Judgment and Decision-Making: a Second Debate

Modus Ponens

If there is fire, there is smoke.

There is fire.

$\therefore$ There is smoke.

Modus Tollens

If there is fire, there is smoke.

There is not smoke.

$\therefore$ There is not fire.

Logical Fallacies

Denial of the Antecedent

If there is fire, there is smoke.

There is not fire.

∴ There is not smoke.

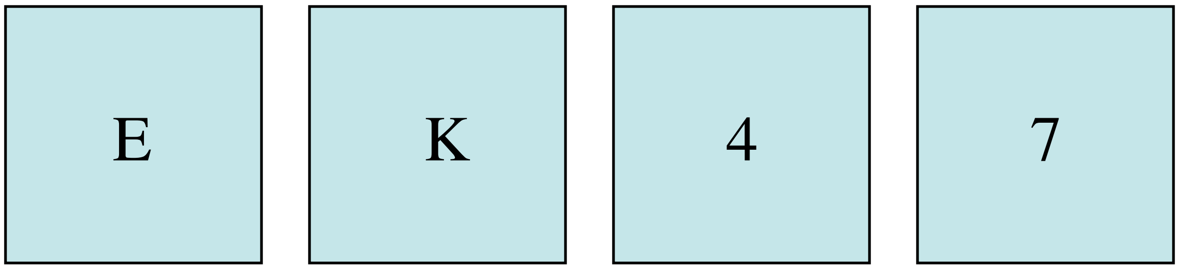
Affirmation of the Consequent

If there is fire, there is smoke.

There is smoke.

∴ There is fire.

Wason's Selection Task



If a card has a vowel on one side, then it has an even number on the other side.

"Permission Schema"

Drinking Beer	Drinking Coke	16 Years Old	22 Years Old

If a person is drinking beer, then the person must be over 19 years of age.

A Gallery of Probability Judgment "Errors"

- Problem Framing
- The Conjunction Effect
- Ignoring Base Rates (Bayes' Theorem)
- Statistical Fluctuations
- Typicality Effects (and the "gambler's fallacy")

Imagine that the United States is preparing for the outbreak of an unusual Asian disease that is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the program are as follows:

If Program A is adopted, 200 people will be saved.

If Program B is adopted, there is a one-third probability that 600 people will be saved and a two-thirds probability that no people will be saved.

Which of the two programs would you prefer?

Imagine that the United States is preparing for the outbreak of an unusual Asian disease that is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the program are as follows:

If Program C is adopted, 400 people will certainly die.

If Program D is adopted, there is a one-third probability that no one will die and a two-thirds probability that 600 people will die.

Which of the two programs would you prefer?

First, we are offered a bonus of $300. Then, we are asked to choose between the two following possibilities:

A. To receive $100 for sure; or

B. To toss a coin. If we win the toss, we will get $200; if we lose, we receive nothing at all.

First, we are offered a bonus of $500. Then, we are asked to choose between the two following possibilities:

C. We are guaranteed to lose $100.

D. We toss a coin, and if we lose, we have to pay $200, but if we win, we don't have to pay anything.

The Conjunction Effect

Bill is 34 years old. He is intelligent, but unimaginative, compulsive, and generally lifeless. In school, he was strong in mathematics but weak in social studies and humanities.

Bill is a doctor, and his hobby is playing poker.

Bill is an architect.

Bill is an accountant.

Bill plays jazz for a hobby.

Bill surfs for a hobby.

Bill is a reporter.

Bill is an accountant who plays jazz for a hobby.

Bill climbs mountains for a hobby.

Steve is very shy and withdrawn, invariably helpful, but with little interest in people or in the world of reality. A meek and tidy soul, he has a need for order and structure, and a passion for detail.

