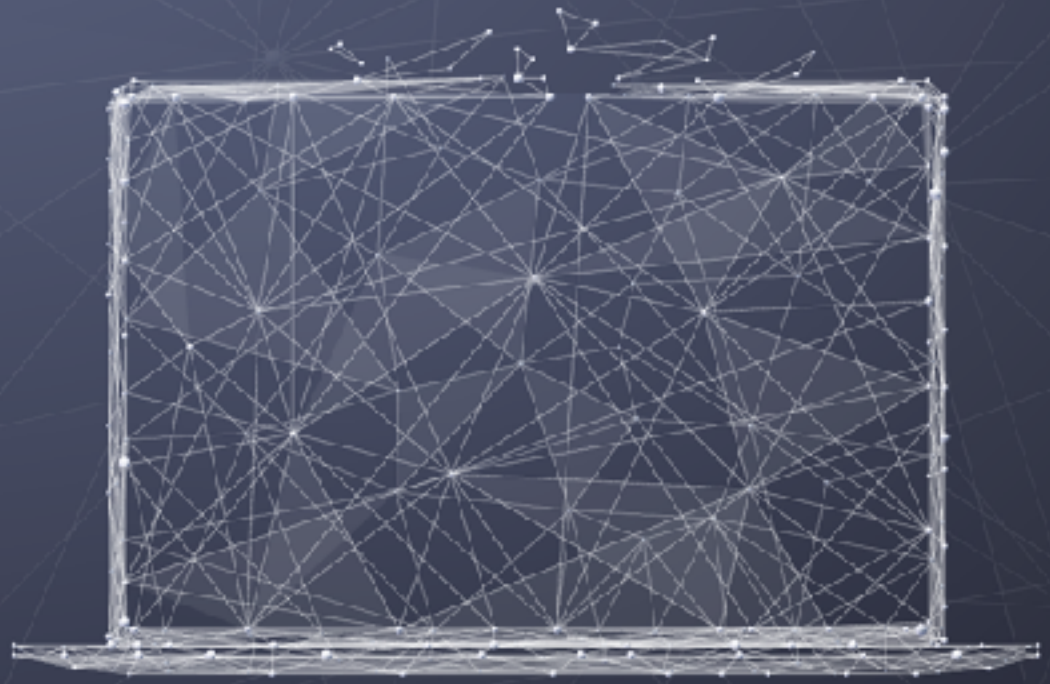
Data Science
Foundations of Decision Making

Heuristics and biases



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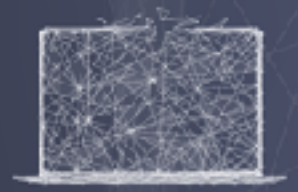

Drawing conclusions from visualizations

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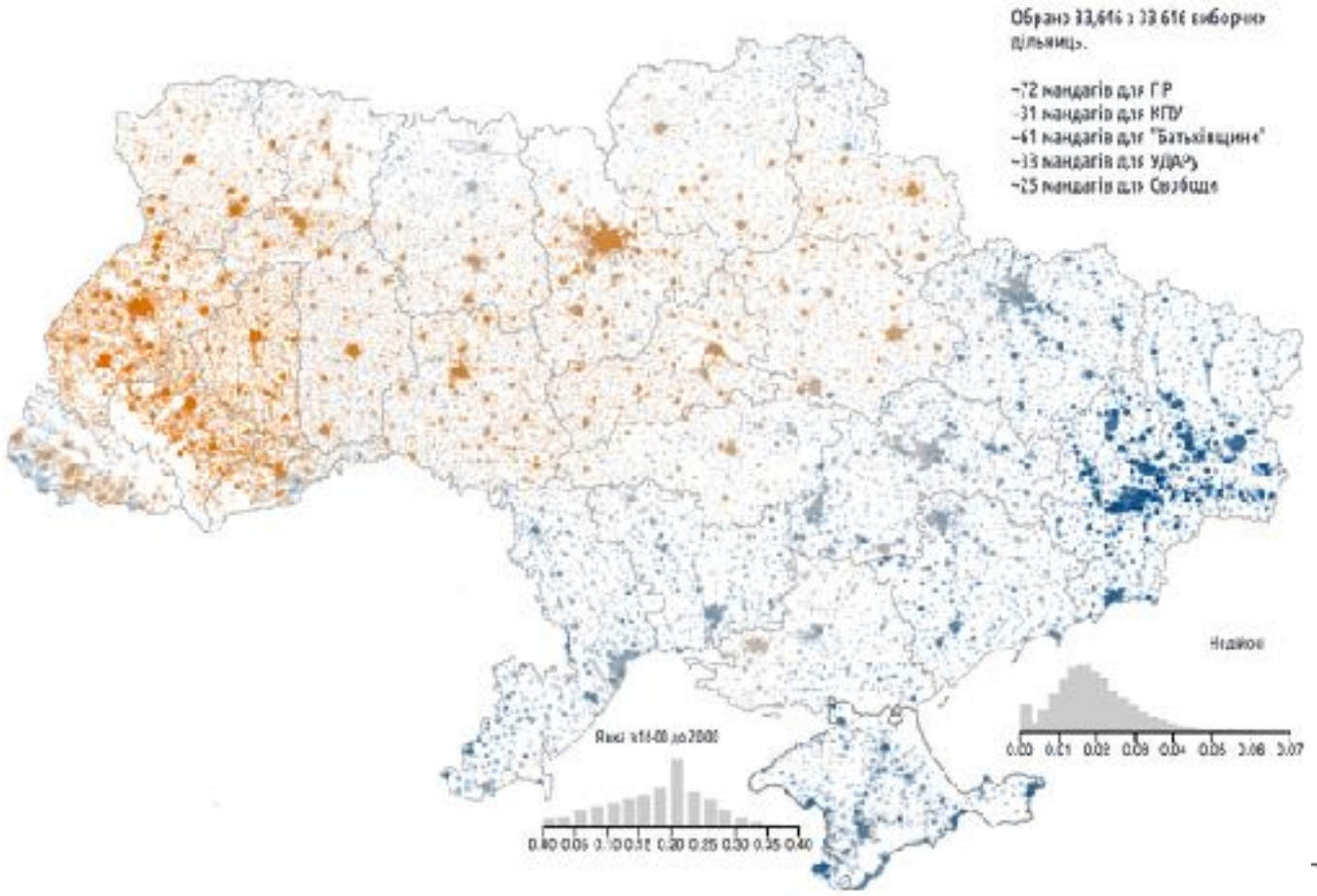
Example



