



Basic Ideas and Examples

ALL INTRODUCTORY TEXTBOOKS begin by attempting to convince the student readers that the subject is of great importance in the world and therefore merits their attention. The physical sciences and engineering claim to be the basis of modern technology and therefore of modern life; the social sciences discuss big issues of governance—for example, democracy and taxation; the humanities claim that they revive your soul after it has been deadened by exposure to the physical and social sciences and to engineering. Where does the subject games of strategy, often called game theory, fit into this picture, and why should you study it?

We offer a practical motivation that is much more individual and probably closer to your personal concerns than most other subjects. You play games of strategy all the time: with your parents, siblings, friends, and enemies, and even with your professors. You have probably acquired a lot of instinctive expertise in playing such games, and we hope you will be able to connect what you have already learned to the discussion that follows. We will build on your experience, systematize it, and develop it to the point where you will be able to improve your strategic skills and use them more methodically. Opportunities for such uses will appear throughout your life; you will go on playing such games with your employers, employees, spouses, children, and even strangers.

Not that the subject lacks wider importance. Similar games are played in business, politics, diplomacy, and wars—in fact, whenever people interact to strike mutually agreeable deals or to resolve conflicts. Being able to recognize such games will enrich your understanding of the world around you and will

make you a better participant in all its affairs. Understanding games of strategy will also have a more immediate payoff in your study of many other subjects. Economics and business courses already use a great deal of game-theoretic thinking. Political science, psychology, and philosophy are also using game theory to study interactions, as is biology, which has been importantly influenced by the concepts of evolutionary games and has in turn exported these ideas to economics. Psychology and philosophy also interact with the study of games of strategy. Game theory provides concepts and techniques of analysis for many disciplines, one might say all disciplines except those dealing with completely inanimate objects.

1 WHAT IS A GAME OF STRATEGY?

The word *game* may convey an impression that the subject is frivolous or unimportant in the larger scheme of things—that it deals with trivial pursuits such as gambling and sports when the world is full of weightier matters such as war and business and your education, career, and relationships. Actually, games of strategy are not “just a game”; all of these weighty matters are instances of games, and game theory helps us understand them all. But it will not hurt to start with game theory as applied to gambling or sports.

Most games include chance, skill, and strategy in varying proportions. Playing double or nothing on the toss of a coin is a game of pure chance, unless you have exceptional skill in doctoring or tossing coins. A hundred-yard dash is a game of pure skill, although some chance elements can creep in; for example, a runner may simply have a slightly off day for no clear reason.

Strategy is a skill of a different kind. In the context of sports, it is a part of the mental skill needed to play well; it is the calculation of how best to use your physical skill. For example, in tennis, you develop physical skill by practicing your serves (first serves hard and flat, second serves with spin or kick) and passing shots (hard, low, and accurate). The strategic skill is knowing where to put your serve (wide, or on the T) or passing shot (crosscourt, or down the line). In football, you develop such physical skills as blocking and tackling, running and catching, and throwing. Then the coach, knowing the physical skills of his own team and those of the opposing team, calls the plays that best exploit his team's skills and the other team's weaknesses. The coach's calculation constitutes the strategy. The physical game of football is played on the gridiron by jocks; the strategic game is played in the offices and on the sidelines by coaches and by nerdy assistants.

A hundred-yard dash is a matter of exercising your physical skill as best you can; it offers no opportunities to observe and react to what other runners in

the race are doing and therefore no scope for strategy. Longer races do entail strategy—whether you should lead to set the pace, how soon before the finish you should try to break away, and so on.

Strategic thinking is essentially about your interactions with others, as they do similar thinking at the same time and about the same situation. Your opponents in a marathon may try to frustrate or facilitate your attempts to lead, given what they think best suits their interests. Your opponent in tennis tries to guess where you will put your serve or passing shot; the opposing coach in football calls the play that will best counter what he thinks you will call. Of course, just as you must take into account what the other player is thinking, he is taking into account what you are thinking. Game theory is the analysis, or science, if you like, of such interactive decision making.

When you think carefully before you act—when you are aware of your objectives or preferences and of any limitations or constraints on your actions and choose your actions in a calculated way to do the best according to your own criteria—you are said to be behaving rationally. Game theory adds another dimension to rational behavior—namely, interaction with other equally rational decision makers. In other words, game theory is the science of rational behavior in interactive situations.

