

THE STRATEGY OF CONFLICT

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BARGAINING, COMMUNICATION, AND LIMITED WAR

Limited war requires limits; so do strategic maneuvers if they are to be stabilized short of war. But limits require agreement or at least some kind of mutual recognition and acquiescence. And agreement on limits is difficult to reach, not only because of the uncertainties and the acute divergence of interests but because negotiation is severely inhibited both during war and before it begins and because communication becomes difficult between adversaries in time of war. Furthermore, it may seem to the advantage of one side to avoid agreement on limits, in order to enhance the other's fear of war; or one side or both may fear that even a show of willingness to negotiate will be interpreted as excessive eagerness.

The study of tacit bargaining — bargaining in which communication is incomplete or impossible — assumes importance, therefore, in connection with limited war, or, for that matter, with limited competition, jurisdictional maneuvers, jockeying in a traffic jam, or getting along with a neighbor that one does not speak to. The problem is to develop a modus vivendi when one or both parties either cannot or will not negotiate explicitly or when neither would trust the other with respect to any agreement explicitly reached. The present chapter will examine some of the concepts and principles that seem to underlie tacit bargaining and will attempt to draw a few illustrative conclusions about the problem of limited war or analogous situations. It will also suggest that these same principles may often provide a powerful clue to understanding even the logically dissimilar case of explicit bargaining with full communication and enforcement.

The most interesting situations and the most important are those in which there is a conflict of interest between the parties involved. But it is instructive to begin with the special simplified case in which two or more parties have identical interests and face the problem not of reconciling interests but only of coordinating their actions for their mutual benefit, when communication is impossible. This special case brings out clearly the principle that will then serve to solve the problem of tacit "bargaining" over conflicting preferences.

TACIT COORDINATION (COMMON INTERESTS)

When a man loses his wife in a department store without any prior understanding on where to meet if they get separated, the chances are good that they will find each other. It is likely that each will think of some obvious place to meet, so obvious that each will be sure that the other is sure that it is "obvious" to both of them. One does not simply predict where the other will go, since the other will go where he predicts the first to go, which is wherever the first predicts the second to predict the first to go, and so ad infinitum. Not "What would I do if I were she?" but "What would I do if I were she wondering what she would do if she were I wondering what I would do if I were she . . . ?"

What is necessary is to coordinate predictions, to read the same message in the common situation, to identify the one course of action that their expectations of each other can converge on. They must "mutually recognize" some unique signal that coordinates their expectations of each other. We cannot be sure they will meet, nor would all couples read the same signal; but the chances are certainly a great deal better than if they pursued a random course of search.

The reader may try the problem himself with the adjoining map (Fig. 7). Two people parachute unexpectedly into the area shown, each with a map and knowing the other has one, but neither knowing where the other has dropped nor able to communicate directly. They must get together quickly to be rescued. Can they study their maps and "coordinate" their behavior? Does the map suggest some particular meeting place so unambiguously

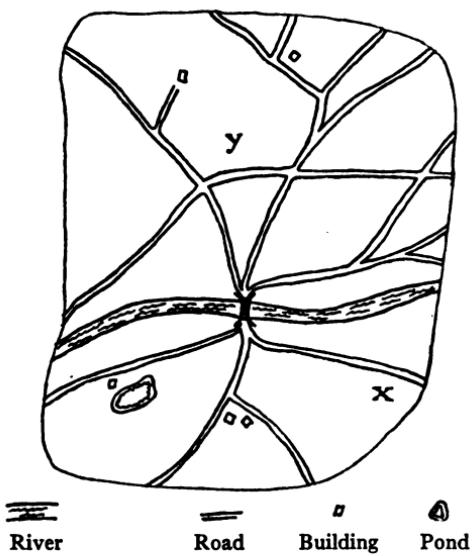


FIG. 7

that each will be confident that the other reads the same suggestion with confidence?

The writer has tried this and other analogous problems on an unscientific sample of respondents; and the conclusion is that people often can coordinate. The following abstract puzzles are typical of those that can be "solved" by a substantial proportion of those who try. The solutions are, of course, arbitrary to this extent: any solution is "correct" if enough people think so. The reader may wish to confirm his ability to concert in the following problems with those whose scores are given in a footnote.¹

¹ In the writer's sample, 36 persons concerted on "heads" in problem 1, and only 6 chose "tails." In problem 2, the first three numbers were given 37 votes out of a total of 41; the number 7 led 100 by a slight margin, with 13 in third place. The upper left corner in problem 3 received 24 votes out of a total of 41, and all but 3 of the remainder were distributed in the same diagonal line. Problem 4, which may reflect the location of the sample in New Haven, Connecticut, showed an absolute majority managing to get together at Grand Central Station (information booth), and virtually all of them succeeded in meeting at 12 noon. Problem 6 showed a variety of answers, but two-fifths of all persons succeeded inconcerting on the number 1; and in problem 7, out of 41 people, 12 got together on \$1,000,000, and only 3 entries consisted of numbers that were not a power of 10; of those 3, 2 were \$64 and, in the

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1. Name "heads" or "tails." If you and your partner name the same, you both win a prize.

2. Circle one of the numbers listed in the line below. You win if you all succeed in circling the same number.

7 100 13 261 99 555

3. Put a check mark in one of the sixteen squares. You win if you all succeed in checking the same square.

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

4. You are to meet somebody in New York City. You have not been instructed where to meet; you have no prior understanding with the person on where to meet; and you cannot communicate with each other. You are simply told that you will have to guess where to meet and that he is being told the same thing and that you will just have to try to make your guesses coincide.

5. You were told the date but not the hour of the meeting in No. 4; the two of you must guess the exact minute of the day for meeting. At what time will you appear at the meeting place that you elected in No. 4?

6. Write some positive number. If you all write the same number, you win.

7. Name an amount of money. If you all name the same amount, you can have as much as you named.

8. You are to divide \$100 into two piles, labeled A and B.

more up-to-date version, \$64,000! Problem 8 caused no difficulty to 36 out of 41, who split the total fifty-fifty. Problem 9 secured a majority of 20 out of 22 for Robinson. An alternative formulation of it, in which Jones and Robinson were tied on the first ballot at 28 votes each, was intended by the author to demonstrate the difficulty of concerting in case of tie; but the respondents surmounted the difficulty and gave Jones 16 out of 18 votes (apparently on the basis of Jones's earlier position on the list), proving the main point but overwhelming the subsidiary point in the process. In the map most nearly like the one reproduced here (Fig. 1), 7 out of 8 respondents managed to meet at the bridge.

Your partner is to divide another \$100 into two piles labeled A and B. If you allot the same amounts to A and B, respectively, that your partner does, each of you gets \$100; if your amounts differ from his, neither of you gets anything.

9. On the first ballot, candidates polled as follows:

Smith	19	Robinson	29
Jones	28	White	9
Brown	15		

The second ballot is about to be taken. You have no interest in the outcome, except that you will be rewarded if someone gets a majority on the second ballot and you vote for the one who does. Similarly, all voters are interested only in voting with the majority, and everybody knows that this is everybody's interest. For whom do you vote on the second ballot?

These problems are artificial, but they illustrate the point. People *can* often concert their intentions or expectations with others if each knows that the other is trying to do the same. Most situations—perhaps every situation for people who are practiced at this kind of game—provide some clue for coordinating behavior, some focal point for each person's expectation of what the other expects him to expect to be expected to do. Finding the key, or rather finding *a* key—any key that is mutually recognized as the key becomes *the* key—may depend on imagination more than on logic; it may depend on analogy, precedent, accidental arrangement, symmetry, aesthetic or geometric configuration, casuistic reasoning, and who the parties are and what they know about each other. Whimsy may send the man and his wife to the "lost and found"; or logic may lead each to reflect and to expect the other to reflect on where they would have agreed to meet if they had had a prior agreement to cover the contingency. It is not being asserted that they will always find an obvious answer to the question; but the chances of their doing so are ever so much greater than the bare logic of abstract random probabilities would ever suggest.

A prime characteristic of most of these "solutions" to the problems, that is, of the clues or coordinators or focal points, is some kind of prominence or conspicuousness. But it is a promi-

nence that depends on time and place and who the people are. Ordinary folk lost on a plane circular area may naturally go to the center to meet each other; but only one versed in mathematics would "naturally" expect to meet his partner at the center of gravity of an irregularly shaped area. Equally essential is some kind of uniqueness; the man and his wife cannot meet at the "lost and found" if the store has several. The writer's experiments with alternative maps indicated clearly that a map with many houses and a single crossroads sends people to the crossroads, while one with many crossroads and a single house sends most of them to the house. Partly this may reflect only that uniqueness conveys prominence; but it may be more important that uniqueness avoids ambiguousness. Houses may be intrinsically more prominent than anything else on the map; but if there are three of them, none more prominent than the others, there is but one chance in three of meeting at a house, and the recognition of this fact may lead to the rejection of houses as the "clue."²

But in the final analysis we are dealing with imagination as much as with logic; and the logic itself is of a fairly casuistic kind. Poets may do better than logicians at this game, which is perhaps more like "puns and anagrams" than like chess. Logic helps—the large plurality accorded to the number 1 in problem 6 seems to rest on logic—but usually not until imagination has selected some clue to work on from among the concrete details of the situation.

