EXPERIMENTAL GAMES
AND BARGAINING THEORY

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GAMES have been used in the study of international politics; if they were not so demanding of time and energy, they would probably be used more. A Berlin crisis, or a busy day in the life of the United Nations, lends itself to this procedure. Participants usually represent "countries" and they may be encouraged to play the "role" of the country, acting as they believe the country would act, or they may be encouraged to behave in the game as they believe the country ought to behave in its own interest. The game may be organized for research, the participants being scholars and policy analysts; or it may be organized as training, to give students vicarious experience in the complexities of international politics.

And *complexities* are precisely what the game usually generates. Games organized for the benefit of students are invariably reported as having opened their eyes, in an unprecedented way, to the varieties of choice that can confront nations, to the varieties of interpretation that can be put on a country's behavior, to the great cloak of detail that surrounds even the simplest international crisis, and to the limitations on formal theory as a guide to international conduct in the real world. These complexities motivate, too, the games organized to examine a problem rather than to raise the sophistication of a student; part of the rationale of game organization is that no straightforward analytical process will generate a "solution" to the problem, predict an outcome, or produce a comprehensive map of the alternative routes, processes, and outcomes that are latent in the problem.

Games do generate these complexities and, by most reports, do it in a fruitful and stimulating way. If an understanding of international politics requires familiarity with both theory and practice, busy games seem to provide an important touch of practice. But though they may be peculiarly suitable for bringing out the rich complexity of international processes, games are not limited in principle to that end of the scale. Frequent references to chess remind us that more austere games may be useful in the study of bilateral or multilateral conflict. The more abstract and stylized game can certainly not pretend to provide vicarious experience in the practice of international politics, but it may have a role in the theory.

A game may be useful in revealing the *structure* of conflicts rather than the details. A game may be useful in the articulation of a theoretical model if it is designed for that purpose, just as games richer in detail may help to fit theory into its institutional context. The purposes do not necessarily compete with each other, nor do the games. It is worthwhile to examine international politics in all its complexity, and worthwhile to examine the underlying structure by the use of an abstract model. Similarly, games may be helpful at either end of the spectrum, or in between.

The methodology will be different, though. One kind of game may be used to elucidate a theoretical model, the other to show its limitations. One may be used to bring out the order, the rationality, and the coherence of the international structure; the other to illustrate the disorder, the irrationality, and the incoherence. Depending on the purpose and what is to be emphasized, one not only designs the game differently but defines the purpose differently. One can question whether an experimental game serves an essential purpose, or even any useful purpose, toward the end of the spectrum that can be encompassed by a theoretical model. Toward the other end, where theory meets its limitations, some need to generate a "sample" of vicarious experience may seem to be compelling; but the haphazard quality of game playing, while helpful in supplementing theoretical models, might seem to be precisely what one wants to eliminate in examining the theory itself.

The question is a sound one, but it does admit an answer. Even the most austere and economical theoretical model is unlikely to be fully determinate. It will be too complex to yield to any straightforward comprehensive analysis. It is not usually a mathematical problem to be "solved," but a model that generates a variety of potential behavior even within the framework of a few variables and constraints. Furthermore, among the processes that it leaves indeterminate will be some that inherently involve the interaction of two or more decision centers.

For this reason there is likely to be, even within the simplified model, some scope for "free activity," for bargaining, for the reaching of understandings and misunderstandings, for accommodation and co-operation, and for conjectures about each other's decision processes, value systems, and information. The theoretical model is thus usually not a comprehensive specification of how the participants behave, but rather a specification of the framework within which they pursue certain objectives according to certain criteria. What the model leads to in terms of

behavior of the participants is usually beyond the reach of straightforward analysis.

Even if it is not, the game itself may be a fruitful way of developing a working acquaintance with a theoretical structure. Just designing the game, checking it for internal consistency and for whether it contains the essentials of the desired theoretical model, can be a useful exercise and sometimes a check on the consistency of the concepts in the model. The game furthermore provides an extensive definition of the terms of the theory, and may facilitate communication and comparison. One can point to phenomena that the game generates, and not be limited to abstract characterizations of what he has in mind.

But the game can go one step farther. A theoretical model often has the characteristic that it is not formally or mathematically determinate of behavior even for fully rational participants who understand the game. The reason is that, among the phenomena of international politics that a theory wants to elucidate, are the processes of understanding and misunderstanding. The theory may therefore want to leave scope for misunderstandings, as well as understandings; and a game designed to correspond to the theory will want to provide for behavior that can lead to understandings and misunderstandings. And there is no straightforward way, no formal analytical way, for ordinary "rational" analysis to anticipate the outcome. The reason is simple: it takes two to make a misunderstanding.

Consider an example. A theoretical model permits certain kinds of communication; correspondingly, a theoretically oriented game permits the transmittal of messages. How can we discover the various ways in which a message may be misinterpreted? Keep in mind that the misinterpretations that the sender of a message can perceive and anticipate, he can guard against; the ones that matter most are those he cannot perceive in advance. The question then becomes, how do we identify the possible interpretations of a message that did not occur to the person who sent it? Putting it more crudely, and more generally, how can an analyst draw up a list of the things that would never occur to him? If the essence of the game is that there are two or more separate participants, two or more centers of consciousness and of decision, we can generate understandings and misunderstandings. Thus the "game" formulation of the theory is a meaningful one; it can contain something essential to the theory. And to study it in relation to the theory—in a sufficiently abstract model to permit theoretical handling, and the isolation of critical variables—an austere, abstract, stylized, theoretical game may have a use.

