Conflict, Cooperation, Coordination, and Communication

1 The Continuum of Strategic Situations

We define a continuum of conflictual situations ranging from **pure cooperative** ones to zero-sum **pure conflict** ones:

- In games of pure cooperation, all actors have harmonious interests and are keenly interested in cooperating. The only problem they might face is one of **coordination** because they still have to make sure they take the "correct" actions to produce the outcome they both want.
- In games of pure conflict, all actors have strictly opposed preferences. A gain for one is a loss for another, which is why such situations are called zero-sum games. Here players have strong incentives to **avoid coordination**.
- In-between the two extreme types are the **mixed-motive games** which exhibit elements of both conflict and cooperation. These are situations where players have an incentive to reach an agreement but have opposing preferences on the terms of that agreements.

2 Coordination Games: Tacit Communication & Focal Points

In its simplest form, the game of pure cooperation is one where cooperating is a strictly dominant strategy for both players:

		Player 2	
		C	N
Player 1	C	$10, 10$	$5, 0$
	N	$0, 5$	$0, 0$

Figure 1: Common Interests, I: Tacit Coordination and Strict Dominance.

In this setup, both players strictly prefer choosing C to N regardless of what the other player is doing. This game has a unique Nash equilibrium: the (C, C) action profile. Neither player can reasonably expect the other to choose anything other than C. There is no need for communication as long as both players share common knowledge of the game, its payoffs, and each other's rationality. Not a terribly interesting situation.

Things become a bit more intriguing if we modify the game slightly by changing the payoffs from C when the other player chooses N:

		Player 2 C	Player 2 N
Player 1	C	10, 10	0, 0
Player 1	N	0, 0	5, 5

Figure 2: Common Interests, II: Tacit Coordination and Focal Points.

Consider the outcome (C, C). Neither player has an incentive to deviate from his strategy given that the other player is choosing C because doing so leaves the deviating player strictly worse off with a payoff of 0 instead of 10. That is, player 1's best response to C is C, as is player 2's. So we have an equilibrium, as expected.

Consider now the outcome (N, N). Again, neither player has an incentive to deviate from his strategy given that the other player is choosing N because doing so leaves the deviating player strictly worse off with a payoff of 0 instead of 5. In other words, N is a best response to N for both players. Since these are mutually best responses, we have another equilibrium!

The problem now becomes deciding *which of the two equilibria players are likely to end up in.*

Players must find a way to **coordinate their expectations** if they are to have any hope of avoiding the outcomes they don't like. In a situation like this, players can coordinate their expectations through **tacit communication**.

Rational players often manage to coordinate without explicitly communicating with each other. In this example many would conclude that since both players do better in the (C, C) outcome, they are likely to pick C each confidently expecting that the other will also pick C for the same reason: It would expect the first one to pick C expecting him to pick it, and so on.

What is quite intriguing, however, is the success rate of coordinating that rational players achieve without explicit communication in situations that may not be as obvious as this one. In Chapter 3 Schelling describes quite a few examples where this occurs. Players manage to select one of the available outcomes for reasons still poorly understood. They select what is called a **focal point** around which their expectations coalesce.

Game Theory lacks a mechanism for formalizing focal points and may never acquire one. This is a problem because tacit bargaining can be shown to exist experimentally and yet cannot be described precisely, which diminishes the predictive power of our theories.

Let's now alter the payoffs for the N actions. We now have a problem of pure coordination. Both (C, C) and (N, N) are equilibria and both are equally liked by the players.

How are the players to coordinate without communication? Even though the situation in the previous example provided an obvious focal point, the better equilibrium, the current one gives no clue.

Both of the equilibria look equally attractive and there is nothing to help expectations form about either of them. In situations like these tacit bargaining is not much help and the likelihood that players will fail to coordinate is probably quite a bit higher than in the

		Player 2	
		C	N
Player 1	C	$10, 10$	$0, 0$
	N	$0, 0$	$10, 10$

Figure 3: Common Interests, III: Coordination and Communication.

previous game.

Explicit communication, on the other hand, will surely help. It is sufficient for one player to announce which strategy he will play for both to succeed in coordinating. Even cheap talk (that is, costless communication) is useful in situations like these.

