

CHAPTER 9

Games with Strategic Moves

TEACHING SUGGESTIONS

The ideas in this chapters can be brought to life and the students can better appreciate the subtleties of various strategic moves and their credibility if you hold classroom discussions based on situations where such strategies are of the essence. Depending on your preference, you can either have the discussion before any formal analysis is done and develop the analytical concepts and techniques out of the ideas that arise during the discussion, or the other way around. Similarly, because brinkmanship is critically linked to the issues covered in this chapter, you may find that you want to cover Chapter 13 before attempting the discussions described below; or you may want to use these discussions as a springboard for the analysis provided there.

We have found that students have the most difficulty grasping the distinction between deterrence and compellence. It is often especially hard for them to identify the four possible types of threats and promises and the circumstances in which the various combinations can best be used. You may want to take the time to construct specific examples of each type of threat and of scenarios in which each is most likely to be used. We emphasize two points: (1) deterrent threats and compellent promises are the most common conditional response rules, and (2) compellent threats and deterrent promises require that the player making the strategic move impose some type of time limit on the rival. In discussion with the class, students usually connect the fact that point 2 helps explain why point 1 holds.

To convey the basic ideas of commitments, threats, and promises using examples other than those in the book, see Dixit and Nalebuff, *Thinking Strategically*, Chapter 5. Or here are some other possible examples.

For a commitment example, you can return to the Battle-of-the-sexes" example suggested in the teaching suggestions

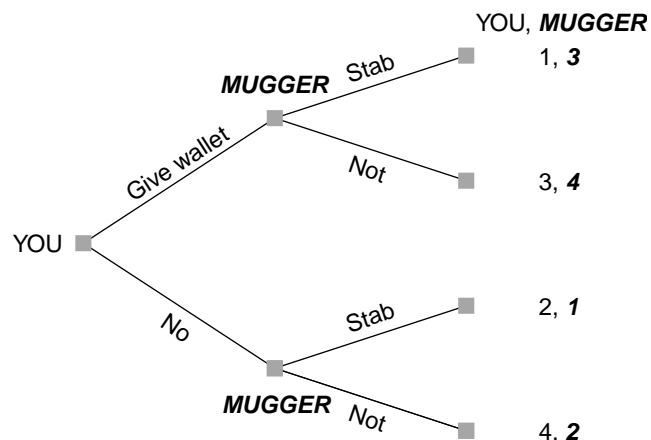
for Chapter 4; the game was between a husband and wife trying to decide on a film to see, *Independence Day* or *The English Patient*. The payoff matrix is as follows:

		WIFE	
		<i>Independence Day</i>	<i>The English Patient</i>
HUSBAND	<i>Independence Day</i>	2, 1	0, 0
	<i>The English Patient</i>	0, 0	1, 2

This game has two Nash equilibria in pure strategies (and one in mixed strategies). Either player in this game could use a strategic move to better his or her expected equilibrium payoff. By restricting her own freedom of action, for instance, the wife could commit to seeing *The English Patient*; she could do so by spending her last \$8 on a ticket for that film. Or the wife could take some action that changed the payoffs in the game, changing her payoff from seeing *Independence Day* with her husband to -1 instead of 1; perhaps his behavior during such films makes it even worse for her to see them with him rather than without him. In either case, the unique Nash equilibrium of the game becomes (*The English Patient*, *The English Patient*).

You can then cover the standard practical difficulties that one must consider with commitment moves. The other player (the husband here) may not receive the necessary information about your commitment move; this may be a deliberate move on the other player's part. In addition, the other player may not believe your commitment (brings up issues of credibility). Finally, simultaneously clashing commitments may lead to a bad outcome.

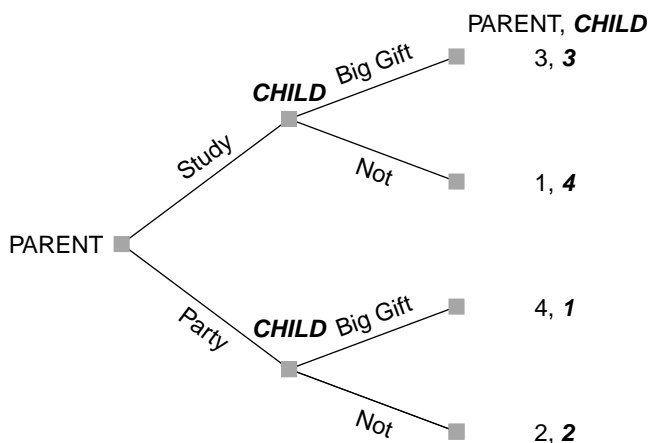
For a different example of a game in which a threat can alter the outcome to a player's benefit, consider a sequential game between you and a mugger: you make the first move and decide whether to give up your wallet; then the mugger decides whether to stab you. The tree for this game in its original (no strategic move) format is illustrated below.



The Nash equilibrium with no strategic moves shows that no stabbing is a dominant strategy for the mugger; given this, you choose not to give up your wallet. The payoffs in equilibrium to you and the mugger are (4, 2). You get your highest possible payoff and can do nothing to improve your payoff in this game, but the mugger can make a threat to change the path of play and improve his outcome.

The mugger can use a threat: “If you don’t give me your wallet, then I will stab you.” This is a compelling threat with an implicit promise that you will not be stabbed if you do hand over your wallet. If you believe the threat, then it is in your interest to give up your wallet (and get a payoff of 3) rather than not (and get a payoff of 2). Of course, it is not optimal for the mugger to carry out the threat if put to the test (mugger gets 1 instead of 2 if he follows through due to the risk of a felony conviction and a long prison term), so credibility is problematic. The mugger could establish credibility in this case through irrationality—acting crazy and out of control.

