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 evaluation, 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:

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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.

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.

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. 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.

1For a more complete introduction to these concepts, see Scheffler, 1965. We shall also return to them throughout this book.
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. There is, in experimental science, the same limitation on control over the evidence-search phase: The scientist cannot pose a question of the form “Give me a result that supports my hypothesis.” This limitation does not apply when evidence is sought from books or from one’s own memory.

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 might revise the rule about immorality: “All immorality involves thoughtlessness, except ______.” Reflection lies at the heart of scholarship, not just in philosophy but also in the social sciences and humanities.

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? 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. Essentially, the only phase under the thinker’s control at all is the search for possibilities. 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.

Prediction. Who will be the next president of the United States? Will the stock market go up or down? Will student X succeed 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 succeed, 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

2Hint: 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?
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our behavior affects ourselves and others. Such learning may occur without thinking, 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 a “pure” activity, with a single goal, behavioral learning has two goals: learning about the situation and 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 and quality of these thinking strategies. This, in turn, may (or may not) depend on the quality of the thinking that went into the learning of these heuristics.

The results of behavioral learning are beliefs about what works best at achieving what goal in what situation. Such beliefs serve as evidence for the making of plans, which, in turn, provide personal goals for later decisions. For example, people who learn that they are admired for a particular skill, such as telling jokes, can form the goal of developing that skill and seeking opportunities to display it.

Learning from observation. This includes all cases in which we learn about our environment from observation alone, without intentional experimentation. As such, it can include behavioral learning without experimentation — namely, learning in which we simply observe that certain actions (done for reasons other than to get evidence) are followed by certain events. It also includes a large part of the learning of syntax, word meanings, and other culturally transmitted bodies of knowledge.

The distinctive property of learning by observation is that the evidence is not under the thinker’s control, except for the choice of whether we attend to it or not. By contrast, Horton (1967, pp. 172–173) has suggested that one of the fundamental properties of scientific thinking is active experimentation: “The essence of the experiment is that the holder of a pet theory does not just wait for events to come along and show whether or not [the theory] has a good predictive performance. He bombards it with artificially produced events in such a way that its merits or defects will show up as immediately and as clearly as possible.”

How do search processes work?

All of these types of thinking involve search. Search for possibilities is nearly always present, and search for evidence or goals is often included as well. The critical aspect
of a search process is that the thinker has the goal of finding some sort of mental representation of a possibility, a piece of evidence, or a goal.

Search is directed by the goals, possibilities, and evidence already at hand. Goals provide the most essential direction. If my goal is to protect the walls in my house from my child’s scribbling, I seek different possibilities than if my goal is to teach my child not to scribble on walls. Possibilities direct our search for evidence for them or against them, and evidence against one possibility might direct our search for new ones.

There are two general ways of finding any object: recall from our own memory, and the use of external aids, such as other people, written sources (including our own notes), and computers. External aids can help us overcome the limitations of our own memories, including the time and effort required to get information into them. As I write this book, for example, I rely extensively on a file cabinet full of reprints of articles, my own library, the University of Pennsylvania library, and my colleagues and students. I rely on my memory as well, including my memory of how to use these tools and of who is likely to be able to help with what.

Thinking is not limited to what we do in our heads. The analogy between thinking and exploration is therefore not just an analogy. When an explorer climbs up a hill to see what lies beyond, he is actually seeking evidence. Moreover, libraries, computers, and file cabinets make us truly more effective thinkers. When we try to test people’s thinking by removing them from their natural environment, which may include their tools and other people they depend on, we get a distorted picture (however useful this picture may be for some purposes).

