

Part I

THINKING IN GENERAL

Part I is about the basics, the fundamentals. Chapters 1 through 3 present the concepts that underlie the rest of the book. Chapter 1 defines thinking, introduces the main types of thinking, and presents what I call the search-inference framework for describing thinking. Chapter 2 introduces the *study* of thinking and decision making, including the three types of questions we shall ask:

1. The *normative* question: How should we evaluate thinking, judgment, and decision making? By what standards?
2. The *descriptive* question: How do we think? What prevents us from doing better according to normative standards?
3. The *prescriptive* question: What can we do to improve our thinking, judgment, and decision making, both as individuals and as a society? What tools are helpful?

These three questions define the content of the book. We can ask them about every topic. The third chapter introduces a theory of the nature of *good* thinking and of how we tend to think poorly. By using a normative theory to evaluate our actual thinking, we can know how it must be improved if it is found wanting.

Chapter 4 briefly introduces the study of logic and argumentation. This is an older tradition in both philosophy and psychology. It is of interest because it has, from the time of Aristotle, taken roughly the approach I have just sketched. Logic provides a standard of reasoning. Although people often reason in accord with this standard, they sometimes depart from it systematically. Scholars across the centuries have therefore asked, “How can we help people to think more logically?”

1 What is thinking?

Beginning to reason is like stepping onto an escalator that leads upward and out of sight. Once we take the first step, the distance to be traveled is independent of our will and we cannot know in advance where we shall end.

Peter Singer (1982)

Thinking is important to all of us in our daily lives. The way we think affects the way we plan our lives, the personal goals we choose, and the decisions we make. Good thinking is therefore not something that is forced upon us in school: It is something that we all want to do, and want others to do, to achieve our goals and theirs.

This approach gives a special meaning to the term “rational.” Rational does not mean, here, a kind of thinking that denies emotions and desires: It means, *the kind of thinking we would all want to do in order to achieve our goals*. People want to think “rationally,” in this sense.

This chapter discusses three basic types of thinking: *thinking about decisions*, *thinking about beliefs*, and *thinking about our goals themselves*. It also describes what I call the *search-inference framework*, a way of identifying the basic elements in all of these thinking processes.

1.1 Types of thinking

We think when we are in doubt about how to act, what to believe, or what to desire. In these situations, thinking helps us to resolve our doubts: It is purposive.

A *decision* is a choice about action – of what to do or not do. Decisions are made to achieve goals, and they are based on beliefs about what actions will achieve the goals. For example, if I believe it is going to rain, and if my goal is to keep dry, I will carry an umbrella. Decisions may attempt to satisfy the goals of others as well as the selfish goals of the decision maker. I may carry an extra umbrella for a friend. Decisions may concern small matters, such as whether to carry an umbrella,

or matters of enormous importance, such as how one government should respond to a provocation by another. Decisions may be simple, involving only a single goal, two options, and clear beliefs, or they may be complex, with many goals and options and with uncertain beliefs. Many actions do not involve decisions. If laughing at a joke resulted from a decision, it would not be a real laugh. Decisions depend on beliefs and goals. Actions, goals, and beliefs are acquired categories that we use to think about our own thinking. Actions, as I use the term, include “doing nothing.”

I use the term “goal” throughout this book, but it is not entirely satisfactory. It evokes images of games like soccer and basketball, in which each team tries to get the ball into the “goal.” Such goals are all-or-none. Either you get one or you don’t. Some of the goals I discuss here are of that type, but others are more like the rating scales used for scoring divers or gymnasts. This kind of rating is closer to the present meaning, which is that the goals are criteria or standards of evaluation. Other words for similar ideas are: “desire” (which implies a feeling of being unsatisfied, which is not necessary for all goals), “criterion” (emphasizing the role of goals as standards, which is reasonable), and “objective” (a fancy word for “goal”). When we decide on a *personal goal*, we make a decision that affects future decisions. If a person decides to pursue a certain career, the pursuit of that career becomes a goal that many future decisions will seek to achieve. When we choose personal goals by thinking, we also try to bind our future behavior.

