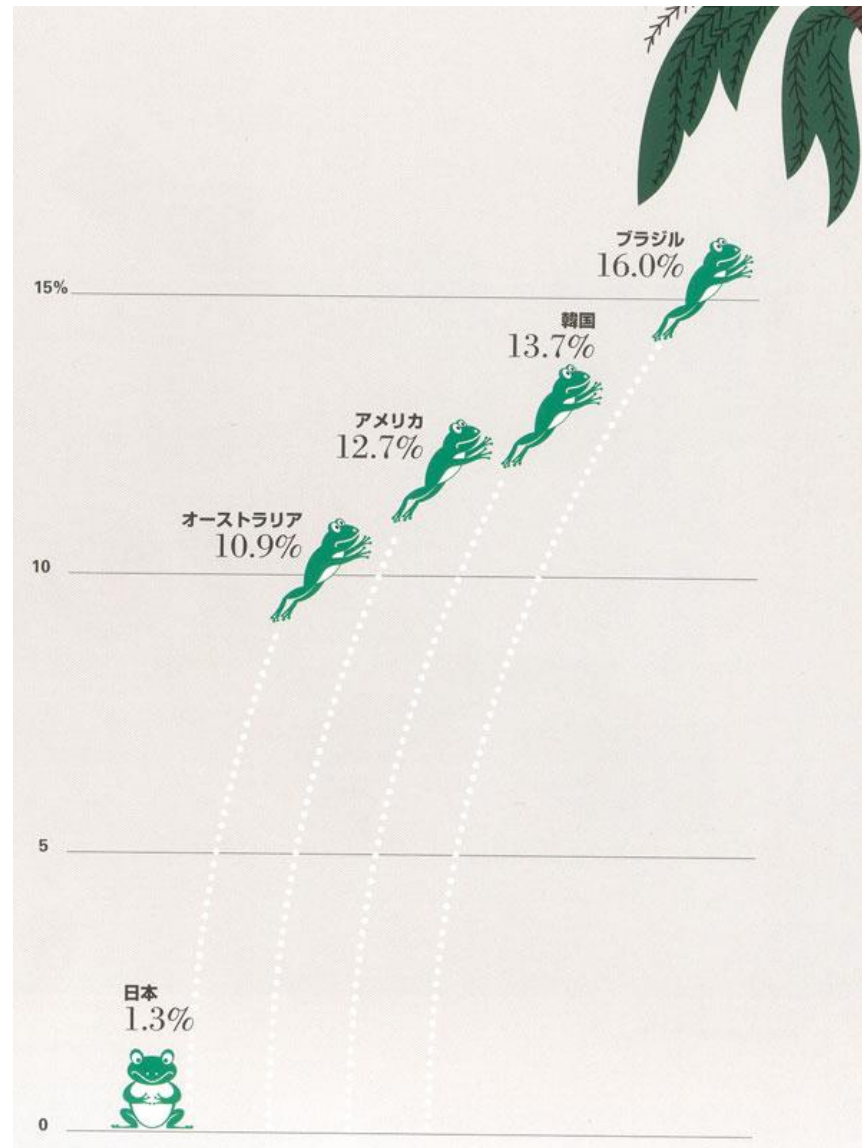
FREITAG 23.04.2004

| | 12:00 | 13:00 | 14:00 | 15:00 | 16:00 | 17:00 |
|--------------------------|--|---|---|--|---|---------------------------------|
| LAGERHALLE | SUICIDE 12:00 // Amsterdam Travelogue / 70 min | OFIF) BALANCE 13:30 // 60 min | RETROSPECTIVE: C. MACLAINE 14:00 // 10 min / 60 min | VISIONS OF DELIGHT 15:00 // 58 min | | |
| ARTHOUSE 4 | | | | | EWIGE SCHÖNHEIT 16:30 // Marcel Schuster / 90 min / mit Vor- film: «elkarina» | DIE P 17:30 // -Artis |
| ARTHOUSE 5 | | | | | VAMPIRE HUNTER 16:30 // Yoshiki Kawajiri / Japan 2000 // 105 min / 35mm / Deutsche Fassung | NIWA 17:30 // -Artis |
| HAUS DER JUGEND (HDJ) | TRANSMITTER PART I 12:00 Dr. Karja Kowalek, Wolf München / Irritation 13:00 Ren Feigold (USA) // Two-Arts 14:00 Tim Fritzsche/Chaos Computer Club (D) // Blinkenlights | | | TRANSMITTER PART II 15:00 Fadelman (D) // Transmitter, Transponder, RFID 16:00 Enric Rull Gell (E) // The Media House 17:00 -Artis | | |
| DGB-GEBÄUDE | | | | | | |