Because thinking involves search, there must be something for the search to find, if thinking is to succeed. Without knowledge, or beliefs that correspond to reality, thinking is an empty shell. This does not mean, however, that thinking cannot occur until one is an expert. One way to become an expert is to think about certain kinds of problems from the outset. Thinking helps us to learn, especially when our thinking leads us to consult outside sources or experts. As we learn more, our thinking becomes more effective. If you try to figure out what is wrong with your car (or your computer, or your body) every time something goes wrong with it, you will find yourself looking up things in books and asking experts (repair people, physicians) as part of your search for possibilities and evidence. You will then come to know more and to participate more fully in thinking about similar problems in the future. It is often thought that there is a conflict between “learning to think” and “acquiring knowledge”; in fact, these two kinds of learning normally reinforce each other.

What we recall (or get from an external aid) may be either an item itself or a rule for producing what we seek. For example, the “What if everybody did that?” rule is not by itself evidence for or against any particular action, but it tells us how to obtain such evidence. When we solve a problem in physics, we recall formulas that tell us how to calculate the quantities we seek. Rules can be learned directly, or we can invent them ourselves through a thinking process of hypothesis testing or reflection. (The use of rules in thinking can be distinguished from the use of rules to guide behavior. We may follow a rule through habit without representing it consciously.)
Recall or external aids may not give us exactly what we want, but sometimes an item suggests something else more useful. We may transform what we get in a variety of ways to make it applicable to our situation. This is the important mechanism of analogy. To see the role of analogies in thinking, try thinking about a question such as “Can a goose quack?” or “How does evaporation work?” (Collins and Gentner, 1986; Collins and Michalski, 1989). To answer the first question, you might think of ducks. To answer the second, some people try to understand evaporation in terms of analogies to things they already know. The escape of a molecule of a liquid might be analogous to the escape of a rocket from the earth. The conclusion drawn from this analogy is that a certain speed is required to overcome whatever force holds the molecules in the liquid. Some people conclude that the force to be overcome is gravity itself. (In fact, gravity plays a role, but other forces are usually more important.)

Notice that analogies, as evidence for possibilities, need different amounts of modification depending on their similarity to the possibility in question. In the 1980s, an analogy with the U.S. military experience in Vietnam was used to argue against military intervention against communists in Nicaragua. Later the same analogy was used (unsuccessfully) to argue against military intervention in Somalia. The analogy was more distant in the latter case, because communists were no longer the enemy. The appeasement of Hitler at Munich has been used repeatedly to support all sorts of military interventions, some closely related, some not so close.

When an analogy requires modification, the person may need to think about how to make the necessary modification. For example, the lesson of Munich may be that fascists should not be appeased, or it could be that one’s enemies should not be appeased. Likewise, if you know how to find the area of a rectangle, how should you apply this knowledge to finding the area of a parallelogram? Do you multiply the base by the length of the sides next to it, or do you multiply the base by the height? For rectangles, both yield the same result. Evidence can be brought to bear about which of these possibilities serves the goal.

Standards for the use of analogies as evidence have changed over the centuries in Western science (Gentner and Jeziorski, 1993). Modern analogies — such as Rutherford’s analogy between the structure of the atom and the structure of the solar system — are based on common relations among elements of two domains: the sun (nucleus) is more massive than the planets (electrons) and attracts them, so they revolve around it. Relations between an element of one domain and an element of the other — such as the fact that the sun gives off electrons — are irrelevant to the goodness of the analogy. By contrast, alchemists made analogies with shifting bases, according to superficial appearance rather than relations among elements. Celestial bodies were matched with colors on the basis of appearance (the sun with gold; the moon with white) but also on the basis of other relations (Jupiter with blue because Jupiter was the god of the sky). For metals, the sun was matched with silver on the basis of color, but Saturn was matched with lead on the basis of speed (Saturn being the slowest known planet, lead being the heaviest, hence “slowest,” metal). Alchemists also thought of some analogies as decisive arguments, while modern
Chapter 9

Actively open-minded thinking

The human understanding when it has once adopted an opinion draws all things else to support and agree with it. And though there be a greater number and weight of instances to be found on the other side, yet these it either neglects and despises, or else by some distinction sets aside and rejects, in order that by this great and pernicious predetermination the authority of its former conclusion may remain inviolate.