Results of 2012 Ukrainian parliamentary elections

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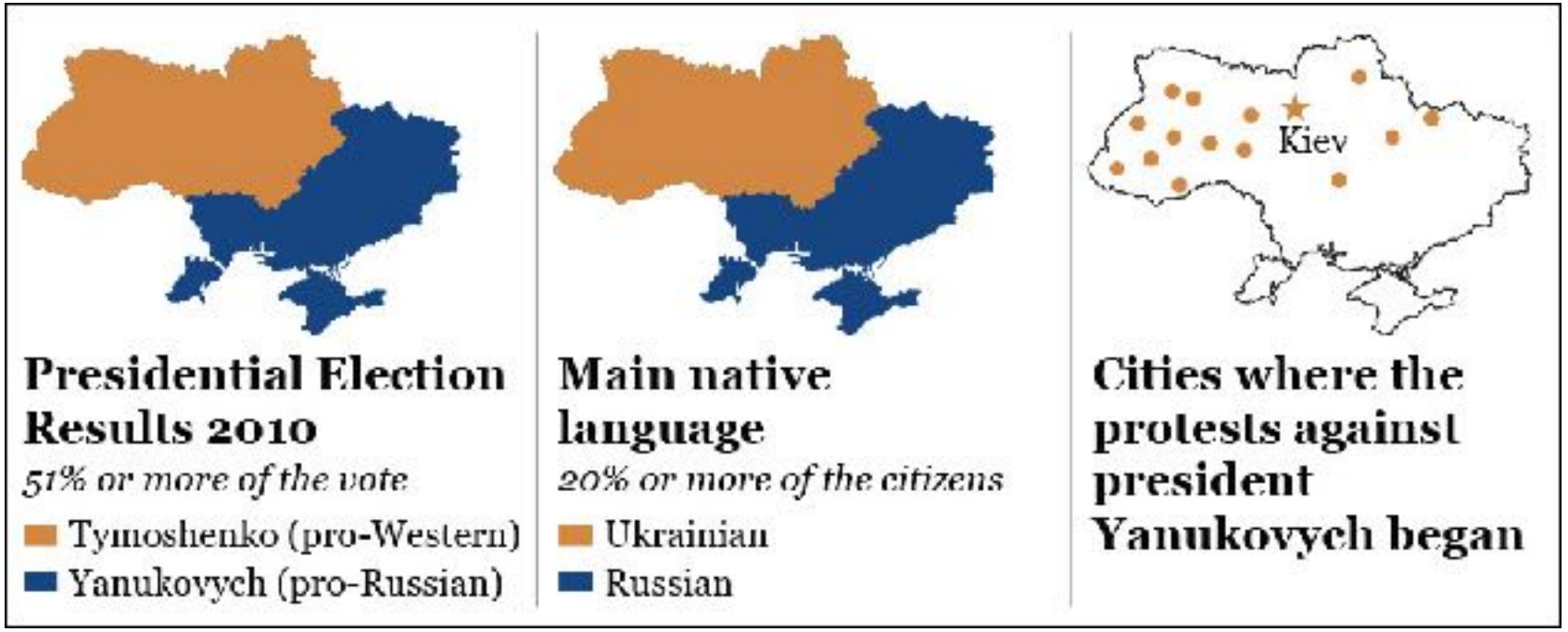
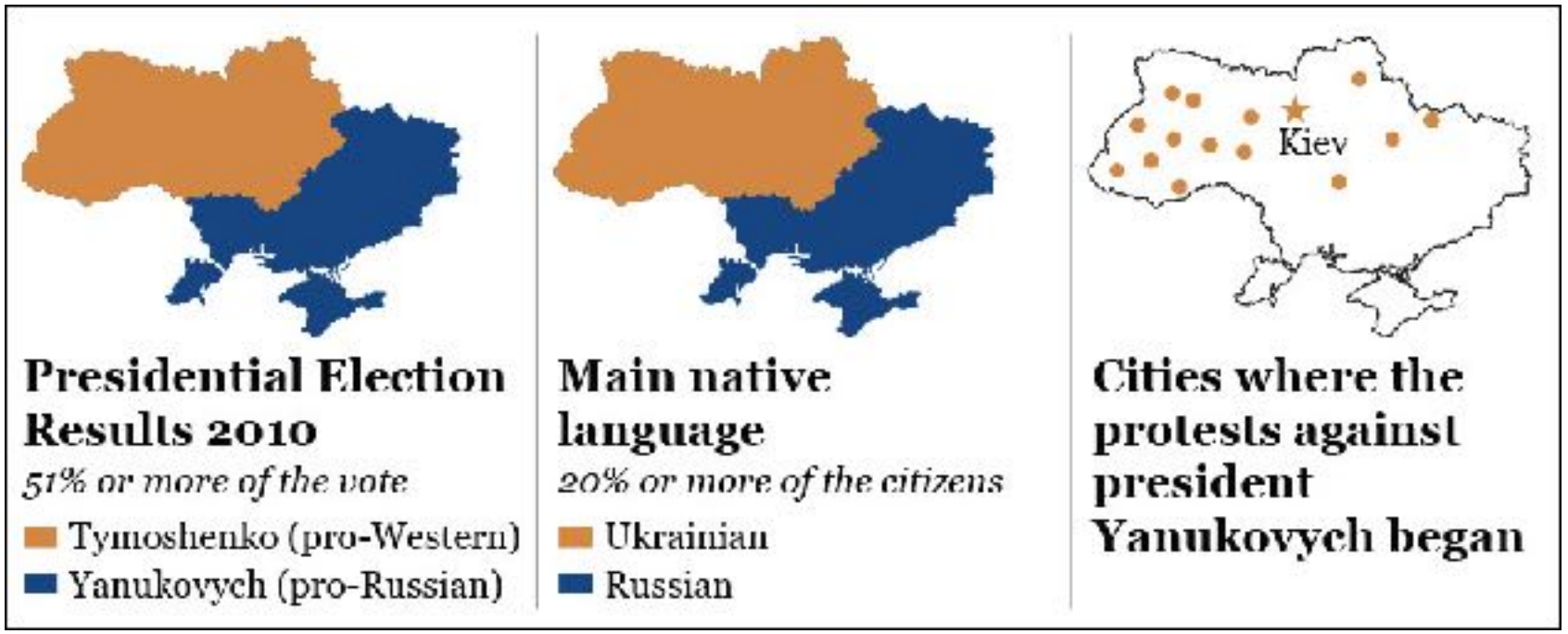
Example