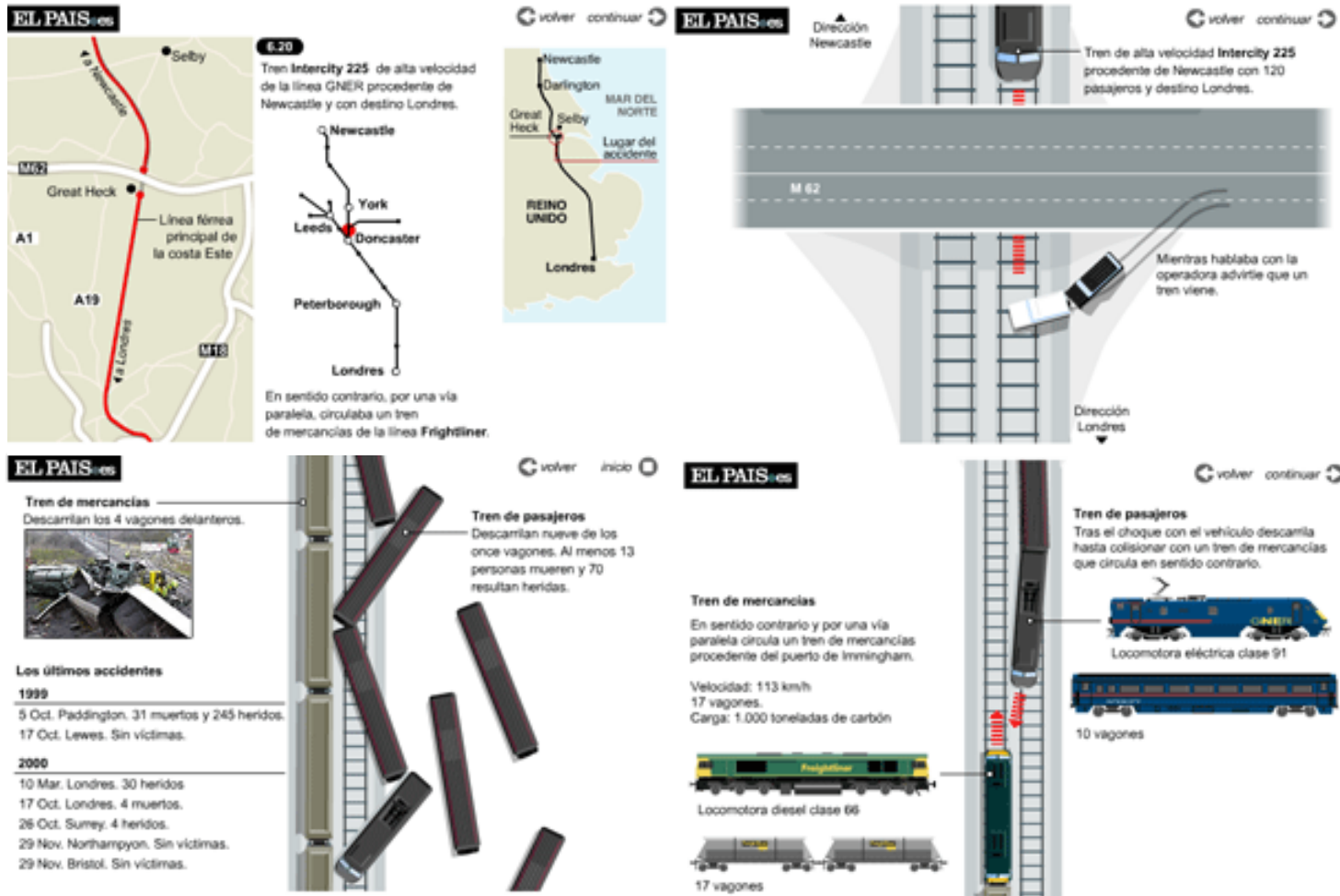
2. Make Visible



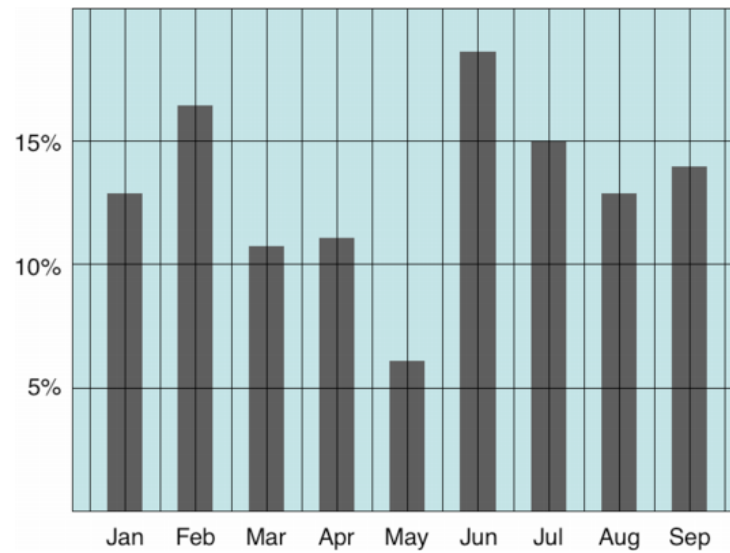
2. Make Visible



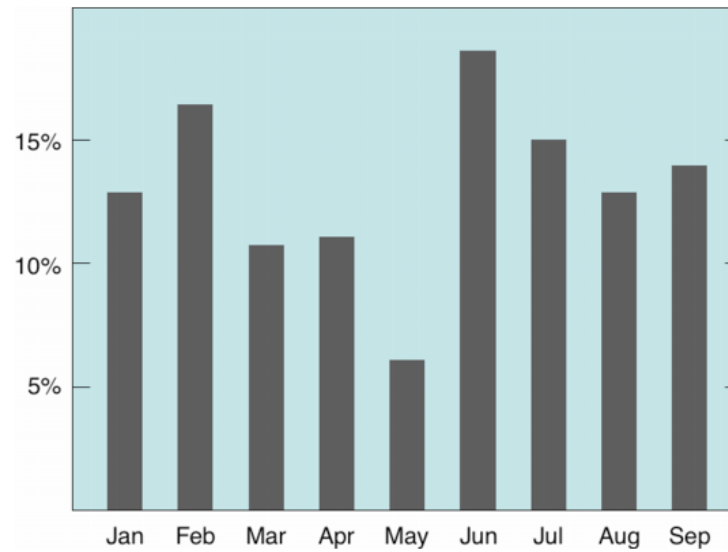
3. Establish Context



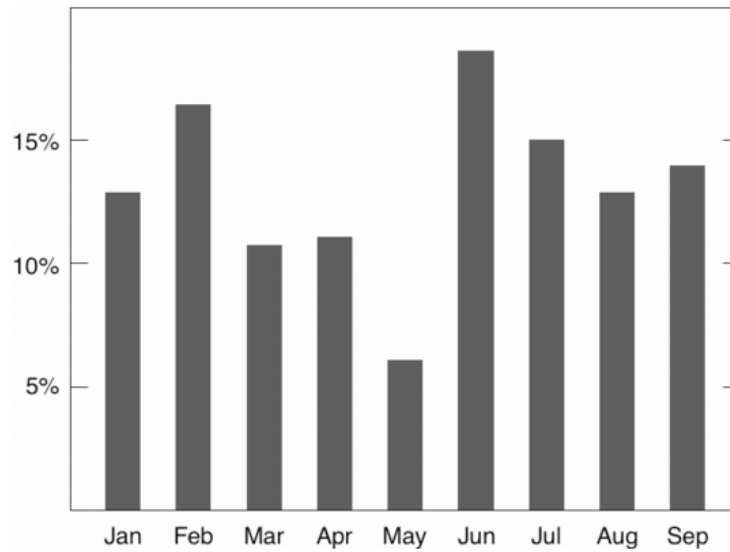
4. Simplify



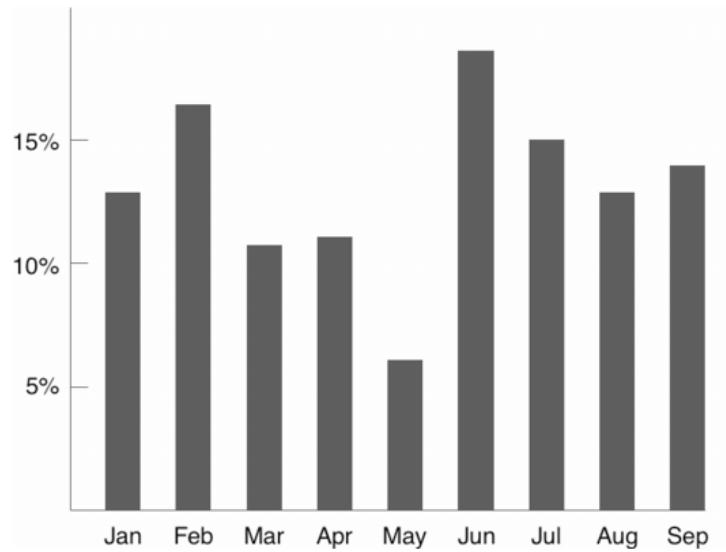
4. Simplify



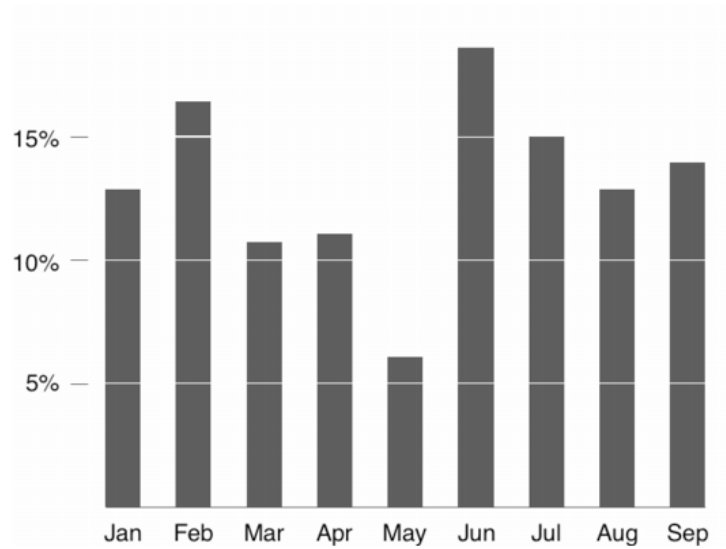
4. Simplify



4. Simplify

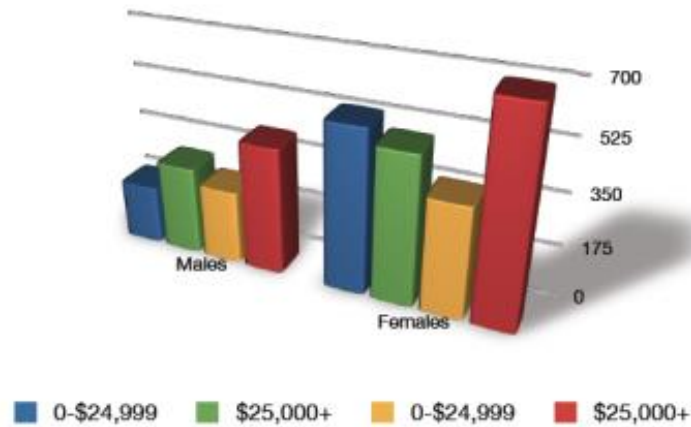


4. Simplify



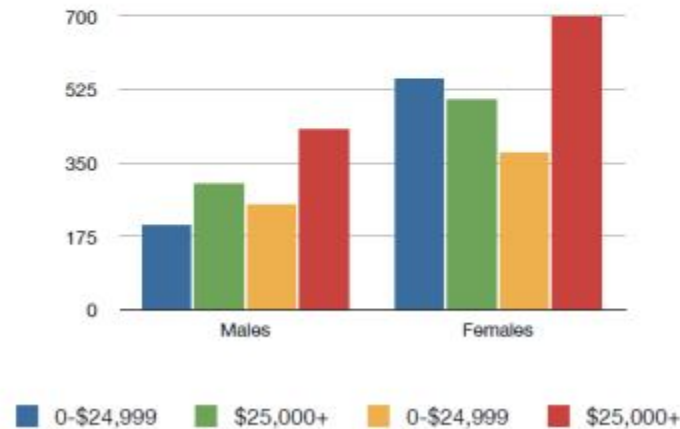
5. Maximize Data-Ink Ratio

$$\text{Data-Ink Ratio} = \frac{\text{Data ink}}{\text{Total ink used in graphic}}$$

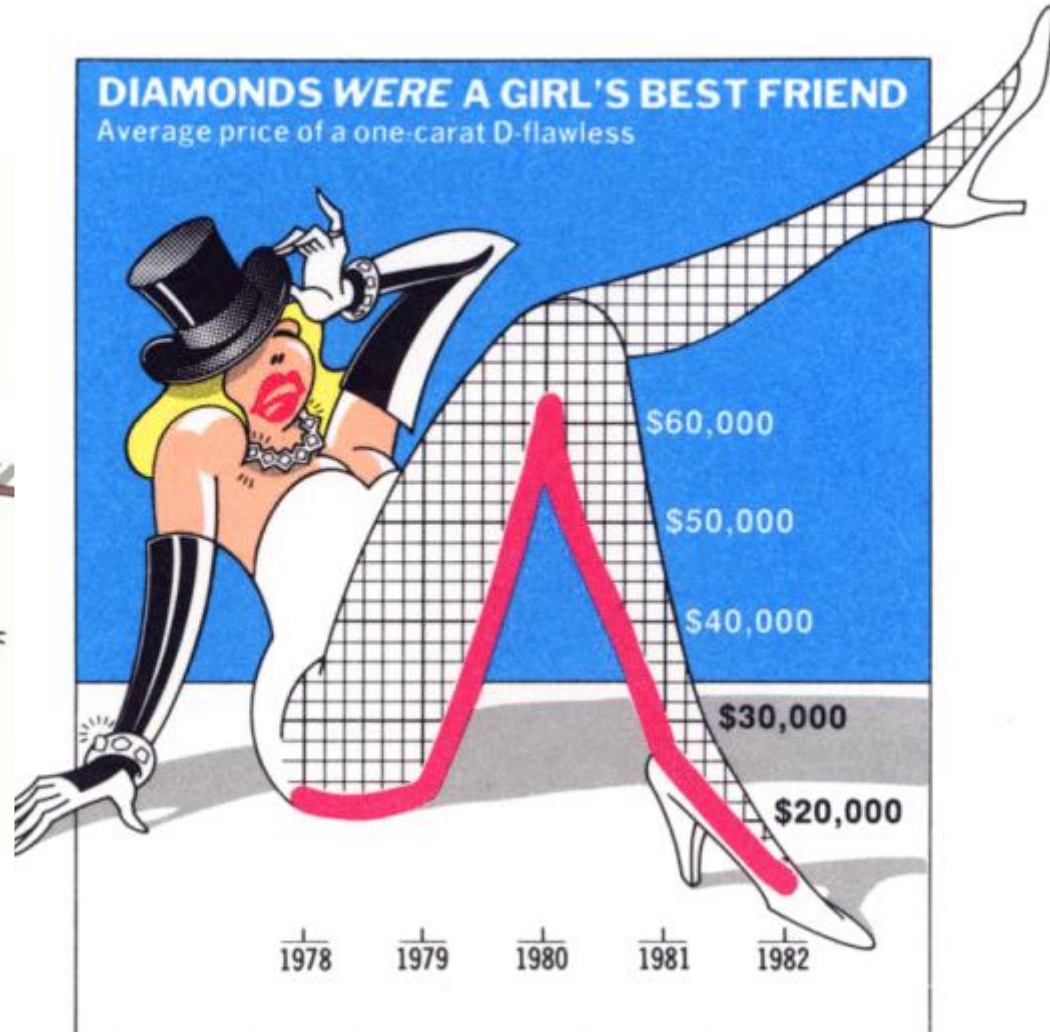
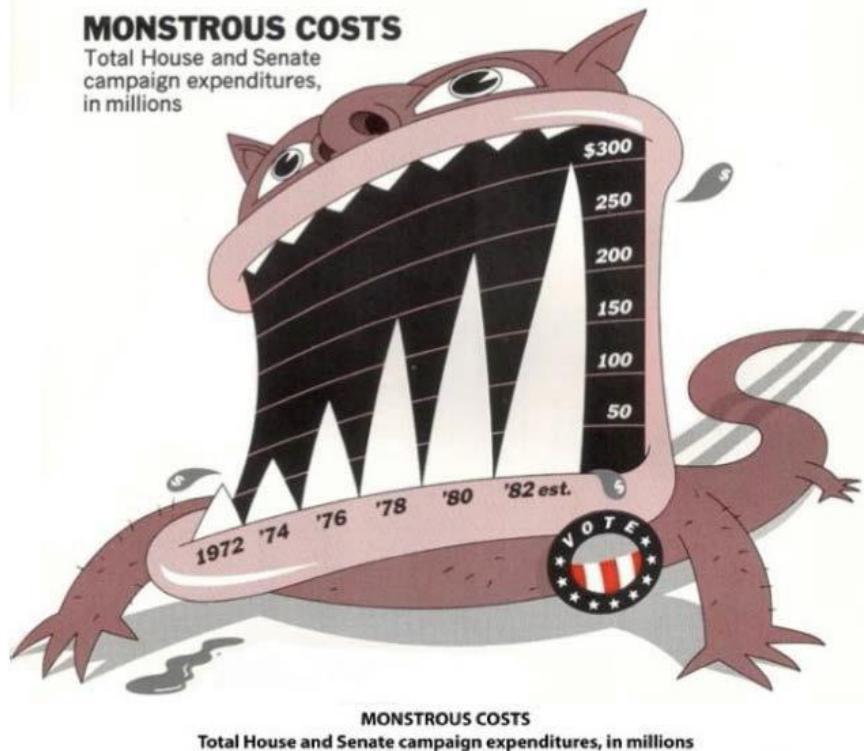