TACIT BARGAINING (DIVERGENT INTERESTS)

A conflict of interest enters our problem if the parachutists dislike walking. With communication, which is not allowed in our problem, they would have argued or bargained over where to meet, each favoring a spot close to himself or a resting place particularly to his liking. In the absence of communication, their overriding interest is to concert ideas; and if a particular spot

² That this would be "correct" reasoning, incidentally, is suggested by one of the author's map experiments. On a map with a single house and many crossroads, the eleven people who chose the house all met, while the four who chose crossroads all chose different crossroads and did not even meet one another.

commands attention as the "obvious" place to meet, the winner of the bargain is simply the one who happens to be closer to it. Even if the one who is farthest from the focal point knows that he is, he cannot withhold his acquiescence and argue for a fairer division of the walking; the "proposal" for the bargain that is provided by the map itself—if, in fact, it provides one—is the only extant offer; and without communication, there is no counter-proposal that can be made. The conflict gets reconciled—or perhaps we should say ignored—as a by-product of the dominant need for coordination.

"Win" and "lose" may not be quite accurate, since both may lose by comparison with what they could have agreed on through communication. If the two are actually close together and far from the lone house on the map, they might have eliminated the long walk to the house if they could have identified their locations and concerted explicitly on a place to meet between them. Or it may be that one "wins" while the other loses more than the first wins: if both are on the same side of the house and walk to it, they walk together a greater distance than they needed to, but the closer one may still have come off better than if he had had to argue it out with the other.

This last case illustrates that it may be to the advantage of one to be unable to communicate. There is room here for a motive to destroy communication or to refuse to collaborate in advance on a method of meeting if one is aware of his advantage and confident of the "solution" he foresees. In one variant of the writer's test, A knew where B was, but B had no idea where A was (and each knew how much the other knew). Most of the recipients of the B-type questionnaire smugly sat tight, enjoying their ignorance, while virtually all the A-questionnaire respondents grimly acknowledged the inevitable and walked all the way to B. Better still may be to have the power to send but not to receive messages: if one can announce his position and state that his transmitter works but not his receiver, saying that he will wait where he is until the other arrives, the latter has no choice. He can make no effective counteroffer, since no counteroffer could be heard.⁸

⁸This is an instance of the general paradox, illustrated at length in Chap-

The writer has tried a sample of conflicting-interest games on a number of people, including games that are biased in favor of one party or the other; and on the whole, the outcome suggests the same conclusion that was reached in the purely cooperative games. All these games require coordination; they also, however, provide several alternative choices over which the two parties' interests differ. Yet, among all the available options, some particular one usually seems to be the focal point for coordinated choice, and the party to whom it is a relatively unfavorable choice quite often takes it simply because he knows that the other will expect him to. The choices that cannot coordinate expectations are not really "available" without communication. The odd characteristic of all these games is that neither rival can gain by outsmarting the other. Each loses unless he does exactly what the other expects him to do. Each party is the prisoner or the beneficiary of their mutual expectations; no one can disavow his own expectation of what the other will expect him to expect to be expected to do. The need for agreement overrules the potential disagreement, and each much concert with the other or lose altogether. Some of these games are arrived at by slightly changing the problems given earlier, as we did for the map problem by supposing that walking is onerous.

A
1. A and B are to choose "heads" or "tails" without communicating. If both choose "heads," A gets \$3 and B gets \$2; if both choose "tails," A gets \$2 and B gets \$3. If they choose differently, neither gets anything. You are A (or B); which do you choose? (Note that if both choose at random, there is only a 50-50 chance of successful coincidence and an expected value of \$1.25 apiece — less than either \$3 or \$2.)

2. You and your two partners (or rivals) each have one of the letters A, B, and C. Each of you is to write these three letters, A, B, and C, in any order. If the order is the same on all three of your lists, you get prizes totaling \$6, of which \$3 goes to the one whose letter is first on all three lists, \$2 to the one whose letter is second, and \$1 to the person whose letter is third. If the letters are not in identical order on all three lists, none of

ter 2, that what is impotence by ordinary standards may, in bargaining, be a source of "strength."

you gets anything. Your letter is A (or B, or C); write here the three letters in the order you choose:

3. You and your partner (rival) are each given a piece of paper, one blank and the other with an "X" written on it. The one who gets the "X" has the choice of leaving it alone or erasing it; the one who gets the blank sheet has the choice of leaving it blank or writing an "X" on it. If, when you have made your choices without communicating, there is an "X" on only one of the sheets, the holder of the "X" gets \$3 and the holder of the blank sheet gets \$2. If both sheets have "X's" or both sheets are blank, neither gets anything. Your sheet of paper has the original "X" on it; do you leave it alone or erase it? (*Alternate*: your sheet of paper is the blank one; do you leave it blank or write an "X"?)

4. You and your partner (rival) are to be given \$100 if you can agree on how to divide it without communicating. Each of you is to write the amount of his claim on a sheet of paper; and if the two claims add to no more than \$100, each gets exactly what he claimed. If the two claims exceed \$100, neither of you gets anything. How much do you claim? \$_____.

5. You and your partner are each to pick one of the five letters, K, G, W, L, or R. If you pick the same letter, you get prizes; if you pick different letters, you get nothing. The prizes you get depend on the letter you both pick; but the prizes are not the same for each of you, and the letter that would yield you the highest prize may or may not be his most profitable letter. For you the prizes would be as follows:

K	\$4	L	\$2
G	\$3	R	\$5
W	\$1		

You have no idea what his schedule of prizes looks like. You begin by proposing to him the letter R, that being your best letter. Before he can reply, the master-of-ceremonies intervenes to say that you were not supposed to be allowed to communicate and that any further communication will disqualify you both. You must simply write down one of the letters, hoping that the other chooses the same letter. Which letter do you

choose? (Alternate formulation for the second half of the sample shows schedule of K-\$3, G-\$1, W-\$4, L-\$5, R-\$2, and has the "other" party make the initial proposal of the letter R before communication is cut off.)

6. Two opposing forces are at the points marked *X* and *Y* in a map similar to the one in Fig. 1. The commander of each force wishes to occupy as much of the area as he can and knows the other does too. But each commander wishes to avoid an armed clash and knows the other does too. Each must send forth his troops with orders to take up a designated line and to fight if opposed. Once the troops are dispatched, the outcome depends only on the lines that the two commanders have ordered their troops to occupy. If the lines overlap, the troops will be assumed to meet and fight, to the disadvantage of both sides. If the troops take up positions that leave any appreciable space unoccupied between them, the situation will be assumed "unstable" and a clash inevitable. Only if the troops are ordered to occupy identical lines or lines that leave virtually no unoccupied space between them will a clash be avoided. In that case, each side obtains successfully the area it occupies, the advantage going to the side that has the most valuable area in terms of land and facilities. You command the forces located at the point marked *X* (*Y*). Draw on the map the line that you send your troops to occupy.

7. A and B have incomes of \$100 and \$150 per year, respectively. They are notified of each other's income and told that they must begin paying taxes totaling \$25 per year. If they can reach agreement on shares of this total, they may share the annual tax bill in whatever manner they agree on. But they must reach agreement without communication; each is to write down the share he proposes to pay, and if the shares total \$25 or more, each will pay exactly what he proposed. If the proposed shares fail to add up to \$25, however, each will individually be required to pay the full \$25, and the tax collectors will keep the surplus. You are A (B); how much do you propose to pay? \$_____.

8. A loses some money, and B finds it. Under the house rules, A cannot have his money back until he agrees with the finder on a suitable reward, and B cannot keep any except what A agrees to. If no agreement is reached, the money goes to the house. The

amount is \$16, and A offers \$2 as a reward. B refuses, demanding half the money for himself. An argument ensues, and the house intervenes, insisting that each write his claim, once and for all, without further communication. If the claims are consistent with the \$16 total, each will receive exactly what he claims; but if together they claim more than \$16, the funds will be confiscated by the house. As they sit pondering what claims to write, a well-known and respected mediator enters and offers to help. He cannot, he says, participate in any bargaining, but he can make a "fair" proposal. He approaches A and says, "I think a reasonable division under the circumstances would be a 2-1 split, the original owner getting two-thirds and the finder one-third, perhaps rounded off to \$11 and \$5, respectively. I shall make the same suggestion to him." Without waiting for any response, he approaches the finder, makes the same suggestion, and says that he made the same suggestion to the original owner. Again without waiting for any response, he departs. You are A (B); what claim do you write?