For an example of a promise, you can use a variant on the parent-child game from Exercise 9.3. This sequential game is illustrated in the tree below. Payoffs assume that the Child



prefers outcomes with a Big Gift over those without a gift and then prefers to Party rather than Study; the Parent wants the Child to Study above all and then prefers outcomes in which no gift is necessary. The Nash equilibrium shows that the parent chooses No regardless of the child's choice, so the child chooses Party rather than Study. The payoffs are 2 to the child and 2 to the parent.

The Parent can improve his outcome—and get the child to Study—by using a compelling promise: “If you study, I will give you a big gift.” The implicit threat here is that there is no big gift if the child parties; this is automatically credible given the payoff structure of the game. Credibility of the promise is questionable because purchasing the big gift is not in the parent's best interest once the child has done the studying. The parent can establish credibility of such a promise with a reputation for following through; this works especially well for younger siblings.

Finally, for an example of a game which requires both a threat and a promise, consider this example about the U.S. House of Representatives vote on Reagan's 1981 tax cut bill. (This example comes from Dixit and Nalebuff, *Thinking Strategically*, pp. 131–135 and is based on a *New York Times* article by Leonard Silk from April 10, 1981.) The payoff table for the game between the Democrats in the House and the Republicans in the House is as follows:

		REPUBLICAN	
		<i>Hard-line Support</i>	<i>Compromise</i>
DEMOCRAT	<i>Weak Opposition</i>	2, 4	3, 3
	<i>Hard-line Attack</i>	1, 2	4, 1

The payoff structure depends on the following considerations related to the various outcomes. In the (Weak Opposition, Hard-Line Support) cell, there is a Republican victory and the Democrats maintain the ability to say, “Don’t blame us.” In the (Weak Opposition, Compromise) cell, the Republicans win but not totally; Reagan is unhappy and the Democrats get to share the credit. In the (Hard-Line Attack, Hard-Line Support) cell, Reagan's program is blocked in the House and the Democrats get the blame for thwarting a popular president. Finally, in the (Hard-Line Attack, Compromise) cell, the Republicans lose much of their program and the Democrats look fiscally responsible.

The Nash equilibrium of the game without strategic moves entails Weak Opposition by the Democrats and Hard-Line Support by the Republicans; payoffs are (2, 4). The Democrats have an incentive to use a strategic move to better their outcome. They could try to use a commitment move, but committing to Hard-Line attack leaves them with a payoff of 1 instead of the 2 they get with Weak Opposition, so a commitment does not help. Instead they must consider a threat and/or a promise.

For a threat, the Democrats would want to say, “If you give Hard-Line Support, we will offer Hard-Line Attack.” This is not immediately credible since Hard-Line Attack is not in the Democrats best interest if the Republicans offer Hard-Line Support. Similarly, the implicit promise that goes along with this threat—“If you compromise, so will we”—is not credible since Weak Opposition is not the choice the Democrats would want to make against compromising Republicans. (If the Democrats wanted to make just the promise, they would find that its implicit threat was not credible.) The Democrats must use a combination of a threat and a promise, explicitly stating both parts of the response rule: “We will match compromise for compromise, hard line for hard line.” Both parts need to be made credible as well, potentially through the establishment of a reputation in the ongoing (repeated) game between House Republicans and Democrats. In reality, this did not happen.

You may find it useful to come up with your own, perhaps university-specific, examples of methods by which players can enhance the credibility of their strategic moves. For universities with an honor code, the credibility of such a code can provide an excellent discussion topic for this chapter. Also, the text discusses how “apparently irrational motives like honor or face” may make it credible that you will deliver on a promise. One possible example of this is the tradition of the U.S. Marines never to leave any of their dead behind on the field of battle; inculcating this philosophy into all Marines may make credible a great deal of trust between soldiers.

As for the discussion topics we mentioned earlier, there are three different scenarios that we have used in order to stimulate class discussions. The first concerns governments’ negotiations with terrorists who are holding hostages. We consider the typical situations in which such negotiations arise, the types of policies governments consider, and the credibility issues that arise, as well as the various components of the negotiations themselves.

In the second scenario, we schedule an extended session of the class and screen the movie *Dr. Strangelove* (which lasts 95 minutes). In the following class session we hold a discussion on the strategic issues that arise in the movie. (Another option is to schedule an evening showing of the film and/or to have students rent the film and see it on their own. Some school libraries may have the film in their collection either on VHS or laser disc.) This movie is full of incidents where threats, promises, credibility, and so on, are of the essence. In movie-buffs’ polls it is often ranked in the all-time top-10 lists, and it engages the interest of most of our students. But it is in black and white, it lacks modern visual special effects, and its premise of superpower nuclear confrontation is ancient history to many of today’s students. If you want to use this film and have the technology available (laser disc would be the easiest), you can bring the film to the discussion class and show critical scenes as they are brought up for discussion.

You can instead use this movie in conjunction with Chapter 13; the impact is greater if the class sees it while the drama of the Cuban missile crisis is fresh in their minds.

