Lecture Notes

# Chapter 12: Reasoning and Decision-Making

## Learning Objectives

* Recognize the difference between reasoning and decision-making
* Differentiate among the types of reasoning
* Apply the phases of decision-making to a dilemma
* Describe common cognitive illusions that cause errors in decision-making
* Compare and contrast the expected utility theory and the multiattribute utility theory
* Analyze the differences and similarities in descriptive models of decision-making
* Summarize various neurological studies involving reasoning and decision-making

**Outline**

**I.** Setting the Stage

**A.** The terms *reasoning* and *decision-making* are often used interchangeably with the term *thinking*.

**B.** Cognitive psychologists distinguish among the meanings of these three terms and see reasoning and decision-making as special cases of thinking.

**1.** Reasoning involves the use of principles of logic or the use of information to make inferences to create new information.

**2.** Decision-making refers to the mental activities involved in making choices among alternatives.

**II.** Reasoning

**A.** Reasoning involves drawing inferences, either through the use of logical reasoning or through the use of our general knowledge.

**1.** It is common to divide reasoning tasks into two types.

**a) Deductive reasoning** goes from general principles to specific statements.

**b) Inductive reasoning** takes specific facts and draws general conclusions from them.

**2.** We can also distinguish these types of reasoning by the types of conclusions that may be drawn from them.

**a)** Done correctly, deductive reasoning results in conclusions that have **deductive validity:** if the premises are true, the conclusion must be true.

**b)** Inductive reasoning does not offer guarantees; good inductive reasoning has **inductive strength,** meaning that it is improbable (but not impossible) for the premises to be true and the conclusion false.

**B.** There are several types of deductive reasoning.

**1. Propositional reasoning** involves drawing conclusions from premises that are in the form of propositions.

**a)** Simple propositions can be hooked together into more complicated propositions by using **logical connectives** such as **&, V,** negation, and “If-then.”

**(1)** Logicians use **truth tables** to represent all possible combinations of truth values of individual propositions in a compound proposition.

(a) If a compound proposition is always true, it is called a **tautology.**

(b) If a compound proposition is always false, it is called a **contradiction.**

**b)** Valid rules of inference, such as *modus ponens* and *modus tollens*, tell us that if the premises are true, the conclusion will also be true.

**c)** “Rules” that can produce conclusions that are false, even if the premises are true, are called **fallacies;** *denying the antecedent* and *affirming the consequent* are two examples of such fallacies.

**d)** Psychological studies (such as Wason’s card task) suggest that people have trouble applying propositional reasoning correctly.

**(1)** Propositional reasoning is frequently subject to a **content effect**, in which we exhibit better reasoning skills in more familiar contexts.

**(2)** People are also more likely to draw invalid inferences when the content of the propositions is emotional rather than neutral.

**(3)** Cosmides argues that people are good at reasoning tasks when the content of the task can be construed in terms of social costs and benefits, for which we are evolutionarily adapted.

**2. Syllogistic reasoning** problems present two or more premises and ask the reasoner to draw or evaluate a conclusion.

**a) Categorical syllogisms** present premises that deal with classes and contain *quantifiers* such as “all,” “some,” or “no.”

**b)** The majority of categorical syllogisms do not have valid conclusions.

**c)** Syllogistic reasoning is prone to at least four types of errors.

**(1)** Content effects are similar to the type that occur for propositional reasoning.

**(2) Believability effects** push us to judge as valid conclusions that reinforce our initial assumptions.

**(3)** Premises that have negatives are more difficult to work with, as are premises that involve the quantifier *some.*

**(4)** People make errors in understanding what the premises mean.

**C.** Inductive reasoning occurs frequently in everyday life and may be more useful than deductive reasoning because inductive conclusions add new information to our thinking.

**1.** Analogical reasoning requires us to determine a relationship between two items and then extend that relationship into a new area.

**a)** The ease of reasoning about an analogy depends upon the complexity of the problem.

**b)** Complexity, in turn, depends on the individual terms, the reasoner’s knowledge, the clarity of the relationship, and the number of possibilities for the blank term.

**2.** Another example of inductive reasoning is hypothesis testing.

**a)** As Wason demonstrated, hypothesis testing is often subject to **confirmation biases;** we true to confirm that our hypothesis is true, instead of actually testing it.

**b)** No pattern of results can prove a theory to be true, although there are many patterns of results that can disconfirm it.

**D.** Thus far, we have discussed **formal reasoning** tasks, but cognitive psychologists are also interested in **everyday reasoning,** the kind of reasoning we do in our ordinary lives.

**1.** Certain kinds of inferences in everyday reasoning do not seem to occur in formal reasoning tasks.

**2.** Everyday reasoning is also subject to a variety of **biases.**

**III.** Decision-Making

**A.** Cognitive psychologists use the term **decision-making** to refer to the mental activities that take place in choosing among alternatives, often under conditions of some *uncertainty.*

**B.** The “goodness” of decision-making cannot be measured by the success of individual decisions.

**1.** Instead, good decision-making is defined as **rational** if it considers all of the relevant goals, involves the careful gathering of information, and examines evidence both for and against your initial inclinications.

**2.** Poor decisions can result from **cognitive overload**, when the available information overwhelms the available cognitive processing.