I. A Game for the Study of Theory

This paper is about such a game, in a research project just being initiated. It is an experimental study of the bargaining process involved in limited war and other conflicts, a process in which bargaining is by maneuver as much as by words, in which communication is poor, legal enforcement is unavailable, and the participants make irreversible moves while they bargain, are uncertain about each other's values, and have some power to inflict gratuitous damage on each other. The research will utilize variants of an experimental game.

The game in its present form bears no particular resemblance to war. It does use a map, but so do a lot of children's games. It may remind one of the game that goes under the name of "Salvo" or "Battle-ship," in which each player places his ships on a set of squares and takes turns firing at the other's ships whose whereabouts he can learn only when the other reports a hit. But there is a difference between the game proposed here and the familiar two-person parlor games.

The difference is that two-person parlor games are always "zero-sum" games—games of pure conflict in which one's gain is the other's loss. Mutual gain and mutual loss are out of the question; and bargains, threats, and co-operation—even grudging co-operation—cannot occur if both players understand the game and play to win. In the game proposed here that is not so. Some outcomes are better for both players than others and the player is to be motivated to get the highest *absolute* score for himself, not to impose a low score on an opponent, and *not* to concern himself with his *relative* score.

The fundamental idea is that war—whether a "fighting" war or a process of strategic maneuver—is not a zero-sum game. It requires at least some co-operation or accommodation between the two sides. It is a "bargaining situation," in which the conflict and the interdependence are inseparable. While secrecy may play a role, it is usually necessary to reveal preferences to reach efficient trades and compromises, to make threats credible, and to demonstrate inability to comply with proposals and threats. It is important to impress on the opponent (partner) some truth about one's own mode of behavior. Communicating one's intentions and what one expects of the other is important to successful play, and is necessarily a preoccupation of the players. The players are both partners and adversaries, as concerned to avoid severe mutual damage as to gain at the expense of each other.

This kind of situation does not arise in the traditional parlor games.[1]

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[1] The reason probably is that non-zero-sum games are no fun unless actual rewards are provided—i.e., unless the partners (competitors, rivals) can jointly beat the "house."

This is why a game like chess has only a limited relevance as a "war game." If one wants to study an actual parlor-type game—an abstract, formalized game—to get insight into the strategy of limited war or the strategy of threats, reprisals, deterrence, and bargaining, there are no ready-made games available. It has been necessary to invent a game.

The game used in this research has been designed to require co-ordination of strategies and to make co-ordination difficult. It has been designed to make it difficult to identify an obviously "fair" or symmetrical outcome. It has been designed to require no significant technical skill that has to be acquired through repeated plays. The skill involved is intended to be more akin to bargaining skills, strategic ingenuity, skill in coercing an opponent, rather than skill in the mechanics of the game itself.

The game differs from traditional war games in two respects. First, virtually all war games have been either explicitly or implicitly "zero-sum" games. They have involved no scope for collaboration between the adversaries; any motivation toward "winning" has been toward winning over the opponent, outdoing the opponent, winning relative to the opponent (except to the extent that, as in tennis, one may be interested in displaying style as well as in winning). Second, this game is not designed to look much like war; it is designed for minimum technical complexity. It is designed for research rather than training. (It does appear, though, to have some important value in the communication of ideas.) It is designed to have a simple enough structure, and few enough variables and parameters, to permit measurement, classification, manipulation, and analysis, in accordance with a theoretical framework. It is also designed to be economical in the interest of repeated plays, and to be capable of reproduction without access to unique materials.

It should be emphasized that in this game players are supposed to play to win. While in some variants there will be a scenario and other details suggestive of some "real" situation, it is not intended that subjects play any such version of it in a "role-playing" sense. The players are not to imitate decision-makers in some real situation that the game is trying to mimic. For the purpose of this game, in contrast to certain very different-looking and less stylized war games and, especially, "political games," one is playing to maximize his score and not for any other purpose.[2]

This poses a problem. Players have to interest themselves in their absolute scores, not just in how well they beat an adversary. While

[2] See note 7 at the end of the paper for references to other experimental games.

competitive spirit is precisely what one wants in studying a zero-sum game, like most parlor games, and can usually be relied on to make people value precisely the kind of score they are supposed to be maximizing, it cannot be relied on to make people interested in their *absolute* scores in a two-person game. Money rewards are therefore used, both to appeal to profit motives and to dramatize the payoff structure of the game and to attach symbolic value to it.

II. A DESCRIPTION OF THE GAME AND ITS STATE OF DEVELOPMENT

A game has been developed. It involves a board and a set of chips or counters. The board is in the form of a map; the map in present use is simply an outline map of the United States, the 48 states being the units into which the map is divided.[3] Each of the two players has a supply of chips; at each play they place chips on the states and remove them, subject to certain limitations. When the game is over, the players' scores depend on the states they possess and the chips they have lost, and any other "damage" they have suffered. The states have different values; their values, furthermore, differ for the two players, and while each player knows the values to himself of the different states, he has little knowledge of his opponent's value system. Each does have full knowledge of the other's past moves. Chips are lost by the process of "fighting" for states; other damage can be suffered because each player has, among the moves available to him, one that is purely punitive in nature. The game is terminated when both players agree to stop. No communication is allowed between the two players.

The game is essentially one of "bargaining by maneuver," of signaling intentions, proposals, threats, refusals, and information about one's preferences through maneuver rather than through words.

The game is completely defined by a set of instructions and the map. The most recent version of the instructions is appended to this paper.