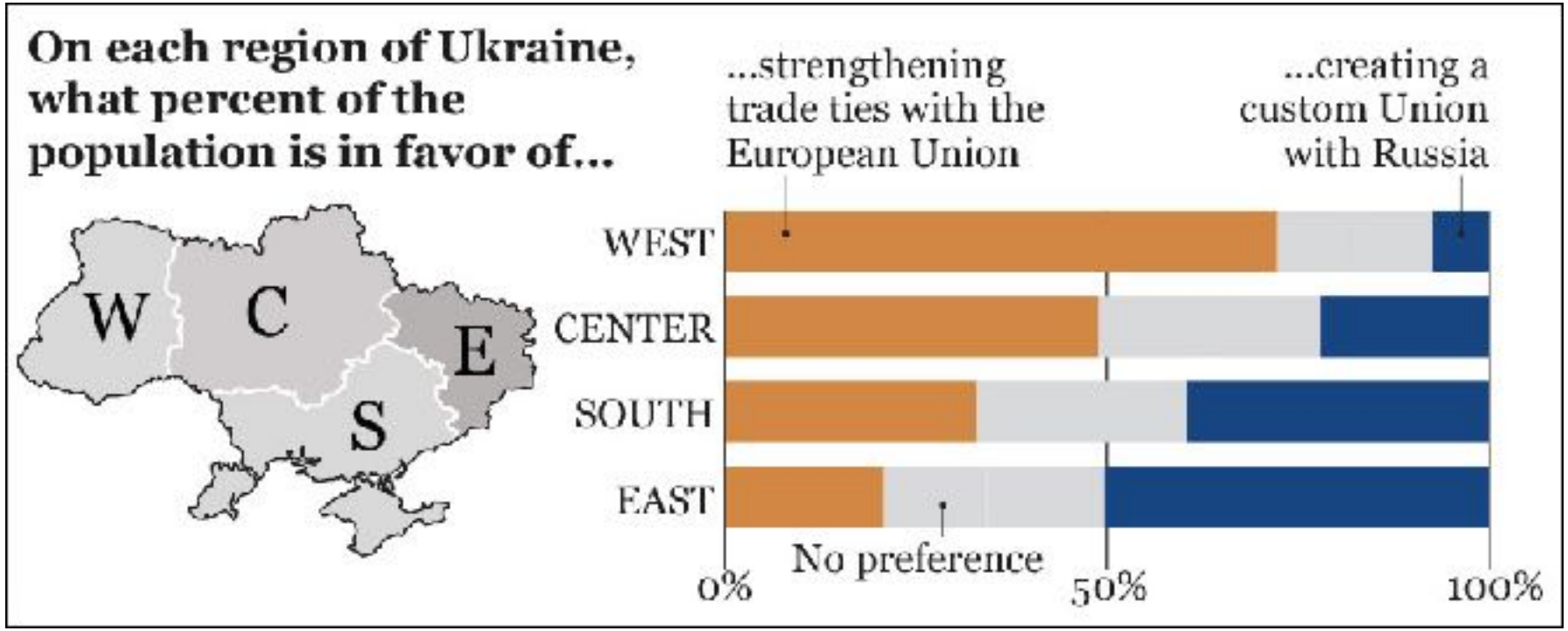

Presidential Election Results 2010
51% or more of the vote
Tymoshenko (pro-Western)
Yanukovych (pro-Russian)
Main native language
20% or more of the citizens
Ukrainian
Russian
Kiev
Cities where the protests against president Yanukovych began