**C.** Decision tasks can be divided into five categories or *phases*.

**1.** Decision makers must set *goals*, taking stock of their plans for the future and their priorities.

**2.** Before making a decision, the decision maker must gather information.

**3.** For a complex decision, decision makers need a way to organize their information; this is called **decision structuring.**

**4.** After all information is gathered, the decision maker selects from the final set of options.

**5.** Often omitted, the last phase of decision-making involved evaluating the entire process.

**IV.** Cognitive Illusions in Decision-Making

**A.** Research on decision-making skills has consistently demonstrated the existence of common **heuristics** (shortcuts) that lead to systematic errors.

**1.** These heuristics are justifiable ways of thinking under most conditions, but can lead to error when they are misapplied.

**2.** Thus, these biases have been labeled **cognitive illusions** and like perceptual illusions, they can provide information about normal cognitive processing.

**B.** The **availability heuristic** involves determining the likelihood of an event by assessing how easily examples come to mind; the problem is that our memories can be biased by many factors.

**C.** The **representativeness heuristic** involves making judgments by considering how representative a particular example is of a group or process; the problem with this heuristic is that we overemphasize representativeness even when other data is available to us.

**1.** For example, we overemphasize a personality sketch that is representative of the category “computer scientist” in spite of base rate data that suggest that computer scientists are rare in this group.

**2.** A related bias, the **gambler’s fallacy,** can lead us to expect results in the short run to mirror long-run probabilities, for example, in betting on red or black at a roulette wheel.

**D.** People evaluate outcomes as changes from a reference point, according to research on **framing effects.**

**1.** Unfortunately, simply changing the description of a situation can lead us to adopt different reference points.

**2.** Seeing an outcome as a gain rather than a loss can change our decision, even when the objective facts of the problem have not changed.

**E.** In estimating numerical answers, we often fall victim to the **anchoring** phenomenon, starting with a quick estimate and then not adjusting enough from that anchor when we have more time to think.

**F.** When we make a decision that has disappointing consequences, the **sunk cost effect** often leads us to stay with our chosen strategy rather than changing course to consider a potentially better option.

**G.** Further, when collecting data on which to base our decisions, we often see nonexistent relationships that “make sense” to us, a phenomenon called **illusory correlation.**

**H.** We may fail to learn from our decision-making mistakes because **hindsight bias** leads us to think that we “knew it all along.”

**I.** Furthermore, we tend to seek out information that confirms our judgments—a phenomenon known as **confirmation bias—**instead of seeking information more objectively.

**J.** Human decision makers also exhibit systematic **overconfidence** in their judgments, a fact shown by plotting **calibration curves** relating accuracy to confidence.

**V.** Utility Models of Decision Making

**A.** Broadly speaking, there are three types of models of decision-making.

**1. Normative models** describe ideal performance under ideal circumstances.

**2. Prescriptive models** tell us how we “ought” to make decisions in real-world circumstances.

**3. Descriptive models** show what people actually do when they make decisions.

**B. Expected utility theory** is seen as the normative model of decisions made when outcomes are not known with certainty.

**1.** “Expected” indicates that outcomes are probabilistic.

**2. Utility** is a measure of psychological happiness, pleasure, or satisfaction from a given outcome.

**3.** Expected utility models tell us to multiply the probability of each possible outcome of a choice by the utility of that outcome and sum the results to see what a particular choice is “worth.”

**4.** According to expected utility theory, we should always choose the option that has the greatest expected utility.

**C. Multiattribute utility theory (MAUT)** is used to integrate different dimensions and goals of a complex decision.

**1.** MAUT involves six steps.

**a)** Break a decision into independent dimensions.

**b)** Determine the relative weights (importance) of each dimension.

**c)** List all of the alternatives that you can choose from.

**d)** Rank all of the alternatives along the dimensions.

**e)** Multiply each ranking by the weight of the dimension.

**f)** Choose the alternative with the highest total value.

**2.** MAUT is usually considered to be a normative model of decision-making.

**3.** However, research suggests that people do not always spontaneously use MAUT, instead relying on simpler strategies such as **elimination by aspects** to narrow their choices and simplify the decision.

**VI.** Descriptive Models of Decision-Making

**A. Image theory** is a descriptive model of how people make decisions.

**1.** In this model, a “prechoice screening of options” narrows the number of options to a small number.

**2.** This prochoice screening is done by asking yourself whether an alternative is compatible with three images: the *trajectory image* (containing your goals for the future), the *value image* (containing your values and morals), and the *strategic image* (the way in which you plan to attain your goals).

**3.** Alternatives that are incompatible with one or more of these three images are dropped from further consideration; no tradeoffs are made.

**B.** When experts make time-pressured, high-stakes decisions, the **recognition-primed decision-making** model may capture their cognitive processes best.

**1.** In these conditions, experts rely on intuition, mental simulation, analogies, and recalling or creating stories.

**2.** Experts consider one option at a time, mentally simulating the likely effect of that decision, and either take action or reject that alternative.

**VII.** Neuropsychological Evidence on Reasoning and Decision-Making

**A.** Trying to localize brain regions involved in reasoning and decision-making is a difficult task.

**1.** These processes involve other cognitive processes such as memory and language.

**2.** Thus, it is likely that no one place in the brain is associated with all instances of reasoning or decision-making.

**B.** Nevertheless, evidence is growing for the role of the prefrontal cortex in higher-order cognitive functions.

**1.** Patients with prefrontal cortex damage were severely hampered in their ability to reason.

**2.** Brain imaging studies of individuals carrying out decision-making tasks support the idea that the prefrontal cortex plays an important role in decision-making.