The game in its present form usually runs for a few hours. It takes about an hour of preliminary instruction to get a player conversant with the technical features of the game and to emphasize the idea that he is playing for an absolute and not a relative score; early in the game a player becomes aware of the possibility of signaling and its importance, and begins the process of working out a "language" with his opponent (partner) and of developing a few notions about strategy. For most of those who have played it, the game has proved to be engrossing and stimulating.

With moderate adaptation of the rules it can be made a three-person

[3] A 1958 map of 48 states is used.

or four-person game. With no change in the rules, it can be played by teams rather than persons.

The physical requirements of the game are modest—a good-sized table to hold two maps measuring about 20 x 30 inches, with a barrier between to keep the players from seeing each other's maps and each other's faces, together with a monitor who can see both maps at the same time. Alternatively the players can be on opposite sides of a room; without too much nuisance they could communicate by telephone. For team play, where privacy of conversation would be required, two rooms or booths would be needed, but telephone communication (two monitors with an open telephone line between) would permit some flexibility in location.

There are several features of the game that can be varied. The *values of the states* can be varied, particularly the correlation between the two players' value systems, i.e., the degree of potential conflict in the exercise of their preferences. The *information* that each has about the other's value system can be varied. The *communication system* can be varied, through the addition of symmetrical or asymmetrical arrangements for direct communication, either free or restricted to certain types of statements or proposals. The *map* can be varied, both to change the geometrical configuration and to change the political and other connotations that may influence the bargaining process. A *scenario* can be provided that may have an important power of suggestion; players may or may not be given information about the outcome of previous plays of the same game—knowledge which may constrain or facilitate the bargaining process. The *number of counters* can be varied; in particular, the number of chips available to the two players could differ. The *tempo* of the game can be affected by varying the number of chips played at each turn, and by requiring that the area claimed by a player's chips be enlarged only incrementally. The *role of reprisal* or *punitive action* can be varied, either in the costs of inflicting damage or by limits on the number or frequency of punitive moves. And new moves and new resources can be added to the game.

Further refinement of the game will take mainly the form of adapting these structural features and parameters. Variation will also, however, be part of the experiment itself, to study the effect on the mode of play and on the outcome, and on the players' interaction with each other.

Further development of the game will require a compromise, between (a) enriching the game's complexity, the variety of moves available, the suggestive details, the communication structure, etc., to generate interesting phenomena, and (b) keeping the game simple enough to be not

only economical but susceptible of analysis in relation to a theoretical model.

III. Theory and Methodology

The basic notion underlying the use of an experimental game in an empirical study of the "bargaining process" is that formal theory—game theory, for example—is inadequate by itself, and necessarily so, in the study of bargaining games. Games of this sort necessarily contain an element of indeterminacy; the constraints imposed by the quantitative structure of the game are insufficient to determine a solution, even for "rational," internally consistent, strategies of behavior by the participants. In any game of this sort there is some need for the concerting of action, for reaching understandings, for communicating and inferring intentions, for arriving at consistent expectations of each other, and for the development of norms, traditions, or other constraints analogous to the limits in limited war. How the participants can interact to teach a shared expectation, how they can invent means of signaling their intentions, what kinds of rules and traditions they can perceive and recognize jointly cannot be arrived at by *a priori* reasoning, even by ideally rational players. There is an essential element of empirical study involved.

This is not, it should be emphasized, simply a matter of players' behaving in practice in a manner different from what a theory of rational behavior would suggest. Rather it is that players are capable, at least in some circumstances, of doing a good deal better than a purely formal theory of rational behavior could account for. How it is that they can do better is a question that, though amenable to theoretical analysis, ultimately requires empirical confirmation.

The possible relevance of experimental work seems demonstrated by some experiments with questionnaires that can be considered "one-move" non-zero-sum games.[4] The research initiated with this new game can be viewed as an attempt to do for bargaining extended over time what the questionnaire did for one-shot games.

An important question is whether the conclusions reached, or the phenomena observed, can be generalized to cover actual conflict situations, actual bargaining processes, of which limited war may be the most vivid example. Here it should first be said that a game of this sort is not intended to reproduce all the significant characteristics of a real conflict; it is not intended to epitomize real, live conflict or to constitute a "well-balanced" model in which all elements receive proper emphasis.

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[4] Reported in T. C. Schelling, "Bargaining, Communication, and Limited War," *Journal of Conflict Resolution*, 1 (March 1957), pp. 19-36; reprinted in Schelling, *The Strategy of Conflict*, Cambridge, Mass., 1960.

It is intended rather to single out aspects of the problem that provide a coherent subject for analysis and are susceptible of experimental simulation in the laboratory. A game of this sort focuses mainly on the perceptual and cognitive processes of the participants, rather than on emotional behavior or individual value systems. (So far as possible the player's value system is provided him by the game itself; and while emotional involvement is undoubtedly present, even if we try to keep it out, it is on a different scale from the duress, tension, preoccupation, and panic that might occur in a real, live conflict situation.)

The game furthermore is limited in its relevance to the behavior of individuals (or perhaps very small groups) and to those aspects of organizational behavior, bureaucratic behavior, group political behavior, and other collective decision processes that most depend on, or are limited by, the capabilities and characteristics of individuals, or at least in which the capabilities and characteristics of individual decision processes can be isolated in analysis.

What makes a game of this sort, limited as it is, attractive as a means of coming to grips with some aspects of limited war and similar conflicts is that we are poor in alternative ways of studying the phenomena empirically. We are generally limited to intensive studies of a few particular cases. The knowledge we can get from experimenting with a game may not be comprehensive or terribly reliable, but, compared with what we have or can get in any other way, it looks good.