Of course, many other more recent movies have brief individual scenes where strategic moves are played. You might be able to arouse greater interest in such films than is possible with *Dr. Strangelove*; if you can put together a videotape that assembles such scenes from a number of movies, you can get more varied and more modern settings and use these as the basis for your discussion. We have just recently tried to do something like this, digitizing short video clips for students to view and comment on electronically. This procedure allows for an ongoing conversation that continues beyond the bounds of a 50- or 70-minute class period; as an added bonus, you get a record of the conversation using this method.

A third possible topic is the game between political prisoners and their jailers. The inspiration for this came from reading Nelson Mandela’s *Long Walk to Freedom*, (Boston: Little, Brown, 1994), especially the chapters “Robben Island: The Dark Years” and “Robben Island: Beginning to Hope.” This topic proved a good way to get across the point that even though your sympathy is entirely on one side, to understand and analyze the game properly you must also understand the strategies and the objectives of the other side.

For your guidance, we append summaries of our discussions of each of these topics. We do this with a twofold purpose. If you choose one of these topics, these summaries will give you points with which you can lead the discussion in interesting directions if it begins to lag or go off in irrelevant directions. If you choose some other topic, these summaries may suggest general ideas about organizing your own topic ahead of time and being ready to offer pointers to the class. We apologize for the terse and notelike (often ungrammatical) quality of these summaries; a fuller version would be too long.

DISCUSSION TOPIC 1 STRATEGIES AGAINST HOSTAGE TAKERS

Typical Situations

Terrorists: usually have several hostages, demands are political, may be fanatics, location may be public or secret, local or foreign

Prison riots: guards as hostages, demands for improved conditions

Kidnapping for ransom: usually a single hostage, demands monetary, usually calculatingly rational, location secret

Policy to Deter Hostage Taking

When asked what policy the government should announce in advance, there is general agreement that the government

should declare that it would never negotiate. This gets at the idea of a commitment. But when an actual incident is depicted, with the hostages' relatives' appearing on TV news asking what the government is going to do, most students recognize that the government would abandon its policy and negotiate. This at once brings home the idea of credibility or lack thereof. (For a film version of such a situation, you can use the example of Harrison Ford in *Air Force One*.) But one or two students in the class generally argue for being tough even though this means the loss of some lives. Discuss this for a while, and bring out the idea that in different countries and at different times, political and social norms differ and hanging tough may be feasible in some cases but not others. The current U.S. setting makes it particularly difficult for the authorities to act tough.

The terrorists may take advantage of the pressure that media and relatives can create by taking hostages most likely to arouse sympathy—the old, the sick, and children.

Some suggestions to enhance the credibility of a tough stance or the reputation of a government trying to take such a stance: (1) Stage a fake incident and resolve it with the terrorists giving in. This may do more harm than good if the truth leaks out. (2) Give the power to retaliate into the hands of an independent bureau or organization like the army. (This leans toward brinkmanship, which is covered in Chapter 13.) But in the United States there are always civilian overrides. (3) Make laws that punish anyone who communicates or deals with terrorists. But again someone or some group can override such laws in a good cause. Thus there is no really good solution in open democratic societies; totalitarian ones have an advantage in this regard.

There is a distinction between terrorism and kidnapping: With the latter, the victim's relatives can capitulate against the government's wishes. The government can try to prevent them from doing so, for example, by freezing their assets. But then in future incidents the relatives may settle secretly without ever notifying the authorities. (It was pointed out that kidnappers would make a mistake by choosing a victim who has sole control over the assets from which the ransom is to be paid; better for them to take the dependent spouse or child of such a person.)

Even if it seems likely that the government will negotiate when an actual incident occurs, there is some uncertainty, and the policy announcement may serve to deter some of the milder or less fanatical potential terrorists.

Negotiations

Several issues arise and each situation has its special features. In one sense the terrorists or kidnappers start out with an advantage; they choose the time and location and are better organized. But governments also prepare and train teams to handle such situations. Some terrorist groups also have a reputation for toughness or fanaticism, while some governments have the opposite reputation.

DEADLINES

If the location is one where the authorities control the food and water supply, and the terrorists have limited numbers, time is on the government's side. Then the authorities may simply seal the place, prevent media coverage, and wait it out. They will certainly try to draw out negotiations, for example invoke the need to refer decisions to higher levels, and use salami tactics. The aim is to exhaust the terrorists' physical and mental stamina and to get a much better deal from them. The terrorists, who are using a compelling threat, must impose a deadline. They can force the issue with limited violence: torture or killing some hostages every day or hour. (Killing all the hostages is not rational, but irrationality or brinkmanship may be used.) Terrorists' violence runs the risk of invoking an irrational tough response from the public or the government.

If the location is secret or under the terrorists' or their sympathizers' control, if the terrorists have the advantage of numbers, control of food, and so on, and if the pressure on the government is great, then the roles are reversed. The terrorists can wait patiently as the government makes concessions or deals.

BARGAINING PROCESS

The government can get a better bargain using counterthreats, for example to bomb the terrorists' camp or country. But then one terrorist group can get revenge on a rival group by acting using its name and invoking such reaction against it.

Terrorists' demands typically include publicity for their cause, release of their comrades in jail, substantive political concessions, and always safe passage for themselves after the incident is over. They hold several hostages. The package can then be split into a series of small steps, facilitating the buildup of mutual confidence in the bargaining process. Thus some hostages (sick, elderly, women, children) can be released in exchange for publicity or partial release of prisoners.

Similar bargaining can occur with kidnappers: the family of the victim can claim that its assets are illiquid, so it can only meet part of the demand without excessive delay. The kidnappers can try to force the issue by torturing or mutilating the victim, but they must periodically send out evidence that the victim is alive.