The general conclusion to take away from these examples is that even with common interests where both players have strong incentives to cooperate they may run into coordination problems. In certain situations players can succeed in forming consistent expectations about the behavior of the other players without explicit communication. They read signals in the details of the bargaining situation and find focal points toward which their expectations converge. When the situation provides no clear focal point, players may be stuck guessing at random or, if possible, communicate with each other explicitly.

3 Pure Conflict Games: Randomized Behavior

In a pure conflict situation, any gain for one player is an automatic loss for another. Suppose you are a military commander who must guard two passes, North and South, against rebel guerillas. You have enough forces to defend only 1 pass and the guerillas can only move though if they stick together. That is, they must all use one of the passes. You have to decide which pass to guard and the guerillas have to decide which pass to use. If they pick the pass you are guarding, then your troops would defeat them for sure. If they pick the other pass, they go by unmolested and wreak general havoc in the country's capital, which results in your instant dismissal.

Here's the payoff matrix for this case. We pick the simple numbers 1 and -1 to represent a gain and a loss. The Army prefers to pick the same pass as the rebels and so gains if the outcome is either (N, N) or (S, S). The rebels, on the other hand, only gain if they pick a different pass; that is, if the outcome is either (N, S) or (S, N).

		Rebels	
		N	S
Army	N	$1, -1$	$-1, 1$
	S	$-1, 1$	$1, -1$

Figure 4: A Strictly Competitive Game.

This game has **no Nash equilibrium in pure strategies**. Pure strategies refer to non-probabilistic choices of actions by the players. That is, these are strategies in which players take particular actions with certainty. Observe that if the Army picks N, then the best response of the Rebels is to choose S, but if the Rebels choose S, the Army's best response is to pick S as well, to which the Rebels would respond by switching to N, in which case the Army would respond with N, and we're back from where we started.

The problem, of course, is that in a strictly competitive situation players are trying their best to **avoid coordinating**. For any action one player takes, the other's best response would make him worse off.

How would players choose their actions in a situation like this? If you are the Army commander, you really want to predict where the rebels will go and at the same time make sure the rebels cannot predict where you will go. The problem, of course, is that the rebels are trying to predict your moves while making their behavior unpredictable.

In any case, if your opponent correctly guesses your action, you lose. Therefore each player's overriding concern is with *preventing the opponent from predicting his behavior correctly*. This is fundamentally different from the incentives in the cooperative games where the incentive was to make the opponent predict correctly.

What would you do to prevent your opponent from guessing your action? You would randomize your actions. That is, instead of choosing an action for certain, you choose one or the other with some probability. So, instead of choosing the North pass, the commander can choose N with probability p and South with probability $1 - p$. This is called a **mixed strategy** because it mixes with probability p among the two pure strategies.

The rebels, of course, would also play a mixed strategy, where with probability q they choose N and with probability $1 - q$ they choose S.

The question now is what probabilities must the players use to make their strategies form an equilibrium? Suppose the rebels pick $q = 1/3$; that is, they play a strategy according to which they go to the North pass with probability $1/3$ and to the South pass with probability $2/3$. You (the army commander) know about this strategy. What is your best response? We calculate the expected utilities of the two actions:

$$EU_A(N) = \left(\frac{1}{3}\right)(1) + \left(\frac{2}{3}\right)(-1) = -\frac{1}{3}$$
$$EU_A(S) = \left(\frac{1}{3}\right)(-1) + \left(\frac{2}{3}\right)(1) = \frac{1}{3}$$

Since $EU_A(S) > EU_A(N)$, you should definitely pick S. This is not surprising: Your chances of meeting the rebels there are higher because their strategy specifies that they would use the South pass with a higher probability.

However, if your strategy is to pick S, the rebels' best response is to definitely pick N instead of with $1/3$ probability, and we're back to where we started: no equilibrium. The problem is that the rebels' strategy still admits a unique best response in pure strategies for the army, in which case the rebels have also a unique best response in pure strategies, which contradicts the assumption that they would play the mixed strategy in the first place.