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5. Maximize Data-Ink Ratio



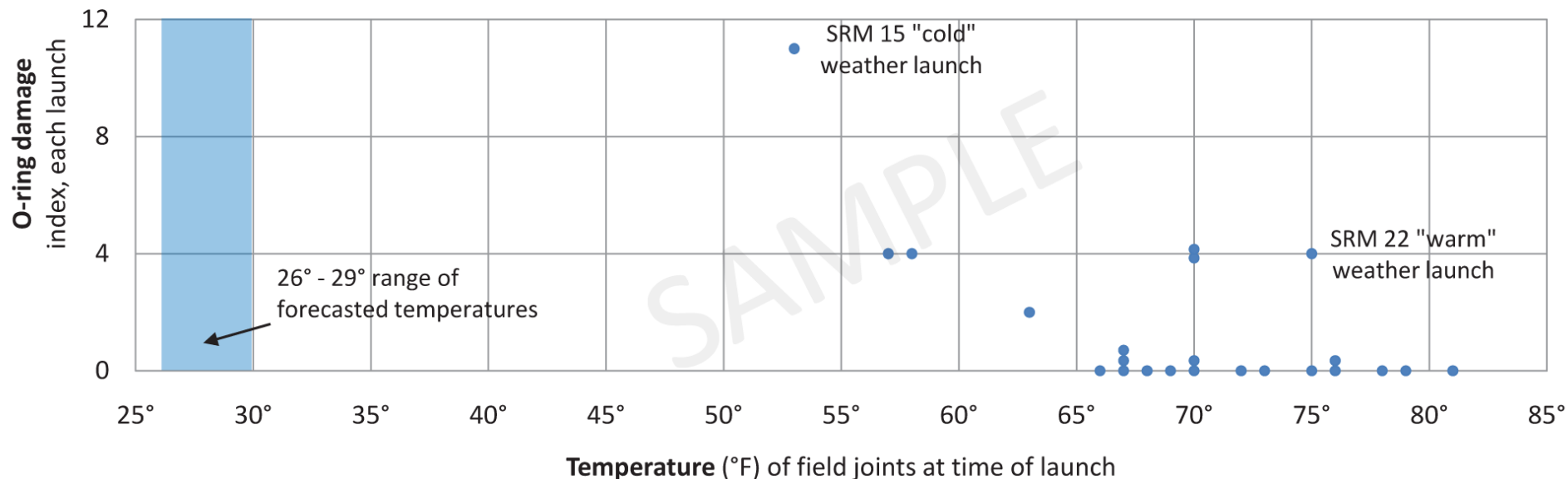
Nigel Holmes

6. Show Cause and Effect

Space Shuttle History of Temperature and O-ring Damage

For All 24 Launches Prior to Challenger on January 28, 1986

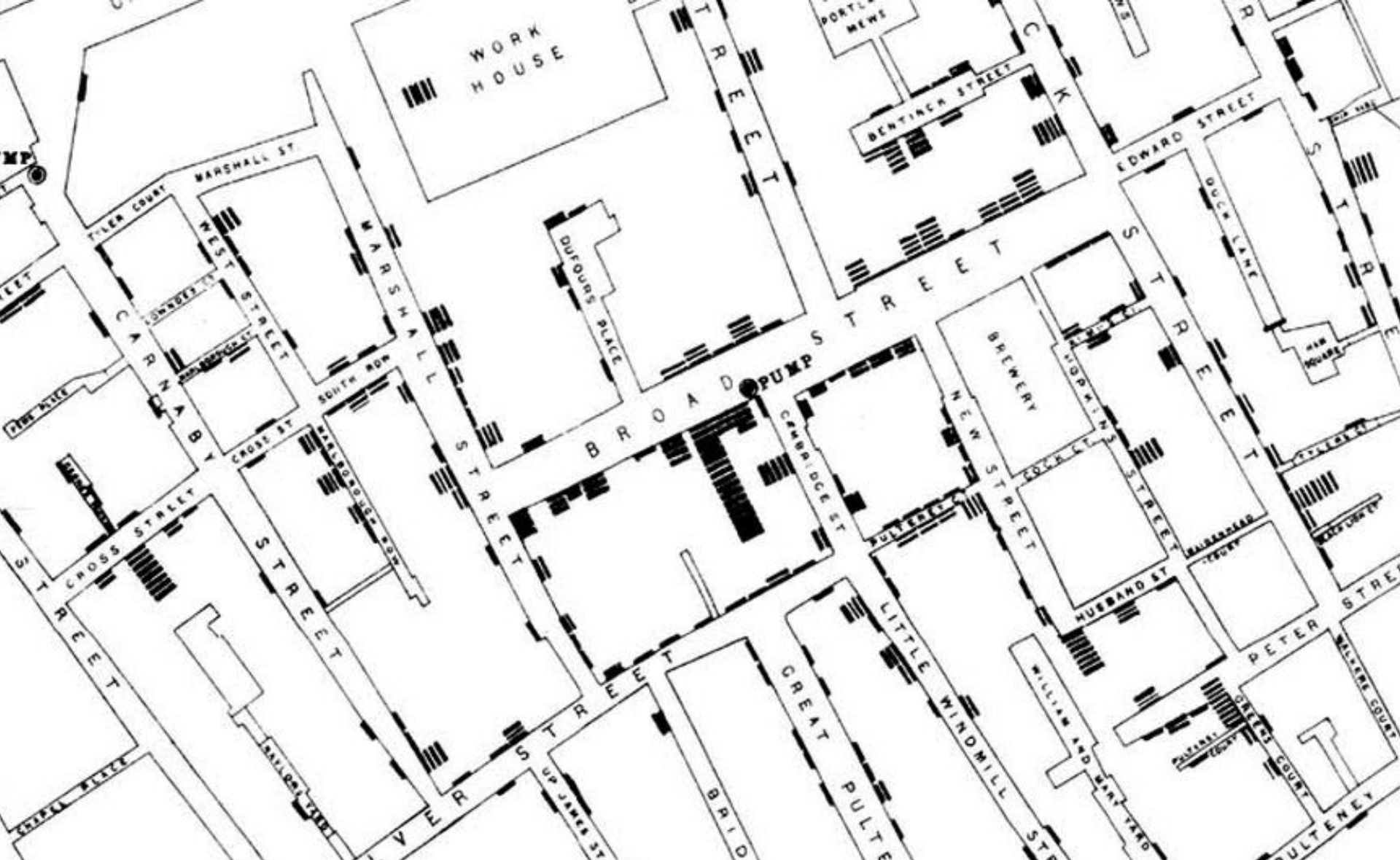
Solid Rocket Motor (SRM) 15 and SRM 22 were the only prior launches discussed in relation to temperature on the eve of the launch.



Sources: Presidential Commission on the Space Shuttle Challenger Accident (PCSSCA) and Post-Challenger Evaluation of Space Shuttle Risk Assessment and Management as quoted in **Visual and Statistical Thinking** by Edward Tufte.

© Joe Bobcat

6. Show Cause and Effect



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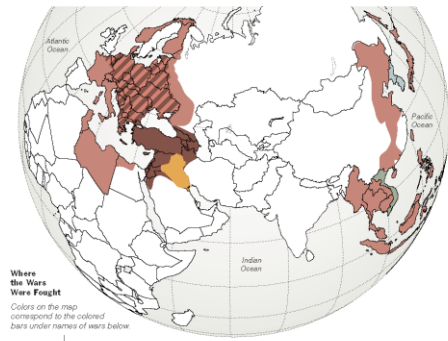
Magician Teller's definition of magic:

"The theatrical linking of a cause with an effect that has no basis in physical reality, but that — in our hearts — ought to."

7. Compare and Contrast

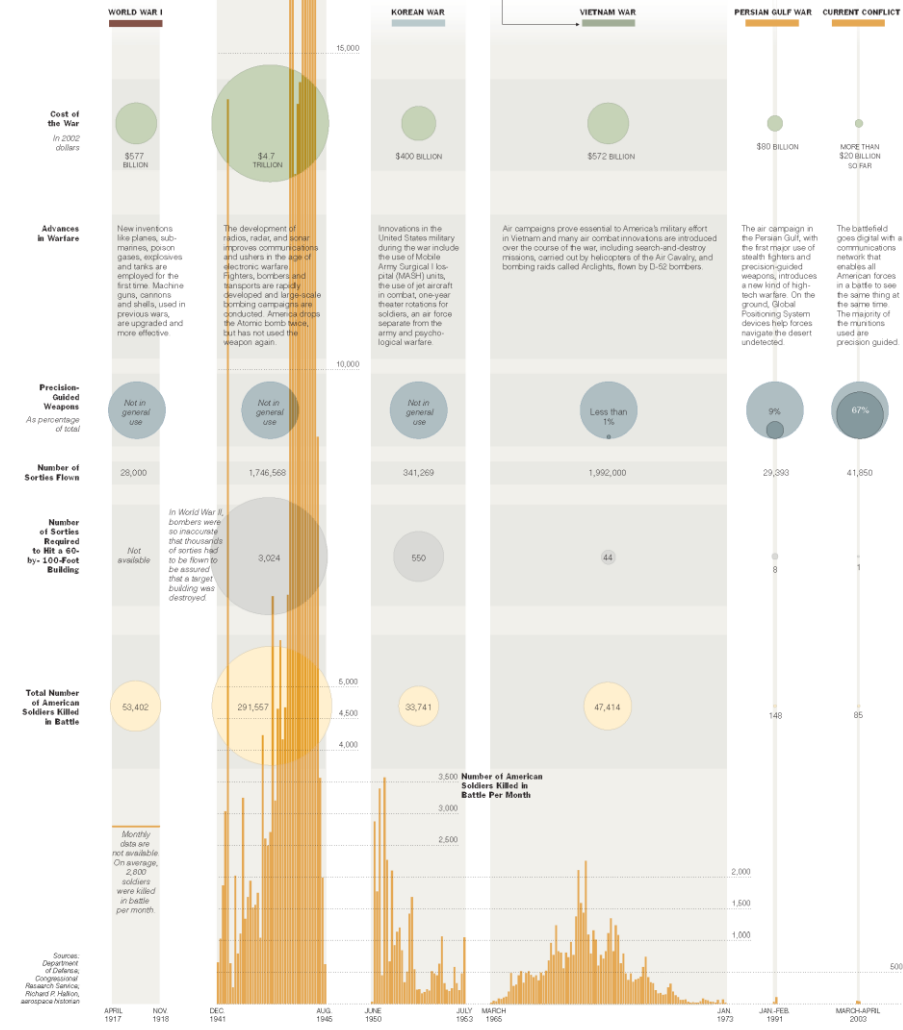
In Perspective: America's Conflicts

The current conflict in Iraq has ushered in the age of digital warfare. Over the years, as technological advances changed the way America fought its wars, casualties in the battlefield and the cost of war tended to fall.