Beliefs refer to propositions that could be true or false. Some beliefs count as “knowledge,” when the beliefs depend on their truth. Thus, in this book, I use the term “belief” to cover propositions that are uncertain (“It will rain today”), certain (“ $2+2=4$ ”), or false (“ $2+2=5$ ”). Note that people also use “beliefs” to refer to commitments, something more like a person’s goals, such as belief *in* a deity; that is not the sense I use here.

We can think about beliefs and goals separately, without even knowing what decisions they will affect. When we think about *belief*, we think to decide how strongly to believe something, or which of several competing beliefs is true or most credible. We may express beliefs in language, even without acting on them ourselves; others may act on the beliefs we express. Many school problems, such as those in mathematics, involve thinking about beliefs that we express in language only, not in actions. Beliefs may vary in strength, and they may be quantified as probabilities. A decision to go out of my way to buy an umbrella requires a stronger belief that it will rain (a higher probability) than a decision to carry an umbrella I already own.

Actions, goals, and beliefs can be the results of thinking, but they can also come about in other ways. For example, we are born with the goal of satisfying physical needs, a desire. It may also make sense to say that we are born holding the belief that space has three dimensions. The distinctions among actions, goals, and beliefs are learned in early childhood (Wellman & Woolley, 1990), but adults may still confuse these concepts.

1.2 The search-inference framework

Thinking about actions, goals, and beliefs can all be described in terms of a common framework, which asserts that thinking consists of *search* and *inference*. We search for certain objects and then we make inferences from and about them.

Let us take a simple example of a decision. Suppose you are a college student trying to decide which courses you will take next term. Most of the courses you have scheduled are required for your major, but you have room for one elective. The question that starts your thinking is simply this: Which course should I take?

You begin by saying to a friend, “I have a free course. Any ideas?” She says that she enjoyed Professor Smith’s course on the rise and fall of the Soviet Union. You think that the subject sounds interesting, and you want to know more about twentieth-century history. You ask her about the work, and she says that there is a lot of reading and a twenty-page paper. You think about all the computer-science assignments you are going to have this term, and, realizing that you were hoping for an easier course, you resolve to look elsewhere. You then recall hearing about a course in American history since World War II. That has the same advantages as the first course – it sounds interesting and it is about modern history – but you think the work might not be so hard. You try to find someone who has taken the course.

This example shows the main characteristics of thinking. It begins with doubt. It involves a search directed at removing the doubt. Thinking involves exploration. In the course of the search, you discovered two possible courses, some good features of both courses, some bad features of one course, and some goals you are trying to achieve. You also made an inference: You tentatively rejected the first course because the work was too hard.

We search for three kinds of objects: possibilities, goals, and evidence.

Possibilities are possible answers to the original question, possible resolutions of the original doubt. (In the example, they are possible courses.) Notice that possibilities can come from inside yourself or from outside. (This is also true of evidence and goals.) The first possibility in this example came from outside: It was suggested by someone else. The second came from inside: It came from your memory.

Goals are the criteria by which you evaluate the possibilities. Three goals have been mentioned in our example: your desire for an interesting course; your feeling that you ought to know something about recent history; and your desire to keep your workload manageable. Some goals are usually present at the time when thinking begins. In this case, only the goal of finding a course is present, and it is an insufficient goal, because it does not help you to distinguish among the possibilities, the various courses you could take. Additional goals must be sought.

Evidence consists of any belief or potential belief that helps you determine the extent to which a possibility achieves some goal. In this case, the evidence consists of your friend’s report that the course was interesting and her report that the workload was heavy. The example ended with your resolution to search for more evidence about the workload of the second possibility, the American history course. Such

a search for evidence might initiate a whole other episode of thinking, the goal of which would be to determine where that evidence can be found. Units of evidence are sometimes called arguments.

In addition to the search for possibilities, goals, and evidence, there is a process of *inference*, in which each possibility is strengthened or weakened on the basis of the evidence, in light of the goals. Goals determine the way in which evidence is used. For example, the evidence about workload would be irrelevant if having a manageable workload were not a goal. The importance of that goal, which seems to be high, affects the importance of that evidence, which seems to be great.