We do not claim that game theory will teach you the secrets of perfect play or ensure that you will never lose. For one thing, your opponent can read the same book, and both of you cannot win all the time. More importantly, many games are complex and subtle, and most actual situations include enough idiosyncratic or chance elements that game theory cannot hope to offer surefire recipes for action. What it does is provide some general principles for thinking about strategic interactions. You have to supplement these ideas and some methods of calculation with many details specific to your situation before you can devise a successful strategy for it. Good strategists mix the science of game theory with their own experience; one might say that game playing is as much art as science. We will develop the general ideas of the science but will also point out its limitations and tell you when the art is more important.

You may think that you have already acquired the art from your experience or instinct, but you will find the study of the science useful nonetheless. The science systematizes many general principles that are common to several contexts or applications. Without general principles, you would have to figure out from scratch each new situation that requires strategic thinking. That would be especially difficult to do in new areas of application—for example, if you learned your art by playing games against parents and siblings and must now practice strategy against business competitors. The general principles of game theory provide you with a ready reference point. With this foundation in place, you can proceed much more quickly and confidently to acquire and add the situation-specific features or elements of the art to your thinking and action.

2 SOME EXAMPLES AND STORIES OF STRATEGIC GAMES

With the aims announced in Section 1, we will begin by offering you some simple examples, many of them taken from situations that you have probably encountered in your own lives, where strategy is of the essence. In each case we will point out the crucial strategic principle. Each of these principles will be discussed more fully in a later chapter, and after each example we will tell you where the details can be found. But don't jump to them right away; for a while, just read all the examples to get a preliminary idea of the whole scope of strategy and of strategic games.

A. Which Passing Shot?

Tennis at its best consists of memorable duels between top players: John McEnroe versus Ivan Lendl, Pete Sampras versus Andre Agassi, and Martina Navratilova versus Chris Evert. Picture the 1983 U.S. Open final between Evert and Navratilova.¹ Navratilova at the net has just volleyed to Evert on the baseline. Evert is about to hit a passing shot. Should she go down the line or crosscourt? And should Navratilova expect a down-the-line shot and lean slightly that way or expect a crosscourt shot and lean the other way?

Conventional wisdom favors the down-the-line shot. The ball has a shorter distance to travel to the net, so the other player has less time to react. But this does not mean that Evert should use that shot all of the time. If she did, Navratilova would confidently come to expect it and prepare for it, and the shot would not be so successful. To improve the success of the down-the-line passing shot, Evert has to use the crosscourt shot often enough to keep Navratilova guessing on any single instance.

Similarly in football, with a yard to go on third down, a run up the middle is the percentage play—that is, the one used most often—but the offense must throw a pass occasionally in such situations “to keep the defense honest.”

Thus, the most important general principle of such situations is not what Evert *should* do but what she *should not* do: she should not do the same thing all the time or systematically. If she did, then Navratilova would learn to cover that, and Evert's chances of success would fall.

Not doing any one thing systematically means more than not playing the same shot in every situation of this kind. Evert should not even mechanically switch back and forth between the two shots. Navratilova would spot and exploit

¹ Chris Evert won her first title at the U.S. Open in 1975. Navratilova claimed her first title in the 1983 final.

this *pattern* or indeed any other detectable system. Evert must make the choice on each particular occasion *at random* to prevent this guessing.

This general idea of “mixing one’s plays” is well known, even to sports commentators on television. But there is more to the idea, and these further aspects require analysis in greater depth. Why is down-the-line the percentage shot? Should one play it 80% of the time or 90% or 99%? Does it make any difference if the occasion is particularly big; for example, does one throw that pass on third down in the regular season but not in the Super Bowl? In actual practice, just how does one mix one’s plays? What happens when a third possibility (the lob) is introduced? We will examine and answer such questions in Chapter 7.

