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 than we do 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?

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 the normative theory to evaluate our actual thinking, we can know how it must be improved if it is found wanting. In this way, we can learn to think more *rationally*, that is, in a way that helps us achieve our goals.

Chapter 4 briefly introduces the study of logic. 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 thus have asked, "How can we help people to think more logically?"

Chapter 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, if we were aware of our own best interests, in order to achieve our goals*. People want to think "rationally," in this sense. It does not make much sense to say that you do not want to do something that will help you achieve your goals: Your goals are, by definition, what you want to achieve. They are the criteria by which you evaluate everything about your life.

The main theme of this book is the comparison of what people do with what they should do, that is, with what it would be rational for them to do. By finding out where the differences are, we can help people — including ourselves — to think more rationally, in ways that help us achieve our own goals more effectively.

This chapter discusses three basic types of thinking that we have to do in order to achieve our goals: *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.

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. We have to think when we *make decisions*, when we *form beliefs*, and when we *choose our personal goals*, and we will be better off later if we think well in these situations.

A *decision* is a choice of 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 strong beliefs about which option will best achieve the goal, or they may be complex, with many goals and options and with uncertain beliefs.

Decisions depend on beliefs and goals, but 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. When we believe a proposition, we tend to act as if it were true. If I believe it will rain, I will carry my umbrella. 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.

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. Personal goals of this sort require self-control.

Actions, beliefs, and personal goals can be the results of thinking, but they can also come about in other ways. For example, we are born with the personal goal of satisfying physical needs. It may also make sense to say that we are born holding the belief that space has three dimensions. The action of laughing at a joke does not result from a decision. If it did, it would not be a real laugh.

The search-inference framework

Thinking about actions, beliefs, and personal goals 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 in Soviet-American relations. You think that the subject sounds interesting, and you want to know more about modern 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.

Clearly, we could go on with this example, but it already shows the main characteristics of thinking. It begins with doubt. It involves a search directed at removing the doubt. Thinking is, in a way, like 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 rejected the first course because the work was too hard.

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

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 work load 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.

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. You either 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 is, in a way, closer to the fundamental meaning, which is that the goals are criteria or standards of evaluation. Other words for the same idea are criteria, objectives, and values (in the sense of e*valu*ation, not the more limited sense referring to morality). Because all these terms are misleading in different ways, I will stick with goals. At least this term conveys the sense that, for most of us, goals have motivational force. We *try* to achieve them. But we also apply them when we make judgments.

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 work load was heavy. The example ended with your resolution to search for more evidence about the work load 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.

In addition to these search processes, there is a process of *inference*, in which each possibility is strengthened or weakened as a choice 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 work load would be irrelevant if having a manageable work load 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. We are conscious of them. 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, evidence, and goals and the inference from the evidence to evaluate the possibilities — do not occur in any fixed order. They overlap. The thinker alternates from one to another.

Why just these phases: the search for possibilities, evidence, and goals, and inference? *Thinking is, in its most general sense, a method of finding and choosing among potential possibilities, that is, possible actions, beliefs, or personal 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 always 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 personal 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 (through the newspaper) or suggestions from outside (tips from friends).

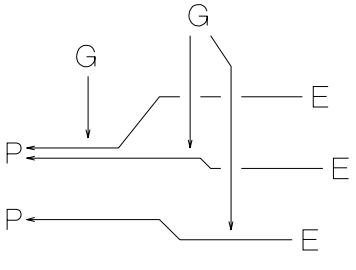
Goals are criteria used for evaluating possibilities. In the apartment-hunting example, goals include factors such as rent, distance from work or school, safety, and design quality. The goals determine what evidence is sought and how it is used. It is not until you think that safety might be relevant that you begin to inquire about 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. Briggs and Krantz (1992) found that subjects can judge the weight of each piece of evidence independently of other pieces.

Each piece of evidence has what I shall call 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 is illustrated in the following diagram:



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*) might make the size a detriment (*negative weight*).

The following story describes the situation of a person who has to make an important decision. As you read it, try to discover the goals, possibilities, evidence, and inferences:

> A corporate executive is caught in a dilemma. Her colleagues in the Eastern District Sales Department of the National Widget Corporation have decided to increase the amount they are permitted to charge to their expense accounts without informing the central office (which is unlikely to notice). When she hears about the idea, at first she wants to go along, imagining the nice restaurants to which she could take her clients, but then she has an uneasy feeling about whether it is right to do this. She thinks that not telling the central office is a little like lying.
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> When she voices her doubts to her colleagues, they point out that other departments in the corporation are allowed higher expense accounts than theirs and that increased entertainment and travel opportunities will benefit the corporation in various ways. Nearly persuaded to go along at this point, she still has doubts. She thinks of the argument that any other department could do the same, cooking up other flimsy excuses, and that if all departments did so, the corporation would suffer considerably. (She makes use here of a type of moral argument that she recognizes as one she has used before, namely, "What if everyone did that?") She also wonders why, if the idea is really so harmless, her colleagues are not willing to tell the central office.
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> Now in a real quandary, because her colleagues had determined to go ahead, she wonders what she can do on her own. She considers reporting the decision to the central office, but she imagines what would happen then. Her colleagues might all get fired, but if not, they would surely do their best to make her life miserable. And does she really want them all fired? Ten years with the company have given her some feelings of personal attachment to her co-workers, as well as loyalty to the company. But she cannot go along with the plan herself either, for she thinks it is wrong, and, besides, if the central office does catch them, they could *all* get fired. (She recalls a rumor that this happened once before.) She finally decides not to go above the company's stated limit for her department's expense accounts herself and to keep careful records of her own actual use of her own expense account, so that she can prove her innocence if the need arises.

In this case, the *goals* were entertaining clients in style; following moral rules; serving the interests of the corporation; being loyal to colleagues; and avoiding punishment. The *possibilities* were going along, turning everyone in, not going along, and not going along plus keeping records. The *evidence* consisted of feelings and arguments — sometimes arguments of others, sometimes arguments that our executive thought of herself.

Initially the executive saw only a single possibility — to go along — but some evidence against that possibility presented itself, specifically, an intuition or uneasy feeling. Such intuitions are usually a sign that more evidence will be found. Here, the executive realized that withholding evidence was a form of lying, so a moral rule was being violated. With this piece of evidence came a new *goal* that was not initially present in the executive's mind, the goal of being moral or doing the right thing. She sought more evidence by talking to her colleagues, and she thought of more evidence after she heard their arguments. Finally, another possibility was considered: turning everyone in. Evidence against this possibility also involved the discovery of other relevant goals — in particular, loyalty to colleagues and self-protection.

The final possibility was a compromise, serving no goals perfectly. It was not as "moral" as turning her colleagues in or trying to persuade them to stop. It might not have turned out to be as self-protective either, if the whole plot had been discovered, and it was not as loyal to colleagues as going along. This kind of result is typical of many difficult decisions.

This example clarifies the distinction between *personal goals* and *goals for thinking*. The goals for thinking were drawn from our executive's personal goals. She had adopted these personal goals sometime in the past. When she searched for goals for her thinking, she searched among her own personal goals. Many of her personal goals were not found in her search for goals, in most cases because they were irrelevant to the decision. Each person has a large set of personal goals, only a few of which become goals for thinking in any particular decision.

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 when they are examined closely. 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, or computer programs, 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, 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.

We may have short-term plans as well as long-term plans. 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.

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 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, 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 essentially never changed, although there may be subepisodes of thinking 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.

[1] For a more complete introduction to these concepts, see Scheffler, 1965. We shall also return to them throughout this book.