The outcomes in the writer's informal sample are given in the footnote.⁴ In those problems where there is some asymmetry between "you" and "him," that is, between A and B, the A formulations were matched with the B formulations in deriving

⁴ In the first problem, 16 out of 22 A's and 15 out of 22 B's chose heads. Given what the A's did, heads was the best answer for B; given what the B's did, heads was the best answer for A. Together they did substantially better than at random; and, of course, if each had tried to win \$3, they would all have scored a perfect zero. Problem 2, however, which is logically similar to 1 but with a more compelling structure, showed 9 out of 12 A's, 10 out of 12 B's, and 14 out of 16 C's, successfully co-ordinating on ABC. (Of the remaining 7, incidentally, 5 discriminated against themselves in departing from alphabetical order, all to no avail.) Problem 3, which is structurally analogous to 1, showed 18 out of 22 A's concerting successfully with 14 out of 19 B's, giving A the \$3 prize. In problem 4, 36 out of 40 chose \$50. (Two of the remainder were \$49 and \$49.99.) In problem 5 the letter R won 5 out of 8 votes from those who had proposed it, and 8 out of 9 votes from those who were on the other side. In problem 6, 14 of 22 X's and 14 of 23 Y's drew their boundaries exactly along the river. The "correctness" of this solution is emphatically shown by the fact that the other 15, who eschewed the river, produced 14 different lines. Of 8 \times 7 possible pairs among them, there were 55 failures and 1 success. Problem 7 showed 5 out of 6 of those with incomes of \$150 and 7 out of 10 of those with incomes of \$100 concerting on a 15-10 division of the tax. In problem 8 both those who lost money and those who found it, 8 and 7 persons respectively, unanimously concerting on the mediator's suggestion of an even \$5 reward.

the "outcome." The general conclusion, as given in more detail in the footnote, is that the participants can "solve" their problem in a substantial proportion of the cases; they certainly do conspicuously better than any chance methods would have permitted, and even the disadvantaged party in the biased games permits himself to be disciplined by the message that the game provides for their coordination.

The "clues" in these games are diverse. Heads apparently beat tails through some kind of conventional priority, similar to the convention that dictates A, B, C, though not nearly so strong. The original X beats the blank sheet, apparently because the "status quo" is more obvious than change. The letter R wins because there is nothing to contradict the first offer. Roads might seem, in principle, as plausible as rivers, especially since their variety permits a less arbitrary choice. But, precisely because of their variety, the map cannot say *which* road; so roads must be discarded in favor of the unique and unambiguous river. (Perhaps in a symmetrical map of uniform terrain, the outcome would be more akin to the 50-50 split in the \$100 example—a diagonal division in half, perhaps—but the irregularity of the map rather precludes a geometrical solution.)

The tax problem illustrates a strong power of suggestion in the income figures. The abstract logic of this problem is identical with that of the \$100 division; in fact, it could be reworded as follows: each party pays \$25 in taxes, and a refund of \$25 is available to be divided among the two parties if they can agree on how to divide it. This formulation is logically equivalent to the one in problem 7, and, as such, it differs from problem 4 only in the amount of \$25 instead of \$100. Yet the inclusion of income figures, just by *suggesting* their relevance and making them prominent in the problem, shifts the focal point substantially to a 10-15 split rather than 12.5-12.5. And why, if incomes are relevant, is a perfectly *proportional* tax so obvious, when perhaps there are grounds for graduated rates? The answer must be that no *particular* graduation of rates is so obvious as to go without saying; and if speech is impossible, by default the uniquely simple and recognizable principle of proportionality has to be adopted. First the income figures take the initial plausibility away from a 50-50

split; then the simplicity of proportionality makes 10-15 the only one that could possibly be considered capable of tacit recognition. The same principle is displayed by an experiment in which question 7 was deliberately cluttered up with *additional* data—on family size, spending habits, and so on. Here the unique attraction of the income-proportionate split apparently became so diluted that the preponderant reply from both the high-income and the low-income respondents was a simple 50-50 division of the tax. The refined signal for the income proportionate split was drowned out by "noise," and the cruder signal for equality was all that came through.

Finally, problem 8 is again logically the same as problem 4, the amount being \$16 available for two people if they can write claims that do not exceed the amount. But the institutional arrangement is discriminatory; finder and loser do not have a compelling equality in any moralistic or legalistic sense, so the 50-50 split seems not quite obvious. The suggestion of the mediator provides the only other signal that is visible; its potency as a coordinator is seen even in the rounding to \$11 and \$5, which was universally accepted.

In each of these situations the outcome is determined by something that is fairly arbitrary. It is not a particularly "fair" outcome, from either an observer's point of view or the points of view of the participants. Even the 50-50 split is arbitrary in its reliance on a kind of recognizable mathematical purity; and if it is "fair," it is so only because we have no concrete data by which to judge its unfairness, such as the source of the funds, the relative need of the rival claimants, or any potential basis for moral or legal claims. Splitting the difference in an argument over kidnap ransom is not particularly "fair," but it has the mathematical qualities of problem 4.

If we ask what determines the outcome in these cases, the answer again is in the coordination problem. Each of these problems requires coordination for a common gain, even though there is rivalry among alternative lines of common action. But, among the various choices, there is usually one or only a few than can serve as coordinator. Take the case of the first offer in problem 5. The strongest argument in favor of R is the rhetorical question,

"If not R, what then?" There is no answer so obvious as to give more than a random chance of concerting, even if both parties wanted to eschew the letter R after the first offer was made. To illustrate the force of this point, suppose that the master-of-ceremonies in that problem considered the first offer already to have spoiled the game and thought he might confuse the players by announcing the reversal of their prize schedules. A will get whatever prize B would have gotten, and B will get the prizes shown in A's schedule in problem 5. Does the original offerer of R have any reason to change his choice? Or suppose that the master-of-ceremonies announced that the prizes would be the same, no matter what letter were chosen, so long as they both picked the same letter. They will still rally to R as the only indicated means of coordinating choices. If we revert to the beginning of this game and suppose that the original proposal of R never got made, we might imagine a sign on the wall saying, "In case of doubt always choose R; this sign is visible to all players and constitutes a means of coordinating choices." Here we are back at the man and his wife in the department store, whose problems are over when they see a conspicuous sign that says, "The management suggests that all persons who become separated meet each other at the information booth in the center of the ground floor." Beggars cannot be choosers about the source of their signal, or about its attractiveness compared with others that they can only wish were as conspicuous.

The irony would be complete if, in game 5, your rival knew your prize schedule and you did not know his (as was the case in a variant of question 5 used in some questionnaires). Since you have no basis for guessing his preference and could not even do him a favor or make a "fair" compromise if you wished to, the only basis for concerting is to see what message you can both read in your schedule. Your own preferred letter seems the indicated choice; it is hard to see why to pick any other or which other to pick, since you have no basis for knowing what other letter is better for him than R itself. His knowledge of your preference, combined with your ignorance of his and the lack of any alternative basis for coordination, puts on him the responsibility of simply choosing in your favor. (This, in fact, was the preponderant

result among the small sample tested.) It is the same situation as when only one parachutist knew where the other was.⁵

EXPLICIT BARGAINING

The concept of "coordination" that has been developed here for tacit bargaining does not seem directly applicable to explicit bargaining. There is no apparent need for intuitive rapport when speech can be used; and the adventitious clues that coordinated thoughts and influenced the outcome in the tacit case revert to the status of incidental details.

Yet there is abundant evidence that some such influence is powerfully present even in explicit bargaining. In bargains that involve numerical magnitudes, for example, there seems to be a strong magnetism in mathematical simplicity. A trivial illustration is the tendency for the outcomes to be expressed in "round numbers"; the salesman who works out the arithmetic for his "rock-bottom" price on the automobile at \$2,507.63 is fairly pleading to be relieved of \$7.63. The frequency with which final agreement is precipitated by an offer to "split the difference" illustrates the same point, and the difference that is split is by no means always trivial. More impressive, perhaps, is the remarkable frequency with which long negotiations over complicated quantitative formulas or *ad hoc* shares in some costs or benefits converge ultimately on something as crudely simple as equal shares, shares proportionate to some common magnitude (gross national product, population, foreign-exchange deficit, and so forth), or the shares agreed on in some previous but logically irrelevant negotiation.⁶

Precedent seems to exercise an influence that greatly exceeds its logical importance or legal force. A strike settlement or an international debt settlement often sets a "pattern" that is fol-

* And it is another example of the power that resides in "weakness," which was commented on in an earlier footnote.

* From a great variety of formulas proposed for the contributions to UNRRA, the winner that emerged was a straight 1 per cent of gross national product — the simplest conceivable formula and the roundest conceivable number. This formula was, to be sure, the preferred position of the United States during the discussion; but that fact perhaps adds as much to the example as it detracts from it.

lowed almost by default in subsequent negotiations. Sometimes, to be sure, there is a reason for a measure of uniformity, and sometimes there is enough similarity in the circumstances to explain similar outcomes; but more often it seems that there is simply no heart left in the bargaining when it takes place under the shadow of some dramatic and conspicuous precedent.⁷ In similar fashion, mediators often display a power to precipitate agreement and a power to determine the terms of agreement; their proposals often seem to be accepted less by reason of their inherent fairness or reasonableness than by a kind of resignation of both participants. "Fact-finding" reports may also tend to draw expectations to a focus, by providing a suggestion to fill the vacuum of indeterminacy that otherwise exists: it is not the facts themselves, but the creation of a specific suggestion, that seems to exercise the influence.