The movie *The Princess Bride* (1987) illustrates the same idea in the “battle of wits” between the hero (Westley) and a villain (Vizzini). Westley is to poison one of two wineglasses out of Vizzini’s sight, and Vizzini is to decide who will drink from which glass. Vizzini goes through a number of convoluted arguments as to why Westley should poison one glass. But all of the arguments are innately contradictory, because Westley can anticipate Vizzini’s logic and choose to put the poison in the other glass. Conversely, if Westley uses any specific logic or system to choose one glass, Vizzini can anticipate that and drink from the other glass, leaving Westley to drink from the poisoned one. Thus, Westley’s strategy has to be random or unsystematic.

The scene illustrates something else as well. In the film, Vizzini loses the game and with it his life. But it turns out that Westley had poisoned both glasses; over the last several years, he had built up immunity to the poison. So Vizzini was actually playing the game under a fatal information disadvantage. Players can sometimes cope with such asymmetries of information; Chapters 8 and 13 examine when and how they can do so.

B. The GPA Rat Race

You are enrolled in a course that is graded on a curve. No matter how well you do in absolute terms, only 40% of the students will get As, and only 40% will get Bs. Therefore, you must work hard, not just in absolute terms, but relative to how hard your classmates (actually, “class enemies” seems a more fitting term in this context) work. All of you recognize this, and after the first lecture you hold an impromptu meeting in which all students agree not to work too hard. As weeks pass by, the temptation to get an edge on the rest of the class by working just that little bit harder becomes overwhelming. After all, the others are not able to observe your work in any detail; nor do they have any real hold over you. And the benefits of an improvement in your grade point average are substantial. So you hit the library more often and stay up a little longer.

The trouble is, everyone else is doing the same. Therefore, your grade is no better than it would have been if you and everyone else had abided by the

agreement. The only difference is that all of you have spent more time working than you would have liked.

This is an example of the prisoners' dilemma.² In the original story, two suspects are being separately interrogated and invited to confess. One of them, say A, is told, "If the other suspect, B, does not confess, then you can cut a very good deal for yourself by confessing. But if B does confess, then you would do well to confess, too; otherwise the court will be especially tough on you. So you should confess no matter what the other does." B is told to confess, with the use of similar reasoning. Faced with this choice, both A and B confess. But it would have been better for both if neither had confessed, because the police had no really compelling evidence against them.

Your situation is similar. If the others slack off, then you can get a much better grade by working hard; if the others work hard, then you had better do the same or else you will get a very bad grade. You may even think that the label "prisoner" is very fitting for a group of students trapped in a required course.

Professors and schools have their own prisoners' dilemmas. Each professor can make his course look good or attractive by grading it slightly more liberally, and each school can place its students in better jobs or attract better applicants by grading all of its courses a little more liberally. Of course, when all do this, none has any advantage over the others; the only result is rampant grade inflation, which compresses the spectrum of grades and therefore makes it difficult to distinguish abilities.

People often think that in every game there must be a winner and a loser. The prisoners' dilemma is different—both or all players can come out losers. People play (and lose) such games every day, and the losses can range from minor inconveniences to potential disasters. Spectators at a sports event stand up to get a better view but, when all stand, no one has a better view than when they were all sitting. Superpowers acquire more weapons to get an edge over their rivals but, when both do so, the balance of power is unchanged; all that has happened is that both have spent economic resources that they could have used for better purposes, and the risk of accidental war has escalated. The magnitude of the potential cost of such games to all players makes it important to understand the ways in which mutually beneficial cooperation can be achieved and sustained. All of Chapter 10 deals with the study of this game.

Just as the prisoners' dilemma is potentially a lose-lose game, there are win-win games, too. International trade is an example; when each country produces more of what it can do relatively best, all share in the fruits of this international division of labor. But successful bargaining about the division of the pie is

² There is some disagreement regarding the appropriate grammatical placement of the apostrophe in the term *prisoners' dilemma*. Our placement acknowledges the facts that there must be at least two prisoners in order for there to be any dilemma at all and that the (at least two) prisoners therefore jointly possess the dilemma.

needed if the full potential of trade is to be realized. The same applies to many other bargaining situations. We will study these in Chapter 17.

