Chapter 11: Reasoning, Judgment, and Choice

Overview

Reasoning involves all of the other cognitive processes that we have talked about. In making decisions, we are influenced by factors that capture our attention, by our memory for past experiences, by the language that is used to frame the question, and by our ideas about how problems are best solved. All questions require some sort of decision. For some, like "Which number is greater, four or seven?" we are able to give very quick answers; we don't really need to think about it. Some require much more thought; if you were asked "Would you rather be four feet tall or seven feet tall?" you would probably want to weigh carefully the options before responding. Some questions immediately raise more questions; if someone asks you if you want to buy a car that costs $15 or one that costs $15,000, your first reaction might be "What's the catch?"

A general introduction to logical principles can be given through a discussion of **syllogistic reasoning**. Syllogistic reasoning involves using principles of logic to help you decide whether a list of specific premises allows you to draw a particular conclusion. Numerous example syllogisms (reasoned through in class) can greatly improve students' understanding of logic principles. It can be noted that people have difficulty with certain syllogisms in particular. For example, it is much more difficult to judge the validity of statements that do not include specific details ("A" and "B" notation). As well, people tend to have more trouble with negative information than positive information. Consider this example:

> If today is not Wednesday, then we will not play golf today.
> We will not play golf today.
> Therefore today is not Wednesday.

It is tricky to assess validity because the statements include negative information. People also tend to have trouble when information is abstract or theoretical rather than concrete. Here's an example:

> If an object is hot, then it is circular.
> This object is not circular.
> Therefore, it is not hot.

Again, this is difficult to verify because the descriptors used (hot and circular) are somewhat abstract.

Kahneman and Tversky's Nobel-prize-winning work is a referenced again and again throughout the chapter. Although there are many examples of their work in the textbook, here is another not mentioned in the book: Tversky and Kahneman's (1983) "Linda Problem." Given a description of a character named "Linda" who majored in philosophy, is concerned with social justice, and takes part in anti-nuclear demonstrations, participants were asked to rank the likelihood of various options for that character. They were likely to rank "bank teller and feminist" as more likely than "bank teller."

Of course, both bank teller and feminist can't possibly be *more* likely than bank teller alone but people are likely to fall victim to the conjunction fallacy: from the description of Linda, it seems likely that she would be a feminist and it doesn't seem likely that she is a bank teller; adding "feminist" to "bank teller" makes that possibility seems more likely. Interestingly, even participants with advanced knowledge of statistics were not immune to the conjunction fallacy.

Heuristics are general strategies that usually produce a satisfactory solution. Heuristics are particularly relevant in making judgements—if we had to carefully think through an individualized solution for every decision we have to make, the sheer volume of judgements made every day would be overwhelming. Fortunately, we have numerous heuristics with which to work. These heuristics, which are usually quite logical, can lead us astray sometimes. Using the **representativeness heuristic**, we judge a particular outcome to be likely to occur if it seems representative of what we expect. The outcome of 10 coin tosses being H H H H H H H H H H seems too orderly and we tend to judge it as unlikely. H H T H T T H T H T is judged to be more likely because it seems more representative of coin-tossing. The two patterns, though, are equally likely.

Using the **availability** heuristic, we tend to rate an event as likely if it is easy to think of an example of the event. If you ask people "Which is a more likely cause of death, strokes or all accidents put together?" they are likely to guess accidents. In fact, a person is almost twice as likely to die of a stroke than an accident. This discrepancy can be explained by the availability heuristic. Accidents tend to get a lot of media coverage and attention. Numerous examples, then, may come to mind for that particular cause of death and this leads to an over-estimation of the frequency. Stroke as a cause of death doesn't get as much attention and is therefore under-estimated.

Using the **adjustment and anchoring** heuristic, anchors also affect judgements. If judges with years of experience are asked to give sentences for theoretical crimes and they are told what sentences a college student recommended, they will be anchored to that number. If they are told what sentences a five-year-old recommended, they will be anchored to that number. Everyone is vulnerable to this effect, even when the source of the anchors is very questionable. Anchors even affect judgements when people are specifically warned about this. Again, this heuristic is generally useful. For example, you are trying to estimate the value of a house and someone says "Well, I got $300,000 for my house and it was similar to this one but a bit smaller," then it is a good strategy to use that $300,000 as an anchor and adjust your estimate from there. The use of anchors can bias us, sometimes unreasonably. As is the case with all heuristics, the price we pay for general usefulness is unreasonable bias in (relatively few) specific situations.

Learning Objectives

In this chapter students will:

- Describe various understandings of syllogistic reasoning.
- Identify various heuristics and biases that affect people's judgments.
- Understand ecological rationality.
- Explore the importance of training in statistical reasoning.