Francis Bacon

The search-inference framework implies that thinking can go wrong for three reasons.

1. Our search misses something that it should have discovered, or we act with high confidence after little search.

2. We seek evidence and make inferences in ways that prevent us from choosing the best possibility.

3. We think too much.

The second of these problems seems to be the most serious. People tend to seek evidence, seek goals, and make inferences in a way that favors possibilities that already appeal to them. For example, we often ignore evidence that goes against a possibility we like.

The same favoritism for a particular possibility may cause us to prematurely cut off our search for alternative possibilities or for reasons against the one we have in mind. This favoritism therefore leads to insufficient thinking or to overconfidence in hasty conclusions — the first reason for poor thinking. This problem is especially great when something is worth thinking about, such as the choice of our personal goals or moral beliefs.

Poor thinking, therefore, tends to be characterized by too little search, by overconfidence in hasty conclusions, and — most importantly — by biases in favor of
the possibilities that are favored initially. In contrast, good thinking consists of (1) search that is thorough in proportion to the importance of the question, (2) confidence that is appropriate to the amount and quality of thinking done, and (3) fairness to other possibilities than the one we initially favor.

These three principles are also the standards we apply when we criticize each other in academic settings. When I read a student’s paper, or a colleague’s, or sometimes even my own, the things I look for are omissions of relevant evidence, omissions of statements about goals or purposes, omissions of alternative possibilities, other answers to the question at issue, and unqualified assertions not supported with evidence. I also look for partiality to the thesis of the paper, partiality that may itself cause the omissions just mentioned. When students take these kinds of criticisms to heart and try to become more thorough and more impartial, they are becoming more intelligent thinkers. They are acquiring abilities — in the form of habits and values — that will increase their effectiveness just as surely as would an improvement in their memory or their mental speed.

Thinking that follows these principles can be called actively open-minded thinking. It is “open-minded” because it allows consideration of new possibilities, new goals, and evidence against possibilities that already seem strong. It is “active” because it does not just wait for these things but seeks them out. These are the features of what I regard as “good thinking.”

A good prescriptive model of thinking, I shall argue, is one that advises and helps people to become more actively open-minded. It counteracts the major biases in thinking, and it serves as a reminder of the normative theory. Advice of this type is an important part of a good prescriptive model. The rest of a prescriptive model consists of many detailed heuristics, or rules of thumb, some of which will be discussed in this book.

Examples of actively open-minded thinking

Here is an example of actively open-minded thinking. Students in a class on thinking and decision making were asked to think about the following problem and transcribe their thoughts. The problem concerned the “best” way to allocate, among the nations of the world, the mining rights to minerals on the ocean floor, a resource not yet developed. One student’s transcribed verbal protocol read as follows:

Wealth must be divided among nations fairly. What does ‘fairly’ mean? Should allocation be based on the size of the country? Some nations are significantly larger than others. But some countries have more people per unit area. Should allocation be based on overall population size? It would be very difficult to get all nations concerned to agree their shares were fair. Wait, the United Nations has a certain number of representatives from each country. They would be the ideal group to handle this. Total wealth should be divided by overall number of representatives, then allocated according to number of representatives per country.
But some nations would be better able to use the mineral wealth. These would be nations with greater technology. Therefore, underdeveloped nations would be unable to benefit as well as nations that are financially more secure. That would be unfair. [The protocol continues for several more pages.]

This student (who earned an A+ in the course) searched for goals, considered several possibilities. After each possibility, she looked for counterevidence and then tried to modify or replace the possibility to meet the objection she had thought of.