There is another reason for supposing that even a quite artificial game can produce results of real significance. A great many propositions about limited war, industrial disputes, etc., are phrased in such general terms, and based on reasoning or evidence of such simplicity and generality, that they would have to apply to a situation as simple and artificial as the kind of game described above. In other words, even if we are skeptical about the propositions that can be proved by the evidence of a game of this sort, a good deal of the existing theory, or lore, is susceptible of being disproved.

Consider, for example, propositions about the advantage or disadvantage of communication between adversaries in limited war, or propositions about the tendency for certain bargaining processes to display outcomes that have some property of "equality" or "symmetry." Many of these seem to be based on very general observation and introspection, expressed in phrases like "It stands to reason that . . ." or "No one would ever. . . ." A game of the sort described *can* demonstrate, with respect to a proposition, that its truth does not follow from any simple universal observation or intuitive hunch. The proposition may, of course,

still be true; but if the reasoning and the evidence can be discredited, it must be abandoned unless new grounds for it can be found.

Take specifically the following question: if in a game like the one described here, which involves a great deal of ignorance on the part of each player about the other's value system, or even in one that involves (as the specific form of the game described above does not) ignorance about some of the moves available to the other player or the moves he has already made, a proposal is made to improve the players' knowledge about each other's value systems, moves available, positions reached, etc., what do we anticipate about the advantages and disadvantages to the two players? A proposition frequently expressed is "It stands to reason that the player to whom we give the greater knowledge about his opponent receives the advantage." Of course, in a game of this sort, both players can be advantaged or disadvantaged simultaneously, it being a non-zero-sum game; this pointed out, the proposition may be rephrased to the effect that the greater gain, or the relative advantage, is bound to go (other things being equal) to the one who gets the greater information. This proposition is based on faulty reasoning, but it seems compatible with intelligence and sophistication. If it is false, as is conjectured here, its falsity can be demonstrated by a game as simple and artificial as the one proposed. Those who hold to a proposition of this sort are likely to hold it on the basis of very general considerations—considerations so general as to be contradicted if the proposition proved to be strikingly false in regard to a simple little game that, simple as it is, is as complex as the theoretical model that was implicitly in mind when the proposition was voiced.

This example illustrates another aspect of the methodology involved in a game like this one. When a game simple enough to be analyzable produces a result contrary to expectation, it is likely to produce it for reasons that become apparent once the phenomenon is observed, particularly when it is observed in relation to the structure of the game or to alternative structures of the game. Thus a conclusion that is reached is not necessarily supported solely by statistical evidence from repeated play of a game whose relevance to the world is in question. Rather the conclusion, once it has been suggested by the experimental results, can often be rationalized in theoretical terms. The game is thus a tangible representation of a theoretical model, a model whose moving parts can be better understood if they can be articulated experimentally.

This point can be expressed in another way. Experimental games can be used to discover, and demonstrate, important *possibilities* that might have been missed without it. The significance and relevance of these

possibilities may still depend on reasoning and on evidence obtained elsewhere; but the existence of the possibilities, and some notion of how they relate to the structure of the game, can be discovered by the artificial game. This would, for example, be true of the proposition that the advantage may well go not to the player who enjoys the increased knowledge and information but to the other player, and that it may even be an absolute disadvantage to one of the players to obtain new information if he cannot conceal the fact that he has it. (This point about information is not being emphasized here as the main one to be investigated, but as a readily comprehensible illustration of an hypothesis to which the experimental game would be relevant.)

On the whole, it is expected that conclusions reached by this kind of experimental research will not depend much on refined statistical analysis. We shall be looking for rather striking results. Since the intent is to relate the observed phenomena to some theory that closely parallels the game itself, as well as to demonstrate the potential significance (rather than the actual significance in a particular context) of the variables to be manipulated and observed, a main effort will be to learn how to manipulate the parameters and structural features of the game in order deliberately to generate particular results and phenomena. The intent is not, therefore, to pursue to the end a prearranged schedule for varying the parameters, and subsequently to analyze the results statistically. Instead there will be fairly continual feedback between the results observed and the further design of the experiments. The results of the questionnaire experiments referred to above illustrate, on a simple scale, this methodology.

There is a secondary purpose of this experimentation that relates to the development of theory. It has to do with the value of the sheer construction of the game and analysis of its structure and manipulation of its parameters. To build a game of this sort, and especially to build into the game particular features that one wishes to represent, requires that one define his concepts operationally. A game of this sort imposes discipline on theoretical model-building; it can be a test of whether concepts and propositions are meaningful, and a means of demonstrating so when they are. In the actual construction of the game, and in discussion of the game's features with persons who have played it or observed it played, it has frequently been the case that certain plausible concepts had to be abandoned when an effort to identify them (or to incorporate them) in the game revealed that they were meaningless or innocuous, or that they rested on inessential distinctions.

Closely related is the use of the game as a means of theoretical com-

munication. If one wishes to define carefully, and to illustrate, a parti-
cular distinction or proposition about the strategy of conflict, the game
often provides a tangible and unambiguous representation of the con-
cepts involved—a way of pointing to what one means and avoiding
reliance on ambiguous verbal description.