Where the Wars Were Fought

Colors on the map correspond to the colored bars under names of wars below



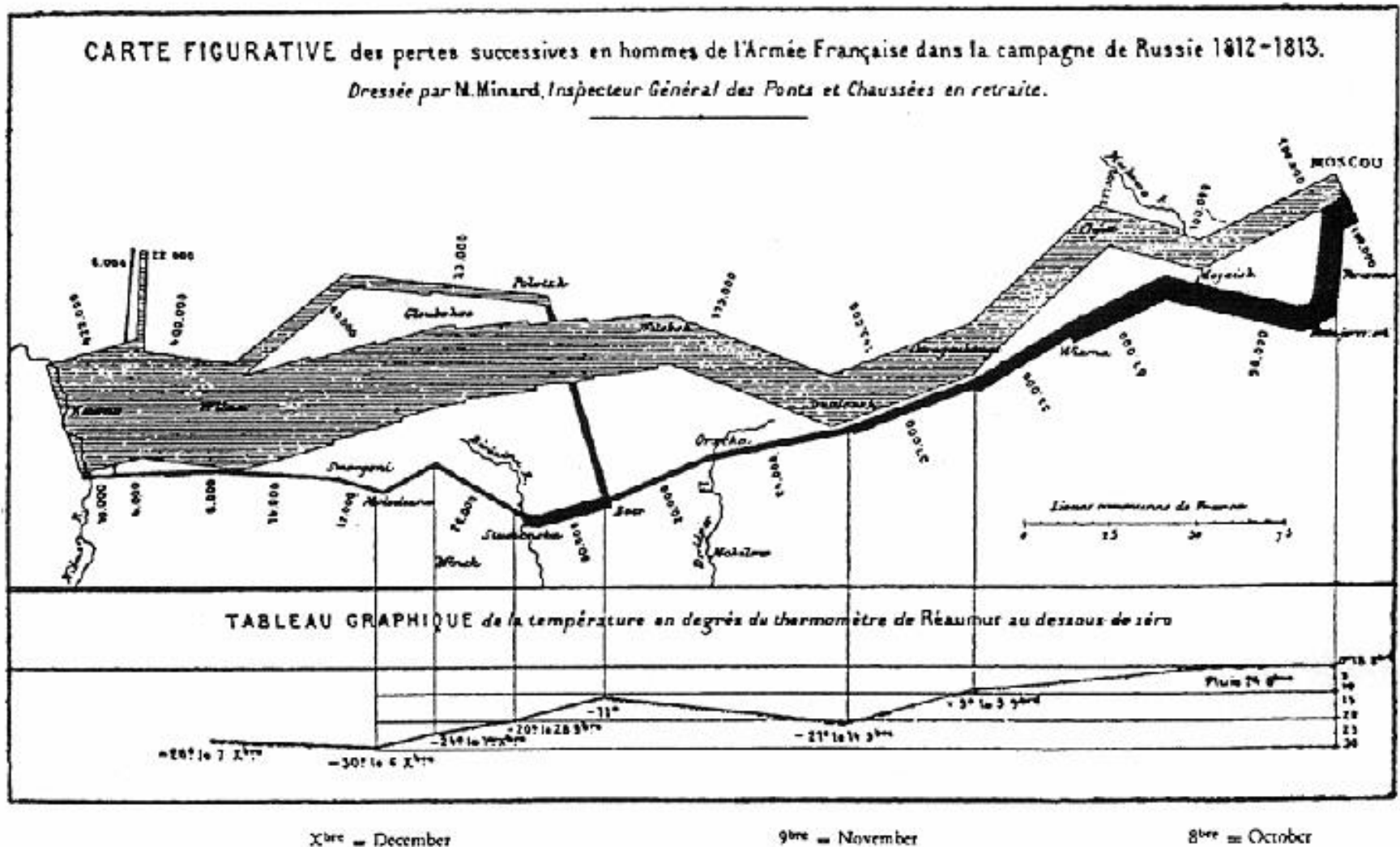
7. Compare and Contrast

The Fallen of World War II is an interactive documentary that examines the human cost of the second World War and the decline in battle deaths in the years since the war. The 15-minute data visualization uses cinematic storytelling techniques to provide viewers with a fresh and dramatic perspective of a pivotal moment in history.

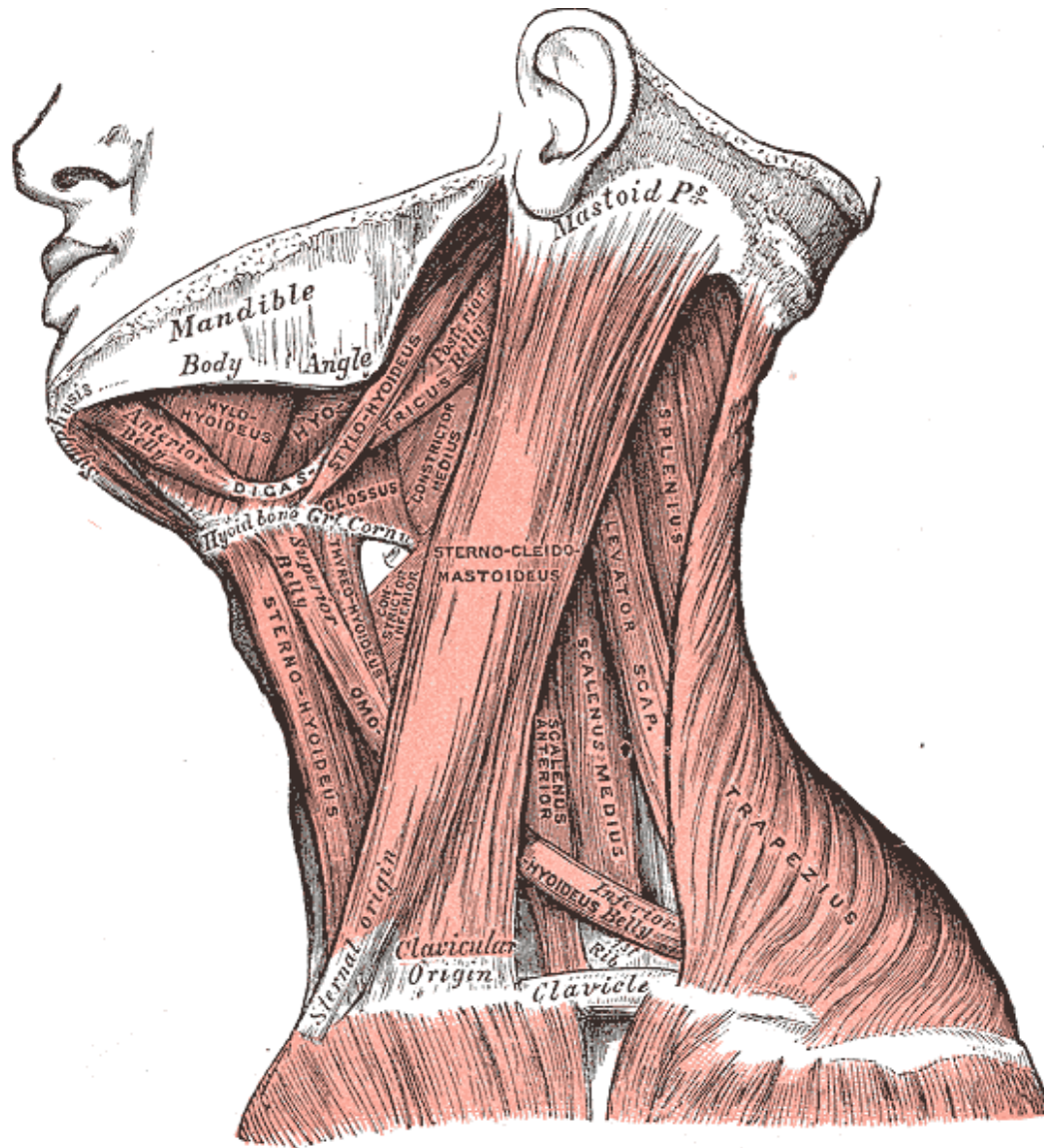
The film follows a linear narration, but it allows viewers to pause during key moments to interact with the charts and dig deeper into the numbers.