The objects of thinking are represented in our minds, consciously. If they are not in our immediate consciousness, we can recall them when they are relevant, even after an episode of thinking resumes following an interruption. The processes of thinking – the search for possibilities, goals, and evidence and the inference from the evidence to evaluate the possibilities – do not occur in any fixed order. The thinker alternates from one to another, with each subjectively successful search leading to other sorts of searches and to inferences.

Why just these phases: the search for possibilities, goals, and evidence, and inference? *Thinking is, in its most general sense, a method of finding and choosing among potential possibilities, that is, possible actions, beliefs, or goals.* For any choice, there must be purposes or goals, and goals can be added to or removed from the list. I can search for (or be open to) new goals; therefore, search for goals is usually possible. There must also be objects that can be brought to bear on the choice among possibilities. Hence, there must be evidence, and it can always be sought. Finally, the evidence must be used, or it might as well not have been gathered. These phases are “necessary” in this sense.

The term “judgment” will be important in this book. By judgment, I mean the *evaluation of one or more possibilities with respect to a specific set of evidence and goals.* In decision making, we can judge whether to take an option or not, or we can judge its desirability relative to other options. In belief formation, we can judge whether to accept a belief as a basis of action, or we can judge the probability that the belief is true. In thinking about goals, we can judge whether or not to adopt a goal, or we can judge how strong it should be relative to other goals. The term “judgment,” therefore, refers to the process of inference.

Let us review the main elements of thinking, using another example of decision making, the practical matter of looking for an apartment. “Possibilities” are possible answers to the question that inspired the thinking: Here, they are possible apartments. Possibilities (like goals and evidence) can be in mind before thinking begins. You may already have seen one apartment you like before you even think about moving. Or possibilities can be added, as a result of active search (on the Internet) or suggestions from outside (tips from friends).

Goals are criteria used for evaluating possibilities. In the apartment-hunting example, goals include factors such as rent, distance from work or school, safety, and design quality. The goals determine what evidence is sought and how it is used. It is not until you think that safety might be relevant that you begin to inquire about

1.2 THE SEARCH-INFERENCE FRAMEWORK

9

building security or the safety of the neighborhood. When we *search for goals*, we ask, “What should I be trying to do?” or “What are my purposes in doing this?” Can you think of other criteria for apartments aside from those listed? In doing so, you are searching for goals. We also often have a *subgoal*, a goal whose achievement will help us achieve some other goal. In this example, “good locks” would be a subgoal for “safety.” Each possibility has what I shall call its *strength*, which represents the extent to which it is judged by the thinker to satisfy the goals. In decision making, the strength of a possibility corresponds to its overall desirability as an act, taking into account all the goals that the decision maker has in mind.

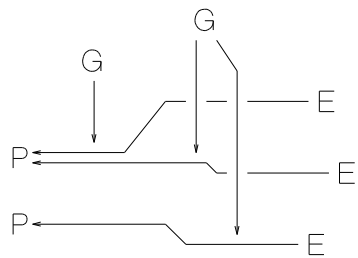
Evidence is sought – or makes itself available. Evidence can consist of simple propositions such as “The rent is \$300 a month,” or it can consist of arguments, imagined scenarios, or examples. One possibility can serve as evidence against another, as when we challenge a scientific hypothesis by giving an alternative and incompatible explanation of the data.

Each piece of evidence has a *weight* with respect to a given possibility and set of goals. The weight of a given piece of evidence determines how much it should strengthen or weaken the possibility as a means of achieving the goals. The weight of the evidence by itself does not determine how much the strength of a possibility is revised as the possibility is evaluated; the thinker controls this revision. Therefore a thinker can err by revising the strength of a possibility too much or too little.

The *use of the evidence* to revise (or not revise) strengths of possibilities is the end result of all of these search processes. This phase is also called *inference*. It is apparent that inference is not all of thinking, although it is a crucial part.

The relationship among the elements of thinking, at a given moment, is illustrated in Figure 1.1.