Two examples may help. One has to do with the notion of equality or
symmetry in the outcome of a game. As mentioned above, the policy-
oriented literature on limited war frequently uses words like "equality"
and "symmetry" and "reciprocity" in describing the kinds of rules and
limits or outcomes that may be acceptable to the parties involved; the
theoretical literature on bargaining and game strategy does the same.[5]
And with an exceedingly unambiguous model or "game" in mind, with
perfect information about value systems and the moves and strategies
available, concepts like "equality" and "symmetry" can at least be
meaningfully defined. Suppose, however, that one enriches the game,
even to the limited extent of the game described—or suppose that one
goes farther still to add contextual detail which, though inessential to
the logical structure of the game, contains some power of suggestion, or
moral, casuistic, or legalistic significance, or which entails some prec-
edent, tradition, or analogy. Then such concepts as "equality" and
"symmetry"—in the strategies employed, in the rules and constraints
that the players generate and observe, or in the outcome of the game—
are embarrassed by the sheer lack of an obviously meaningful definition.
The empirical contents of the original proposition therefore disappear.
One cannot define "equality" in terms of the acceptability of an out-
come or a rule to both players, and simultaneously preserve any em-
pirical content in the proposition that rules or outcomes will be accept-
able only if they meet the condition of "equality."

The second example concerns the structure of conflict that is built into
the game. It is interesting to argue whether the game described, or a
variant of it, captures the spirit of the conflict involved in war, race
relations, industrial disputes, interagency disputes, bureaucratic rivalry,
or competition in traffic for the right of way. If one doubts whether a
particular game embodies the essentials of a particular dispute, it is

[5] Closely related is the idea that both sides must accept the "same" limits—a proposi-
tion that not only may prove false in actual play but can prove meaningless within the
structure of the game unless the game itself is designed with a symmetrical move
structure and scoring system. See, for example, James E. King, Jr., "Nuclear Plenty and
Limited War," *Foreign Affairs*, xxxv (January 1957), pp. 238-56. For the symmetry
notion in bargaining theory, see, for example, John Harsanyi, "Approaches to the
Bargaining Problem Before and After the Theory of Games," *Econometrica*, xxiv
(April 1956), pp. 144-57; R. Duncan Luce and Howard Raiffa, *Games and Decisions*,
New York, 1957, pp. 114ff.; and T. C. Schelling, "For the Abandonment of Symmetry
in Game Theory," *Review of Economics and Statistics*, xli (August 1959), pp. 213-44.

interesting to see whether the game can be made to represent that dispute by varying the scoring system, the information structure, or the timing and nature of the moves; if it cannot, it is interesting then to see whether radical changes in, or additions to, the moves and scoring system can reproduce the essentials of the dispute in question. In the trial plays held so far, it has frequently been the case that during *post mortem* a player denied the analogy between the game and the kind of conflict involved in international disputes; a revision in the scoring system was attempted to reflect someone's notion of what was essential to an international dispute. It is interesting that in many cases the revision that would satisfy a particular analyst could be demonstrated to be a non-essential change—a change only in certain parameters, and not in the structure of the game. In other cases it became clear that certain types of dispute were inherently incapable of being represented. But clarity and agreement could be reached much more quickly on these theoretical points by working with the actual game than if no tangible model had been present.

IV. Research to Be Undertaken

A general discussion of questions worth investigating with a game of this sort has already been published.[6] The present section will repeat some of those ideas, supplement them, and relate them to research procedure.

There are three main elements to describe. The first is the game, the rules and constraints under which it will be played, the background against which it will be played, the particular players who will play it, and so forth. The second concerns what will be observed—the outcome of the game, the behavior of the players, the records kept by the players, particular situations that develop in the course of play, and so forth. Third are the questions or hypotheses that guide the inquiry, toward which the manipulation of the game and the observation of game phenomena are oriented. To illustrate: one can have the game played with different rules of communication; one can observe the outcome in terms, say, of the two players' scores; and one can generalize about the value of communication or its absence to the participants in a bargaining process.

(1) THE GAME TO BE PLAYED

Under the first heading—the way the game will be played or used—the following arrangements are contemplated. First, a standard version

[6] Cf. Schelling, *The Strategy of Conflict*, pp. 259-63.

of the game will be used with a large number of players to study the relation of outcomes to modes of play, of outcomes to the players' interpretations of their own and each other's modes of play, and whether there tends to be continuity or discontinuity in the frequency distribution of outcomes. For this purpose, of course, a theoretical framework for the classification and analysis of outcomes, strategies or modes of play, and players' interpretations must be developed. This can be done only in the course of the project itself, since it requires actual play.

Second, certain features or parameters of the game will be varied. The communication structure has already been mentioned; the information structure (information of each player about the other's value system, etc.) will be varied; the suggestive details of the game will be varied—the scenario, the actual map, the precedents that can be created and brought to bear, the language describing the game and its purpose, hints about symmetry, hints about signaling, etc.; the quantitative features of the game will be varied—the extent of potential conflict generated by the scoring system, the potency of the "reprisal" moves available, the ratio of resources available to the two sides, etc.

Third, the arrangement of plays of the game will include schedules of repeated play within self-contained groups, play between members of different groups that have already experienced extended intra-group play, play that pairs experienced with experienced players, inexperienced with inexperienced, and experienced with inexperienced; play that involves teams; play that is under the influence of a "mediator" who can make certain kinds of proposals to the players; play with three or more players in which coalition behavior becomes possible; and possibly some play with the strategy prescribed for one of the players.