Reporter

Architect

Farmer

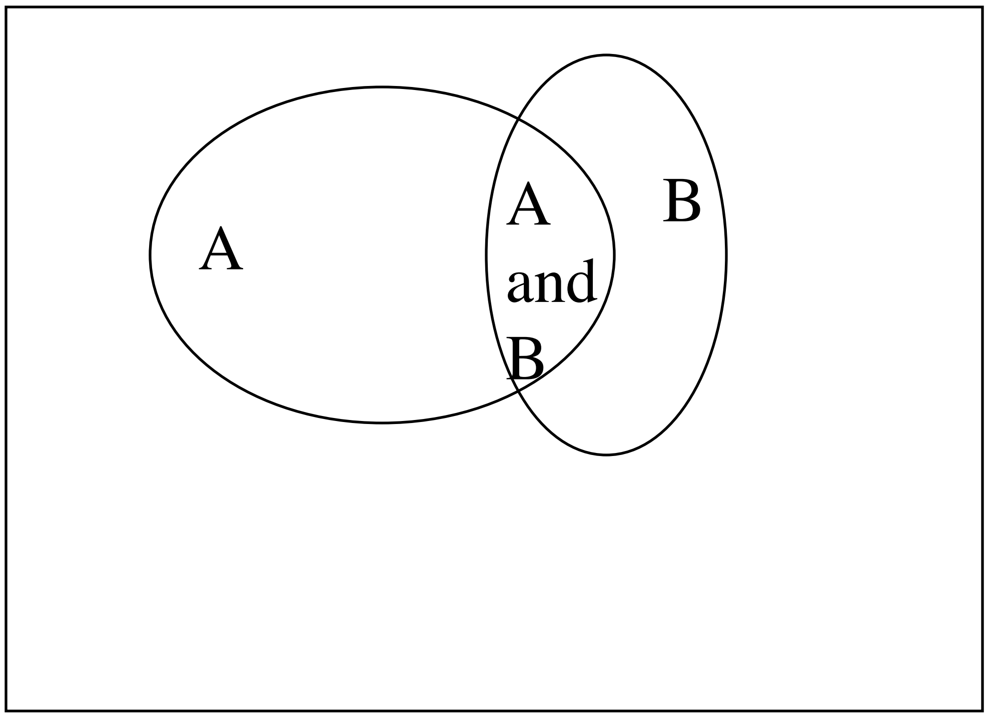
Librarian

Biologist

Taxi Driver

Bayes' Law:

P(A|B) = P(A and B)/P(B)
P(B|A) = P(A and B)/P(A)
so…
P(A|B) P(B) = P(B|A) P(A)



A clinical test, designed to diagnose a specific illness, comes out positive for a certain patient.

We are told that:

1. The test is 90 percent reliable. That is, if we give the test to 100 people who have the disease, 90 percent of the tests will come out positive; if we give the test to 100 people who do not have the disease, 90 percent will come out negative.

2. On average, this illness affects 1 percent of the population in the same age group as the patient.

What is the probability that this patient actually has the illness?

$$P(\text{sick} \mid \text{pos}) = \frac{P(\text{pos} \mid \text{sick}) * P(\text{sick})}{P(\text{pos})}$$

$$= \frac{P(\text{pos} \mid \text{sick}) * P(\text{sick})}{P(\text{pos} \mid \text{sick}) * P(\text{sick}) + P(\text{pos} \mid \text{well}) * P(\text{well})}$$

$$= \frac{0.9 * 0.01}{(0.9 * 0.01) + (0.1 * 0.99)}$$

$$= 0.083$$

Statistical Fluctuations

A certain town is served by two hospitals. In the larger hospital about 45 babies are born each day, and in the smaller hospital about 15 babies are born each day. As you know, about 50 percent of all babies are boys. The exact percentage of baby boys, however, varies from day to day. Sometimes it may be higher than 50 percent, sometimes lower.

For a period of one year, each hospital recorded the days on which (more/less) than 60 percent of the babies born were boys. Which hospital do you think recorded more such days?

Typicality Effects

Which sequence of coin tosses is more likely?

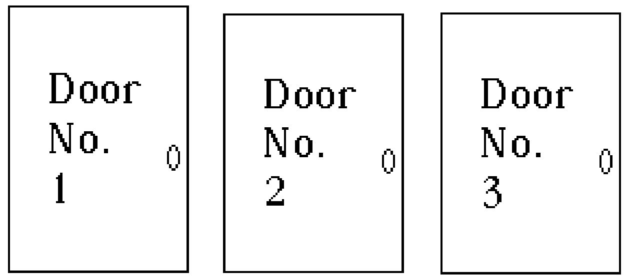
H H H H H H H H

H T T H T H T H

Memory Effects

Estimate the proportion of English words that begin with the letter "K" versus words that have a "K" in the third position.

The Let's Make A Deal Problem



• Behind one door is a great prize. (The usual "great prize" on the old Let's Make a Deal show was a car.)

• The other two doors conceal a "Zonk" prize. (The usual "Zonk prize" on the old show was a goat or some other farm animal.)