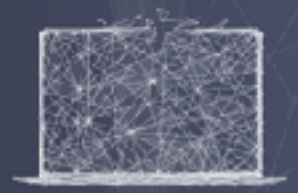
Example



But it's not as simple as these plots make it appear

Example

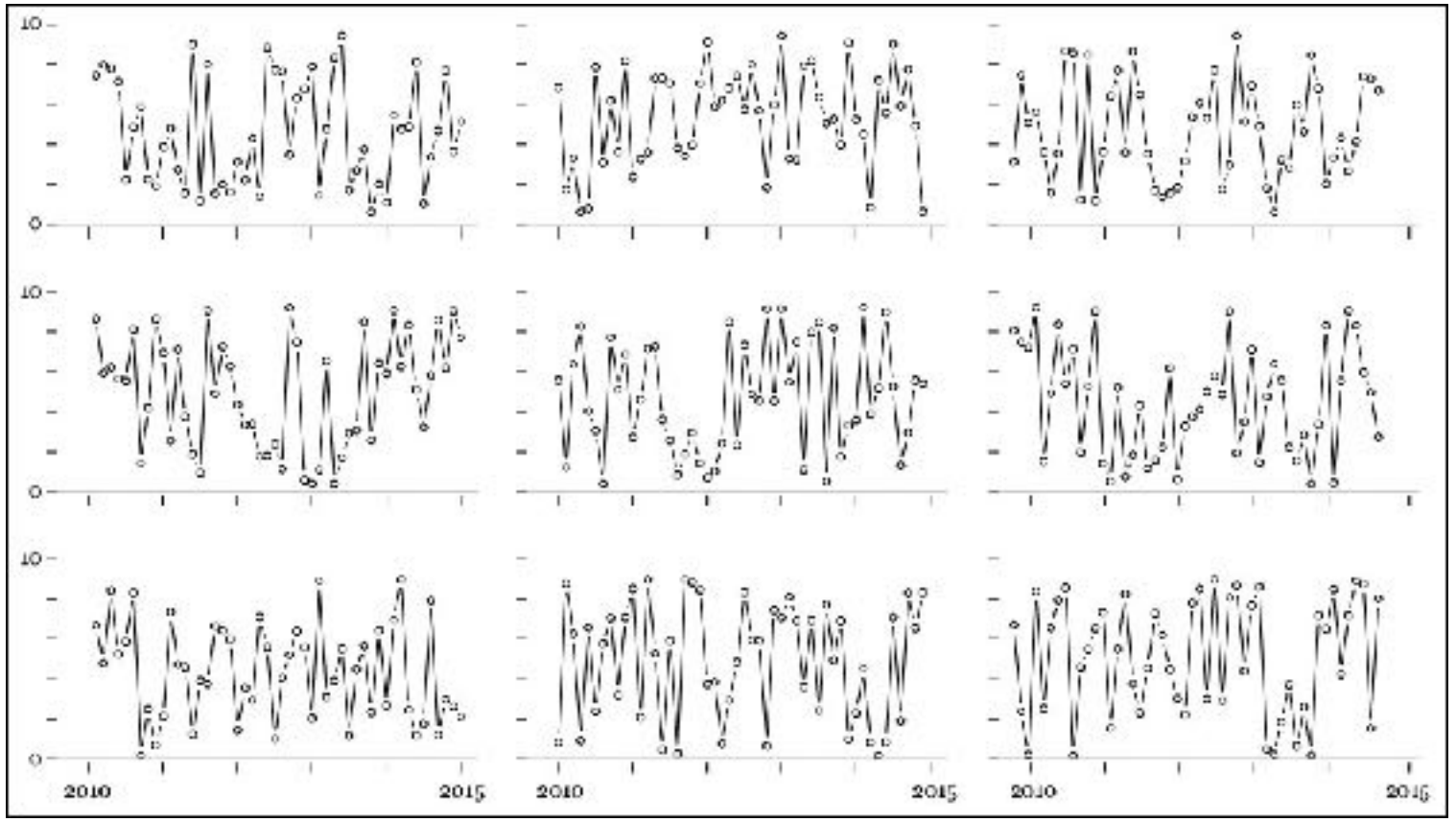

On each region of Ukraine, what percent of the population is in favor of...
...strengthening trade ties with the European Union
...creating a custom Union with Russia
W
C
E
S
WEST
CENTER
SOUTH
EAST
No preference
0%
50%
100%



Why do we make mistakes when interpreting plots?