There is, in a similar vein, a strong attraction to the *status quo ante* as well as to natural boundaries. Even parallels of latitude have recently exhibited their longevity as focal points for agreement. Certainly there are reasons of convenience in using rivers as the agreed stopping place for troops or using old boundaries, whatever their current relevance; but often these features of the landscape seem less important for their practical convenience than for their power to crystallize agreement.

These observations would be trivial if they meant only that bargaining results were *expressed* in simple and qualitative terms or that minor accommodations were made to round off the last few cents or miles or people. But it often looks as though the ultimate focus for agreement did not just reflect the balance of bargaining powers but provided bargaining power to one side or the other. It often seems that a cynic could have predicted the outcome on the basis of some "obvious" focus for agreement, some strong suggestion contained in the situation itself, without much regard to the merits of the case, the arguments to be made, or the pressures to be applied during the bargaining. The "obvious" place to compromise frequently seems to win by some

⁷ This and the preceding paragraph are illustrated by the speed with which a number of Middle Eastern oil-royalty arrangements converged on the 50-50 formula a few years after World War II.

kind of default, as though there is simply no rationale for settling anywhere else. Or, if the "natural" outcome is taken to reflect the relative skills of the parties to the bargain, it may be important to identify that skill as the ability to set the stage in such a way as to give prominence to some particular outcome that would be favorable. The outcome may not be so much conspicuously fair or conspicuously in balance with estimated bargaining powers as just plain "*conspicuous*."

This conclusion may seem to reduce the scope for bargaining skill, if the outcome is already determined by the configuration of the problem itself and where the focal point lies. But perhaps what it does is shift the locus where skill is effective. The "obvious" outcome depends greatly on how the problem is formulated, on what analogies or precedents the definition of the bargaining issue calls to mind, on the kinds of data that may be available to bear on the question in dispute. When the committee begins to argue over how to divide the costs, it is already constrained by whether the terms of reference refer to the "dues" to be shared or the "taxes" to be paid, by whether a servicing committee is preparing national-income figures or balance-of-payments figures for their use, by whether the personnel of the committee brings certain precedents into prominence by having participated personally in earlier negotiations, by whether the inclusion of two separate issues on the same agenda will give special prominence and relevance to those particular features that they have in common. Much of the skill has already been applied when the formal negotiations begin.⁸

If all this is correct, as it seems frequently to the author to be, our analysis of tacit bargaining may help to provide an understanding of the influence at work; and perhaps the logic of tacit bargaining even provides a basis for believing it to be correct. The fundamental problem in tacit bargaining is that of *coordination*; we should inquire, then, what has to be coordinated in ex-

⁸ Perhaps another role for skill is contained in this general approach. If one is unsuccessful in getting the problem so formulated that the "obvious" outcome is near his own preferred position, he can proceed to confuse the issue. Find multiple definitions for all the terms and add "noise" to drown out the strong signal contained in the original formulation. The technique may not succeed, but in the variant of our income-tax problem mentioned above it certainly did.

plicit bargaining. The answer may be that explicit bargaining requires, for an ultimate agreement, some coordination of the participants' expectations. The proposition might be as follows.

Most bargaining situations ultimately involve some range of possible outcomes within which each party would rather make a concession than fail to reach agreement at all. In such a situation any potential outcome is one from which at least one of the parties, and probably both, would have been willing to retreat for the sake of agreement, and very often the other party knows it. Any potential outcome is therefore one that either party could have improved by insisting; yet he may have no basis for insisting, since the other knows or suspects that he would rather concede than do without agreement. Each party's strategy is guided mainly by what he expects the other to accept or insist on; yet each knows that the other is guided by reciprocal thoughts. The final outcome must be a point from which neither expects the other to retreat; yet the main ingredient of this expectation is what one thinks the other expects the first to expect, and so on. Somehow, out of this fluid and indeterminate situation that seemingly provides no logical reason for anybody to expect anything except what he expects to be expected to expect, a decision is reached. These infinitely reflexive expectations must somehow converge on a single point, at which each expects the other not to expect to be expected to retreat.

If we then ask what it is that can bring their expectations into convergence and bring the negotiation to a close, we might propose that it is the intrinsic magnetism of particular outcomes, especially those that enjoy prominence, uniqueness, simplicity, precedent, or some rationale that makes them qualitatively differentiable from the continuum of possible alternatives. We could argue that expectations tend not to converge on outcomes that differ only by degree from alternative outcomes but that people have to dig in their heels at a groove in order to make any show of determination. One has to have a reason for standing firmly on a position; and along the continuum of qualitatively undifferentiable positions one finds no rationale. The rationale may not be strong at the arbitrary "focal point," but at least it can defend itself with the argument "If not here, where?"

There is perhaps a little more to this need for a mutually identifiable resting place. If one is about to make a concession, he needs to control his adversary's expectations; he needs a recognizable limit to his own retreat. If one is to make a finite concession that is not to be interpreted as capitulation, he needs an obvious place to stop. A mediator's suggestion may provide it; or any other element that qualitatively distinguishes the new position from surrounding positions. If one has been demanding 60 per cent and recedes to 50 per cent, he can get his heels in; if he recedes to 49 per cent, the other will assume that he has hit the skids and will keep sliding.

If some troops have retreated to the river in our map, they will expect to be expected to make a stand. This is the one spot to which they can retreat without necessarily being expected to retreat further, while, if they yield any further, there is no place left where they can be expected to make a determined stand. Similarly, the advancing party can expect to force the other to retreat to the river without having his advance interpreted as an insatiable demand for unlimited retreat. There is stability at the river — and perhaps nowhere else.

This proposition may seem intuitively plausible; it does to the writer, and in any event some kind of explanation is needed for the tendency to settle at focal points. But the proposition would remain vague and somewhat mystical if it were not for the somewhat more tangible logic of tacit bargaining. The latter provides not only an analogy but the demonstration that the necessary psychic phenomenon — tacit coordination of expectations — is a real possibility and in some contexts a remarkably reliable one. The "coordination" of expectations is analogous to the "coordination" of behavior when communication is cut off; and, in fact, they both involve nothing more nor less than intuitively perceived mutual expectations. Thus the empirically verifiable results of some of the tacit-bargaining games, as well as the more logical role of coordinated expectations in that case, prove that expectations can be coordinated and that some of the objective details of the situation can exercise a controlling influence when the coordination of expectations is essential. *Something* is perceived by both parties when communication is absent;

it must still be perceptible, though undoubtedly of lesser force, when communication is possible. The possibility of communication does not make 50-50 less symmetrical or the river less unique or A B C a less natural order for those letters.

If all we had to reason from were the logic of tacit bargaining, it would be only a guess and perhaps a wild one that the same kind of psychic attraction worked in explicit bargaining; and if all we had to generalize from were the observation of peculiarly "plausible" outcomes in actual bargains, we might be unwilling to admit the force of adventitious details. But the two lines of evidence so strongly reinforce each other that the analogy between tacit and explicit bargaining seems a potent one.

To illustrate with the problem of agreeing explicitly on how to divided \$100: 50-50 seems a plausible division, but it may seem so for too many reasons. It may seem "fair"; it may seem to balance bargaining powers; or it may, as suggested in this paper, simply have the power to communicate its own inevitability to the two parties in such fashion that each appreciates that they both appreciate it. What our analysis of tacit bargaining provides is evidence for the latter view. The evidence is simply that *if* they had to divide the \$100 without communicating, they could concert on 50-50. Instead of relying on intuition, then, we can point to the fact that in a slightly different context — the tacit-bargaining context — our argument has an objectively demonstrable interpretation.

To illustrate again: the ability of the two commanders in one of our problems to recognize the stabilizing power of the river — or, rather, their inability not to recognize it — is substantiated by the evidence that if their survival depended on some agreement about where to stabilize their lines *and communication were not allowed*, they probably could perceive and appreciate the qualities of the river as a focus for their tacit agreement. So the tacit analogy at least demonstrates that the idea of "coordinating expectations" is meaningful rather than mystical.

Perhaps we could push the argument further still. Even in those cases in which the only distinguishing characteristic of a bargaining result is its evident "fairness," by standards that the participants are known to appreciate, we might argue that the

moral force of fairness is greatly reinforced by the power of a "fair" result to focus attention, if it fills the vacuum of indeterminacy that would otherwise exist. Similarly, when the pressure of public opinion seems to force the participants to the obviously "fair" or "reasonable" solution, we may exaggerate the "pressure" or at least misunderstand the way it works on the participants unless we give credit to its power to coordinate the participants' expectations. It may, to put it differently, be the power of *suggestion*, working through the mechanism described in this paper, that makes public opinion or precedent or ethical standards so effective. Again, as evidence for this view, we need only to suppose that the participants had to reach ultimate agreement without communicating and visualize public opinion or some prominent ethical standard as providing a strong suggestion analogous to the suggestions contained in our earlier examples. The mediator in problem 7 is a close analogy. Finally, even if it is truly the force of moral responsibility or sensitivity to public opinion that constrains the participants, and not the "signal" they get, we must still look to the source of the public's own opinion; and there, the writer suggests, the need for a simple, qualitative rationale often reflects the mechanism discussed in this paper.