Key Concepts with Illustrative Examples

availability (see page 360)

Which is more dangerous—a dog or your sofa? You would probably answer "dog" because you might have heard many stories about dog bite incidents but have almost never heard stories of people being hurt by their sofas. In actuality, you are 30 times more likely to be hurt from falling off a piece of furniture than you are to be bitten by a dog. This is an example of the availability heuristic where you make a judgement based on the ease with which something can be brought to mind.

confirmation bias (see page 350)

People have a tendency to process information in a way that confirms their working hypotheses. Rather than looking for evidence that falsifies a hypothesis, we are biased to look for support for it. A psychic reading can seem eerily accurate when the listener is looking only for *matches* between their life events and the psychic's statements.

gambler's fallacy (see page 358)

When people go to a casino, they often spend more money than they plan. Part of this is that once they begin using a machine they often don't want to leave it. If they have been winning, they believe they are "on a streak", and if they are losing, they think that it must soon be time for a win. These people have fallen victim to the gambler's fallacy—the mistaken belief that an event that has not occurred on several independent trials is more likely to happen on future trials. Slot machines are set to pay out on a random schedule; therefore, there is never a "winning streak" or a predictable win.

illusory correlation (see page 358)

An illusory correlation can sometimes be created between two unrelated variables. Stereotypes, for example, are often the result of illusory correlations: one memorable experience with a crooked lawyer or an unintelligent blond may make it seem as though there are relationships there (between unscrupulousness and being a lawyer or between lack of intelligence and having blond hair) even if, in fact, there are not.

natural deductions systems (see page 351)

People tend to use propositions (which include connectives such as "if . . . then") that are stored in memory to follow deductive rules. A person trying to get from Montreal to Toronto when Highway 401 is closed may apply the following logical algorithm:

The 401 is a direct route from the Quebec border to Toronto. If the 401 is closed, then I will have to find an alternate route for that part of the journey.

parsimony (see page 349)

The saying, "If you hear hoof beats, think horses not zebras", is suggesting that you should abide by the principle of parsimony. Parsimony is a principle of Johnson-Laird's theory that suggests that people tend to construct the simplest mental model possible.

recognition heuristic (see page 366)

You may have heard someone describe themselves as either a "Mac" person or a "PC" person when referring to their preference for computers. The next time you hear this, particularly for the PC person, ask them if they have ever used a Mac computer. Chances are that their computer preference is more related to their familiarity with the PC product rather than any logical reason. This is an example of the recognition heuristic which suggests that, when choosing between two objects (according to some criterion), if one is recognized or familiar, and the other is not, a person will likely select the familiar object.

regression to the mean (see page 361)

When two variables are imperfectly correlated, if there is an extreme value for one variable, the value of the other variable will tend to be more toward the centre of the distribution. Since the physical attractiveness of parents and their children is imperfectly correlated (due to a hereditary influences), regression to the mean would predict that the biological children of Brad Pitt and Angelina Jolie may be somewhat less attractive than their parents.

representativeness heuristic (see page 358)

The representativeness heuristic occurs when we make inferences on the assumption that small samples resemble one another and the population from which they are drawn. For example, suppose that half of the staff in an office is male and the other half female. This might lead us to assume that when some of the staff take lunch, there will be an even split between the number of men and women in the lunch room.

syllogism (see page 342)

Consisting of two premises and a conclusion, a syllogism specifies a relationship between two categories. For example:

All humans are mortal.
All Greeks are humans.
All Greeks are mortal.

Discussion and Debate Ideas

1. The key to generating the correct answer to Wason's selection task is to try to falsify (rather than verify) the rule. Have the class think about this as a general strategy in answering questions: an attempt to *dis*prove something can be more productive than trying to prove something. In fact,

this is the core of the scientific method: a good theory has to be falsifiable (if there is no way you can possibly prove it wrong, then it's not useful) and we can never say that a theory is "proven" because we can't prove anything beyond a doubt. Science progresses by attempts to disprove hypotheses and revise theories accordingly.

2. People sometimes make irrational decisions. As Kahneman and Tversky pointed out, people will choose to drive across town to save $5 on a $15 calculator but they will not make the drive to save $5 on a $125 coat.
   Why is $5 different in the context of the calculator compared to the coat?
   When people are irrational, it can usually be traced to a generally rational strategy (a heuristic). What's the rational strategy in this example?