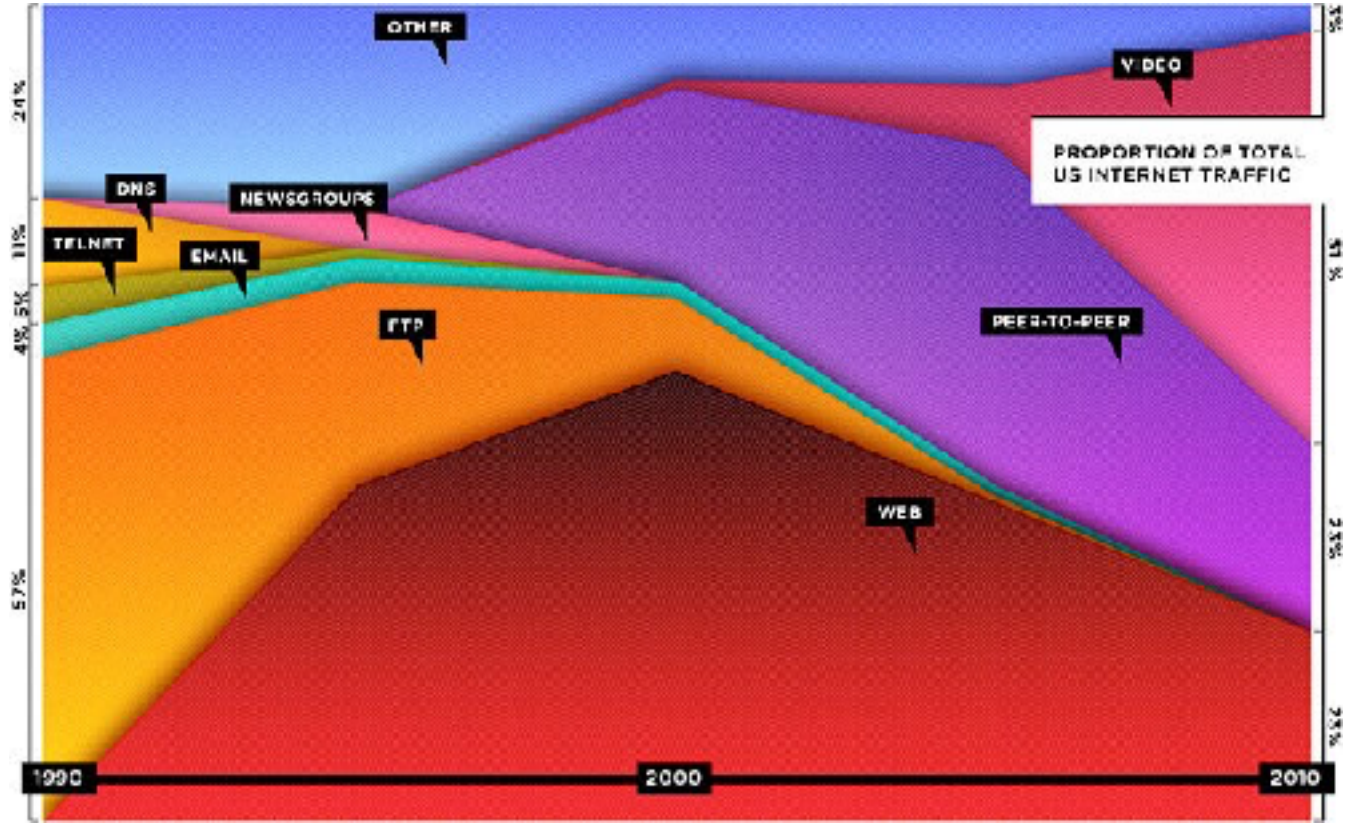
- Patternicity bug
  - Our eyes detect “interesting” patterns regardless of whether they are real or not
- Storytelling bug
  - We are good at coming up with coherent explanations for those patterns
- Confirmation bug
  - We tend to look for additional information to fit our explanation, rather than look for information to refute it

Example: patternicity



Which time series have notable/interesting patterns?