By contrast, the following protocol, handed in by another student, shows no evidence of actively open-minded thinking (although it is possible that some such thinking went on beforehand):

I believe that the most logical way of allocating the mineral wealth beneath the ocean is to allocate the ocean floors by extending national borders outward along the ocean floors. In effect, this plan would treat the ocean floor in the same way as exposed land surfaces. The water above the floor should still remain international territory, except where it is already considered national property. . . . Establishing boundaries in this manner is fairly simple, but it will favor nations with long coastlines along large bodies of water, but is no less fair than the rules for establishing national air space. [This protocol also went on for a page or two.]

It must be remembered that this kind of prescriptive model advises moderation, a middle course. More thinking, as we have already noted, is not always better. The search for counterevidence and alternative possibilities reaches a point of diminishing returns — often quickly. We can compare active open-mindedness to a virtue such as thriftiness. Thriftiness, too, must be practiced in moderation. We think of thriftiness as a virtue because most people usually do not have enough of it, but some people are too thrifty, penny-pinchers unable to enjoy the fruits of their labor. Similarly, active open-mindedness is a virtue because most people do not have enough of it, but too much of it can lead to intellectual paralysis.

Here is another example of two thinkers, C and S, sixth-grade students in Alberta, Canada, who were asked to report their thoughts after reading each segment of the following story (Norris and Phillips, 1987):

1. The stillness of the morning air was broken. The men headed down the bay.
2. The net was hard to pull. The heavy sea and strong tide made it even more difficult for the girdie. The meshed catch encouraged us to try harder.
3. With four quintels aboard we were now ready to leave. The skipper saw mares’ tails in the north.
4. We tied up to the wharf. We hastily grabbed our prongs and set to work. The catch was left in the stage while we had breakfast.
5. The splitting was done by the skipper. The boys did the cutting and gutting.

6. Catching fish is filled with risk.

C’s response to segment 1 was, “The men are going shopping. [Why do you say that?] They’re going to buy clothes at The Bay [a Canadian department store]. [Any questions?] No.” Notice the lack of qualification, the high confidence in this statement. C continues the interpretation of a shopping trip through the story, forcing the subsequent details to fit; at the end, C concluded, “Like I said before, they went shopping and got some fish, met some horses and then went to a show.”

S, on the other hand, said, “I think they might be going sailing.” S states a possibility, but qualified, so that it can be easily revised with subsequent evidence. S’s response to segment 3 illustrates well the potential of actively open-minded thinking: “I wonder what quintels are? I think maybe it’s a sea term, a word that means perhaps the weight aboard. Yes, maybe it’s how much fish they had aboard. [So you think it was fish?] I think fish or maybe something they had found in the water but I think fish more because of the word ‘catch.’ [Why were they worried about the mares’ tails?] I’m not sure. Mares’ tails, let me see, mares are horses but horses are not going to be in the water. They are out in a boat on the bay so there’s nothing around except sky and water. The mares’ tails are in the north. Here farmers watch the north for bad weather, so maybe the fishermen do the same thing. Yeah, I think that’s it, it’s a cloud formation, which could mean strong winds and hail or something which I think could be dangerous if you were in a boat and a lot of weight aboard. [Any questions?] I am curious now about whether I’m right about the mares’ tails.” S considers and rejects possibilities (horses), actively searches for evidence, finds the analogy with local farmers, but remains unsure, awaiting confirmation.

The last example suggests that active open-mindedness can be measured by asking people to think aloud and by subjectively scoring the result for various signs of active open-mindedness, such as considering reasons against a tentative view. Indeed, several measures of this sort have been developed, often on the basis of theoretical schemes very similar to the one I have just presented, although the terms employed are usually different. Ordinarily, some training is required in order to learn to score the results. After the training, the reliability of the scoring can be checked by looking at the correlation between the responses of different judges. One scoring technique is the measure of “integrative complexity” described in Chapter 2. Another scoring system, developed by Perkins, Bushey, and Faraday (1986), scores subjects’ written responses to questions such as whether a state should have a compulsory returnable-bottle law. Responses are scored for whether or not they consider both sides of the question.