3. To demonstrate the adjustment and anchoring heuristic, have students generate estimates in response to a trivia question after exposure to different anchors. One way of doing this is to present half of the class (with the other half closing their eyes) these two questions on a PowerPoint slide: "Was Elvis Presley older or younger than 80 when he died?" and "How old was Elvis Presley when he died?" Before they answer, present to the other half of the class these two questions: "Was Elvis Presley older or younger than 20 when he died?" and "How old was Elvis Presley when he died?" Have students from both halves of the class make estimates. Estimates from the 80 condition are likely to be higher than the 20 condition. Of course, neither 80 nor 20 are at all close to the true answer (42) but those numbers act as anchors. Have the class discuss how this heuristic works. In this particular example, those in the 80 group may have thought "Well he was definitely younger than 80 . . . maybe he was about 55" and those in the 20 group may have thought "He was certainly older than 20 . . . maybe he was 35?" We tend to be anchored to a number with which we are provided.
   Consider some real-world examples. Here's one: tort reform in the US. Insurance companies are all for setting limits on putative damages for lawsuits (so that they don't have situations where a plaintiff is awarded many millions of dollars). What they don't realize is that setting a limit means establishing an anchor. If the limit is $1 million, then $1 million would act as an anchor. And, of course, most lawsuits are not nearly in the million-dollar range but that number is still an anchor. Setting a limit would get rid of the multi-million-dollar awards but it would probably drive up the numbers in general. In short, insurance companies should be careful what they wish for.

4. Have the class discuss the link between intuitive statistics and superstitions. If you are wearing your red sweater when your favourite team wins the Stanley Cup, what are you going to wear the next time you go to a game? You might even choose to wear that "lucky" red sweater when you buy a lottery ticket. Our tendency to infer (sometimes illusory) correlations between variables can make us quite superstitious.

5. Demonstrate gambler's fallacy by asking students to select six numbers that they would choose for a lottery ticket. Ask them to explain why they chose the numbers they did. You will probably find most student choose numbers that either correspond to special dates or are random, but spaced out. Tell them you are going to choose the numbers 1, 2, 3, 4, 5, and 6. Ask them what they think your chances are of winning with six consecutive numbers and why. Most will likely think the odds are lower for winning with these numbers than 6 random numbers. Explain that the numbers of winning lottery numbers are chosen randomly; therefore your numbers have equal odds of winning as theirs do.

6. Present the students with the following syllogism and discuss its validity:

   All mammals have hair.
   Dolphins have hair.
   Therefore, dolphins are mammals.

   Ask for a show of hands for those who think the syllogism is valid (this is valid, as dolphins have a small amount of hair around their blow hole). Ask for another show of hands for those who believe the conclusion is true. Discuss the difference between true and valid in syllogistic reasoning.

7. Discuss how heuristics are exploited by advertisers. Which ones do they use? (e.g., recognition-based heuristics).

8. Discuss which reasoning approaches might help students on an exam. Are there any heuristics that might be useful for answering multiple choice questions?

9. Discuss the similarities between conditional reasoning and computer programming. For example, both make use of "if...then..." statements. Ask students for other examples.

Further Reading, Media Suggestions, and Teaching Aids

1. **Kahneman, D. 2011. *Thinking Fast and Slow*. Doubleday.**

   This book provides a fascinating summary of Kahneman's (and Tversky's) seminal work on decision-making.

2. **Kahneman, D., and Tversky, A. 1972. Subjective probability: A judgment of representativeness. *Cognitive Psychology, 3*, 430–454.**

   This is one specific example of Kahneman and Tversky's ground-breaking work. Participants were asked to answer the following question:

   > A nearby town is served by two hospitals. In the larger hospital, about 45 babies are born each day. In the smaller hospital, about 15 babies are born each day. Approximately 50 per cent of babies are boys. However, the exact percentage of babies who are boys will vary from day to day. Some days it may be higher than 50 per cent, some days it may be lower. For a period of one year, both the larger hospital and the smaller hospital recorded the number of days on which more than 60 per cent of the babies born were boys.
   >
   > Which hospital do you think recorded more such days, the larger hospital, the smaller hospital, or were each about the same?

   In fact, it is more likely that the smaller hospital recorded more of those days (since deviations from a mean are much more likely for small samples) but 56 per cent of participants responded

"about the same." The findings demonstrate that people tend to commit the small-sample fallacy; that is, they assume that small samples are representative of the larger population

3. **Which are deadlier—sharks or horses? (availability heuristic)**
   https://www.youtube.com/watch?v=2_wkv1Gx2vM&feature=youtu.be

   This shot video clip reviews the availability heuristic with examples.

4. **How to understand syllogisms**:
   https://www.youtube.com/watch?v=dRCS0CSwhsg&feature=youtu.be

   This video explains inductive/deductive reasoning as well as syllogisms by using the example of rainbow trout as a valid syllogism.

5. **Types of Heuristics: Availability, Representativeness, and Base-Rate:**
   https://www.youtube.com/watch?v=4nwAJ6salXE

   This video is an excellent introduction to the concept of heuristics. Specifically, it explains and provides examples of the availability, representativeness, and base-rate heuristics.