So what we really want is a mixed strategy that renders the opponent indifferent between his two possible choices. Only when the opponent is indifferent will he rationally play a strategy that randomizes between his possible actions. That is, the rebels want to find a mixed strategy because (a) they need the commander to be unable to guess correctly their choice, but (b) is such that they actually have an incentive to play it given the best response of the commander. If the commander has a best response in pure strategies, then the mixed strategy won't work because the rebels would also have a best response in pure strategies.

The rebels must therefore find q such that the army commander is indifferent between his two pure strategies. When he is indifferent, he can also play a mixed strategy that would make the rebels indifferent between their two choices, which in turn would justify their use of a mixed strategy in the first place.

How do we find the q? It must be such that the army commander is indifferent between his pure strategies:

$$\begin{aligned}
EU_A(N) &= EU_A(S) \\
q(1) + (1-q)(-1) &= q(-1) + (1-q)(1) \\
2q - 1 &= 1 - 2q \\
4q &= 2 \\
q &= \frac{1}{2}
\end{aligned}$$

That is, the rebels must choose N with probability exactly $1/2$ to make the army commander indifferent between his two choices. What is the commander's expected utility if the rebels play this strategy?

$$EU_A(N) = \left(\frac{1}{2}\right)(1) + \left(\frac{1}{2}\right)(-1) = 0 = \left(\frac{1}{2}\right)(-1) + \left(\frac{1}{2}\right)(1) = EU_A(S)$$

Since the commander is indifferent between his two pure strategies, he can mix between them as well. Using the same logic as for the rebels, we conclude that his strategy must be such that the rebels are indifferent between their two pure strategies (otherwise they won't play their mixed strategy in the first place). Since the army chooses N with probability p, we find

$$\begin{aligned}
EU_R(N) &= EU_R(S) \\
p(-1) + (1-p)(1) &= p(1) + (1-q)(-1) \\
1 - 2p &= 2p - 1 \\
4p &= 2 \\
p &= \frac{1}{2}
\end{aligned}$$

The rebels' expected utility from this army strategy is $EU_R(N) = 0 = EU_R(S)$.

What do we have then? A **mixed strategy Nash equilibrium**. In this equilibrium, the army commander chooses each pass with a probability of exactly $1/2$, and so do the rebels. The probability that they will meet is exactly $1/2$ as well (they meet with probability $1/4$ at the South pass and $1/4$ at the North pass). The army has a 50% chance of intercepting the rebels.

Note that given the opponent's strategy, neither player can do better. The moment a player shifts to some other probability, his opponent immediately reacts by playing a pure strategy for certain, which leaves the deviating player with a negative expected payoff, which is strictly worse than the expected payoff of 0 in the mixed strategy Nash equilibrium. That is, neither player has an incentive to deviate from his mixed strategy.

Generally, to find mixed strategy Nash equilibria, you have to find the probabilities for one player's actions that make *his opponent* indifferent between his actions. When you do this for both players, you have probabilities that make up the equilibrium.

4 Mixed-Motive Games: Strategic Bargaining

The mixed-motive situations are essentially occasions for **bargaining**, where players want to **coordinate but on different outcomes**. Each player tries to pull the agreement closer to the terms it likes most (hence the conflict) while at the same time preferring some agreement to none at all (hence the cooperation).

Bargaining occurs when players want to coordinate expectations. That is, they want to convince each other that they will not offer more than they currently are offering. Agreement becomes possible only after the expectations of all participants converge sufficiently that they become quite sure that they cannot obtain better terms. The big question then is *how rational players coordinate expectations*. It turns out that the answer to this question depends in large on the players' ability to make strategic moves.

4.1 Sequential (Strategic) Moves

Although we have learned how to compute Nash equilibria for simple simultaneous-moves games, we are still limited in our ability to explore the most interesting situations that Schelling describes because our simple models thus far lack an essential feature: they allow for no sequential moves. Yet it is precisely the possibility of taking such moves that makes bargaining the interesting area of study that it is.

Strategic moves can serve a great variety of purposes in bargaining because they can influence the expectations of the other party. Bargaining, as all non-zero-sum conflict, is all about these expectations. In fact, we can say that bargaining is a process that simultaneously reveals information to both parties about each other and that serves for them to establish commitments.

What purposes can strategic moves serve? We shall discuss two very important roles: (a) information transmission, and (b) establishing credible commitments.