(2) PHENOMENA TO BE OBSERVED

A meaningful scheme for recording the outcomes of games must be devised. For a standard version of the game, this can be done in terms of individual net scores and gross scores (gross scores showing gross gains and gross losses). For comparing the outcomes of different variants of the game, a means has to be devised to "normalize" the scores; this is not an easy matter because there is no straightforward way, for example, of measuring what a player has got relative to what he should have been expected to get in the course of play. (Since one purpose of varying the game itself is to discover what difference doing so makes in the outcome, we cannot rely on *a priori* expectations about "reasonable" scores relative to which the actual scores might be normalized.)

A scheme for classifying the players' interpretations of what they are about also has to be set up initially in connection with actual play—that is, to some extent by trial and error. It must furthermore recognize that the players' perception of the game, and their mode of play, can undoubtedly be affected by the instructions they are given, the questionnaires they are asked to maintain, and the notes they are asked to take on their own strategies or on their partners' play. (How quickly a player becomes alert to the possibilities of signaling in the game is undoubtedly affected by whether he has been instructed to look for signals and to record his own. His actual perception of signals and choice of methods of signaling will likely be affected if particular types of signals that he is to look for are specified in the instructions.) In general, the player's self-consciousness is likely to be stimulated by any explicit analytical framework in which he is asked to record his intentions at each move, the intentions he imputes to his partner, and the understandings he thinks the two of them have reached. Nevertheless records of this sort will be an essential part of the research, since an important purpose is to study the development of understandings and misunderstandings, the process of inventing language for communicating proposals, the identification of critical "turning points" in the course of a game, the relation of each player's expectations to the suggestive details built into the game, the correctness of players' conjectures about missing information, and each player's basic conception of strategy, such as the claims he insists on and the risks he is willing to take. How many of these attributes of the course of the game, as perceived by a player, can be defined operationally and put into a log or questionnaire without disrupting the game too much remains to be seen; it also remains to be seen by trial and error which among these records produce data that promise to be interesting.

The analytical categories for observing and recording modes of play will also have to be worked out in actual observation of play. "Co-operative" vs. "unco-operative," "bold" vs. "cautious," "aggressive" vs. "fair and reasonable," "self-oriented" vs. "partner-oriented," and other distinctions may or may not prove useful in practice and are undoubtedly inadequate. It remains to be seen, too, whether a player, his partner, and the observer share similar perceptions about the mode of play, and the intentions behind it. The alertness of a player to his partner's proposals, his reliance on collaborating in search of a language, his interest in exploring his opponent's value system, his conception of the proper use of stubbornness or punishment, his refusal to communicate, or his pretense at not understanding his partner, as well as various more

"topological" aspects of the moves he makes, may prove to be meaningful categories for analysis.

(3) LINES OF INQUIRY

A particular phenomenon to be investigated is the development of language, rules, and traditions in an inbred group of players. Repeated two-person play on a random or round-robin basis among, say, four to six players should provide an interesting opportunity for studying the invention of language through the medium of moves of the game, and the development of rules and limits of conflict that are governed by sheer force of tradition and expectation. The extent to which these processes can be retarded or stimulated by adding suggestive materials to the game; how the invention of signals interacts with any actual overt communication that is permitted; how rapidly signals or rules are converged on in the course of repeated play; the correlation among the signals and rules that develop in different inbred groups; and the question of what happens when pairs are drawn from two different inbred groups—all these will be part of the study. (Here it will be particularly difficult to get players to express themselves in response to interviews and questionnaires without contaminating the process itself.)

A specific feature of the game to be investigated is the determinants of "instability." By "instability" is meant here the tendency of a game to generate mutually destructive behavior and low scores. The trial plays of the present variant suggest that it may be difficult, at least for certain kinds of players, to get them out of a cautious and co-operative frame of mind and to create something analogous to "war" or observable conflict. Experiment suggests that more conflict can be generated by rearranging the values of states on the map. It seems worth conjecturing that the "reprisal" move contained within the game, or a change in the moves that gives a strong advantage to the player who breaks an agreement (engages in "surprise attack," for example), may create instability. There is also evidence that the tempo of the game, as measured by the number of moves that can be made at each turn, or the pace at which pieces can be advanced over the board, affects stability. And there is reason to conjecture (plus a bit of suggestive evidence from the trial plays) that the distribution of outcomes may be quite discontinuous with respect to continuous variation of certain parameters—i.e., that a strikingly bimodal distribution of scores (mainly due to the degree of "destruction" of value) occurs with respect to variation in one of these features.

There is no fixed schedule of plays and variations to be pursued. There

is rather an array of important and fascinating questions that the game may help to pursue or may not. As indicated earlier, the general intention is to identify the most striking results, to pursue those questions to which the most interesting answers seem to be emerging, and to manipulate the game to generate interesting phenomena, particularly those that contradict offhand expectation. The initial experimentation will therefore have to be exploratory. In any case, a good deal of trial and error will be involved in working out the analytical framework. In other words, the object is not to test a set of available hypotheses, so much as to generate hypotheses through exploratory experimentation, to manipulate the game and its environment in an effort to bring the suggested hypotheses into clearer relief, and to rationalize the results in terms of a theoretical model that can be identified within the structure of the game.[7]

[7] A recent, fairly comprehensive description and discussion of less formalized "political games" that involve a good deal of free activity is in Herbert Goldhamer and Hans Speier, "Some Observations on Political Gaming," World Politics, xii (October 1959), pp. 71-83. A much more tightly formalized game structure has been used by Harold Guetzkow (and described in papers presented to conferences at Northwestern University in April 1959 and West Point in June 1959). An extensive history of war gaming, especially in the nineteenth century and up to World War II (but with some discussion of more recent games), is in John P. Young, A Survey of Historical Developments in War Games, Washington, D.C., Operations Research Office, Johns Hopkins University, March 1959; another rather comprehensive discussion is in Clayton J. Thomas and Walter L. Deemer, "The Role of Operational Gaming in Operations Research," Operations Research, v (February 1957), pp. 1-27.