<http://www.fallen.io/ww2/>

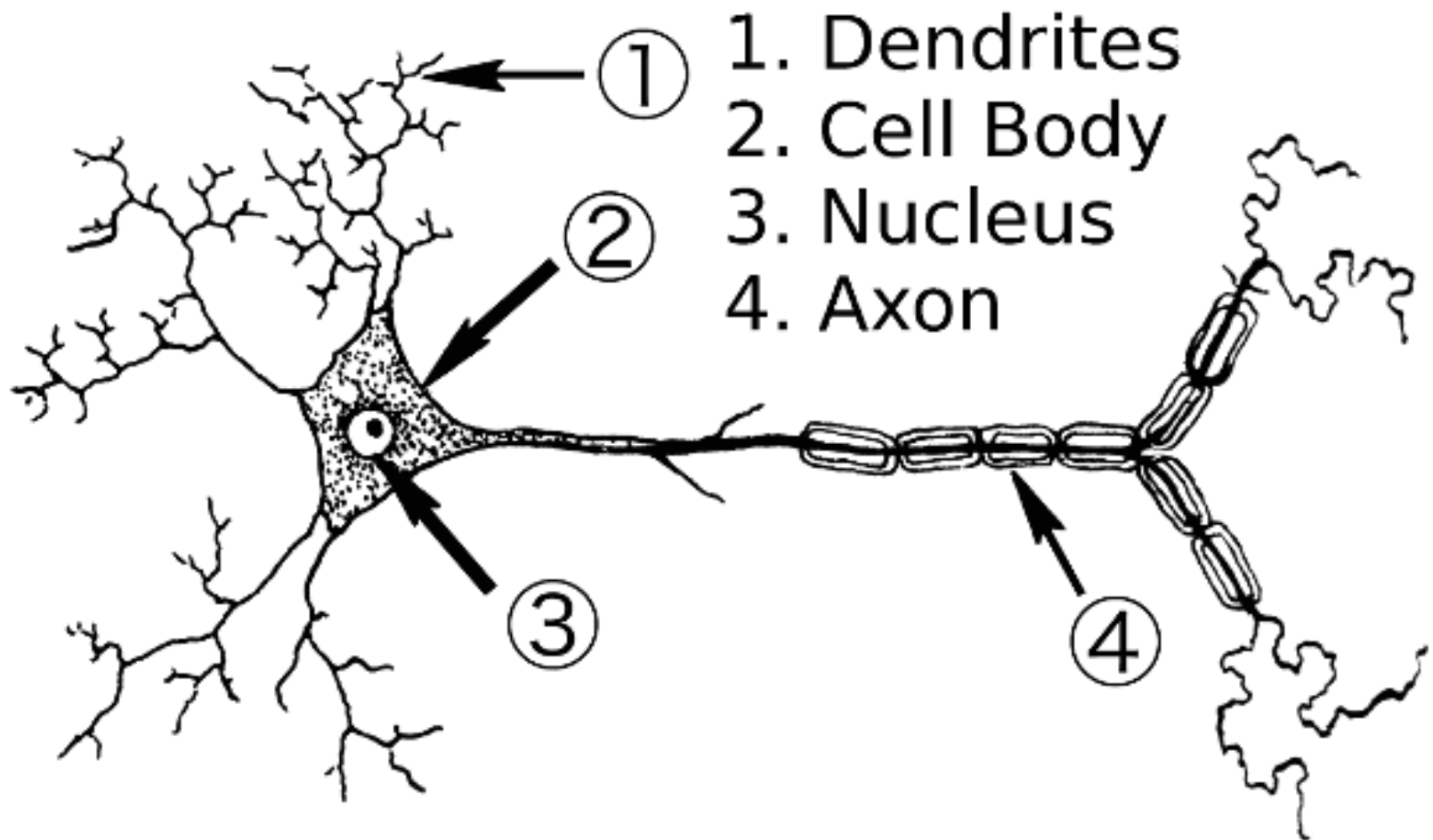
8. Show Multiple Dimensions



9. Integrate



9. Integrate



Case Study: Antibiotic Effectiveness

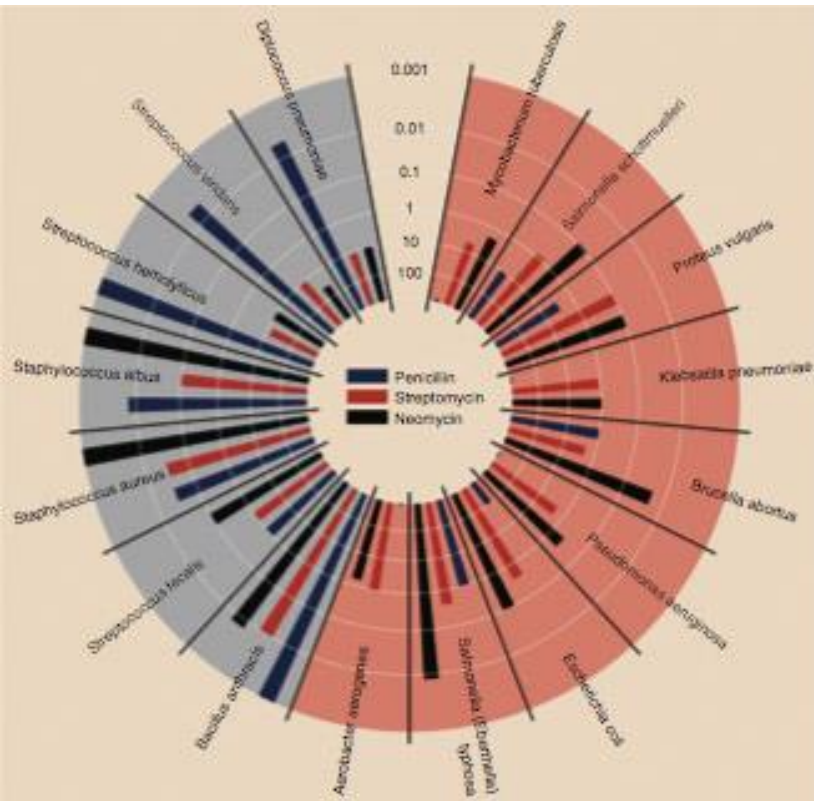
- In 1951, Will Burtin published a graphic display that was admired for the clarity and economy with which it showed the efficacy of three antibiotics on 16 different kinds of bacteria
- The dependent variable was the minimum concentration of the drug required to prevent the growth of the bacteria in vitro—the minimum inhibitory concentration (MIC)
- The three drugs were penicillin, neomycin and streptomycin, and their efficacy varied over six orders of magnitude
- The scale varies from 1,000 micrograms per milliliter to .001 micrograms per millilitre
- Lower is better, indicating less antibiotic is needed to treat the bacteria

Burtin's dataset: What questions might we ask?

Table 1: Burtin's data.

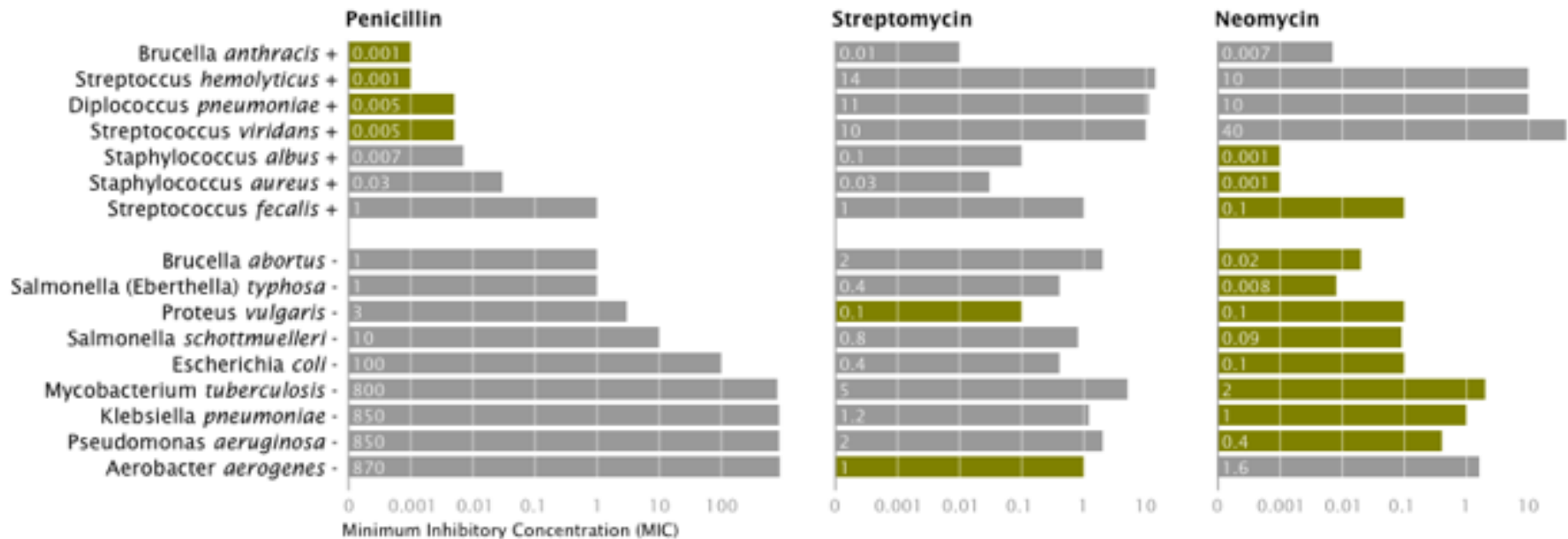
| Bacteria | Antibiotic | | | Gram Staining |
|--|------------|--------------|----------|---------------|
| | Penicillin | Streptomycin | Neomycin | |
| <i>Aerobacter aerogenes</i> | 870 | 1 | 1.6 | negative |
| <i>Brucella abortus</i> | 1 | 2 | 0.02 | negative |
| <i>Brucella anthracis</i> | 0.001 | 0.01 | 0.007 | positive |
| <i>Diplococcus pneumoniae</i> | 0.005 | 11 | 10 | positive |
| <i>Escherichia coli</i> | 100 | 0.4 | 0.1 | negative |
| <i>Klebsiella pneumoniae</i> | 850 | 1.2 | 1 | negative |
| <i>Mycobacterium tuberculosis</i> | 800 | 5 | 2 | negative |
| <i>Proteus vulgaris</i> | 3 | 0.1 | 0.1 | negative |
| <i>Pseudomonas aeruginosa</i> | 850 | 2 | 0.4 | negative |
| <i>Salmonella (Eberthella) typhosa</i> | 1 | 0.4 | 0.008 | negative |
| <i>Salmonella schottmuelleri</i> | 10 | 0.8 | 0.09 | negative |
| <i>Staphylococcus albus</i> | 0.007 | 0.1 | 0.001 | positive |
| <i>Staphylococcus aureus</i> | 0.03 | 0.03 | 0.001 | positive |
| <i>Streptococcus fecalis</i> | 1 | 1 | 0.1 | positive |
| <i>Streptococcus hemolyticus</i> | 0.001 | 14 | 10 | positive |
| <i>Streptococcus viridans</i> | 0.005 | 10 | 40 | positive |

Burtin's dataset: How do the drugs compare?



| Bacteria | Penicillin | Antibiotic Streptomycin | Neomycin | Gram stain |
|--|------------|-------------------------|----------|------------|
| <i>Aerobacter aerogenes</i> | 870 | 1 | 1.6 | — |
| <i>Brucella abortus</i> | 1 | 2 | 0.02 | — |
| <i>Bacillus anthracis</i> | 0.001 | 0.01 | 0.007 | + |
| <i>Diplococcus pneumoniae</i> | 0.005 | 11 | 10 | + |
| <i>Escherichia coli</i> | 100 | 0.4 | 0.1 | — |
| <i>Klebsiella pneumoniae</i> | 850 | 1.2 | 1 | — |
| <i>Mycobacterium tuberculosis</i> | 800 | 5 | 2 | — |
| <i>Proteus vulgaris</i> | 3 | 0.1 | 0.1 | — |
| <i>Pseudomonas aeruginosa</i> | 850 | 2 | 0.4 | — |
| <i>Salmonella (Eberthella) typhosa</i> | 1 | 0.4 | 0.008 | — |
| <i>Salmonella schottmuelleri</i> | 10 | 0.8 | 0.09 | — |
| <i>Staphylococcus albus</i> | 0.007 | 0.1 | 0.001 | + |
| <i>Staphylococcus aureus</i> | 0.03 | 0.03 | 0.001 | + |
| <i>Streptococcus fecalis</i> | 1 | 1 | 0.1 | + |
| <i>Streptococcus hemolyticus</i> | 0.001 | 14 | 10 | + |
| <i>Streptococcus viridans</i> | 0.005 | 10 | 40 | + |

Burtin's dataset: How do the drugs compare?