DOUBLE-CROSSING

This can happen when the negotiations approach or reach an endgame.

If there is a partial release of hostages, the authorities can debrief them for information about the terrorists (their numbers, weapons, state of mind), about the numbers and condition of the remaining hostages, and about the physical layout of the location. This increases the chances of a successful rescue operation. Hostages who get out alive can also help identify their holders for later arrest or trial. Therefore it is

in the mutual interest of the terrorists and the hostages that the terrorists be masked or the victims blindfolded.

The problem of a double cross is at its most serious after the hostages are released and it only remains for the government to fulfill its promise of safe passage to the terrorists. Should the government renege and kill the terrorists or shoot down their escape plane? If the government does this, it might serve to deter future hostage taking; however, if there is a positive probability that some fanatics will do similar things in the future anyway, then this precedent will make it much harder to negotiate with them.

DISCUSSION TOPIC 2 STRATEGIES IN DR. STRANGELOVE

Here are the main points that have emerged from our classroom discussions over the years.

Plan R

The reason for creating Plan R was that the U.S. nuclear deterrent was not credible in the sense that killing the President would prevent a U.S. nuclear retaliation. This sense is different from the one used in game theory; in game theory we would say that the nuclear deterrent was not credible if the U.S. President, left free to choose after a Soviet attack, would not want to unleash retaliation. The difference is between the *ability* and the *will* to act.

In strategic terms, the plan improved our second strike capability—the ability to retaliate after being subjected to a first strike. If both sides have better second strike capability, the nuclear balance is safer because neither has the temptation to launch a preemptive first strike and neither feels the need to do so because of a perception or fear that the other side might launch a preemptive first strike. But the plan seems to have been a secret; even the President was unaware of it. Its existence should have been better publicized. Certainly the Soviets should have been informed, to make it clear to them that a sneak attack that destroyed Washington and killed the President would gain them nothing.

The plan failed because it did not have effective safeguards to prevent a lower-echelon commander from launching an uncalled-for attack; the plan was too risky. Any plan of this kind has a trade-off between effectiveness and safety. Some less-risky versions of the plan include: (1) The authority to launch an attack rests with a group of military commanders, perhaps at different bases, and, say, three out of five Go commands are needed. (Allowing any one of the five to give the Go code is too unsafe; requiring unanimity is too ineffective.) Or the code could be in two or more parts. Similar controls exist in some systems for the actual launching of missiles, where two people must turn keys simultaneously. (2) The ability to issue the Go code could be conditioned on some objective event, for example, a sufficiently high level

of radiation in the United States. (3) The planes could be required to obtain confirmation of the go-code from a different base than the one that issued the initial order. (4) Automatic instead of human pilots could be used. But these would have been less effective in real war; they would not have saved the plane with heroics after the missile attack.

To allow the President to retrieve the situation after an unprovoked launch of Plan R, there could be an overriding recall code or a second radio receiver controlled directly from the Pentagon. The risk of destruction of the plane's receiver circuits could be handled by requiring that the mission be aborted if the CRM-114 is not functional. But this may err on the side of too little effectiveness; the mission may be essential to the United States.

The Soviet Union actually had something very like Plan R but with various human and mechanical safeguards. It was (wrongly) called "Russia's Domsday Machine" (Bruce G. Blair, *New York Times*, October, 10, 1993, Op.Ed.p.).

General Ripper's Attack

To commit the United States to his attack, Ripper "hijacked" several elements of Plan R itself: (1) He sealed off the base, cut off communications, and impounded radios. (2) He sent a phone message and was then unavailable for further discussions or questions. (3) He sent the Go code when the planes were already at fail-safe so they would not need a further authorization. (4) He kept the recall code secret and finally killed himself (the ultimate irreversible commitment) rather than risk revealing it under torture.

He put the President and the general staffs under great time pressure and reckoned that it would compel them to back him up with an all-out attack. In the War Room meeting, General Turgidson supported this course of action, as it would yield a less bad postwar environment: "only" 10 to 20 million dead.

Flaws in Ripper's strategy: (1) He did not reckon that the President would refuse to launch an all-out attack and would instead contact the Soviet Premier and even help the Soviets shoot down the planes. (2) The base was not perfectly sealed: Mandrake discovered a working radio playing music and later a pay phone (and a Coke machine to supply coins!). (3) The base defenses were overcome very quickly. (4) Ripper's obsessive doodling enabled Mandrake to guess the recall code.

The Domsday Machine

Its important features: (1) It threatened a very dire consequence, namely destruction of all human and animal life on earth, to serve as a deterrent. (2) It was automatic, making it credible as a commitment to actions that "no sane man would take." Its crucial flaw: It was kept a secret. The Soviets should not only have announced it as soon as it was operational but also have invited U.S. officials to inspect it.

Would this have deterred Ripper? If he was truly concerned about the purity of the U.S. people's precious bodily fluids, he would not have wanted them to be destroyed by radioactivity. But if this was just a symptom of some underlying psychosis, who knows what he might have done.

But given the risk of errors, the doomsday machine is too large a threat. Besides the error that occurred in the movie, such a machine might be triggered by mistake (or a runaway computer as in the movie *War Games*) or by a "very small" attack. It might also prove too unpopular with the U.S. public. For such reasons the United States had decided not to build such a device.