A discussion of what war gaming can and cannot do is in Robert D. Specht, War Games, The RAND Corporation, Paper P-1041, 1957. For a discussion of whether experimental games have, in principle, research validity in the sense of producing empirical evidence, see Herman Kahn and Irwin Mann, War Gaming, The RAND Corporation, Paper P-1167. (The present proposal, and the questionnaire experiments reported in the earlier article, are at variance with the view expressed by Kahn and Mann.)

Some formalized one-move and two-move games, in some cases iterated through a series of plays, are reported in Morton Deutsch, "Trust and Suspicion," Journal of Conflict Resolution, ii (December 1958), pp. 265-79; in Merrill M. Flood, "Some Experimental Games," Management Science, v (October 1958), pp. 5-26; in Bernhardt Lieberman, "Human Behavior in a Strictly Determined 3 x 3 Matrix Game," Behavioral Science, v (October 1960), pp. 317-22; in J. Sayer Minas, Alvin Scodel, Philburn Ratoosh, and Milton Lipetz, "Some Descriptive Aspects of Two-Person Non-Zero-Sum Games," Journal of Conflict Resolution, iii (June 1959), pp. 114-19; and in Richard H. Willis and Myron L. Joseph, "Bargaining Behavior," ibid., pp. 102-13.

Business games, which have come into vogue as training devices and as research tools, are usually nearer (in formalization) to the present game than the political games described by Goldhamer and Speier, are a degree more formal than the Guetzkow games, and are more like the older, highly stylized war games of the nineteenth century than like the war gaming presently practiced. For a buying-and-selling game that was designed for and extensively used in research, see Sidney Siegel and Lawrence E. Fouraker, Bargaining and Group Decision Making, New York, 1960.

The game that comes closest in spirit to the one described in the present paper is probably the "balance of power" game described in Morton A. Kaplan, Arthur Lee

Appendix

INSTRUCTIONS FOR THE GAME

Taking part in this study presents you with the opportunity of earning from a minimum of three dollars to a maximum of seven to ten dollars. This game is not like chess, checkers, or monopoly, where what one player gains his opponent loses. In this game it is often the case that certain outcomes will be better for *both players* than other outcomes. Some manner of play may maximize the amount each player can earn. But, at the same time, in the game there will probably be values (states worth money) which both you and the other player will want. Thus, the situation is one in which there is some element of conflict; but also some element of "common interest" or "common gain" is present. *The purpose of playing the game is not to defeat the other player but to earn as much money as possible.*

The game is not necessarily "fair" in the sense that if the players arrive at what appears to be an equal division of the states, they will each earn an equal amount of money. The number of colored states may be quite different for each player, and the arrangement of the colored states on their maps may tend to produce unequal earnings. It is also possible that an apparently unequal division of the states may yield earnings that are approximately equal.

The game involves a map, a set of chips, a scoring system, and a set of rules about moves. The players move in turn: at each turn a player can place a number of chips on the map and remove a number. At the end of the game a player's earnings depend on the configuration of his chips on the map, and on the "losses" he has suffered in the course of play.

The Map

The map is an ordinary outline map of the 48 states of the continental United States. The 48 states are the units into which the map is divided.

Player's Earnings

A player's earnings depend on the values of the states he possesses at the end of the game, plus the chips he possesses, minus the "damage" done to him.

State Values and Their Possession: The Integral Area

The values of many of the states differ for the two players. Each player knows the values of all the states to himself but not their values to the other player.

Each player has a number of colored states (red or blue) which have a

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premium value; they are worth 50¢. The remaining states are white and are worth 5¢ each. These values are what the states are worth to the players if he *possesses* them at the end of the game.

The colored states are chosen by a random process and so there is no way of determining, at the very beginning of the game, the colored states of the other player. It is possible that one or more states may be colored red *and* blue.

The play of the game uses two maps separated by a barrier. Each player has before him a map, with his own state value-system fully observable to him, but he is not able to see the other player's state values. Each player makes his own moves and also reproduces the other player's moves on his map. Thus all moves are visible to both players, but each other's state values are not.

A state is *possessed* by a player, *at the end of the game*, if it is part of an *integral area* that he occupies.

A player's *integral area* consists of a set of states which are *occupied solely* by his chips, or bounded by states which are occupied solely by his chips. The area must contain the player's home base and must not also contain his opponent's home base. The states in it must be geographically connected to each other and must form a distinct area. Each state within the area need not be occupied by the player's chips but a boundary must exist. This boundary must consist of states occupied solely by the player's chips, except that the border of the United States may be used to form the bounds of the integral area. States within the bounds of an integral area need not be occupied to be possessed.

Another way of defining an integral area is to say that it is an area (set of states), including the player's home base, which the second player cannot enter from his own home base without moving through a state (placing chips on it) which the first player occupies solely, or by going outside the border of the United States.

At the end of the game, if both players have chips on a state, neither can possess the state, nor are the chips lost. The state values possessed by a player at the end of the game consist of the sum of the values of the states contained in the area he possesses, including the boundary states, according to his own schedule of state values as indicated on his own map. The state values on the second player's map do not affect the first player's score.

During the course of play the first two integral areas formed by each player will be announced.

Home base, a specified state for each player, is marked on both maps and is known to both players. A player always occupies or possesses his home base, whether or not he places any chips on it. A player can never possess or occupy the second player's home base.