But, if this general line of reasoning is valid, any analysis of explicit bargaining must pay attention to what we might call the "communication" that is inherent in the bargaining situations, the signals that the participants read in the inanimate details of the case. And it means that tacit and explicit bargaining are not thoroughly separate concepts but that the various gradations from tacit bargaining up through types of incompleteness or faulty or limited communication to full communication all show some dependence on the need to coordinate expectations. Hence all show some degree of dependence of the participants themselves on their common inability to keep their eyes off certain outcomes.

This is not necessarily an argument for expecting explicit outcomes as a rule to lean toward exactly those that would have emerged if communication had been impossible; the focal points may certainly be different when speech is allowed, except in some of the artificial cases we have used in our illustrations. But

what may be the *main* principle in tacit bargaining apparently may be at least *one* of the important principles in the analysis of explicit bargaining. And, since even much so-called "explicit" bargaining includes maneuver, indirect communication, jockeying for position, or speaking to be overheard, or is confused by a multitude of participants and divergent interests, the need for convergent expectations and the role of signals that have the power to coordinate expectations may be powerful.

Perhaps many kinds of social stability and the formation of interest groups reflect the same dependence on such coordinators as the terrain and the circumstances can provide: the band wagon at political conventions that often converts the slightest sign of plurality into an overwhelming majority; the power of constitutional legitimacy to command popular support in times of anarchy or political vacuum; the legendary power of an old gang leader to bring order into the underworld, simply because obedience depends on the expectation that others will be obedient in punishing disobedience. The often expressed idea of a "rallying point" in social action seems to reflect the same concept. In economics the phenomena of price leadership, various kinds of nonprice competition, and perhaps even price stability itself appear amenable to an analysis that stresses the importance of tacit communication and its dependence on qualitatively identifiable and fairly unambiguous signals that can be read in the situation itself. "Spontaneous" revolt may reflect similar principles: when leaders can easily be destroyed, people require some signal for their coordination, a signal so unmistakably comprehensible and so potent in its suggestion for action that everyone can be sure that everyone else reads the same signal with enough confidence to act on it, thus providing one another with the immunity that goes with action in large numbers. (There is even the possibility that such a signal might be provided from outside, even by an agent whose only claim to leadership was its capacity to signal the instructions required for concerted action.)

TACIT NEGOTIATION AND LIMITED WAR

What useful insight does this line of analysis provide into the practical problems of tacit bargaining that usually confront us,

PART II

**A REORIENTATION OF
GAME THEORY**

TOWARD A THEORY OF INTERDEPENDENT DECISION

On the strategy of pure conflict — the zero-sum games — game theory has yielded important insight and advice. But on the strategy of action where conflict is mixed with mutual dependence — the nonzero-sum games involved in wars and threats of war, strikes, negotiations, criminal deterrence, class war, race war, price war, and blackmail; maneuvering in a bureaucracy or in a traffic jam; and the coercion of one's own children — traditional game theory has not yielded comparable insight or advice. These are the "games" in which, though the element of conflict provides the dramatic interest, mutual dependence is part of the logical structure and demands some kind of collaboration or mutual accommodation — tacit, if not explicit — even if only in the avoidance of mutual disaster. These are also games in which, though secrecy may play a strategic role, there is some essential need for the signaling of intentions and the meeting of minds. Finally, they are games in which what one player *can* do to avert mutual damage affects what another player *will* do to avert it, so that it is not always an advantage to possess initiative, knowledge, or freedom of choice.

Traditional game theory has, for the most part, applied to these mutual-dependence games (nonzero-sum games) the methods and concepts that proved successful in studying the strategy of pure conflict. The present chapter and the one to follow attempt to enlarge the scope of game theory, taking the zero-sum game to be a limiting case rather than a point of departure. The proposed extension of the theory will be mainly along two lines. One is to identify the perceptual and suggestive element in the

formation of mutually consistent expectations. The other (in the following chapter) is to identify some of the basic "moves" that may occur in actual games of strategy, and the structural elements that the moves depend on; it involves such concepts as "threat," "enforcement," and the capacity to communicate or to destroy communication.

That game theory is underdeveloped along these two lines may reflect its preoccupation with the zero-sum game. Suggestions and inferences, threats and promises, are of no consequence in the accepted theory of zero-sum games. They are of no consequence because they imply a relation between the two players that, unless perfectly innocuous, must be to the disadvantage of one player; and he can destroy it by adopting a minimax strategy, based, if necessary, on a randomizing mechanism. So the "rational strategies" pursued by two players in a situation of pure conflict — as typified by pursuit and evasion — should not be expected to reveal what kind of behavior is conducive to mutual accommodation, or how mutual dependence can be exploited for unilateral gain.

If the zero-sum game is the limiting case of pure conflict, what is the other extreme? It must be the "pure-collaboration" game in which the players win or lose together, having identical preferences regarding the outcome. Whether they win fixed shares of the total or shares that vary with the joint total, they must rank all possible outcomes identically, in their separate preference scales. (And, to avoid any initial conflict, it has to be evident to the players that the preferences are identical, so that there is no conflict of interest in the information or misinformation that they try to convey to each other.)

What is there about pure collaboration that relates it to game theory or to bargaining? A partial answer, just to establish that this game is not trivial, is that it may contain problems of perception and communication of a kind that quite generally occur in nonzero-sum games. Whenever the communication structure does not permit players to divide the task ahead of time according to an explicit plan, it may not be easy to coordinate behavior in the course of the game. Players have to understand each other, to dis-

cover patterns of individual behavior that make each player's actions predictable to the other; they have to test each other for a shared sense of pattern or regularity and to exploit clichés, conventions, and impromptu codes for signaling their intentions and responding to each other's signals. They must communicate by hint and by suggestive behavior. Two vehicles trying to avoid collision, two people dancing together to unfamiliar music, or members of a guerrilla force that become separated in combat have to concert their intentions in this fashion, as do the applauding members of a concert audience, who must at some point "agree" on whether to press for an encore or taper off together.

If *chess* is the standard example of a zero-sum game, *charades* may typify the game of pure coordination; if *pursuit* epitomizes the zero-sum game, *rendezvous* may do the same for the coordination game.

An experiment of O. K. Moore and M. I. Berkowitz provides a nice mixture in which the two limiting cases are both visible.¹ It involves a zero-sum game between two teams, each team consisting of three people. The three members of the team have identical interests but, because of a special feature of the game, cannot behave as a single entity. The special feature is that the three members of each team are separated and can communicate only by telephone and that all six telephones are connected on the same line so that everyone can hear both the other team and his own teammates. No prearrangement of codes is permitted. Between teams we have here a pure-conflict game; among the members of the team we have a pure-coordination game.

If in this game we suppress the "other team" and if the three players simply try to coordinate a winning strategy in a game of skill or chance in the face of communication difficulty, we have a three-person pure-coordination game. Several "games" of this sort have been studied, both experimentally and formally; in fact, there is substantial overlap at this point between the nonzero-sum game and organization or communication theory.²

¹ O. K. Moore and M. I. Berkowitz, *Game Theory and Social Interaction*, Office of Naval Research, Technical Report, Contract No. SAR/NONR-609 (16) (New Haven, November, 1956).

² An extensive formal analysis of the coordination problem is developed by Jacob Marschak, "Elements for a Theory of Teams," and, "Toward an Eco-

The experiments reported in Chapter 3 showed that coordinated choice is possible even in the complete absence of communication. Further, they showed that there are tacit bargaining situations in which the *conflict* of interest in the choice of action may be overwhelmed by the sheer need for concerting on *some* action; in those situations, the limiting case of pure coordination isolates the essential feature of the corresponding nonzero-sum game.

So we do have, in this *coordinated problem-solving*, with its dependence on the conveyance and perception of intentions or plans, a phenomenon that brings out an essential aspect of the nonzero-sum game; and it stands in much the same relation to it as the zero-sum game, namely, that of "limiting case." One is the mixed conflict-cooperation game with all scope for cooperation eliminated; the other is the mixed conflict-cooperation game with the conflict eliminated. In one the premium is on secrecy, in the other on revelation.

It is to be stressed that the pure-coordination game is a *game of strategy* in the strict technical sense. It is a behavior situation in which each player's best choice of action depends on the action he expects the other to take, which he knows depends, in turn, on the other's expectations of his own. This interdependence of expectations is precisely what distinguishes a game of strategy from a game of chance or a game of skill. In the pure-coordination game the interests are convergent; in the pure-conflict game the interests are divergent; but in neither case can a choice of action be made wisely without regard to the dependence of the outcome on the mutual expectations of the players.⁸

nomic Theory of Organization and Information," *Cowles Foundation Discussion Papers*, Nos. 94 and 95 (New Series), and, with Roy Radner, "Structural and Operational Communication Problems in Teams," *Cowles Foundation Discussion Papers, Economics*, No. 2076. Examples of relevant empirical work can be found in Alex Bavelas, "Communication Patterns in Task-oriented Groups," in D. Cartwright and A. F. Zander, *Group Dynamics* (Evanston, 1953), G. A. Heise and G. A. Miller, "Problem Solving by Small Groups Using Various Communication Nets," in P. A. Hare, E. F. Borgatta, and R. F. Bales, *Small Groups* (New York, 1955), H. J. Leavitt and R. A. H. Mueller, "Some Effects of Feedback on Communication," in *Small Groups*, and L. Carmichael, H. P. Hogan, and A. A. Walter, "An Experimental Study of the Effects of Language on the Reproduction of Visually Perceived Form," *Journal of Experimental Psychology*, 15:73-86 (February, 1932).

