Reasoning and Decision Making

Chapter 13

Some Questions to Consider

• What kinds of errors do people make in reasoning?
• What kinds of reasoning “traps” do people get into when making decisions?
• How do emotions influence decisions?
• How does the fact that people sometimes feel a need to justify their decisions affect the process by which they make those decisions?

Reasoning

• Cognitive processes by which people start with information and come to conclusions that go beyond that information

• **Deductive reasoning** is reasoning which attempts to show that a conclusion necessarily follows from a set of premises or hypotheses
  - Ravens are black birds.
  - That is a black bird.
  - Therefore, that is a raven.
Deductive Reasoning

- Syllogism
  - Two statements called premises
  - Third statement called conclusion
- Categorical syllogism
  - Describe relation between two categories using *all, no, some, only, etc.*

Deductive Reasoning

- Syllogism is valid if conclusion follows *logically* from its two premises
- Aristotle’s “perfect” syllogism
  - Premise 1: all A are B
  - Premise 2: all B are C
  - Conclusion: Therefore, all A are C

This syllogism is valid because *the conclusion follows from the premises.*

Premise 1: all A are B
Premise 2: all B are C
Conclusion: Therefore, all A are C
Validity vs Truth

- If two premises of a valid syllogism are true, the syllogism’s conclusion must be true
- **Important!** Do not confuse “validity” with “truth”

- All cats are birds.
- All birds can fly.
- **All cats can fly.**  
  *This is valid, but not true:*
  *Truth* comes from the truth of the premises.  
  *Validity* come from the structure/form.

Syllogism

- No homework is fun.
- Some reading is homework.
  - **∴ Some reading is not fun.**

- Some cats have no tails.
- All cats are mammals.
  - **∴ Some mammals have no tails.**

Valid or Invalid?

- All students are tired.
- Some tired people are irritable.
  - **∴ Some students are irritable.**
How Well Can People Judge Validity?

- **Evaluation**: ask people if conclusion follows logically from premises
- **Production**: ask people to indicate what logically follows from premises

How Well Can People Judge Validity?

- Many errors in evaluation
  - **Atmosphere effect**: use of words *all, some, or no* influences evaluation of validity of conclusion (2 “alls” suggests an “all” conclusion, etc.)
  - **Belief bias**: if syllogism is true or agrees with a person’s beliefs, more likely to be judged valid (or disagrees/invalid)

Deductive Reasoning

- Conditional syllogisms
  - “If p, then q”
    - Affirming the antecedent
    - Denying the consequent
    - Affirming the consequent
    - Denying the antecedent
Four syllogisms that begin with the same first premise

<table>
<thead>
<tr>
<th>Syllogism</th>
<th>Second Premise</th>
<th>Conclusion</th>
<th>Is It Valid?</th>
<th>Judged Correctly?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affirming</td>
<td>p (abracad)</td>
<td>q (breathe, breathe)</td>
<td>Therefore g (fail a grade)</td>
<td>Yes</td>
</tr>
<tr>
<td>Contradicting</td>
<td>Not p</td>
<td>q (study)</td>
<td>Therefore, not g (fail a grade)</td>
<td>Yes</td>
</tr>
<tr>
<td>Contradicting</td>
<td>g</td>
<td>q (work)</td>
<td>Therefore, not r (fail a grade)</td>
<td>Yes</td>
</tr>
<tr>
<td>Contradicting</td>
<td>Not g</td>
<td>q</td>
<td>Therefore, not r (fail a grade)</td>
<td>Yes</td>
</tr>
</tbody>
</table>

The Wason Four-Card Problem

- Effect of using real-world items in a conditional reasoning problem
- Determine *minimum* number of cards to turn over to test the conditional statement:
  - if there is a vowel on one side, then there is an even number on the other side


If vowel, then even number.

Peter Wason
1924-2003
The Wason Four-Card Problem

- Falsification principle: to test a rule, you must look for situations that falsify the rule
- Most participants fail to do this
- When problem is stated in concrete everyday terms, correct responses greatly increase.

- If there is a beer in your hand, must be 21 years old.

If there is a beer in your hand, must be 21 years old.

Beer  Soda  17  25

The Wason Four-Card Problem

- Pragmatic reasoning schema: thinking about cause and effect in the world as part of experiencing everyday life
- Permission schema: if A is satisfied, B can be carried out (if legal drinking age, then can drink alcohol)
  - Used in the concrete versions
  - People are familiar with rules
Inductive Reasoning

• Premises are based on past experience
• We generalize from these cases to more general conclusions with varying degrees of certainty

Swans are white.