Example: storytelling



Wired 2010: The Web is dead, long live the Internet!

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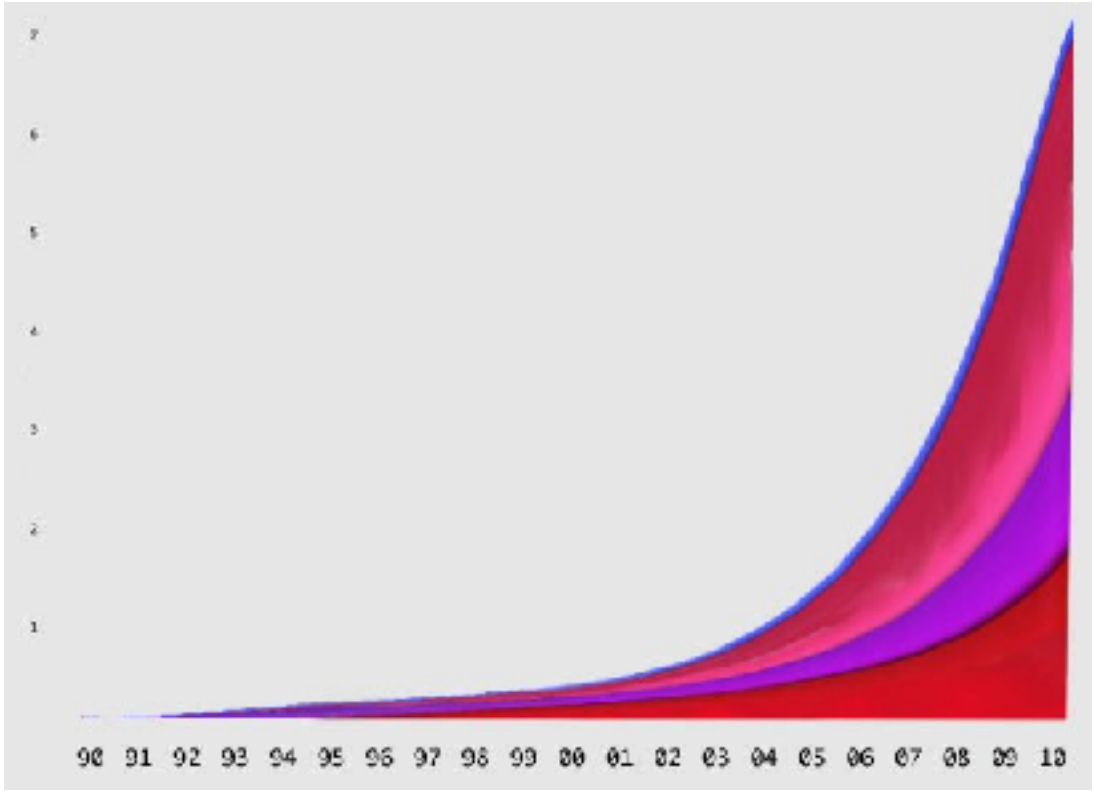
Example: storytelling