* Concerning this point, Carl Kaysen in his review of Von Neumann and

Recall the famous case of Holmes and Moriarty on separate trains, neither directly in touch with the other, each having to choose whether to get off at the next station. We can consider three kinds of payoff. In one, Holmes wins a prize if they get off at different stations, Moriarty wins it if they get off at the same station; this is the zero-sum game, in which the preferences of the two players are perfectly correlated inversely. In the second case, Holmes and Moriarty will both be rewarded if they succeed in getting off at the same station, whatever station that may be; this is the pure-coordination game, in which the preferences of the players are perfectly correlated positively. The third payoff would show Holmes and Moriarty both being rewarded if they succeed in getting off at the same station, but Holmes gaining more if both he and Moriarty get off at one particular station, Moriarty gaining more if both get off at some other particular station, both losing unless they get off at the same station. This is the usual nonzero-sum game, or "imperfect-correlation-of-preferences" game. This is the mixture of conflict and mutual dependence that epitomizes bargaining situations. By specifying particular communication and intelligence systems for the players, we can enrich the game or make it trivial or provide an advantage to one of the two players in the first and third variants.

The essential game-of-strategy element is present in all three cases: the best choice for either depends on what he expects the other to do, knowing that the other is similarly guided, so that each is aware that each must try to guess what the second guesses the first will guess the second to guess and so on, in the familiar spiral of reciprocal expectations.

Morgenstern's *Theory of Games and Economic Behavior* says: "The theory of such games of strategy deals precisely with the actions of several agents, in a situation in which all actions are interdependent, and where, in general, there is no possibility of what we called parametrization that would enable each agent (player) to behave as if the actions of the others were given. In fact, it is this very lack of parametrization which is the essence of a game." Similar language is used by R. Duncan Luce and Howard Raiffa in *Games and Decisions* (New York, 1957): "Intuitively, the problem of conflict of interest is, for each participant, a problem of individual decision making under a mixture of risk and uncertainty, the uncertainty arising from his ignorance as to what the others will do" (p. 14). Their preoccupation is with the conflict, however; the case of coincident preferences they dispose of as trivial (pp. 59, 88), and they deal with such players as a single individual (p. 13).

A RECLASSIFICATION OF GAMES

Before going further, we can usefully reclassify game situations. The twofold division into zero-sum and nonzero-sum lacks the symmetry that we need and fails to identify the limiting case that stands opposite to the zero-sum game. The essentials of a classification scheme for a two-person game could be represented on a two-dimensional diagram. The values of any particular outcome of the game, for the two players, would be represented by the two coordinates of a point. All possible outcomes of a pure-conflict game would be represented by some or all of the points on a negatively inclined line, those of a pure common-interest game by some or all of the points on a positively inclined line. In the mixed game, or bargaining situation, at least one pair of points would denote a negative slope and at least one pair a positive slope.⁴

⁴If the nature of the game makes it desirable for a player to use a random device in the choice of his strategy, or feasible for the players to negotiate an enforceable agreement that, like a drawing of lots, depends on a chance mechanism, there may be room for cooperation in the choice of *strategies* even when there is perfect disagreement over the ranking of *outcomes*. In that case the points representing the pure-conflict game must meet the tighter restriction of lying on a straight line, with the two axes measuring the players' "utilities" in the sense now familiar in game theory. This restriction also applies to the pure common-interest game, since players who agree perfectly on the ranking of *outcomes* may not agree on the desirability of, say, one particular point over a fifty-fifty chance between the two points immediately above and below it. Thus "strictly pure" conflict and common-interest games, providing no scope for collaboration in the one case and no scope for disagreement in the other, would have to show the *expected values* of all pertinent mixed (random) strategies lying along the downward-sloping and upward-sloping lines, respectively, with axes measured in "utility units" of the kind mentioned; this in turn means that the points denoting *outcomes* must lie on a *straight line*.

Also, the pure games cannot admit "side payments." If one of the partners in a pure common-interest game threatens to sabotage the effect unless he is paid — assuming that the communication and enforcement structure of the game makes this possible — a conflict of interest is introduced; in effect, the point denoting the payment of a bribe would appear to the upper left or lower right of another point or points on the upward-sloping line, producing the configuration of a mixed game. And if one of the players in a pure-conflict game can threaten damage or offer compensation to induce his opponent to yield in this game, there is scope for bargaining; there is no longer a relation of pure conflict, and the points denoting the threatened damage or promised compensation would lie off the downward-sloping line. In other words, *all* pertinent potential outcomes must be allowed for. (Two simultaneous pure-conflict games, even if

We could stay close to traditional terminology, with respect to the strictly pure games, by calling them *fixed-sum* and *fixed-proportions* games, getting the unwieldy *variable-sum-variable-proportions* as the name for all games except the limiting cases. We could also call them perfect-negative-correlation games and perfect-positive-correlation games, referring to the correlation of their preferences with respect to outcomes, leaving for the richer mixed game the rather dull title of "imperfect-correlation game."

The difficulty is in finding a sufficiently rich name for the mixed game in which there is both conflict and mutual dependence. It is interesting that we have no very good word for the *relation* between the players: in the common-interest game we can refer to them as "partners" and in the pure-conflict game as "opponents" or "adversaries"; but the mixed relation that is involved in wars, strikes, negotiations, and so forth, requires a more ambivalent term.⁵ In the rest of this paper I shall refer to the mixed game as a *bargaining game* or *mixed-motive game*, since these terms seem to catch the spirit. ("Mixed-motive" refers not, of course, to an individual's lack of clarity about his own preferences but rather to the ambivalence of his relation to the other player — the mixture of mutual dependence and conflict, of partnership and competition.) "Nonzero-sum" refers to the mixed game together with the pure common-interest game. And, because it characterizes the problem and the activity involved, *coordination game* seems a good name for the perfect sharing of interests.

GAMES OF COORDINATION

While most of this book will be about the mixed game, a brief discussion of the pure coordination game, beyond that of Chapter _____ they meet the restriction of straight lines, provide room for negotiation unless the slopes of the two lines happen to be identical.)

⁵ It deserves to be emphasized that nonzero-sum games can as properly be classed under theory of partnership as under theory of conflict; and for providing insight into problems like that of limiting war, there is merit in using words that bring out the common interest of the adversaries and the "bargaining process" involved in the military maneuvers themselves. As will be seen in Chapter 9, even the problem of surprise attack is logically equivalent to a problem in partnership discipline. If *theory of games* has become endowed with a too conflict-oriented connotation, perhaps something like *theory of interdependent decision* would be a neutral term that equally covers the two limiting cases as well as the mixed case.

3, will help to show that this is an important game in its own right and will identify certain qualities of the mixed game that appear most clearly in the limiting case of pure coordination.

Recall the various pure coordination problems of Chapter 3. Each of them evidently provided some focal point for a concerted choice, some clue to coordination, some rationale for the convergence of the participants' mutual expectations. It was argued there that the same kind of coordinating clue might be a potent force not only in pure coordination but in the mixed situation that includes conflict; and, in fact, the experiments demonstrated that, in the complete absence of communication, this is certainly true. But there are a number of instances in which pure coordination itself — the *tacit* procedure of identifying partners andconcerting plans with them — is a significant phenomenon. A good example is the formation of riotous mobs.

It is usually the essence of mob formation that the potential members have to know not only where and when to meet but just when to act so that they act in concert. Overt leadership solves the problem; but leadership can often be identified and eliminated by the authority trying to prevent mob action. In this case the mob's problem is to act in unison without overt leadership, to find some common signal that makes everyone confident that, if he acts on it, he will not be acting alone. The role of "incidents" can thus be seen as a coordinating role; it is a substitute for overt leadership and communication. Without something like an incident, it may be difficult to get action at all, since immunity requires that all know when to act together. Similarly, the city that provides no "obvious" central point or dramatic site may be one in which mobs find it difficult to congregate spontaneously; there is no place so "obvious" that it is evident to everyone that it is obvious to everyone else. Bandwagon behavior, in the selection of leadership or in voting behavior, may also depend on "mutually perceived" signals, when a part of each person's preference is a desire to be in a majority or, at least, to see some majority coalesce.⁶

Excessively polarized behavior may be the unhappy result of

⁶A closely related phenomenon is appreciated by the person who tries to blend into the crowd to avoid being called on to recite, picked on by a bully, or singled out for "election" to some post that everybody wants to escape.

dependence on tacit coordination and maneuver. When whites and Negroes see that an area will "inevitably" become occupied exclusively by Negroes, the "inevitability" is a feature of convergent expectation.⁷ What is most directly perceived as inevitable is not the final result but the *expectation* of it, which, in turn, makes the result inevitable. Everyone expects everyone else to expect everyone else to expect the result; and everyone is powerless to deny it. There is no stable focal point except at the extremes. Nobody can expect the tacit process to stop at 10, 30, or 60 per cent; no *particular* percentage commands agreement or provides a rallying point. If tradition suggests 100 per cent, tradition could be contradicted only by explicit agreement; if coordination has to be tacit, compromise may be impossible. People are at the mercy of a faulty communication system that makes it easy to "agree" (tacitly) to move but impossible to agree to stay. Quota systems in housing developments, schools, and so forth, can be viewed as efforts to substitute an explicit game with communication and enforcement for a tacit game that has an undesirably extreme "solution."