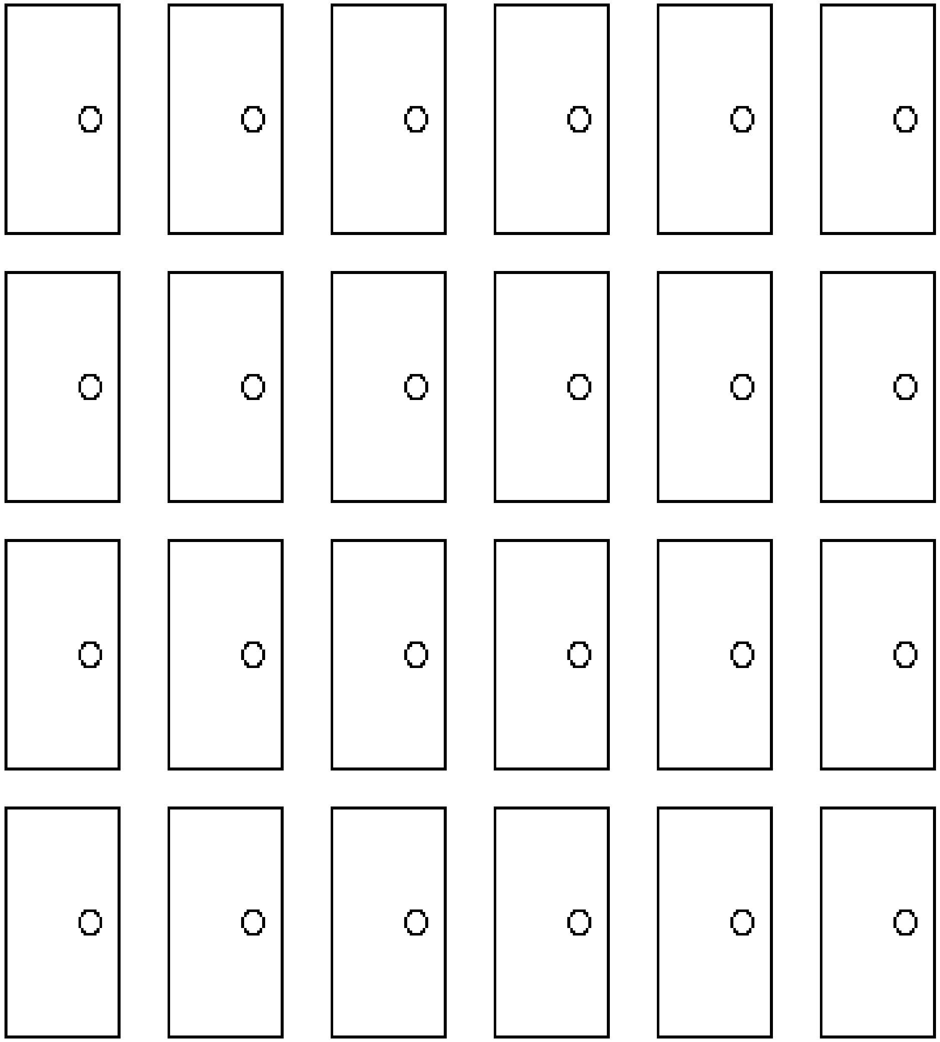
• You get to choose one door.

• Once you have chosen, Monty Hall will open a "Zonk" door among the remaining two doors, and will ask "Do you want to change your choice to another door?"

Should you change your choice?

Example: You choose Door No. 1. Monty opens up Door 2 (revealing the inevitable goat) and asks if you want to switch to Door No. 3.

Let's Make A Deal (The Manic Version)



- You choose a door among these 24.

- Monty throws open 22 Zonk doors and asks "Do you want to switch?"

Suppose we have to choose between pairs drawn from a list of 100. Further suppose:

a. When both objects are recognized, we have a 60 percent chance of getting the right answer. (E.g., is Munich a bigger city than Berlin?)

b. When both objects are unrecognized, we have a 50 percent chance. (Essentially, we're just "flipping a coin": is Dortmund bigger than Duisberg?)

c. When one object is unrecognized, we have an 80 percent chance of getting the right answer. (Is Munich bigger than Dortmund?)

Three people take the test, which has 100 * 99 /2 = 4950 questions. One (person A) recognizes each and every object in the list. His score is:

.6 * (100 * 99 / 2) = 2970

Person B doesn't know a thing about the objects in the list. His score is:

0.5 * (100 * 99/2) = 2475

Person C knows half the list. His score is:

0.5 * (50 * 49 / 2) + 0.6 * (50 * 49 / 2) + 0.8 * (50 * 50) =

612.5 + 735 + 2000 = 3347.5

Moral: A little ignorance can sometimes help.

Themes of the “Adaptive Toolbox” approach to judgment

- “Fast and frugal” heuristics: recognition heuristic, take-the-best, follow-the-majority
- Interpretations of probability: frequentists vs. subjectivists
- Ecological/evolutionary treatment of judgment