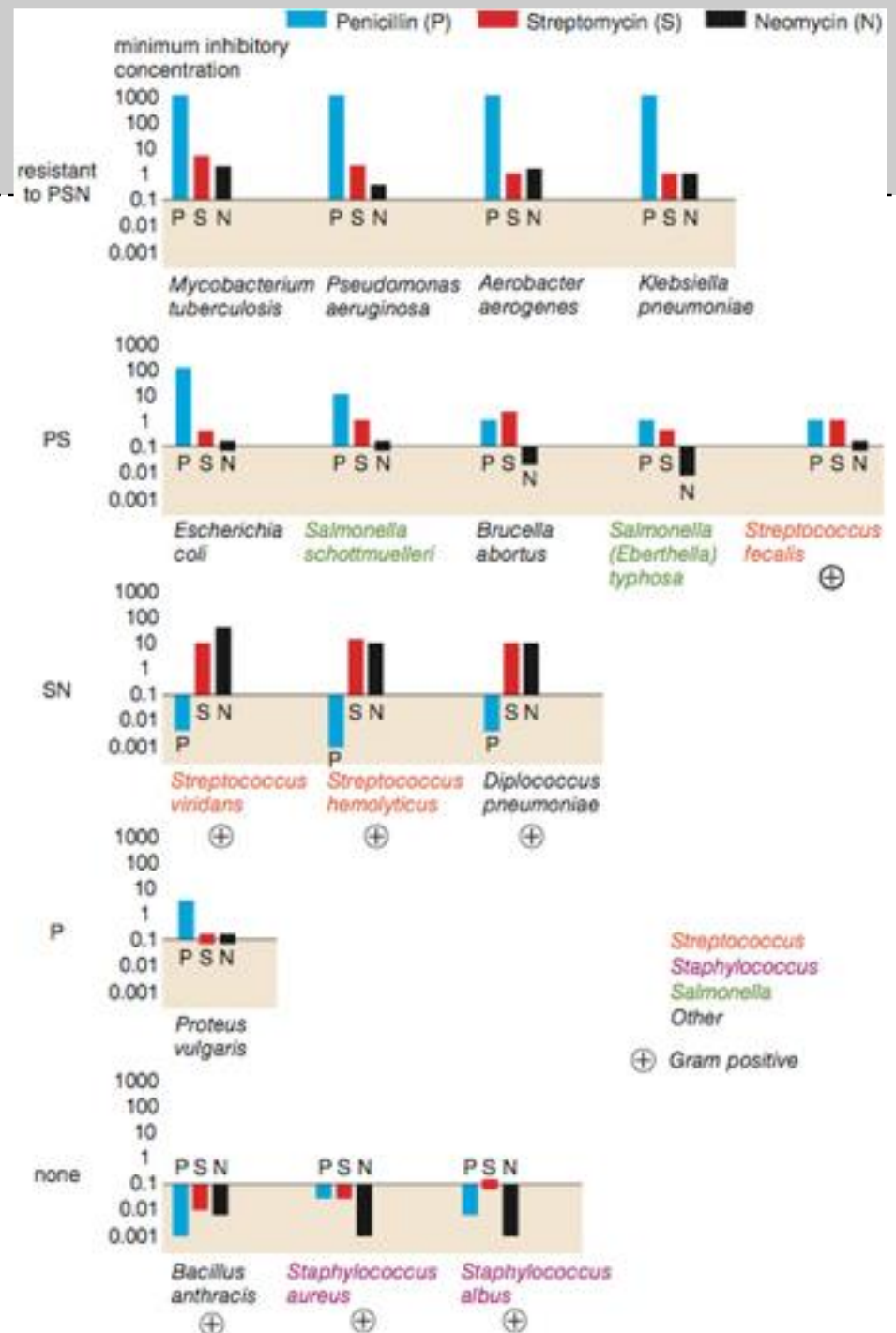


X-axis: Antibiotic | $\log(\text{MIC})$

Y-axis: Gram-Staining | Species

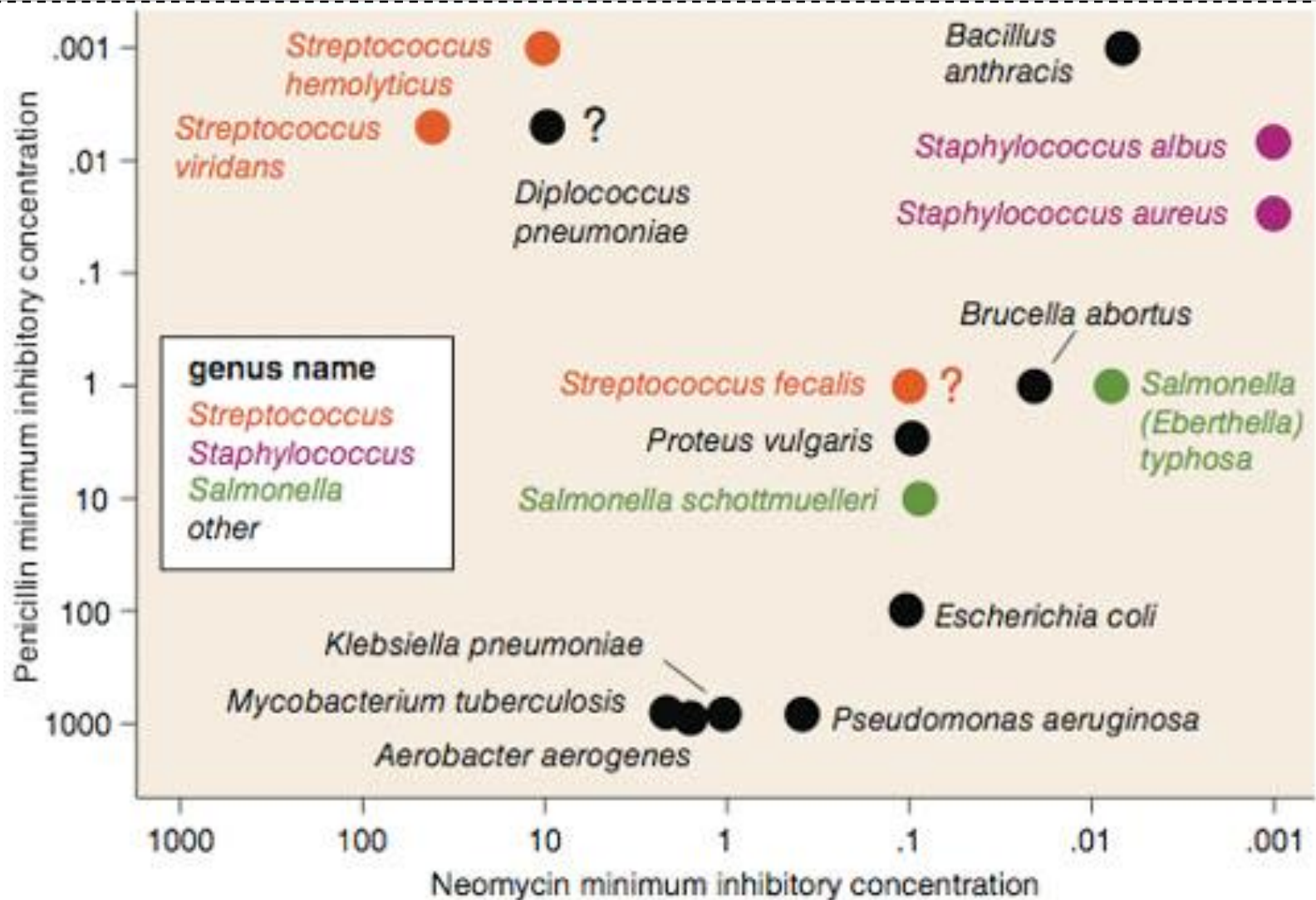
Colour: Most-Effective

Do bacteria group by antibiotic resistance?



Wainer & Lysen
American Scientist, 2009

Do different antibiotics correlate?



Lesson: Iterative Exploration

Exploratory Process:

1. Construct graphics to address questions
2. Inspect "answer" and assess new questions
3. Repeat...

Transform data appropriately (e.g., invert, log)

"Show data variation, not design variation" -Tufte

Visualization Taxonomy

Comparison
Proportion
Distribution
Correlation

Data Visualization Process & Graphs
Hanspeter Pfister's slides on visualization taxonomy