One general problem of these sorts of measures is that certain issues, for some people, do not lend themselves to two-sided thinking. If most people today were asked to comment on the question “Is slavery wrong?” or “What do you think of the character of Adolph Hitler?” they would probably not have much to say on the “other side.” In other cases, people have already thought through some position even though others remain on the opposite side. A devout Christian is unlikely to produce
MYSIDE BIAS AND IRRATIONAL BELIEF PERSISTENCE

a two-sided discussion of the existence of God. Yet such people are not necessarily poor thinkers in general, or even about these issues.

Even the presence of two-sided discussions does not necessarily indicate actively open-minded thinking, however, when the topic is truly a difficult one. Most people initially consider both sides of an issue when making a decision that they find hard. True active open-mindedness shows itself only after some tentative commitment to one side has been made. Those who still seek out the other side before jumping to a conclusion are the real actively open-minded thinkers. In sum, tests that look at whether people spontaneously consider both sides of an issue are imperfect indicators of the propensity to think well. Perhaps better measures would assess the understanding of the need to consider the other side, in general, before reaching a conclusion. This can be done by asking people to evaluate examples of the thinking of others.

Myside bias and irrational belief persistence

An important part of actively open-minded thinking is fairness to possibilities, regardless of their initial strength. People tend to favor possibilities that are already strong, both in search (particularly search for evidence) and in making inferences from evidence at hand. People tend not to look for evidence against what they favor, and, when they find it anyway, they tend to ignore it. David Perkins has named these two characteristics “myside bias” (Perkins et al., 1986). The term refers to “my side” of the issue at hand rather than one side of an argument with another person. (Of course, it happens there, too.)

Irrational belief persistence may result from myside bias in the search for evidence and in inference. As a result of these biases, incorrect beliefs are slow to change, and they can even become stronger when they ought to become weaker. Hence, their persistence is irrational.

The irrational persistence of belief is one of the major sources of human folly, as many have noted (Bacon, 1620/1960; Janis and Mann, 1977; Kruglanski and Ajzen, 1983; Nisbett and Ross, 1980). We tend to hold to our beliefs without sufficient regard to the evidence against them or the lack of evidence in their favor.

Irrational belief persistence affects our lives in many forms in addition to its effect on the judgment of probability and correlation. Good students, for example (like good scholars), must remain open to counterevidence and criticism, willing to be persuaded of alternative views and willing to criticize their own efforts so as to improve them; poor students often seem to be rigid in defending their mistaken beliefs about what they are learning in school (Baron, Badgio, and Gaskins, 1986).

Certain forms of psychopathology, such as delusions, are essentially defined by irrational persistence of belief. A delusional patient is not just someone who believes (wrongly) that her sneezing and coughing mean that she is dying of an incurable disease; she is someone who continues to believe this even after five reputable physicians tell her that her symptoms are caused by a simple allergy to ragweed.
Depressives, Beck has argued, maintain their depression by ignoring evidence that could cheer them up and by taking seriously only the evidence consistent with their gloomy outlook (Beck, 1976). Beck’s cognitive therapy of depression tries to teach the patient to treat the relevant evidence more impartially.

Irrational belief persistence has also been implicated in faulty decision making by individuals and governments alike. In any war in which one side clearly loses, the loss is apparent before it occurs, but both the government and people of the losing side continue to believe that they can see victory just around the corner. Moral beliefs that underlie political controversies, such as the controversies concerning abortion, sex, or racial inequality, also seem particularly resistant to arguments or evidence.

Irrational belief persistence can cause serious difficulties in personal matters such as relationships and business ventures, too. In romance and in business, confidence is usually a good thing, because it inspires us to undertake difficult ventures, to initiate relationships, to pursue lofty goals, but when the evidence tells us that a particular endeavor — whether a love affair or a new company — is not getting off the ground after several attempts, we need, for our own sakes, to be responsive to the evidence, and sometimes we are not.