Inductive Reasoning

• Strength of argument is based on:
  • Representativeness of observations
  • Number of observations
  • Quality of observations

Inductive Reasoning

• Used to make scientific discoveries
• Hypotheses and general conclusions
• Used in everyday life
• Make a prediction about what will happen based on observation about what has happened in the past
• Heuristics!
Heuristics

- **Availability heuristic**: events more easily remembered are judged as being more probable than those less easily remembered

<table>
<thead>
<tr>
<th>More Likely</th>
<th>Less Likely</th>
<th>Percent Picking Less Likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homicide (20)</td>
<td>Appendicitis</td>
<td>9</td>
</tr>
<tr>
<td>Drowning (5)</td>
<td>Auto-train collision</td>
<td>34</td>
</tr>
<tr>
<td>Asthma (900)</td>
<td>Botulism</td>
<td>41</td>
</tr>
<tr>
<td>Asthma (20)</td>
<td>Tornado</td>
<td>58</td>
</tr>
<tr>
<td>Appendicitis (2)</td>
<td>Pregnancy</td>
<td>83</td>
</tr>
</tbody>
</table>

Adapted from Lichtenstein et al., 1978.

**Likely-causes-of-death experiment results.**
Pairs of “causes of death”, with the more likely cause on the left.

The number in parentheses on indicates how many times more people were killed by the cause on the left (e.g., 20 homicides per case of appendicitis).

Heuristics

- **Illusory correlations**: correlation appears to exist, but either does not exist or is much weaker than assumed
- Stereotypes
Heuristics

- **Representativeness heuristic**: the probability that A comes from B can be determined by how well A resembles properties of B
  - Use base rate information if it is all that is available
  - Use descriptive information if available and disregard base rate information

You see this man eating in a truck stop. Do you think it is more likely that he is:

- A. a truck driver.
- B. a university professor.

Heuristics

- **Conjunction rule**: probability of two events cannot be higher than the probability of the single constituents

Linda is 31 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.

**Which is more probable?**
- A. Linda is a bank teller.
- B. Linda is a bank teller and is active in the feminist movement.
Because feminist bank tellers are a subset of bank tellers, it is always more likely that someone is a bank teller than a feminist bank teller.

Heuristics

- **Law of large numbers**: the larger the number of individuals randomly drawn from a population, the more representative the resulting group will be of the entire population
- Representativeness does not necessarily hold for small samples.

Heuristics

- **The confirmation bias**: tendency to selectively look for information that conforms to our hypothesis and overlook information that argues against it
Heuristics

• The confirmation bias
• Lord and coworkers (1979)
  • Had those in favor of capital punishment and those against it read the same article
  • Those in favor found the article in favor
  • Those against found the article against

Decision Making

• Expected utility theory
  • People are rational
  • If they have all relevant information, they will make a decision that results in the maximum expected utility
  • Utility: outcomes that are desirable because they are in the person's best interest
  • Monetary payoff

Decision Making

• Advantages for utility approach
  • Specific procedures to determine the “best choice”
• Problems for utility approach
  • Not necessarily money, people find value in other things
  • Many decisions involve payoffs that cannot be calculated
What Else Influences Decisions?

- Emotions affect decisions
- Expected emotions
  - Emotions that people *predict* that they will feel concerning an outcome
  - Immediate emotions: Experienced at the time a decision is being made.

Emotions in Decision Making

- People inaccurately predict their emotions.
- Risky decisions
  - Risk aversion strategy used when problem is stated in terms of gains.
  - Risk taking strategy when problem is stated in terms of losses.

- The results of Kermer et al.’s (2006) experiments showing that people overestimate the expected negative effect of losing (left red bar), compared to the actual effect of losing (right red bar).
Organ donation by country

Decision Making

• Decisions depend on how choices are presented
  • Opt-in procedure
    • Active step to be organ donor
  • Opt-out procedure
    • Organ donor unless request not to be

Decision Making

• Framing effect: decisions are influenced by how a decision is stated
  • Can highlight one aspect of situation
• Tversky and Kahneman (1981).
• Participants were asked to “imagine that the U.S. is preparing for the outbreak of an unusual disease, which is expected to kill 600 people.
• Two alternative programs to combat the disease have been proposed. Assume the exact scientific estimate of the consequences of the programs are as follows.”

• The first group of participants were presented with a choice between programs: In a group of 600 people,
  • Program A: “200 people will be saved”
  • Program B: “there is a 1/3 probability that 600 people will be saved, and a 2/3 probability that no people will be saved”

• The second group of participants were presented with the choice between: In a group of 600 people,
  • Program C: “400 people will die”
  • Program D: “there is a 1/3 probability that nobody will die, and a 2/3 probability that 600 people will die”
How framing affects decision-making.
These pie charts diagram the conditions set forth for Programs A, B, C, and D in the text. Note that the number of deaths and probabilities for programs A and B are exactly the same as for programs C and D. The percentages indicate the percentage of participants who picked each program when given choices between A and B or between C and D.

PFC and Reasoning

- Arrange names according to height.
  - Easy Task
    - Sam is taller than Nate.
    - Nate is taller than Roger
  - Hard Task
    - Sam is taller than Nate.
    - Roger is taller than Sam

- What general PFC process is being more taxed in the hard than easy task?

Ultimatum Game

Insula: pain, distress, hunger, anger, disgust.
PFC: cognitive demands.