The coordination game probably lies behind the stability of institutions and traditions and perhaps the phenomenon of leadership itself. Among the possible sets of rules that might govern a conflict, tradition points to the particular set that everyone can expect everyone else to be conscious of as a conspicuous candidate for adoption; it wins by default over those that cannot readily be identified by tacit consent. The force of many rules of etiquette and social restraint, including some (like the rule against ending a sentence with a preposition) that have been divested of their relevance or authority, seems to depend on their having become "solutions" to a coordination game: everyone expects everyone to expect everyone to expect observance, so that non-observance carries the pain of conspicuouslyness. Clothing styles and motorcar fads may also reflect a game in which people do not wish to be left out of any majority that forms and are not

⁷ The phenomenon, called "tipping," is analyzed by M. Grodzins, "Metropolitan Segregation," *Scientific American*, 197:33-41 (October, 1957). A more innocuous example of explosively convergent expectations, based on tacit communication that has an almost electric quality, is the snicker that ignites an outburst of uncontrollable laughter in a nervous crowd. An important example was the collapse of the Batista regime, or of the Fourth Republic.

organized to keep majorities from forming. The concept of *role* in sociology, which explicitly involves the expectations that others have about one's behavior, as well as one's expectations about how others will behave toward him, can in part be interpreted in terms of the stability of "convergent expectations," of the same type that are involved in the coordination game. One is trapped in a particular role, or by another's role, because it is the only role that in the circumstances can be identified by a process of tacit consent.

A good example might be the *esprit de corps* (or lack of it) of an army unit or naval vessel or the value system of a particular college or fraternity. These are social organisms that are subject to a substantial rate of replacement but that maintain their own peculiar identities to an extent that does not seem to be accounted for by selective or biased recruitment. The individual character of one of these units seems to be largely a matter of convergent expectations — everyone's expectation of what everyone expects of everyone — with the new arrivals' expectations being molded in time to help mold the expectations of subsequent arrivals. There is a sense of "social contract," the particular terms of which are sensed and accepted by each incoming generation. I am told that this persistence of a tradition in a social entity is one of the reasons why the legal identity of an army division or regiment — its name and number and history — is often deliberately preserved when its strength has fallen to where abolition might seem indicated: the tradition that goes with the legal identity of the group is an asset worth preserving for a future buildup. It may be the same phenomenon that makes it possible to collect income tax in some countries and not in others: if appropriate mutual expectations exist, people will expect evasion to be on a scale small enough not to overwhelm the authorities and may consequently pay up either out of a sense of reciprocated honesty or out of fear of apprehension, thus together justifying their own expectations.

Nature of the intellectual process in coordination. It should be emphasized that coordination is not a matter of guessing what the "average man" will do. One is not, in tacit coordination, trying to

guess what another will do in an objective situation; one is trying to guess what the other will guess one's self to guess the other to guess, and so on ad infinitum. ("Meeting" someone in the personal column of a newspaper is a good example.⁸) The reasoning becomes disconnected from the objective situation, except insofar as the objective situation may provide some clue for a concerted choice. The analogy is not just trying to vote with the majority but trying to vote with a majority when everyone wants to be in a

* So is meeting on the same radio frequency with whoever may be signaling to us from outer space. "At what frequency shall we look? A long spectrum search for a weak signal of unknown frequency is difficult. But, just in the most favored radio region there lies a unique, objective standard of frequency, which must be known to every observer in the universe: the outstanding radio emission line at 1420 megacycles of neutral hydrogen" (Giuseppe Cocconi and Philip Morrison, *Nature*, Sept. 19, 1959, pp. 844-846). The reasoning is amplified by John Lear: "Any astronomer on earth would say, 'Why, 1420 megacycles of course! That's the characteristic radio emission line of neutral hydrogen. Hydrogen being the most plentiful element beyond the earth, our neighbors would expect it to be looked for even by tyros in astronomy'" ("The Search for Intelligent Life on Other Planets," *Saturday Review*, Jan. 2, 1960, pp. 39-43). What signal to look for? Cocconi and Morrison suggest a sequence of small prime numbers of pulses, or simple arithmetic sums.

And this suggests an alternative orientation of those experiments in which subjects are instructed to make guesses, throughout a long random sequence of red or green lights, whether red or green will come up next. Subjects apparently persist in guessing on the basis of some pattern they think they perceive, an "irrational" mode of behavior given their knowledge that the sequence is generated by a random device. But, as Herbert Simon points out, "Man is not only a learning animal; he is a pattern-finding and concept-forming animal" ("Theories of Decision-Making in Economics and Behavioral Science," *American Economic Review*, 44:272). Why not, then, add to the experiment a cooperating pattern-maker, who generates the signals subject to various constraints and random interferences, and let the persistent pattern-seeking subject use his skill in finding the pattern planted by a cooperative partner rather than spend it futilely on random series? If, to make it tax the communicators' ingenuity, we add a third party whose reward is inversely related to that of the cooperating partners, who is allowed to intercept the message and within limits to alter it, we have something akin to the game of Moore and Berkowitz described earlier. Enriching the materials available beyond the binary choice of red and green might provide scope for genuinely creative pattern forming, of the kind that is interesting for Gestalt psychology, esthetics, and even higher-order problem solving. Simon notes in the same article (p. 426) that even a computer can be programmed "to use something akin to imagery or metaphor in planning its proofs" of geometrical theorems. This is pattern seeking of real interest. (It reminds us that the assumption of "malevolent nature" by the zero-sum game theorist is not applicable to, say, mathematical invention. Nature gives hints; she presents her secrets in patterns that make them infinitely easier to guess than if an exhaustive scanning were required to find them.)

majority and everyone knows it — not to predict Miss Rheingold of 1960 but to buy the stock or real estate that everyone expects everyone to expect everyone to buy. Investment in diamonds may be a perfect example; the greatest of all may be the monetary role of gold, which can perhaps be explained only as the “solution” of a coordination game. (A common household version of the co-ordination game occurs when two people are cut off in a telephone conversation; if they both call back, they only get busy signals.)

Consider the game of “name a positive number.” Experiments like those of Chapter 3 demonstrate that most people, asked just to pick a number, will pick numbers like 3, 7, 13, 100, and 1. But when asked to pick the same number the others will pick when the others are equally interested in picking the same number, and everyone knows that everyone else is trying, the motivation is different. The preponderant choice is the number 1. And there seems to be good logic in this: there is no unique “favored number”; the variety of candidates like 3, 7, and so forth, is embarrassingly large, and there is no good way of picking the “most favorite” or most conspicuous. If one then asks what number, among all positive numbers, is most clearly unique, or *what rule of selection would lead to unambiguous results*, one may be struck with the fact that the universe of all positive numbers has a “first” or “smallest” number.⁹

⁹There is a widely quoted passage in Keynes (p. 156) that may be worth repeating in order to point out that, while it deals with exactly the problem dealt with here, its conception of the “solution” is *not* at all the same: “Professional investment may be likened to those newspaper competitions in which the competitors have to pick out the six prettiest faces from a hundred photographs, the prize being awarded to the competitor whose choice most nearly corresponds to the average preference of the competitors as a whole; so that each competitor has to pick, not those faces which he himself finds prettiest, but those which he thinks likeliest to catch the fancy of the other competitors, all of whom are looking at the problem from the same point of view. It is not a case of choosing those which, to the best of one’s judgment, are really the prettiest, nor even those which average opinion genuinely thinks prettiest. We have reached the third degree where we devote our intelligence to anticipating what average opinion expects the average opinion to be. And there are some, I believe, who practice the fourth, fifth, and higher degrees” (J. M. Keynes, *The General Theory of Employment, Interest and Money* [New York, 1936], p. 156). This class of games demonstrates, incidentally, that the usual correlation between parametric behavior and large numbers does not hold for tacit

Game-theory formulation of the coordination problem. The payoff matrix for a pure coordination problem would look something like that in Fig. 8. One player chooses a row, the other a column;

1	0	0	0	0
0	1	0	0	0
0	0	1	0	0
0	0	0	1	0
0	0	0	0	1

FIG. 8

and they receive the rewards denoted by the numbers contained in the cell where their choices intersect. If to each choice of one player there corresponds a single choice for the other that "wins" for both of them, we can arrange columns so that all the winning cells lie along the diagonal. In those cells there are positive payoffs to both players, in the rest we can put zeros. (For our present purpose there is nothing lost by letting a single number stand in each cell for the payoff to both players.)