A doomsday machine could be made safer by programming it to react only to a "large enough" attack, but that would make it vulnerable to salami tactics—repeated attacks each of which is too small to trigger it. The machine could be made probabilistic like Russian roulette, but this concept might be too difficult to explain to the public or even to the opposing military chiefs. But if the machine can be overridden by a human, its crucial automatic nature is lost.

A country might announce that it has a doomsday machine without actually building one. It could even construct the appearances—computers, and so on—but leave out the actual bombs. This might be a very effective deterrent. But in the United States there might be adverse public reaction. Moreover, if, say, an investigative reporter found out the truth, that might jeopardize the credibility of the real deterrents.

The Phone Conversation

President Merkin Muffley used various devices to convince Premier Kissoff that he was sincere and was not launching a massive attack: (1) He brought the Soviet Ambassador into the highly confidential War Room, showed him the full situation, and had him talk to the Premier first. (2) He pointed out that if he had meant to launch a sneak attack, he would have done so without calling first, so the very act of making the phone call was an assurance of good intentions: "If it wasn't a friendly call, you would never even have got it." (Incidentally, this is one of the few nonartificial examples known to us of forward induction, where your past actions are credible signals of your future intentions.) (3) The Soviets' trust was reinforced when the locations of the planes were correctly revealed, some were shot down, and others were recalled.

But all this was defeated by the cowboy pilot's initiative, namely his decision to bomb an alternative target. Possible ways of avoiding this risk: (1) Have a general rule that the bomb cannot be dropped other than on the specified primary or secondary targets. (2) Do not give the pilot the coordinates of any other targets. In the movie he could have got those from the profile envelopes for all the other attack plans, but these days one could transmit the plans electronically very fast with the initial Go order itself. (3) The Soviets should not have focused *all* their forces on that one location,

to guard against just such a mishap or, even more important, against deliberate U.S. cheating. (4) There could be a device located in each plane to destroy it in just such an emergency on an electronic command from the United States. But if the Soviets found out the destruction signal, they would have a surefire defense. Also, the knowledge that such a device existed would seriously lower the morale of U.S. aircrews. Again, there is a trade-off between risk and effectiveness, and there is no ideal solution.

DISCUSSION TOPIC 3 STRATEGIES FOR POLITICAL PRISONERS

The first point to note is that, no matter how much you side with the political prisoners and hate the authorities in these situations, you must coolly and objectively examine the strategic possibilities for the authorities, too, if you are to devise the best strategies for the prisoners. That is the essential feature of a game of strategy; you must analyze it by considering together the perspectives of all players. Mandela recognizes this well; he says, "One must know the enemy's purpose." With this in mind, we list some actions available to each side and some counterstrategies for the prisoners. The parentheses give the page numbers where each action is mentioned in Mandela's book.

Authorities' Strategies

1. ISOLATION

Isolate the prisoners from one another and from the outside world (341).

(Mandela says the authorities' failure to do this sowed the seeds of their eventual defeat. The same is said to be true in other situations, for example, in India during the British rule and during the "emergency" of 1975 to 1977.)

2. HUMILIATION

Enforcement of petty rules (343).

Required to wear short trousers (355, 359, 393).

Poor food, associated insults (342–343).

Provide bad news about family, to provoke anger, depression (370).

(To counter these, the prisoners must know their legal rights—if any—and insist upon their observance (344–345). Measures listed below under "Preservation of dignity" are also important.)

3. AGENT PROVOCATEURS

One instigated a false complaint to get Mandela's support and then retracted to make him look bad (355–357). This taught Mandela to be wary and may have saved his life.

Another offered an escape plot. This was really a secret police plot to kill Mandela while escaping; he did not fall for it (398).

4. REWARD AND PUNISHMENT SCHEMES

A–D grading, with some privileges (347–348).

Charges, solitary confinement (361, 363).

Create divisions among prisoners or between prisoners and their colleagues outside (458, 465).

(To counter these, establishing leadership to maintain unity and discipline among prisoners is essential. Must also anticipate fears of outside colleagues that the prisoners are being softened or turned by the authorities and work to maintain communication to remove these fears.)

Prisoners' Strategies

1. RESERVATION OF DIGNITY

Regard prison as continuation of wider struggle (341, 360, 363); for Mandela this was the highest priority.

Preserve sense of time (340).

Ongoing education, discussion (360, 374–375).

Not reveal any weakness that could be exploited, for example, do not show any emotions or eagerness receiving letters or visits (349, 352).

Constant use of all available legal channels of protest and complaint even if they often don't work (345, 347, 372).

2. COMMUNICATION

With each other, during morning cleaning, work, showers, night (342–344, 366–367).

With outside world, visitors; receiving and sending news via lawyers (368); using secret codes (351, 368); newspapers (most important to political prisoners everywhere), receiving and reading (360–362, 374) or generating news coverage (346, 369), and most important during hunger strikes (369); complaints to Red Cross (357–359) and to judges' panel (401–402). (The public's attention may be better held if coverage is focused on a specific person such as Mandela, than on prisoners generally.)

3. CULTIVATING RELATIONS WITH INDIVIDUAL WARDERS

Recognizing and reciprocating occasional goodwill (365–366).

Willingness to reason and compromise (402–403).

Bribery and even blackmail (373–374).

4. EXPLOITING DIFFERENT OBJECTIVES AMONG AUTHORITIES

The South African apartheid government wanted to keep

some pretense of legitimacy before the international community. Therefore it:

1. Allowed some visits by lawyers, family (maintain communication)
2. Preserved access to Red Cross, and so on (avenue of complaint)
3. Made physical torture or beatings less feasible or effective
4. Lent some effectiveness to hunger strikes (369)

(Contrast this to the Soviet Gulag or some other dictatorships.)