Irrational belief persistence involves two types of biases that we have frequently encountered earlier in this book:

1. The overweighing of evidence consistent with a favored belief or the underweighing of evidence against it: for example, a general’s attending to reports of enemy casualties and ignoring reports of their troop strength.

2. The failure to search impartially for evidence: For example, when supporters of U.S. intervention in Nicaragua searched for historical analogies, they were likely to discover the Munich agreement with Hitler, and opponents, when they searched for analogies, were likely to discover U.S. support of Batista in Cuba or the unsuccessful Bay of Pigs invasion.

Some belief persistence is not irrational. Often the evidence against a belief is not strong enough to make a convincing case for giving it up. Michael Faraday persisted in believing that electrical currents could be induced with magnets despite several failures to produce such currents experimentally and finally, of course, succeeded (Tweney, 1985). If we all gave up beliefs as soon as there was evidence against them, we would hold very few beliefs with any certainty, and we would give up many beliefs that were true.

The amount of belief persistence that is rational is whatever best serves the goals of the thinker. In most cases, the goal is to adopt beliefs that provide the best basis for decisions that achieve those goals. We cannot judge the rationality ofpersisting in a belief by knowing the truth in hindsight. Although rationally formed beliefs are, on the whole, more likely to be true than irrationally formed beliefs, we cannot assume that false beliefs are always irrationally formed. For example, many efforts have been made to show that it was irrational of President Roosevelt and his advisers not to suspect that the Japanese would attack Pearl Harbor. Such critics claim that
the president and his policy makers possessed much evidence that favored such an attack but explained it away or ignored it. Some evidence must always be “explained away” or considered less important, however, even when beliefs are true. Evidence is not always consistent. The question is, how much explaining away is too much? For every failure to predict something that happened, Jervis asserts that, “we could look at an event that did not take place, and, acting as though it had occurred, find a large number of clues indicating the event’s probable occurrence which the officials had ignored or explained away” (1976, p. 175).

If we want to find out if, when, and why irrational persistence of belief occurs, we need some normative standards for belief persistence itself. We cannot typically use probability theory as a normative model. Some of the beliefs include strongly held personal commitments that shape a person’s moral, social, and political attitudes. Many of these things are really goals (in the sense of ch. 1). A person who says that she believes strongly that abortion is wrong (or not wrong) may be willing to spend some time every day campaigning for her views. It is worthwhile to bear in mind, though, that people think about their goals in much the same way in which they think about their beliefs. For example, we think about goals by asking whether they are consistent with other goals, and we think about beliefs by asking whether they are consistent with other beliefs. Probabilities apply to propositions that are either true or false, but goals are not propositions of this sort, and the beliefs of interest here are difficult to study in this way.

**The order principle, the primacy effect, and total discrediting**

How can we tell whether people are weighing evidence in a way that is normatively correct? We have discussed the difficulties in using probability theory as our normative standard. A good alternative might be to focus on the process of weighing evidence itself and to look for general normative principles that a rational response to evidence would have to obey. Once we find such constraints, we can ask whether people violate them.

One such principle is the **order principle**: *When the order in which we encounter two pieces of evidence is not itself informative, the order of the two pieces of evidence should have no effect on our final strength of belief.* Or, put more crudely, “When the order doesn’t matter, the order shouldn’t matter.” Suppose I want to find out which of two political candidates is better, and I start out with no opinion at all. I run into a trusted friend, who tells me that Candidate X is better. Later, another equally trusted friend tells me that Candidate Y is better, but by this time I have already formed an inclination to vote for X, so I question the second friend very carefully. It was simply chance that made me run into X first, so the order of the evidence does not matter, yet I might end up favoring X because that evidence came first.

Such an effect is called a **primacy effect**, because the first piece of evidence is weighed more heavily than it should be. One explanation of the primacy effect is that the initial evidence leads to an opinion, which then biases the search for subsequent evidence, as well as the interpretation of that evidence when it is found. This would