Total Web traffic



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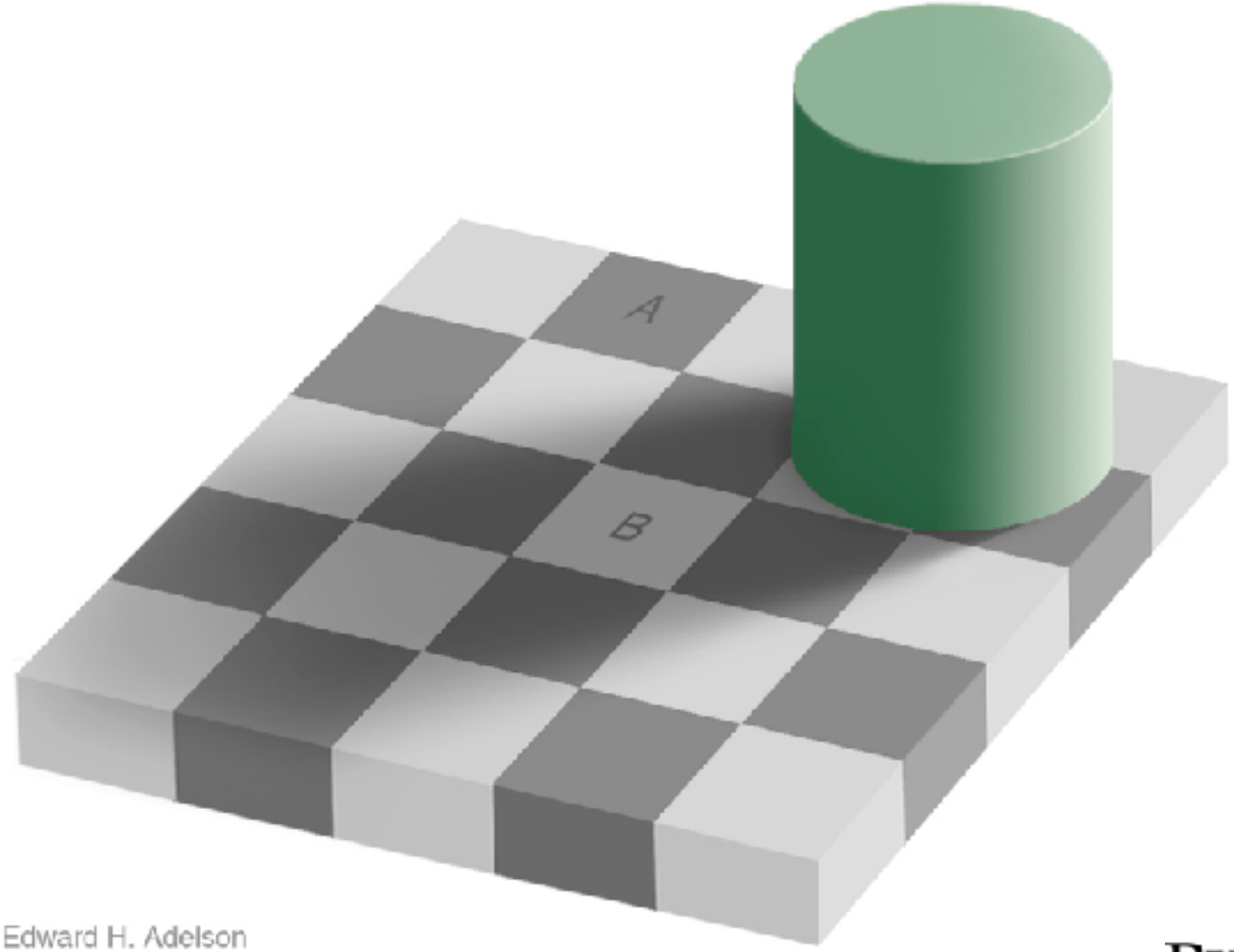
How humans make mistakes interpreting data

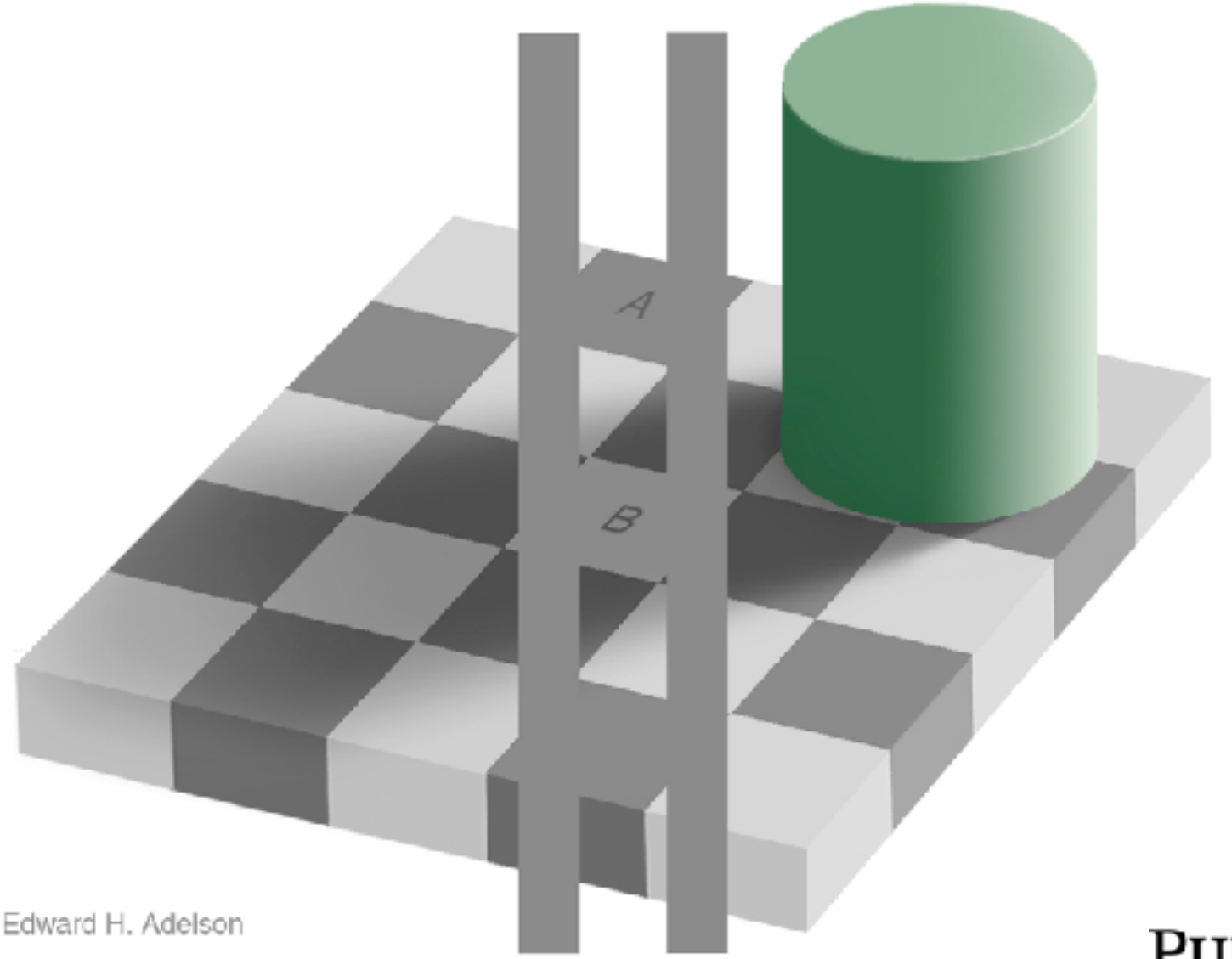
- There has been a significant amount of research showing how humans are prone to errors in human reasoning
- Some is based on biases in visual perception
- Some is based on cognitive heuristics that we use to reason quickly, which makes us pay attention to some types of information more than others