Homework or Study Questions

1. **What are three principles of Johnson-Laird's theory of mental models?**

   Mental models are "iconic." That is, there is a correspondence between the elements of the situation and the elements of the representation of the situation in mind. By inspecting mental models, relationships that were not initially evident can be identified. Mental models, then, may have "emergent consequences." People tend to be "parsimonious" in their construction of mental models. That is, they tend to construct the fewest and simplest mental model(s) possible.

2. **What impact does a social contract have on performance on Wason's selection task?**

   In Wason's selection task, participants are presented with four cards (E, F, 2, 5) and a rule to be verified ("If a card has a vowel on one side, then it has an even number on the other side") and must choose which card(s) to turn over. The E card must be turned over to verify that an even number is on the other side. As well, it is necessary to turn over the 5 card; if it has a vowel on the other side, then the rule is falsified. People often mistakenly choose to turn over the 2 card. They seem to be making the mistaken assumption that the two parts of the rule can be switched—that if a card has an even number on one side, it must have a vowel on the other side.

   Cosmides (1989) has argued that when a selection task has the content of a social contract, people will make inferences consistent with social contract theory. This is demonstrated by a variant of the selection task used by Griggs and Cox (1982). In this example, each card has a beverage on one side and an age on the other side. The rule is: If a person is drinking beer, then he must be over 21 years old. Detecting a cheater requires turning over the beer card and the 16 card. Participants make few errors in this version, possibly because the content elicits evolved social contract inferences.

3. **How does the law of large numbers contribute to the existence of the gambler's fallacy? How is the law of small numbers related to the representativeness heuristic?**

Using the example of a coin toss, according to the law of large numbers, an unbiased coin will come up heads 50 per cent of the time in the long run. However, in the short run, it may come up heads more or less than 50 per cent of the time. The gambler's fallacy, a belief that it is more likely that a coin will come up tails after a sequence of heads, can be thought of as misapplying the law of large numbers to a small number event. 50–50 does not necessarily apply for relatively short sequences; the odds for each individual coin toss are independent from any other coin toss.

The law of small numbers is the belief that a small sample should be representative of the population from which it is drawn. The representativeness heuristic involves making inferences on the assumption that small samples resemble the population from which they are drawn.

4. **Name and provide the representation for the four forms of syllogistic reasoning.**

Universal affirmative – All A are B
Universal negative – No A are B
Particular affirmative – some A are B
Particular negative – some A are not B

5. **How does Rips (1989) natural deduction approach to reason differ from Johnson-Laird's mental models approach?**

The natural deduction model differs in that it suggests that people carry out deduction representing the problem information, making further assumptions, drawing inferences, and coming to conclusions based on this process.

6. **What do studies of the adjustment and anchoring heuristic tell us about how we make judgments?**

Studies on the adjustment and anchoring heuristic suggest that judgment can be biased by aspects of the situation in which the judgment is made.

7. **What may be a cause of illusory correlations?**

Illusory correlations may be caused by availability because people mistakenly believe that two events happen together more than they actually do. This can lead to associating one event with the other.

8. **Sometimes when a student makes an extremely high grade on the first midterm in a course, they are very disappointed when the grade on the second midterm is somewhat lower. How would you explain this to the student?**

This could be explained by regression to the mean in that as the scores on the two tests are not perfectly correlated, the scores on the second test are likely to be closer to the class mean.

9. **Explain the difference between the availability and recognition heuristics.**

The availability heuristic suggests a participant will decide in favour of the most easily recalled alternative. The recognition heuristic, on the other hand, suggests that participants do not need to recall anything; they just need to recognize one of the choices.

Suggestions for Research Paper Topics

1. Is logical reasoning an essential part of human nature? With reference to studies that demonstrate human irrationality, make the argument that logicism is a fallacy.

2. As discussed in the textbook, judging the validity of syllogisms is made more difficult when the term "some" is included. What other factors create difficulty?

3. Does training in statistics leave people relatively immune to common intuitive statistical mistakes? Review the evidence.

4. Investigate real-world applications of the less-is-more effect. For example, how do advertisers exploit this effect?

5. Think back to the last big decision you made (e.g., renting an apartment, buying a car, etc.). What type of approach did you use? Based on the readings of the chapter, was it the correct approach? If not, what would you do differently?

6. Is there a "logical" person? If so, what type of personality characteristics would such a person have? Review the literature on personality and decision-making.

7. B. F. Skinner believed that all of our behaviours arose out of responses to environmental stimuli and from rewards and punishment. Review Skinner's behaviourist perspective and apply it to the principles of reasoning.

8. Examine how decision-making and reasoning is affected by emotion. Are there circumstances where emotion can positively or negatively affect our decision-making?

9. Research some of the errors we make in decision-making. Are they typically because of heuristics? What types of errors are most common? Provide examples.