Figure 1.1 *Relation of possibilities, goals, and evidence*



The evidence (*E*) affects the strengths of the possibilities (*P*), but the weight of the evidence is affected by the goals (*G*). Different goals can even reverse the weight of a piece of evidence. For example, if I want to buy a car and am trying to decide between two different ones (*possibilities*), and one of the cars is big and heavy (*evidence*), my concern with safety (a *goal*) might make the size a virtue (*positive weight*), but my concern with mileage (another *goal*) or the environment might make the size a detriment (*negative weight*).

The examples presented so far are all readily recognizable as decisions, yet there are other types of thinking – not usually considered to be decision making – that

can be analyzed as decision making. For instance, any sort of inventive or creative thinking can be analyzed this way. When we create music, poetry, paintings, stories, designs for buildings, scientific theories, essays, computer programs, or dinners, we make decisions at several levels. We decide on the overall plan of the work, the main parts of the plan, and the details. Often, thinking at these different levels goes on simultaneously. We sometimes revise the overall plan when problems with details come up. At each level, we consider possibilities for that level, we search for goals, and we look for evidence about how well the possibilities achieve the goals.

Planning is decision making, except that it does not result in immediate action. Some plans – such as plans for a Saturday evening – are simply decisions about specific actions to be carried out at a later time. Other plans are shorter still: When we are trying to solve a math problem, we often make a plan about how to proceed, which we may revise as we work on the problem.

Other, long-term plans produce personal goals, which then become the goals for later episodes of thinking. For example, a personal career goal will affect decisions about education. Thinking about plans may extend over the period during which the plans are in effect. We may revise our plans on the basis of experience. Experience provides new evidence. The goals involved in planning – the criteria by which we evaluate possible plans – are the personal goals we already have. We therefore create new goals on the basis of old ones. We may also decide to give up (or temporarily put aside) some personal goals.

Note that the discovery of goals in the course-choice example is in part the result of looking for problems with some of the options. I discuss this process in Chapter 15. However, the search for goals need not be the result of a particular decision opportunity. It could also involve an ongoing process of thinking about deeper, persistent goals, which would apply to a great many decisions. For example, the student might have thought about a career in the foreign service, which would indeed require an understanding of modern history but might also benefit from some sort of independent study, such as working with a political science professor concerned with European politics. This would be “outside the box” of the original decision, narrowly defined. But ongoing attempts to clarify these deeper goals might be a good idea. In a way, the original problem was framed too narrowly. It would have been better to frame it as “What should I do with this opportunity?” rather than “What course should I take?” The process of decision making might benefit from greater effort on setting up the problem, before trying to solve it (Siebert & Keeney, 2020).

1.3 Thinking about beliefs

The search-inference framework applies to thinking about beliefs as well as thinking about decisions. When we think about beliefs, we make decisions to strengthen or weaken possible beliefs. One goal is to bring our beliefs into line with the evidence. (Sometimes we have other goals as well – for example, the goal of believing certain things, regardless of their fit with the evidence.) Roughly, beliefs that are most in line

1.3 THINKING ABOUT BELIEFS

11

with the evidence are beliefs that correspond best with the world as it is. They are beliefs that are most likely to be *true*. If a belief is true, and if we hold it because we have found the right evidence and made the right inferences, we can be said to *know* something.¹ Hence, thinking about beliefs can lead to knowledge.

Examination of a few types of thinking about belief will show how the search-inference framework applies. (Each of these types is described in more detail in later chapters.)

Diagnosis. In diagnosis, the goal is to discover what the trouble is – what is wrong with a patient, an automobile engine, a leaky toilet, a stew, or a piece of writing. The search for evidence is only partially under the thinker’s control, both because some of the evidence is provided without being requested and because there is some limitation on the kinds of requests that can be obeyed. In particular, the import of the evidence cannot usually be specified as part of the request (for example, a physician cannot say, “Give me any evidence *supporting a diagnosis of ulcers*,” unless the patient knows what this evidence would be). In the purest form of diagnosis, the goal is never changed, although sub-episodes of thinking may be directed toward subgoals, such as obtaining a certain kind of evidence.