But we must rule out a possible axiom that might seem to be suggested by analogy with other game theories, namely, that (to use the term of Luce and Raiffa) the "labeling" of rows, columns, and players should make no difference to the outcome.¹⁰ It is pre-

play with multiple equilibria. To adapt "parametrically" to the behavior of others requires in this case that their behavior be observable, not conjectural; the nonparametric character of tacit coordination remains, no matter how large the number of players.

¹⁰ Labeling of the *players* is explicitly ruled out by Luce and Raiffa (pp. 123-127) in discussing cooperative games and in effect is ruled out by Nash in his symmetry assumption (J. F. Nash, "The Bargaining Problem," *Econometrica*, 18:155-162 [1950], and "Two Person Cooperative Games," *Econometrica*, 21:128-140 [1953]). Labeling of *strategies* for tacit or explicit nonzero-sum games is implicitly precluded by dealing only with games in normal form, that is, the abstract version of them as represented by a payoff matrix (which is itself an *analytical* device, not part of the game, and hence provides no left-right, upper-lower, or numerical ordering of the actual strategies). A good example in which the labeling of *players* is the controlling factor is the interrupted

cisely because strategies are "labeled" in some sense — that is, have symbolic or connotative characteristics that transcend the mathematical structure of the game — that players can rise above sheer chance and "win" these games; and it is for that same reason that these games are interesting and important.

Even the game portrayed in Fig. 8 which might seem to have a minimum of symbolic significance attached to rows and columns, is not a hard one to "win," that is, for players to do substantially better on than chance would suggest, if it is portrayed in a matrix as shown. (If we give that same game an infinite series of rows and columns, it seems to become easier rather than harder. In that case it is formally identical with the game mentioned earlier, "Pick a positive number," but, because the "labeling" is different, there is less tendency for minorities to congregate at 3, 7, 13, and so forth.) Just forming the matrix prejudices the choice, since it focuses attention on "first," "middle," "last," and so forth.¹¹ If strategies are not given sequential labels, that is, labels that can be ordered like numbers and alphabets, but are given individual names, and these are not presented in any particular order, it is the names that must coordinate choice.

And here it becomes emphatically clear that the intellectual processes of choosing a strategy in pure conflict and choosing a strategy of coordination are of wholly different sorts. At least this is so if one admits the "minimax" solution, randomized if necessary, in the zero-sum game. In the pure-coordination game, the player's objective is to make contact with the other player through some imaginative process of introspection, of searching for shared clues; in the minimax strategy of a zero-sum game — most strikingly so with randomized choice — one's whole objective is to avoid any meeting of minds, even an inadvertent one.¹²

telephone call mentioned earlier, with the problem of who should call back and who should wait for the call.

¹¹This point is typical of a number of demonstrations in the author's experiments reported earlier, to the effect that the postulate regarding the "independence of irrelevant alternatives" cannot be credited in the tacit game and, for analogous reasons, should not be expected to hold in the explicit bargaining game. Potential outcomes can be relevant to the coordination of choice, though not themselves near to being chosen. For a statement and discussion of this postulate see Luce and Raiffa, p. 127.

¹²Randomized strategies may nevertheless be useful to achieve a coordinated

To illustrate, suppose that I am to name one card in an ordinary deck of fifty-two and you are to guess which one I name. Traditional game theory gives guidance on how to make my choice on the assumption that I do not want you to outguess me; I can select at random and defy you to have a better than random chance of guessing what I name. But if the game is that I *do* want you to guess correctly and you know that I will try to pick one that facilitates your guess, the random device can only guarantee to make tacit cooperation impossible. Holmes can *destroy* the labeling of the stations by flipping a coin to decide where to get off the train; and Moriarty has only a fifty-fifty chance of guessing a coin. But in the common-interest version they must somehow *use* the labeling of the stations in order to do better than pure chance; and how to use it may depend more on imagination than on logic, more on poetry or humor than on mathematics. It is noteworthy that traditional game theory does not assign a "value" to this game: how well people can concert in this fashion is something that, though hopefully amenable to systematic analysis,

distribution of votes, say, among a panel of candidates. If a 55 per cent majority exists and knows that it does, among a hundred voters; if two out of six candidates are congenial to it; and if the three candidates polling the largest numbers of votes become the board of directors, there is danger that uncoordinated polling may concentrate too many votes on the first (or second) majority choice, leaving the minority two winning candidates with 22 votes apiece. But if each member of the majority flips a coin to cast his vote for one of his party's men, the likelihood of one's getting as few as 22 votes is only one chance in six. If the minority, too, lacks an overt means of collaborating and relies on a chance device, the majority's chances are excellent.

A partial randomized strategy may also be used to reduce an area of conflict. Suppose two people, seated at North and East sides of a card table, are to move to another card table adjacent that is identically oriented, must choose without communication what seats they will take at the other table, and will win prizes of \$1 apiece if they pick adjacent seats. This is an easy coordination problem; but let us subvert the incentives, by giving an additional \$2 premium to the player who is on the other's right in the event they succeed in sitting next to each other. This game has no equilibrium point; interests do not converge; there is no seating arrangement that would not give one an incentive to move. (Each may wish that he could promise to sit on the other's left, but cannot.) A random strategy yields each player a minimax value of \$1. But, if each decides where he would sit in the pure common-interest game, then flips a coin to see whether he does sit there or sits opposite, the players guarantee that they neither choose the same seat nor sit opposite each other and share equal chances of winning the premium. This is an equilibrium pair of (mixed) strategies, worth an expected value of \$2 apiece.

cannot be discovered by reasoning a priori. This corner of game theory is *inherently* dependent on empirical evidence.¹⁸

It should particularly be noted that to assert the influence of "labels" (that is, of the symbolic and connotative details of the game) and the dependence of the theory on empirical evidence does not involve the question of whether game theory is predictive or normative — concerned with generalizations about actual choice or the strategy of correct choice. The assertion here is *not* that people simply *are* affected by symbolic details but that they *should* be for the purpose of correct play. A normative theory must produce strategies that are at least as good as what people can do without them. More, it must not deny or expunge details of the game that can demonstrably benefit two or more players and that the players, consequently, should not expunge or ignore in their mutual interest. Two couples jockeying for space on a dance floor or two armies jockeying for a truce line may jointly suffer

¹⁸ In cases like this we need only to consider the question of what *price* players would pay for a bit of coordinating information, and what different information patterns yield what chances of coordinating, to find ourselves in the middle of Marschak's *theory of teams*.

There is, incidentally, a version of "prisoners' dilemma" for this game: two accomplices, apprehended before their alibi is prepared and interrogated separately, must concert the alibis they invent or be revealed in their guilt. A tantalizing variant can be built by supposing that confession carries a lighter sentence than unconfessed guilt; each player has a "minimax" strategy of confession and must not only consider which particular alibi constitutes the *best* alibi strategy but *how good it is* (in terms of likely coincidence with his partner's) and whether they share the decision to try it. The matrix might be:

.5	o	.5	o	o
.5	x	o	o	o
o	o	x	x	o
o	o	o	o	x

(Lower left entry in each cell is payoff to player choosing row, upper right to player choosing column.)

from decision processes that are limited to the abstract properties of the situation.

A particular implication of this general point is that the game in "normal" (mathematically abstract) form is not logically equivalent to the game in "extensive" (particular) form, once we admit the logic by which rational players concert their expectations of each other. As pointed out in Chapter 3, these same considerations seem to be powerfully present in explicit bargaining as well. A terminological implication of these considerations is that "noncooperative" is a poor name for the game of tacit coordination; it is desperately cooperative in its own peculiar way and is still so when we add conflict and form the tacit mixed-motive game (In Appendix C it is argued that certain solution concepts familiar in game theory can be given an interpretation in terms of the coordination concept.)

SUGGESTION AND MUTUAL PERCEPTION IN THE MIXED-MOTIVE GAME

Coordination-game theory, while interesting in its own right, is interesting mainly for the light that it sheds on the nature of the mixed-motive game. The coordination element shows up most strikingly in a purely tacit game, in which there is neither communication nor any sequence of moves by which the two players accommodate themselves to each other. An example, similar to problem 6 on page 62, would be the following.

One player is "located" in Cincinnati, the other in San Francisco; they have identical maps of the United States and are to divide the country between them. Each is to draw a line dividing the United States into two parts; the line may be straight or curved, related or unrelated to physical or political landmarks. If the two of them divide the map differently, neither gets anything; but if they draw identical division lines on their maps, they are both rewarded. The reward for each player depends on what is contained in his piece after the division, that is, the piece that contains the city in which he is located. Let us leave these rewards vague; they may depend partly on area, partly on population, partly on industrial wealth and agricultural resources,