C. “We Can’t Take the Exam Because We Had a Flat Tire”

Here is a story, probably apocryphal, that circulates on the undergraduate e-mail networks; each of us has independently received it from our students:

There were two friends taking chemistry at Duke. Both had done pretty well on all of the quizzes, the labs, and the midterm, so that going into the final they each had a solid A. They were so confident the weekend before the final that they decided to go to a party at the University of Virginia. The party was so good that they overslept all day Sunday, and got back too late to study for the chemistry final that was scheduled for Monday morning. Rather than take the final unprepared, they went to the professor with a sob story. They said they each had gone up to UVA and had planned to come back in good time to study for the final but had a flat tire on the way back. Because they didn’t have a spare, they had spent most of the night looking for help. Now they were really too tired, so could they please have a makeup final the next day? The professor thought it over and agreed.

The two studied all of Monday evening and came well prepared on Tuesday morning. The professor placed them in separate rooms and handed the test to each. The first question on the first page, worth 10 points, was very easy. Each of them wrote a good answer, and greatly relieved, turned the page. It had just one question, worth 90 points. It was: “Which tire?”

The story has two important strategic lessons for future partygoers. The first is to recognize that the professor may be an intelligent game player. He may suspect some trickery on the part of the students and may use some device to catch them. Given their excuse, the question was the likeliest such device. They should have foreseen it and prepared their answer in advance. This idea that one should look ahead to future moves in the game and then reason backward to calculate one’s best current action is a very general principle of strategy, which we will elaborate on in Chapter 3. We will also use it, most notably, in Chapter 9.

But it may not be possible to foresee all such professorial countertricks; after all, professors have much more experience seeing through students’ excuses than students have making up such excuses. If the two students in the story are unprepared, can they independently produce a mutually consistent lie? If each picks a tire at random, the chances are only 25% that the two will pick the same one. (Why?) Can they do better?

You may think that the front tire on the passenger side is the one most likely to suffer a flat, because a nail or a shard of glass is more likely to lie closer to that side of the road than to the middle, and the front tire on that side will

encounter the nail or glass first. You may think this is good logic, but that is not enough to make it a good choice. What matters is not the logic of the choice but making the same choice as your friend does. Therefore, you have to think about whether your friend would use the same logic and would consider that choice equally obvious. But even that is not the end of the chain of reasoning. Would your friend think that the choice would be equally obvious to you? And so on. The point is not whether a choice is obvious or logical, but whether it is obvious to the other that it is obvious to you that it is obvious to the other. . . . In other words, what is needed is a convergence of expectations about what should be chosen in such circumstances. Such a commonly expected strategy on which the players can successfully coordinate is called a focal point.

There is nothing general or intrinsic to the structure of these games that creates such convergence. In some games, a focal point may exist because of chance circumstances about the labeling of strategies or because of some experience or knowledge shared by the players. For example, if the front passenger side of a car were for some reason called the Duke's side, then two Duke students would be very likely to choose it without any need for explicit prior understanding. Or, if the front driver's side of all cars were painted orange (for safety, to be easily visible to oncoming cars), then two Princeton students would be very likely to choose that tire, because orange is the Princeton color. But without some such clue, tacit coordination might not be possible at all.

We will study focal points in more detail in Chapter 4. Here in closing we merely point out that when asked in classrooms, more than 50% of students choose the front driver's side. They are generally unable to explain why, except to say that it seems the obvious choice.

D. Why Are Professors So Mean?

Many professors have inflexible rules not to give makeup exams and never to accept late submission of problem sets or term papers. Students think the professors must be really hardhearted to behave in this way. The true strategic reason is often exactly the opposite. Most professors are kindhearted and would like to give their students every reasonable break and accept any reasonable excuse. The trouble lies in judging what is reasonable. It is hard to distinguish between similar excuses and almost impossible to verify their truth. The professor knows that on each occasion he will end up by giving the student the benefit of the doubt. But the professor also knows that this is a slippery slope. As the students come to know that the professor is a soft touch, they will procrastinate more and produce ever-flimsier excuses. Deadlines will cease to mean anything, and examinations will become a chaotic mix of postponements and makeup tests.

Often the only way to avoid this slippery slope is to refuse to take even the first step down it. Refusal to accept any excuses at all is the only realistic

alternative to accepting them all. By making an advance commitment to the “no excuses” strategy, the professor avoids the temptation to give in to all.