Scientific thinking. A great deal of science involves testing hypotheses about the nature of some phenomenon. What is the cause of a certain disease? What causes the tides? The “possibilities” are the hypotheses that the scientist considers: germs, a poison, the sun, the moon. Evidence consists of experiments and observations. Pasteur, for example, inferred that several diseases were caused by bacteria after finding that boiling contaminated liquid prevented the spread of disease – an experiment. He also observed bacteria under a microscope – an observation.

Science differs from diagnosis in that the search for goals is largely under the thinker’s control and the goals are frequently changed. Scientists frequently “discover” the “real question” they were trying to answer in the course of trying to answer some other question. But experimental science has much the same limitation on control over the result of a search for evidence: The scientist cannot do an experiment that is sure to give a particular answer; the experiment may fail.

Reflection. Reflection includes the essential work of philosophers, linguists, mathematicians, and others who try to arrive at general principles or rules on the basis of evidence gathered largely from their own memories rather than from the outside world. Do all words ending in “-ation” have the main stress on the syllable “a”? Does immoral action always involve a kind of thoughtlessness? In reflection, the search for evidence is more under the control of the thinker than in diagnosis and experimental science; in particular, thinkers can direct their memories to provide evidence either for or against a given possibility (in this case, a generalization). One can try to think of words ending in “-ation” that follow the proposed rule or words that violate it. One can try to recall, or imagine, immoral actions that do or do not involve thoughtlessness. In reflection (and elsewhere), new possibilities may be modifications of old ones. For example, after thinking of evidence, a philosopher

¹ For a more complete introduction to these concepts, see Scheffler (1965).

might revise the rule about immorality: “All immorality involves thoughtlessness, except _____.” Reflection lies at the heart of all scholarship, not just philosophy.

Insight problems. Much of the psychology of thinking concerns thinking of a very limited sort, the solution of puzzle problems. For example, why is any number of the form ABC,ABC (such as 143,143 or 856,856) divisible by 13?² These are problems whose solution usually comes suddenly and with some certainty, after a period of apparently futile effort. Many are used on intelligence tests. The search for possibilities is critical. Often, it is difficult to come up with any possibilities at all (as in the 13 problem). In other cases, such as crossword puzzles, possibilities present themselves readily and are rejected even more readily. In either case, search for evidence and inference (acceptance or rejection) are essentially immediate, and the goal is fixed by the problem statement. It is this immediate, effortless occurrence of the other phases that gives insight problems their unique quality of sudden realization of the solution. While the search is proceeding, it produces few if any signs of progress, so that people are unable to predict whether they will find the answer, or to determine whether they are making progress (Metcalf & Wiebe, 1987).

Prediction. Who will be the next president of the United States? Will the stock market go up or down tomorrow? Will student X finish her degree if we admit her to graduate school? Prediction of likely future events is like reflection, in form, although the goal is fixed. The evidence often consists of memories of other situations the thinker knows about, which are used as the basis of analogies – for example, student Y, who did finish, and who was a lot like X.

Behavioral learning. In every realm of our lives – in our social relationships with friends, families, colleagues, and strangers, and in our work – we learn how our behavior affects ourselves and others. Such learning may occur without conscious thinking, as it probably does in cockroaches and sea slugs, but thinking can also be brought to bear. When it is, each action is a search for evidence, an experiment designed to find out what will happen. The evidence is the outcome of this experiment. Each possibility we consider is a type of action to take.

This kind of learning can have much in common with science. Whereas science is usually about learning, behavioral learning has an additional goal of obtaining immediate success or reward in the task at hand. These goals frequently compete (Schwartz, 1982). We are often faced with a choice of repeating some action that has served us reasonably well in the past or taking some new action, hoping either that it might yield an even better outcome or that we can obtain evidence that will help us decide what to do in the future. Some people choose the former course too often and, as a result, achieve adaptations less satisfactory to them than they might achieve if they experimented more.

An example of behavioral learning with enormous importance for education is the learning of ways of proceeding in thinking tasks themselves – for example, the important strategy of looking for reasons why you might be wrong before concluding that you are right. The effectiveness of thinking may depend largely on the number

² Hint: What else are such numbers also divisible by? Another hint: What is the smallest number of this form? Another hint: A and B can both be 0. Another hint: Is it divisible by 13?