Chart Suggestions—A Thought-Starter

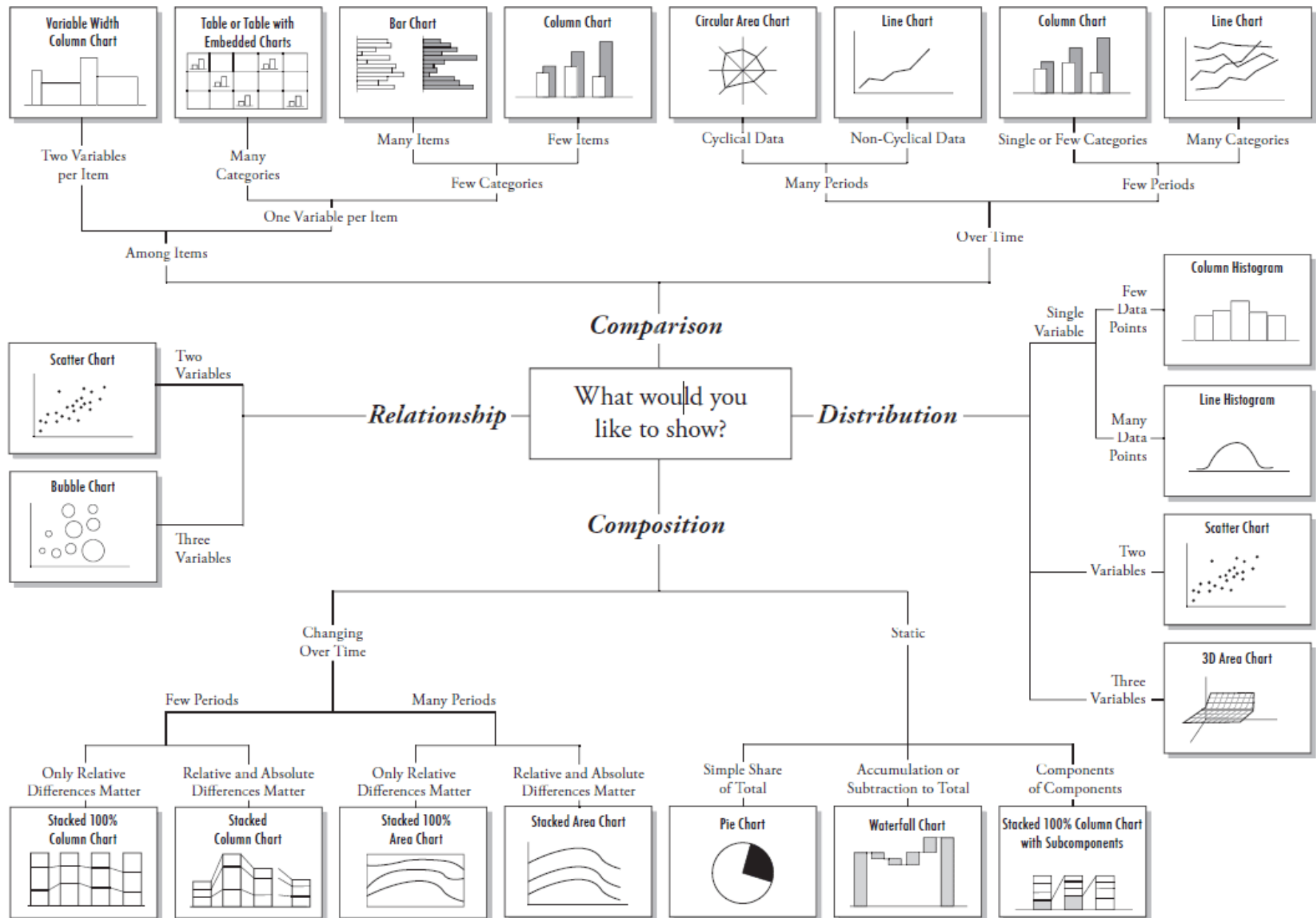
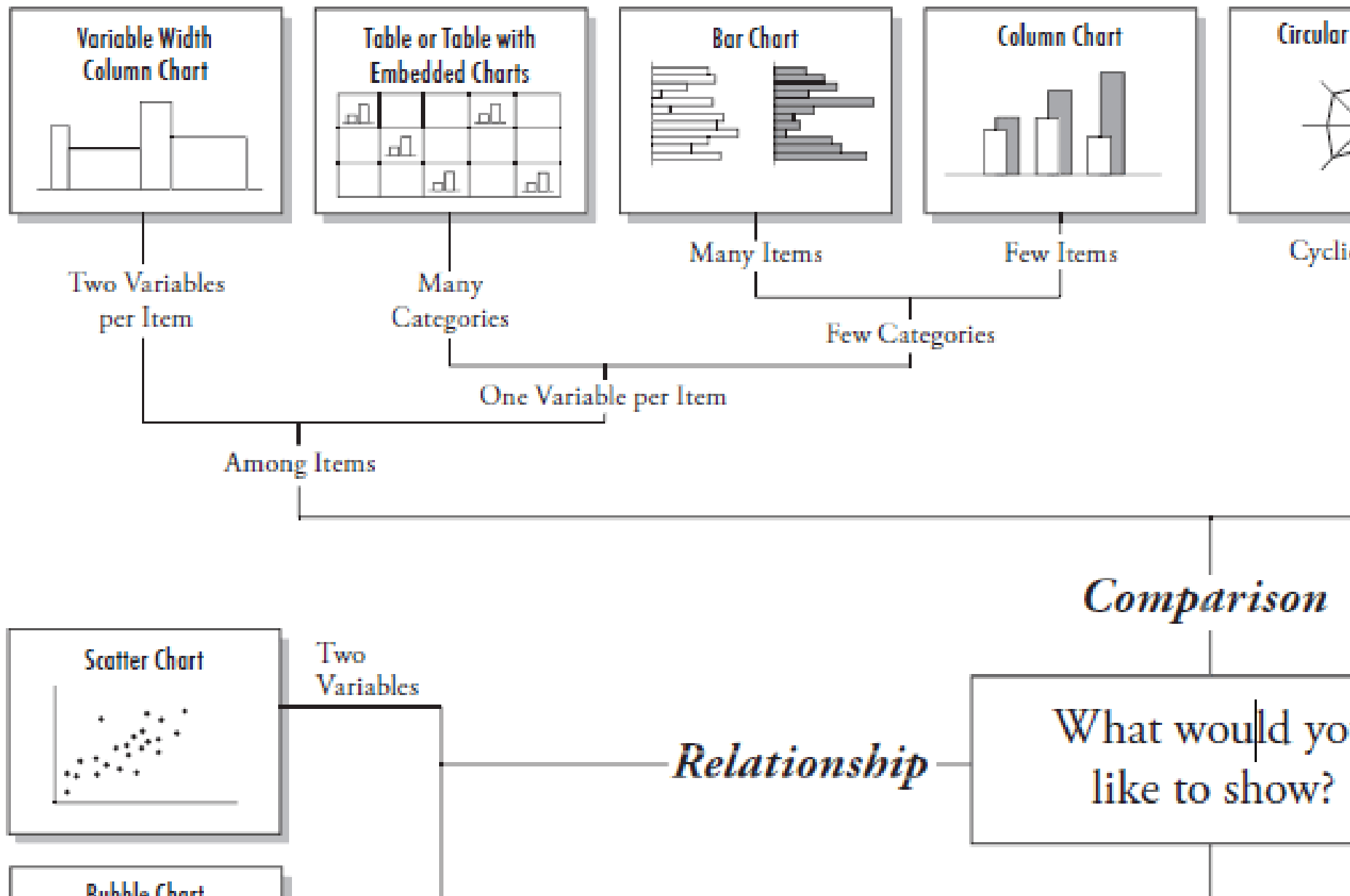
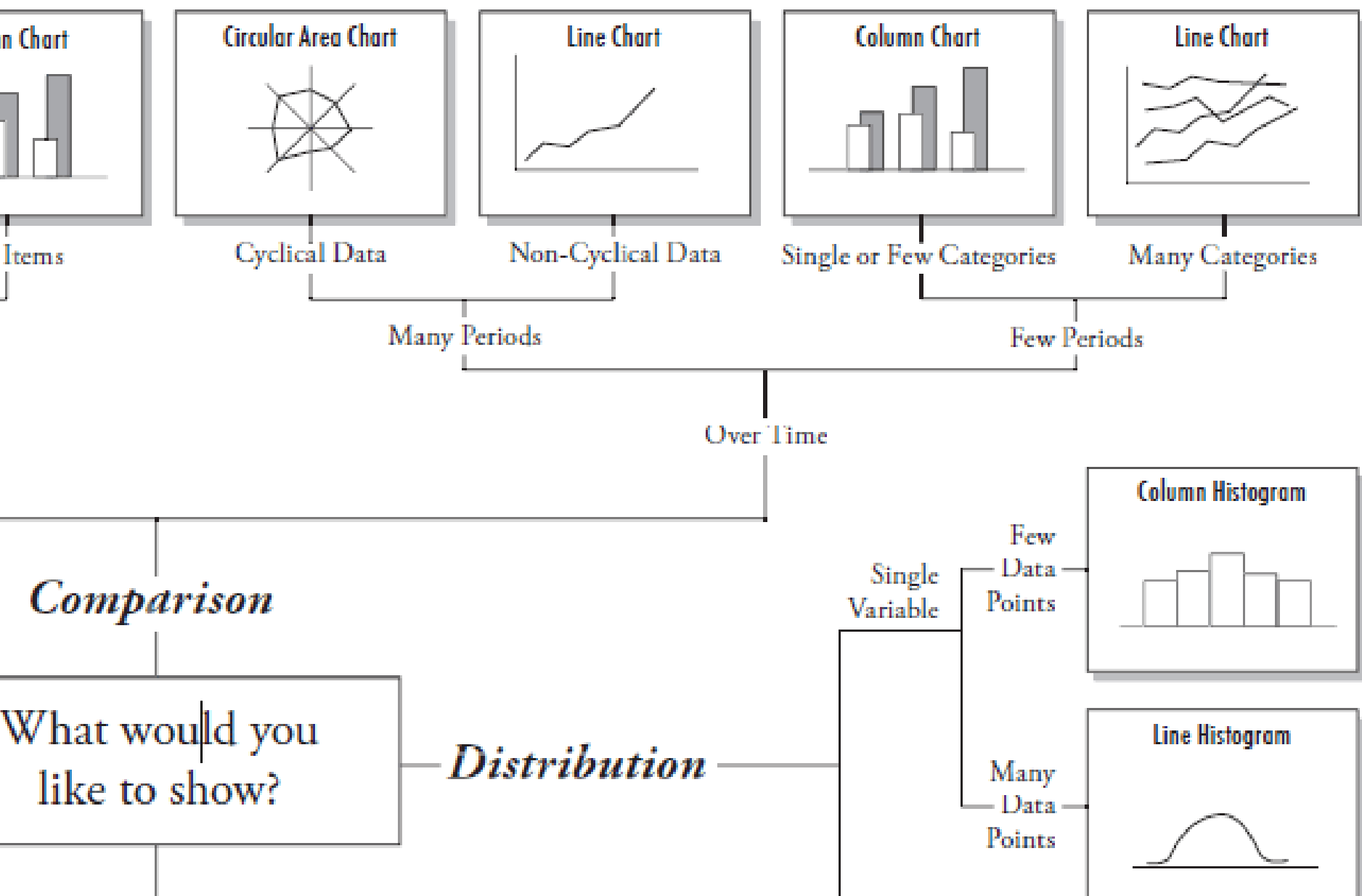
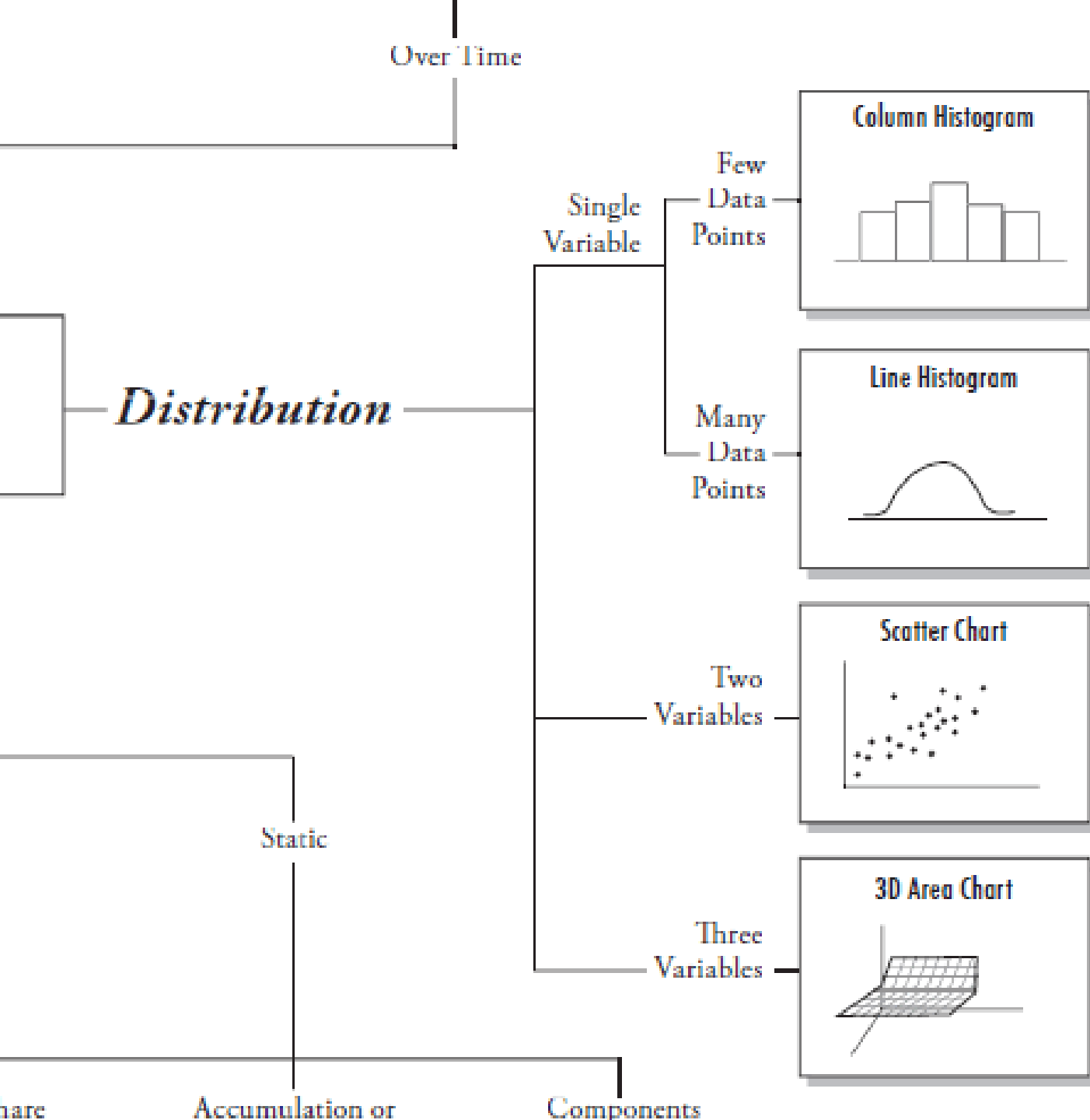