Higher officials will judge a prison warden by his ability to keep his prison trouble-free, so a threat of disobedience campaigns and disruption has some effect.

Can exploit divisions among guards; play them against each other.

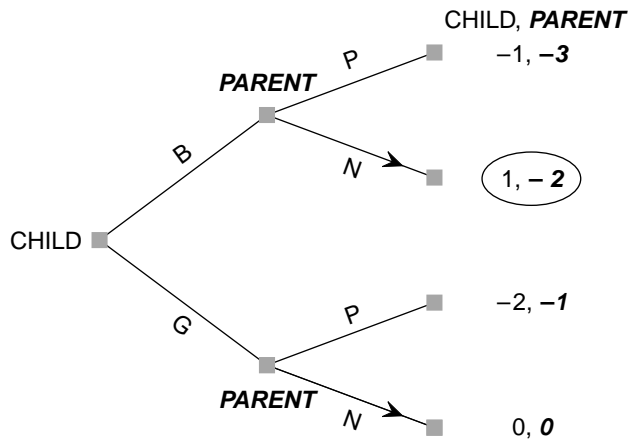
ANSWERS TO EXERCISES FOR CHAPTER 9

1. (a) (i) There are two pure-strategy equilibria (Down, Left) and (Up, Right); there is also a mixed-strategy equilibrium in which Row uses Up with probability $2/3$ and Column uses Left with probability $2/3$. The payoffs from the mixed-strategy equilibrium are $2/3$ to each player.
(ii) If Row commits to Up, he ensures himself a payoff of 2. Similarly, if Column commits to Left, he ensures himself a payoff of 2.
(b) (i) Both players have dominant strategies; equilibrium: (Up, Right); payoffs (3, 4).
(ii) Row can achieve his best payoff of 4 by using the threat "Down if Right."
(c) (i) Both players have dominant strategies; equilibrium: (Up, Right); payoffs (2, 2).
(ii) Either player can make a promise that moves the game to (Down, Left) and payoffs (3, 3). Row can promise "Down if Left;" Column can promise "Left if Down."
2. Baker could benefit from making a threat: "I will choose 10 if you choose 90:10."
3. (a) The simultaneous move game is two by two as shown in the following matrix:

		PARENT	
		P	N
CHILD	B	−1, −3	1, −2
	G	−2, −1	0, 0

Both players have dominant strategies; equilibrium is (B, N) with payoffs (1, −2).

- (b) Subgame-perfect equilibrium is (Bad, Always Not) for same payoffs (1, -2).



- (c) The parent can commit to four possible strategies: (1) “P Always,” (2) “N Always,” (3) “P if B” (and “N if G”), or (4) “P if G” (and “N if B”). Then the game has a two-by-four matrix as shown below:

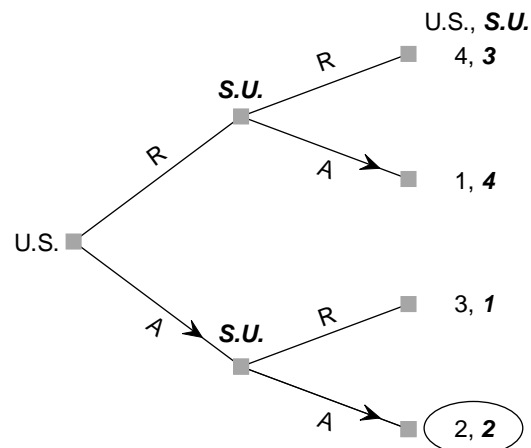
		PARENT			
		<i>P always</i>	<i>N always</i>	<i>P if B</i>	<i>P if G</i>
CHILD	B	-1, -3	1, -2	-1, -3	1, -2
	G	-2, -1	0, 0	0, 0	-2, -1

This game has three Nash equilibria: (B, N Always) leading to (1, -2), (G, P if B) leading to (0, 0), and (B, P if G) leading to (1, -2).

- (d) The first equilibrium noted in part c—(B, N always)—is also the subgame-perfect equilibrium in the sequential game from part b. The second equilibrium—(G, P if B)—is not a subgame-perfect equilibrium of the extensive form shown in part b. In this case, the parent is making a threat which constitutes a commitment, as if the parent had written the instruction “P if B” to a third party (like a disciplinarian nanny) with the sole responsibility for carrying it out. Therefore, the child chooses G. This differs from the choice made in the sequential form of the game where the child knows that the parent has the freedom of action after the fact and will choose N even if the child chooses B. Then the threat is not credible and the child will choose B. Finally, the third equilibrium in part c—(B, P if G)—is only a Nash equilibrium in a weak sense. When the child is playing her equilibrium strategy, B, the parent does not actually gain by deviating from her equilibrium strategy, “P if G”. One might eliminate “P if G” at the outset as being weakly dominated by N.

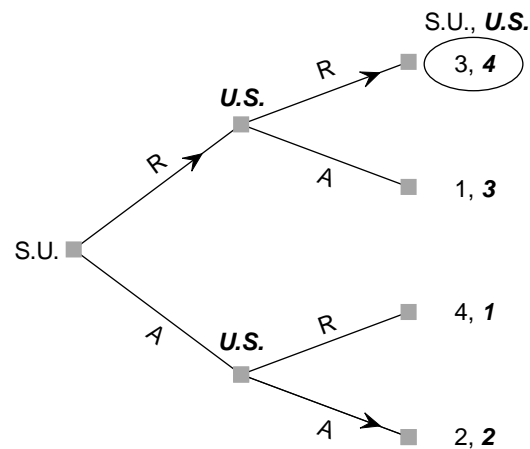
4. (a) Nash equilibrium is (Aggressive, Aggressive).