Are A and B the same color?



Edward H. Adelson

The trick uses the “biases” in the human visual system



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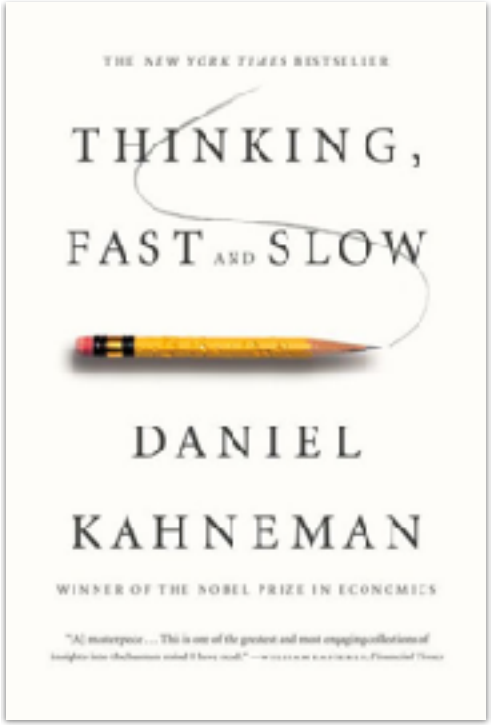
Heuristics and biases

- Tversky & Kahneman, psychologists, propose that people often do not follow rules of probability when making decisions
- Instead, decision making may be based on heuristics
- Lowers cognitive load but may lead to systematic errors and biases
- Examples:
  - Confirmation bias
  - Availability heuristic
  - Representativeness heuristic



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- Confirmation bias: People often seek information that confirms rather than disconfirms their original hypothesis

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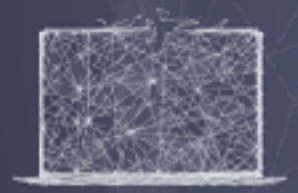
- Availability heuristic: Tendency for people to make judgments of frequency on basis of how easily examples come to mind



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- When people are asked to make up random sequences, they tend to make the proportion of H and T closer to 50% than would be expected by random chance
- Representativeness heuristic: Probability of an event is judged by its similarity to the population from which sample is drawn
    - Tversky and Kahneman interpretation: people believe that short sequences should be representative of longer ones

POLITICS

Science Confirms: Politics Wrecks Your Ability to Do Math

Farewell, Enlightenment: New research suggests that people even solve math problems differently if their political ideology is at stake.

By **Chris Mooney** | Wed Sep. 4, 2013 12:50 PM EDT

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What was the result?

Highly numerate people were more susceptible to letting politics skew their reasoning than were those with less mathematical ability.

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Interpretation of these findings

- People do not use proper statistical/probabilistic reasoning... instead people use heuristics which can bias decisions
- Heuristics can often be very effective (and efficient) for social inferences and decision-making
- ... but be aware that heuristics can bias our interpretation of results from exploratory data analysis and other modeling efforts