Chart Suggestions—A T

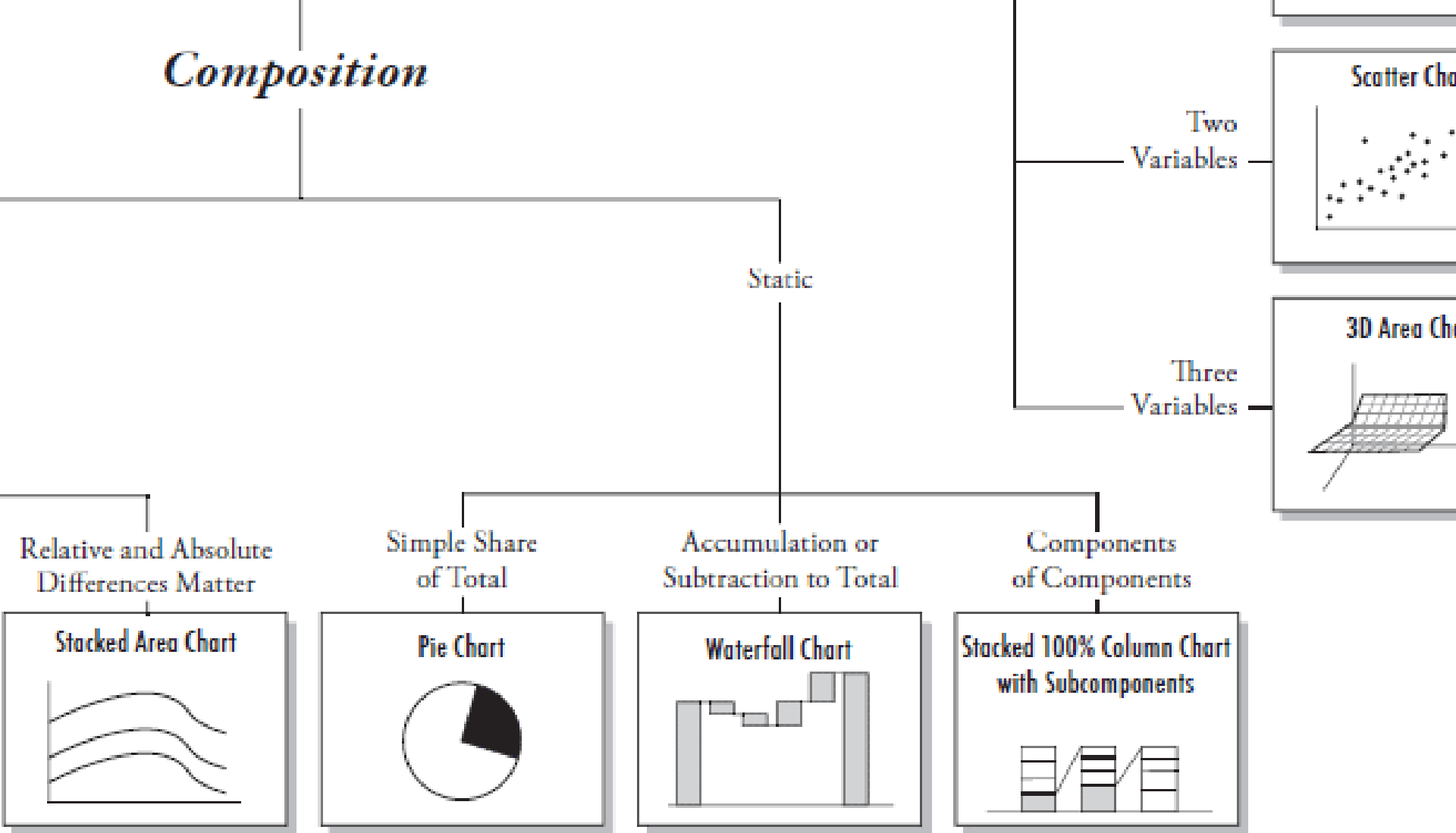


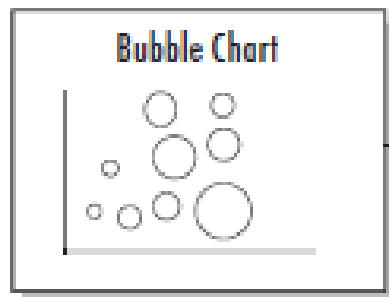
ions—A Thought-Starter





Composition





Three
Variables

Relationship

like to show?

Composition

Changing
Over Time

Few Periods

Many Periods

Only Relative
Differences Matter

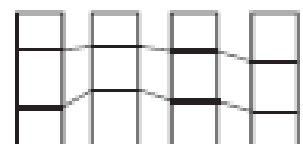
Relative and Absolute
Differences Matter

Only Relative
Differences Matter

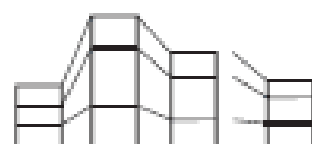
Relative and Absolute
Differences Matter

Simple
of Total

**Stacked 100%
Column Chart**



**Stacked
Column Chart**



**Stacked 100%
Area Chart**

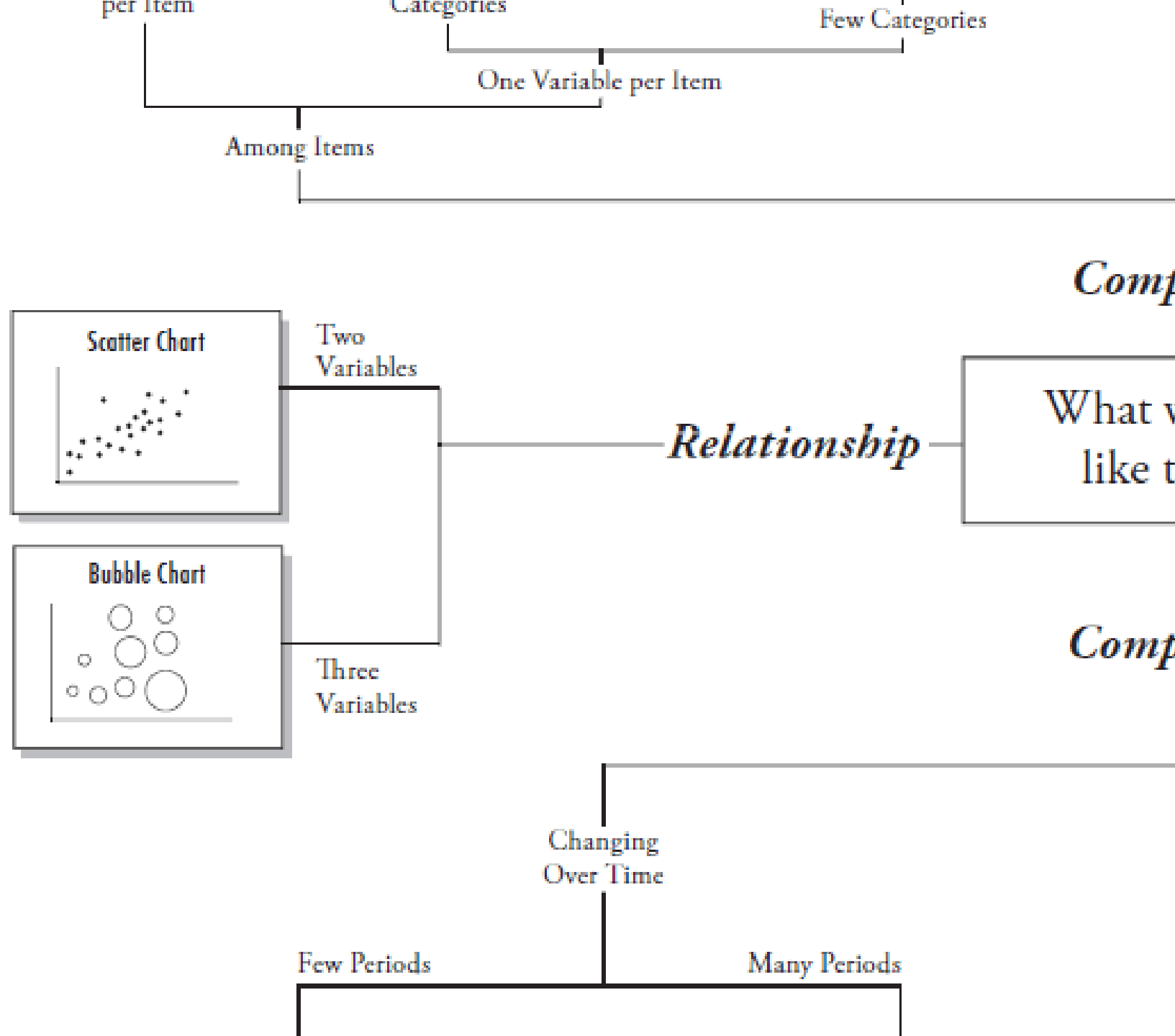


Stacked Area Chart



Pie Chart





Assignment 2

In this assignment, you will design a visualization for a small data set and provide a rationale for your design choices. The choices you make will demonstrate your understanding of the data, visual and encoding principles you have learned so far.

The data set is a collection of measurements related to the IITB's Million Solar Lamp project -- demographics of beneficiaries, and the assembly, distribution & repairs of solar lamps in the Jhauba Block, Jhauba District of Madhya Pradesh state.

The data are summarised in multiples tables in given report. Your challenge is to combine these data in one single visualization that can fit in a A3 size paper. Submit a short write-up (1 page), providing a rigorous rationale for your design decisions. Explain the visual encodings you used and why they are appropriate for the data.

The best visualization will be incorporated into the final reports and duly credited. Assignment Due on 7 Mar 2016, 11:59 pm.