(b) (i)



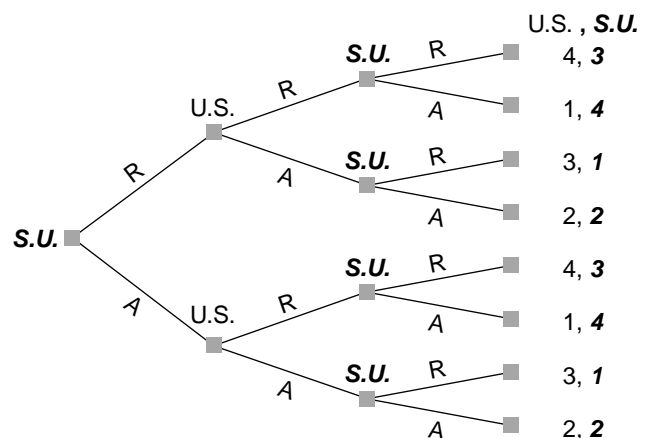
Subgame-perfect equilibrium is (Aggressive, Always Aggressive).

(ii)



Subgame-perfect equilibrium is (Restrained, Restrained if Restrained but Aggressive if Aggressive)

(iii)



Subgame-perfect equilibrium is (U.S. Always Aggressive, S.U. Always Aggressive at last move regardless of first move).

- (c) Both the United States and the Soviet Union are better off in the situation in which the United States moves last. This is the situation in which the United States retains its flexibility and can respond to the actions of the Soviets.

With this order of timing, the Soviet Union's awareness of the United States's ability to respond to its action discourages it from acting aggressively. The Soviets know that if they did so, the United States would match their aggression, and they would suffer as a result. In turn, the Soviet Union knows that restraint will be met with restraint.

If the Soviet Union moves last, the United States knows that nothing will restrain the Soviets from acting aggressively. Anticipating this, the United States will also have to act in the same way, and the outcome in which both are aggressive is worse for both countries than the outcome in which both are restrained is.

The key point is that the U.S. must retain its flexibility. If it committed to either action (Restraint or Aggression), it would lose its ability to influence the action of the Soviet Union; if the U.S. action is previously determined, the Soviet Union should choose its dominant strategy of Aggression.

In order to retain its influence, the United States should not commit to any actions; it should remain credibly flexible. For example, the U.S. should not state that it will never be aggressive (it should not renounce the use of nuclear weapons) nor should it adopt a unitarily aggressive posture.

5. The Keaton character made the mistake of believing that the Allen character would follow through on his part of the deal. If Keaton really "knows" that Allen can't listen to "too much Wagner," she should have realized that Allen's promise was not credible.

Keaton could have required that Allen attend the opera before going to the hockey game—if Allen did not stay, Keaton would not have had to watch hockey; made attending all of the opera part of a bigger game, so there would be a consequence to Allen's leaving; or picked a non-Wagnerian opera (if she didn't care which opera they attended), in order to make it easier for Allen to keep his promise.

6. Note that the answers provided here are deliberately imprecise and open ended; their purpose is to get students thinking about real-world issues using game-theoretic perspectives. Here are some suggestions for getting discussions started.

- (a) The current members of the European Monetary Union want to achieve compellence from Britain.

They can use a threat (if you don't join, we will exclude you from important European decisions like defense) or promise (if you join, we will give you better deals on other European issues like reforming the common agricultural policy). For both kinds of moves, credibility is problematic. Britain may not believe that the others will be able to do without her in defense matters or that after she has joined, the French will renege on their promises concerning agriculture.

- (b) The United States wants to deter North Korea primarily, and also Iran, China, and so on, secondarily. The usual strategic move for this is a threat.

However, we do not have many good threats in this context. Short of a military attack, there is little we can do to hurt North Korea or Iran. With North Korea, withholding food aid will look inhumane. And the United States business community has successfully argued to every United States administration that economic relations with China are too important to be risked for any reason. This is a case where a deterrent promise may stand a better chance of success than a threat. An example would be: "Each year that North Korea refrains from exporting missiles, we will give it so much food and fuel." Such a move needs careful monitoring and timing.

- (c) The United Auto Workers (UAW) wants to deter the firms from investing abroad and to compel the U.S. government to restrict imports. This needs a combination of policies, for example, a threat of a strike against U.S. firms and promises of contributions to politicians. In recent years strikes have had a very mixed record of success, and the threat may not be credible. If the threat against the firms is not credible, then knowing that, the government is also less likely to give in; why impose tariffs that would raise the cost of autos to domestic consumers if the jobs are going to be lost anyway?

- (d) The students can try to achieve deterrence with threats, demonstrations, sit-ins, exposing the high salaries of the top administrators and professors, and so on. The credibility of such moves will depend on the perceived willingness of the students to bear the costs of disruption of their academic activities, possible disciplinary action, and so on, as well as the financial facts of the situation and the attitude of the administration and the trustees.

