

# Thinking and deciding

**JONATHAN BARON**

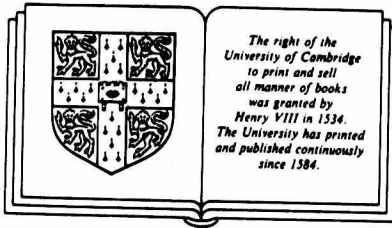
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JONATHAN BARON

*University of Pennsylvania*



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## Preface

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Many people have been saying that schools ought to do a better job of teaching students how to think. These critics believe that students, and the adults they become, are deficient in making personal decisions, participating intelligently in public affairs, solving technical problems, and writing reflectively and creatively. Articles and books have appeared proposing new ways to remedy these deficiencies. Often lacking in these proposals, however, is a clear statement of what the problem is and why it should be solved one way rather than another.

The underlying issues that need to be dealt with before such statements can be made are these: What *is* thinking, anyway? How *should* individuals go about making decisions and evaluating beliefs? When do we think as we should, when do we err, and in what ways do we err? Can our errors be cured or prevented with the right kind of instruction?

The importance of these questions for educating our children is reason enough to concern ourselves with them, but they also affect other parts of our lives. Government agencies rely upon the new field of decision analysis for help in making policy decisions, and businesses increasingly rely on it for management decisions. Computer analysis enhances human judgment in fields such as medicine, where computer programs are now being used to diagnose diseases and select treatments. Psychotherapists have designed new therapies intended to help clients improve the way in which they think about personal problems.

As this listing suggests, knowledge about thinking and decision making has been scattered among a number of different fields. Philosophers, psychologists, educators, economists, decision scientists, and computer scientists all have different approaches to the theory of thinking and decision making. The approach represented in this book represents my own effort to draw together some of the key ideas about thinking from these different disciplines into a unified theory. Much of this theory is not original or new: If it were either of these, I would not be so confident that it is basically correct.

I argue, in this book, that all goal-directed thinking and decision making can be described in terms of what I call the *search-inference framework*: Thinking can be described as inferences made from possibilities, evidence, and goals that are discovered through searching. The main problem with our thinking and decision making is that much of it suffers from a lack of *active*

*open-mindedness*: We ignore possibilities, evidence, and goals that we ought to consider, and we make inferences in ways that protect our favored ideas.

In the course of this book, I apply these ideas to the major concepts and theories in the study of thinking. I begin, in part I, with general considerations: the nature of rationality; methods for studying thinking; the theory of problem solving; learning; intelligence; creativity; and logic. Part II is concerned with belief formation, which is a form of thinking in which the goal of thinking is held constant. In this part, I introduce probability theory as a formal standard. Part III concerns decision making, including the making of decisions about personal plans and goals, and decisions that affect others, such as those that involve moral issues or matters of public concern. This part introduces utility theory, which formalizes many of the ideas that run throughout the book. Part IV draws together the lessons of the rest of the book for education.

This book was written to serve as a text in undergraduate (and beginning graduate) psychology courses in thinking and decision making. The early drafts have been used as a primary text (with additional reading and laboratory assignments) in a one-semester course entitled "Thinking and Decisions," taught in the Psychology Department of the University of Pennsylvania. Most of the students are psychology majors who have taken one or more courses in psychology. Many such courses are being taught elsewhere, but without texts that cover the full range of relevant topics in depth. I hope this book will encourage other courses of this type.

Although the approach is broad, some things are left out. I deal here with thinking as a purposive activity – as a way of choosing actions, beliefs, and personal goals – not as an experience. I also exclude such highly skilled behavior as speaking and understanding language. Such skills can help us think, and thinking well can help us to acquire them, but these skills in themselves do not fit into the framework.

This book overlaps with the subject matter of cognitive psychology, but it leaves out many topics in that field, such as attention and skilled performance, and it includes several topics that are not traditionally part of cognitive psychology, such as moral thinking. It is therefore possible for psychologists to teach both a course that uses this book and a more traditional course in cognitive psychology without substantial overlap.