4.2 Information Transmission

Strategic moves can send **signals**, which is a fancy way of saying that they can reveal to the other party something you know. You may want them to learn it or you may not: your actions transmit information either way, so you better make sure that what you do does not send the "wrong" signal. (We define "wrong" as simply a signal that is not in your interest to send; for example, a signal to a belligerent opponent that you are weak.)

Moves can **screen** out the opponent. That is, some moves set up the incentives in such a way that the response of the opponent reveals some information about it. These moves are sometimes called “probes” because you are probing the extent of your opponent’s commitments. For example, you can test the waters during negotiations by making an offer than only a fairly uncommitted opponent would accept. If the offer is rejected, you can conclude that the probability of facing such an opponent is lower.

Of course, this situation is complicated by the fact that your opponent is probably aware of your strategic incentives, and so may behave to frustrate you by pretending he is stronger than he actually is, hoping that you will change your expectations anyway and make a better offer.

You, of course, also know that and so may try to treat his signal as a bluff and call it. We shall learn what conditions permit information transmission to be more reliable. In particular, we shall learn that **cheap talk** is called the way it is for a good reason. Action speak louder than words, we are told. But we shall see why it is the case. In fact, we shall see that not just any action can “speak”, only the ones that are costly to the one taking them. That is, **costly signaling** is one way to convey information credibly.

4.3 Making Commitments Credible

Learning about the opponent and revealing known information as appropriate are not useful by itself. Information is only useful when it allows to judge the credibility of your opponent’s commitments and establish the credibility of your own commitments.

What is a commitment? A **commitment** is a pledge to perform some action in the future. It can be a **threat** if this action involves inflicting pain on your opponent, or it can be a **promise** if it involves providing some benefit to the opponent. Perhaps somewhat to our surprise, we shall see that threats and promises are essentially the same. That is **both threats and promises are intended to influence the expectations of another actor and cause a change in his behavior**.

As we have seen, we are interested in how rational players coordinate their expectations. Since threats and promises (commitments) are the means of influencing the opponent’s expectations, it follows that we must study *how rational actors use commitments strategically*.

At the most basic level, we want to see (and this is the central theme of Schelling’s book) *what makes commitments credible; that is, what makes threats and promises believable*. It is easy to see that a threat/promise that is unbelievable will not change the expectations of the other actor because the other actor will simply disregard it.

Seeing that a non-credible commitment will not serve its intended purpose is not difficult. However, studying what makes a commitment credible can be. We want to know how one actor can persuade its opponent that it will follow through on this commitment. The actor wants to bind himself to his commitment but doing so can sometimes be surprisingly difficult.

4.4 The Role of Communication

We have already seen that communication can be quite important for pure cooperative games where it can facilitate coordination. Communication need not be explicit. Indeed, we saw that rational players can often coordinate quite nicely with tacit communication. This will also be true for the mixed-motive games.

Because strategic moves can convey information, it may often not be necessary to communicate explicitly. (Actions can speak louder than words.) On the other hand, making certain strategic moves may require destroying communication completely. In-between are opportunities for strategic information transmission. We shall take a look how actors can communicate their commitments.

5 Summary

- the interaction between actors can be arranged along of continuum of situations according to the degree of conflict of interest, from **pure cooperative** situations to **pure conflictual** ones;
- pure cooperative games often require players to **coordinate** their actions, which they can do through **tacit** or **explicit** communication
- pure conflict games require players to avoid coordination, which they can do through playing **mixed strategies** to keep the opponent guessing
- between the two extremes lie the **mixed-motive** situations in which players have a common interest in reaching an agreement but conflict over the terms of that agreement
- outcomes in such situations depend on the **expectations** actors have of each other
- players engage in **bargaining**, which is a process through which they **influence expectations** and can coordinate them
- bargaining is both **transmission of information** and establishment of **commitments**
- actors **signal** something they know or **screen** an opponent for something he knows
- commitments are pledges to take some action in the future that can be interpreted either as a **threat** or as a **promise** depending on what they do for the other player
- to influence expectations, commitments have to be **credible** and signals **costly**
- we shall study how to establish credible commitments in bargaining situations