

Cognitive Processes

Daniel Kahneman and Amos Tversky

- ▶ Errors of reasoning
 - ▶ Highlight biases
 - ▶ Indicate the underlying heuristics by which people reason
- ▶ Revolutionized economics and psychology

Words in a Natural Language

- ▶ Which words are more numerous in English
 - ▶ Those that begin with “r” (e.g., rat)
 - ▶ Those that have “r” in the third position (e.g., tar)

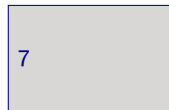
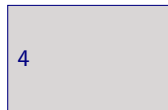
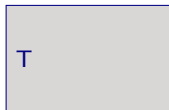
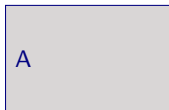
Abstract vs. Concrete Concepts

- ▶ Which words are more numerous in English
 - ▶ Those for abstract concepts (e.g., love, hate)
 - ▶ Those for concrete concepts (e.g., door, computer)

Reasoning with Conditionals

Wason 1966

- ▶ Playing cards
 - ▶ One number on one side
 - ▶ One letter on the other side
- ▶ Rule: If a card has a vowel on one side, it has an even number on the other
- ▶ Which cards would you need to flip to verify this rule?



Adjustment

► What is larger?

A: $1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8$

B: $8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$

Chance

- ▶ Fair coin
- ▶ What is more likely in series of coin tosses?
 - A: H – H – T – H – T – H
 - B: H – H – H – H – H – H

Hospital Births

- ▶ Two maternity hospitals in Raleigh
 - ▶ WakeMed sees about 15 births per day
 - ▶ Rex sees about 45 births per day
- ▶ Boy Day: when $\geq 60\%$ of babies are boys
- ▶ Over 2020, which hospital is likelier to have more Boy Days?
 - ▶ WakeMed is likelier
 - ▶ Rex is likelier
 - ▶ Neither (both will have the same number of Boy Days)

Medical Diagnosis

- ▶ Rare disease, occurs in $\frac{1}{1000}$ of the population
- ▶ Medical test of 95% accuracy
- ▶ Vlad receives a “positive” result (bad news)
- ▶ How probable is it that Vlad has the disease?

Hit and Run Accident

- ▶ Small town with 800 taxi cabs
 - ▶ Blue: 200
 - ▶ Green: 600
- ▶ Alice witnesses a hit and run accident
- ▶ Alice reports a blue taxi hit and drove off
- ▶ Alice's accuracy is 75%
- ▶ What is the probability it was a blue taxi?

$$3/16$$

$$3/8$$

$$3/4$$

$$1/2$$

Linda's Vignette

Linda is thirty-one years old, single, outspoken, and very bright. She majored in Philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations.

Rank these statements from highest to lowest probability:

- a. Linda is a teacher in an elementary school
- b. Linda works in a bookstore and takes Yoga classes
- c. Linda is active in the feminist movement
- d. Linda is a psychiatric social worker
- e. Linda is a member of the League of Women Voters
- f. Linda is a bank teller
- g. Linda is an insurance salesperson
- h. Linda is a bank teller and is active in the feminist movement

Gifts

Split the class into two groups

- ▶ Discuss possible gifts you can buy your Mom
 - ▶ Each group to produce a list of three gifts
 - ▶ Not too long a discussion!
 - ▶ No need to check prices online (just guess)
- ▶ G₁: gifts under \$30
- ▶ G₂: gifts of \$70–\$100

Geography Pop Quiz (Not Graded!)

Without looking anywhere, estimate how many countries there are in Africa and in South America

Gigerenzer's Critique

Back and forth between these authors

- ▶ Bayesian reasoning is not natural
- ▶ An explicit representation with a table is clearer to people
 - ▶ Valuable insight for building user interfaces to avoid confusion
- ▶ Many of the Kahneman and Tversky problems are artificial
 - ▶ Most people assume if someone is being tested for a rare disease they must be at an elevated risk
 - ▶ Vlad won't be a random person off the street
- ▶ The phrasing is potentially misleading as in the Linda case

Nudge Theory

Richard Thaler

- ▶ How to persuade people to change behavior
- ▶ Suppose we want people to adopt good practices
 - ▶ Eat healthy
 - ▶ Save money from paycheck for old age
- ▶ Traditional: give people reasons and explanations
 - ▶ Problem: no one cares!
- ▶ Traditional: Force people
 - ▶ They resent and resist suggestions
- ▶ Choice architecture: make the desired choice convenient
 - ▶ Place healthy food at the front: they can skip it but may not
 - ▶ Automatically set paycheck savings: they can opt out but may not
- ▶ Also called Libertarian Paternalism
- ▶ Sometimes criticized for being manipulative