But how can a softhearted professor maintain such a hardhearted commitment? He must find some way to make a refusal firm and credible. The simplest way is to hide behind an administrative procedure or university-wide policy. “I wish I could accept your excuse, but the university won’t let me” not only puts the professor in a nicer light, but also removes the temptation by genuinely leaving him no choice in the matter. Of course, the rules may be made by the same collectivity of professors that hides behind them, but once they are made, no individual professor can unmake the rules in any particular instance.

If the university does not provide such a general shield, then the professor can try to make up commitment devices of his own. For example, he can make a clear and firm announcement of the policy at the beginning of the course. Any time an individual student asks for an exception, he can invoke a fairness principle, saying, “If I do this for you, I would have to do it for everyone.” Or the professor can acquire a reputation for toughness by acting tough a few times. This may be an unpleasant thing for him to do and it may run against his true inclination, but it helps in the long run over his whole career. If a professor is believed to be tough, few students will try excuses on him, so he will actually suffer less pain in denying them.

We will study commitments, and related strategies, such as threats and promises, in considerable detail in Chapter 9.

E. Roommates and Families on the Brink

You are sharing an apartment with one or more other students. You notice that the apartment is nearly out of dishwasher detergent, paper towels, cereal, beer, and other items. You have an agreement to share the actual expenses, but the trip to the store takes time. Do you spend your own time going to the store or do you hope that someone else will spend his, leaving you more time to study or relax? Do you go and buy the soap or stay in and watch TV to catch up on the soap operas?³

In many situations of this kind, the waiting game goes on for quite a while before someone who is really impatient for one of the items (usually beer) gives in and spends the time for the shopping trip. Things may deteriorate to the point of serious quarrels or even breakups among the roommates.

This game of strategy can be viewed from two perspectives. In one, each of the roommates is regarded as having a simple binary choice—to do the

³ This example comes from Michael Grunwald’s “At Home” column, “A Game of Chicken,” in the *Boston Globe Magazine*, April 28, 1996.

shopping or not. The best outcome for you is where someone else does the shopping and you stay at home; the worst is where you do the shopping while the others get to use their time better. If both do the shopping (unknown to each other, on the way home from school or work), there is unnecessary duplication and perhaps some waste of perishables; if neither does the shopping, there can be serious inconvenience or even disaster if the toilet paper runs out at a crucial time.

This is analogous to the game of chicken that used to be played by American teenagers. Two of them drove their cars toward each other. The first to swerve to avoid a collision was the loser (chicken); the one who kept driving straight was the winner. We will analyze the game of chicken further in Chapter 4 and in Chapters 7, 11, and 12.

A more interesting dynamic perspective on the same situation regards it as a “war of attrition,” where each roommate tries to wait out the others, hoping that someone else’s patience will run out first. In the meantime, the risk escalates that the apartment will run out of something critical, leading to serious inconvenience or a blowup. Each player lets the risk escalate to the point of his own tolerance; the one revealed to have the least tolerance loses. Each sees how close to the brink of disaster the others will let the situation go. Hence the name “brinkmanship” for this strategy and this game. It is a dynamic version of chicken, offering richer and more interesting possibilities.

One of us (Dixit) was privileged to observe a brilliant example of brinkmanship at a dinner party one Saturday evening. Before dinner, the company was sitting in the living room when the host’s 15-year-old daughter appeared at the door and said, “Bye, Dad.” The father asked, “Where are you going?” and the daughter replied, “Out.” After a pause that was only a couple of seconds but seemed much longer, the host said, “All right, bye.”

Your strategic observer of this scene was left thinking how it might have gone differently. The host might have asked, “With whom?” and the daughter might have replied, “Friends.” The father could have refused permission unless the daughter told him exactly where and with whom she would be. One or the other might have capitulated at some such later stage of this exchange or it could have led to a blowup.

This was a risky game for both the father and the daughter to play. The daughter might have been punished or humiliated in front of strangers; an argument could have ruined the father’s evening with his friends. Each had to judge how far to push the process, without being fully sure whether and when the other might give in or whether there would be an unpleasant scene. The risk of an explosion would increase as the father tried harder to force the daughter to answer and as she defied each successive demand.

In this respect, the game played by the father and the daughter was just like that between a union and a company’s management who are negotiating a labor contract or between two superpowers that are encroaching on each

other's sphere of influence in the world. Neither side can be fully sure of the other's intentions, so each side explores them through a succession of small incremental steps, each of which escalates the risk of mutual disaster. The daughter in our story was exploring previously untested limits of her freedom; the father was exploring previously untested—and perhaps unclear even to himself—limits of his authority.