Students and scholars in related fields, such as philosophy, education, decision sciences, and social psychology, should find this book useful in gaining perspective about the relation of their fields to the psychology of thinking and decision making. Prospective teachers and psychotherapists can also benefit. More generally, this book is addressed to anyone who is disturbed by irrationality and poor thinking, both individual and collective, and wants to understand and correct it. It may also be helpful to those who want to improve their own thinking or decision making and who are puzzled about how to do that.

I have tried to give sufficient background to permit further reading in primary sources. The chapters on utility theory (chs. 16 and 17) are probably the farthest from achieving that goal: The study of decision theory has now become very mathematical, and research in this field moves so quickly that summaries are rapidly outdated. Students who want to pursue that topic should supplement this text with recent reviews. (I have cited some of these, but others will undoubtedly appear shortly.)

Parts of chapters 1, 3, and 6 are taken from my earlier book *Rationality and Intelligence* (1985b), and a few passages in chapter 16 are taken from my paper "Tradeoffs among Reasons for Action" (1986).

Judy Baron, Kathie Galotti, and anonymous reviewers each gave useful advice about several chapters. Other chapters or sections were helpfully read by George Ainslie, Dorrit Billman, Colin Camerer, Allan Collins, Deborah Frisch, John R. Hayes, John C. Hershey, Joel Kupperman, David Messick, and David Perkins. Several students provided helpful comments on drafts used in my course: Sarah Pantelias, Heather Shay, Mark Spranca, and others who chose anonymity. My recent thinking about matters in this book has been informed by several colleagues, particularly Colin Camerer, John C. Hershey, David Perkins, and John Sabini, and by my students, particularly Jane Beattie, Deborah Frisch, and Mark Spranca. Christie Lerch, as an editor for Cambridge University Press, provided the final, most demanding, most detailed, and most helpful set of criticisms and constructive suggestions concerning all levels of writing and organization.

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## Part I

### Thinking in general

Part 1 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: What is good thinking, ideally?
2. The *descriptive* question: How do we think? What prevents us from doing our best thinking?
3. The *prescriptive* question: What can we do to improve our thinking and decision making, both as individuals and as a society?

These three questions define the contents 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 comparing our actual thinking to the thinking specified by the normative theory, we can evaluate it with a view to improving it 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.

Chapters 4 through 10 present the traditional subjects in the psychology of thinking: problem solving (ch. 4), the learning of simple and complex material (chs. 5 and 6), intelligence and creativity (chs. 7 and 8), and logic (chs. 9 and 10). These topics have been part of modern psychology since it began in the late nineteenth century. There would have been much to say about them 30 years ago, and little to say about psychological approaches to the topics covered in the rest of the book. Of course, there is even more to say about these topics now than there was 30 years ago, because they are still active fields of research. I shall review and reassess these traditions from the point of view introduced in chapters 1 through 3.



# 1 What is thinking?

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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 own 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.

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 a way that helps 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 the objects we have found.

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 20-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 for something else. After thinking about it yourself, you 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 imaginary 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 have 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 have also made an inference: You rejected the first course because the work was too hard.

There are three kinds of objects we search for: possibilities, evidence, and goals.

*Possibilities* are possible answers to the original question, possible resolutions of the original doubt. (In the example just given, they are the two 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 that 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 object 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*, or *use of evidence*, in which each possibility is strengthened or weakened as a choice on the basis of the evidence, in the 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 was 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 after an interruption. The processes of thinking – the search for possibilities, evidence, and goals and the use of the evidence to evaluate possibilities – do not go on 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 the use of evidence? *Thinking is, in its most general sense, a method of 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 is my purpose 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



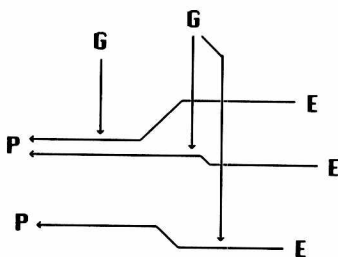


Figure 1.1. Diagram of thinking, showing the relation between possibilities (*P*), the evidence for and against them (*E*), and the goals that determine the weight of the evidence (*G*).

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. Evidence, in other words, is defined by its function, which is to increase or decrease the strengths of the possibilities.

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 Figure 1.1. 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*)