- (e) This is a question of sustaining mutual promises. The usual approach is to break up the deal into a succession of small steps, such that the prospect of future benefits keeps each side willing to adhere to the promises of good behavior it has made so far. Eventually this can become problematic as the endgame approaches. The cooperative equilibrium

can last if even a small defection (reneging on the last step promised) will unravel the whole deal. Given the possibility of errors, it is too costly to build a certainty of such collapse into the deal, but creating a risk (brinkmanship) may work. Another possibility is for an interested third party to promise some reward to the two main parties; for example the United States promised economic aid to Egypt and Israel during the Camp David negotiations in 1978.

7. Accounts should incorporate a specific example of one of the strategic moves discussed in the chapter: commitments, threats, promises, or a combination. Note that the strategic notion of commitment is different from the interpretation given to the word *commitment* in daily usage. Many sporting examples are possible, as are examples from interactions with parents, roommates, colleagues, or partners.

ADDITIONAL EXERCISES WITH ANSWERS

1. Consider the following voting game between two members of a three-member commission. This commission has two potential proposals it can either accept or reject. Member A loves proposal X and will definitely vote for it; she'd prefer that proposal Y didn't pass, but she may or may not also vote for it. The chairperson loves proposal Y and is definitely voting for it; he also likes proposal X, but may or may not vote for it. The commission also includes Member B, who will definitely vote against both X and Y. A proposal will therefore be accepted only if both Member A and the chairperson vote for it. Suppose that the following matrix illustrates the payoffs (higher numbers again representing more favorable outcomes) to Member A and to the chairperson based on their votes.

		MEMBER A	
		Vote for X Only	Vote for X and Y
CHAIRPERSON	Vote for Y Only	1, 2	3, 1
	Vote for X and Y	2, 4	4, 3

Commission votes are taken in the following way: Members A and B announce their votes and then the chairperson announces his.

- (a) When Member A votes first and then the chairperson votes, how will each person vote? What is the outcome of the game, and what payoff does each person receive?

- (b) Which of the players in this game would have a reason to try to alter the outcome you just described by employing a strategic move?
- (c) Assuming it's credible, what statement (of the form "if you ____, then I'll ____" would the person you identified in part b wish to make? What would be the outcome of the game if this statement were made (and believed)?
- (d) The statement you just specified can be described as what sort of strategic move?

ANSWER (a) Member A votes for X only; the chairperson votes for X and Y. Only X passes. Member A's payoff is 4; the chairperson's is 2. (b) The chairperson. (c) The chairperson wishes to state, "If you vote for X only, then I'll vote for Y only." If Member A believes the chairperson's statement, she will vote for X and Y; the chairperson will do the same. Both X and Y pass. (d) This statement is a threat, since it describes an action that hurt both Member A and the chairperson.

2. Both threats and promises can be used to try to influence how another player acts in a strategic situation. State whether the following is true or false and explain why. One of the differences between issuing a threat and issuing a promise is that there may be some doubt about whether the issuer will carry through on a threat (because doing so hurts her as well as the other player) but there will never be any doubt about whether the issuer will carry through on a promise (because doing so helps her as well as the other player).

ANSWER False. Both carrying through on a promise and on a threat hurt the promiser.

3. The following table describes a two-layer game. There is one payoff that is unknown to us, but that payoff (Z) will equal 5, 7, or 9.

		PLAYER 2	
		Action X	Action Y
PLAYER 1	Action A	8, 8	Z, 6
	Action B	8, 8	6, 10

Complete the following. Suppose that Player 2 is able to commit itself to either action X or action Y before Player 1 moves. Player 2's commitment is public and irreversible, and Player 2 is confident that Player 1 will react in a rational manner. In this situation, Player 2 would choose to commit to action Y if Z = ____.

- (a) 5 only
 (b) 9 only
 (c) either 5 or 7
 (d) either 7 or 9

ANSWER (a)

4. Suppose that a person wishes to use a *strategic move* in order to alter the outcome of a game. In such a situation, the best time for the person to use such a move is _____ the other player makes a move.

- (a) at the same time as
- (b) before
- (c) after

ANSWER (b)

5. According to the list in the text, which of the following types of behavior may help to confirm the credibility of a strategic move?

- (a) An established reputation
- (b) A pattern of irrationality
- (c) A cutoff of communication
- (d) All of the above are correct.

ANSWER (d)

6. Consider the following two-player games, where higher number represent more favorable outcomes.

GAME 1

		PLAYER 2		
		<i>Action A</i>	<i>Action B</i>	<i>Action C</i>
PLAYER 1	Action X	4, 4	5, 2	3, 6
	Action Y	6, 1	2, 5	1, 3

GAME 2

		PLAYER 2		
		<i>Action A</i>	<i>Action B</i>	<i>Action C</i>
PLAYER 1	Action X	1, 5	6, 3	3, 6
	Action Y	5, 2	4, 4	2, 1

When played as a simultaneous game, each of the above has a unique (pure-strategy) Nash equilibrium, in which Player 1 gets a relatively low payoff. Player 1 may thus be interested in trying to improve his payoff by employing a strategic move (which will be observed by Player 2). (Ignore the possibility that Player 2 might counter with her own strategic move.) Complete the following. Player 1 can help himself (in other words, can alter the game's outcome in a way that leaves his payoff higher than it would be in the original simultaneous-game Nash equilibrium) by employing a simple unconditional commitment to choose a particular action in _____.

- (a) Game 1 only
- (b) Game 2 only
- (c) both Game 1 and Game 2
- (d) neither Game 1 nor Game 2

ANSWER (b)