This was an example of brinkmanship, a game of escalating mutual risk, par excellence. Such games can end in one of two ways. In the first way, one of the players reaches the limit of his own tolerance for risk and concedes. (The father in our story conceded quickly, at the very first step. Other fathers might be more successful strict disciplinarians, and their daughters might not even initiate a game like this.) In the second way, before either has conceded, the risk that they both fear comes about, and the blowup (the strike or the war) occurs. The feud in our host's family ended “happily”; although the father conceded and the daughter won, a blowup would have been much worse for both.

We will analyze the strategy of brinkmanship more fully in Chapter 9; in Chapter 14, we will examine a particularly important instance of it—namely, the Cuban missile crisis of 1962.

F. The Dating Game

When you go on a date, you want to show off the best attributes of your personality to your date and to conceal the worst ones. Of course, you cannot hope to conceal them forever if the relationship progresses, but you are resolved to improve or hope that by that stage the other person will accept the bad things about you with the good ones. And you know that the relationship will not progress at all unless you make a good first impression; you won't get a second chance to do so.

Of course, you want to find out everything, good and bad, about the other person. But you know that if the other is as good at the dating game as you are, he or she will similarly try to show the best side and hide the worst. You will think through the situation more carefully and try to figure out which signs of good qualities are real and which ones can easily be put on for the sake of making a good impression. Even the worst slob can easily appear well groomed for a big date; ingrained habits of courtesy and manners that are revealed in a hundred minor details may be harder to simulate for a whole evening. Flowers are relatively cheap; more expensive gifts may have value, not for intrinsic reasons, but as credible evidence of how much the other person is willing to sacrifice for you. And the “currency” in which the gift is given may have different significance, depending on the context; from a millionaire, a diamond may be worth less in this regard than the act of giving up valuable time for your company or time spent on some activity at your request.

You should also recognize that your date will similarly scrutinize your actions for their information content. Therefore, you should take actions that are credible signals of your true good qualities, and not just the ones that anyone can imitate. This is important not just on a first date; revealing, concealing, and eliciting information about the other person's deepest intentions remain important throughout a relationship. Here is a story to illustrate that.

Once upon a time in New York City there lived a man and a woman who had separate rent-controlled apartments, but their relationship had reached the point at which they were using only one of them. The woman suggested to the man that they give up the other apartment. The man, an economist, explained to her a fundamental principle: it is always better to have more choice available. The probability of their splitting up might be small but, given even a small risk, it would be useful to retain the second low-rent apartment. The woman took this very badly and promptly ended the relationship!

Economists who hear this story say that it just confirms the principle that greater choice is better. But strategic thinking offers a very different and more compelling explanation. The woman was not sure of the man's commitment to the relationship, and her suggestion was a brilliant strategic device to elicit the truth. Words are cheap; anyone can say, "I love you." If the man had put his property where his mouth was and had given up his rent-controlled apartment, this would have been concrete evidence of his love. The fact that he refused to do so constituted hard evidence of the opposite, and the woman did right to end the relationship.

These are examples, designed to appeal to your immediate experience, of a very important class of games—namely, those where the real strategic issue is manipulation of information. Strategies that convey good information about yourself are called signals; strategies that induce others to act in ways that will credibly reveal their private information, good or bad, are called screening devices. Thus, the woman's suggestion of giving up one of the apartments was a screening device, which put the man in the situation of offering to give up his apartment or else revealing his lack of commitment. We will study games of information, as well as signaling and screening, in Chapters 8 and 13.

3 OUR STRATEGY FOR STUDYING GAMES OF STRATEGY

We have chosen several examples that relate to your experiences as amateur strategists in real life to illustrate some basic concepts of strategic thinking and strategic games. We could continue, building a whole stock of dozens of similar stories. The hope would be that, when you faced an actual strategic situation,

you might recognize a parallel with one of these stories, which would help you decide the appropriate strategy for your own situation. This is the *case study* approach taken by most business schools. It offers a concrete and memorable vehicle for the underlying concepts. However, each new strategic situation typically consists of a unique combination of so many variables that an intolerably large stock of cases is needed to cover all of them.

An alternative approach focuses on the general principles behind the examples and so constructs a *theory* of strategic action—namely, formal game theory. The hope here is that, facing an actual strategic situation, you might recognize which principle or principles apply to it. This is the route taken by the more academic disciplines, such as economics and political science. A drawback to this approach is that the theory is presented in a very abstract and mathematical manner, without enough cases or examples. This makes it difficult for most beginners to understand or remember the theory and to connect the theory with reality afterward.

But knowing some general theory has an overwhelming compensating advantage. It gives you a deeper understanding of games and of *why* they have the outcomes they do. This helps you play better than you would if you merely read some cases and knew the recipes for *how* to play some specific games. With the knowledge of *why*, you can think through new and unexpected situations where a mechanical follower of a “how” recipe would be lost. A world champion of checkers, Tom Wiswell, has expressed this beautifully: “The player who knows how will usually draw; the player who knows why will usually win.”⁴ This is not to be taken literally for all games; some games may be hopeless situations for one of the players no matter how knowledgeable he may be. But the statement contains the germ of an important general truth—knowing *why* gives you an advantage beyond what you can get if you merely know *how*. For example, knowing the *why* of a game can help you foresee a hopeless situation and avoid getting into such a game in the first place.

Therefore, we will take an intermediate route that combines some of the advantages of both approaches—case studies (*how*) and theory (*why*). We will organize the subject around its general principles, generally one in each of the Chapters 3–7. Therefore, you don’t have to figure them out on your own from the cases. But we will develop the general principles through illustrative cases rather than abstractly, so the context and scope of each idea will be clear and evident. In other words, we will focus on theory but build it up through cases, not abstractly. Starting with Chapter 8, we will apply this theory to several types of strategic situations.

Of course, such an approach requires some compromises of its own. Most important, you should remember that each of our examples serves the purpose

⁴ Quoted in Victor Niederhoffer, *The Education of a Speculator* (New York: Wiley, 1997), p. 169. We thank Austin Jaffe of Pennsylvania State University for bringing this aphorism to our attention.

of conveying some general idea or principle of game theory. Therefore, we will leave out many details of each case that are incidental to the principle at stake. If some examples seem somewhat artificial, please bear with us; we have generally considered the omitted details and left them out for good reasons.

A word of reassurance. Although the examples that motivate the development of our conceptual or theoretical frameworks are deliberately selected for that purpose (even at the cost of leaving out some other features of reality), once the theory has been constructed, we pay a lot of attention to its connection with reality. Throughout the book, we examine factual and experimental evidence in regard to how well the theory explains reality. The frequent answer—very well in some respects and less well in others—should give you cautious confidence in using the theory and should be a spur to contributing to the formulation of better theories. In appropriate places, we examine in great detail how institutions evolve in practice to solve some problems pointed out by the theories; note in particular the discussion in Chapter 10 of how prisoners' dilemmas arise and are solved in reality and a similar discussion of more general collective-action problems in Chapter 11. Finally, in Chapter 14, we will examine the use of brinkmanship in the Cuban missile crisis. Theory-based case studies, which take rich factual details of a situation and subject them to an equally detailed theoretical analysis, are becoming common in such diverse fields as business studies, political science, and economic history; we hope our original study of an important episode in the diplomatic and military areas will give you an interesting introduction to this genre.

To pursue our approach, in which examples lead to general theories that are then tested against reality and used to interpret reality, we must first identify the general principles that serve to organize the discussion. We will do so in Chapter 2 by classifying or dichotomizing games along several key dimensions of different strategic matters or concepts. Along each dimension, we will identify two extreme pure types. For example, one such dimension concerns the order of moves, and the two pure types are those in which the players take turns making moves (sequential games) and those in which all players act at once (simultaneous games). Actual games rarely correspond to exactly one of these conceptual categories; most partake of some features of each extreme type. But each game can be located in our classification by considering which concepts or dimensions bear on it and how it mixes the two pure types in each dimension. To decide how to act in a specific situation, one then combines in appropriate ways the lessons learned for the pure types.

Once this general framework has been constructed in Chapter 2, the chapters that follow will build on it, developing several general ideas and principles for each player's strategic choice and the interaction of all players' strategies in games.