Chips and Their Use

Red, blue, black, and white chips will be used in the game. One player, known as "Red," makes his moves with red and black chips; the other, known as "Blue," makes his moves with blue and white chips.

A chip placed on a state can do one of the following things: it can *occupy solely, occupy jointly, challenge,* or *fight.*

When a player places one, or more, of his red (or blue) chips on a state he occupies it. He *occupies* it *solely* if the second player does not place (or has not already placed) his blue (or red) chips on the state. A state is *occupied jointly* if both red and blue chips are placed on it and it is not at *challenge*.

When a player places one of his black (or white) challenge chips on a state, that state is then at *challenge*. Challenges can be made whether or not the second player has chips on the same state, and even if there is no red or blue chip on a state. A player may make as many challenges as he wishes and withdraw as many as he wishes on each play, but only the player who made a particular challenge may withdraw it. Only one challenge chip may be on a state at any time.

If one player has chips on a state and the second places chips on the same state and challenges, the first must *withdraw* or *fight*. He withdraws by removing his chips from that state at his next turn. He fights by indicating so at his next turn, and both players' chips are removed from the state in equal numbers so that only the excess number of chips (if any) that one player had remains on the state. The chips so removed are *lost*. (At the end of the game lost chips do not contribute to a player's earnings.)

If a player responds to a challenge in a particular state by "fighting" for it, and places more chips on it than the other player has there, so that upon removal of equal numbers he has some remaining, his remaining chips are automatically at challenge at the next turn. (The fight, in effect, is still on.) The player who first challenged may add chips at his turn, removing equal numbers again, and so on until, *for one turn, one player adds no chips to the disputed state*. At that point "fighting is over" on that state; the remaining chips, once one player has played a turn without continuing the fight, are at challenge unless the challenge chip is removed.

If a player places chips on a state that has no chips of the other player, and challenges, the other player cannot subsequently place chips of his own on the state without automatically fighting, i.e., without removing equal numbers of chips for both players so that only the excess of chips of one player remains. (One may fight with a greater number of chips, thus having chips on the state after removal; one may fight with an equal number of chips, so that all chips are removed from the state; or one may fight with a lesser number of chips, so that the challenger retains some chips on the state.)

It can happen during the course of a dispute for a state that neither or only one player has colored chips (red or blue) on a state. In these cases neither player solely occupies the state unless the other player has had an opportunity to make a move (i.e., place one of his red or blue chips on the state) and has not placed chips on the disputed state.

Once a player has formed an integral area, the second player cannot place a chip within the boundary of that area. To place a chip within the boundary, he must first "break" the boundary of the integral area by placing one or more of his red (or blue) chips on a boundary state (or states, if this is necessary). (This may or may not result in fighting, depending on whether the boundary states are at challenge.)

Cutting off

At any time during the game that one player possesses an integral area, any chips of the second player within the area bounded may be (but need not be) removed by the first. If they are removed, they are *lost* to their owner.

Chips lost in this fashion are referred to as "cut off." Note that a chip may become cut off, if the player cutting it off completes a boundary by placing chips on unclaimed states, or if he accepts a challenge and fights, the fight ending with his possession of the state. If he has to challenge or fight in order to achieve sole occupancy of a state forming the boundary, the second player may, at his turn, remove the chips that are in danger of being cut off. (The number that may be removed is subject to the over-all limit on number removable at a turn, mentioned below.) In addition, the integral area is not completed until the fight for the state is completed, i.e., until the player who gives up the state has had an opportunity to place one or more chips on the state and has declined the opportunity.

If, after the game is terminated, a player's chips are within the other player's integral area, these chips are not cut off. They are removed from the board and returned to their owner.

Home-Base Damage

A chip may be used to inflict damage on the other player. This is done by placing it on his home base. If that is done, the chip is removed and lost to the player whose chip it is, but the player whose home base was so affected loses an amount of money equivalent to the value of five chips (25¢). A chip on a home base has only this result and does not "claim" anything.

Play

The play of the game consists of a series of moves. A move consists of removing and placing one or more chips on one or more states. Who makes the first move is decided by flipping a coin. At each turn, *a player may remove any number up to five of his own chips from states they were on and may place any number up to five of his chips on states.* He need not move any chips; this is done by indicating a "pass." (Chips removed, except when lost by fighting or cut off, are available to be placed again on the map, and may be so used at the same turn, subject to the limit of five in the total number that may be placed on states at a turn.)

A player may make as many challenges as he wishes at a turn, and withdraw as many challenges as he wishes.

There is no limit to how many chips a player may place, at a turn, on the other's home base (except, of course, that no more than five may be removed from states for that purpose at a turn in the event none are otherwise available).

Each player has 50 red and 50 blue chips. (Red's blue chips are used to reproduce Blue's moves on Red's map, and vice versa.)

The game is terminated when one player (a) makes no move and (b) makes an offer to terminate, and the other player accepts the offer, making

no move. If the offer is not accepted, the player making the offer may not then move until his next turn.

At termination, if any state contains chips of both players (and is not at challenge), the chips are removed from these states and returned to each player. Neither player occupies or possesses the state.

The amount each player earns depends on the chips he has remaining (either on states or not on states), the values of the states he possesses, and the damage he has suffered. A player's earnings are not dependent on the other player's earnings. (It is *absolute earnings*, not relative earnings, that matter.)

No communication between players is permitted. Each player writes his move on a card and makes the move on his own map. The Experimenter then executes the move on the second player's map. He removes all chips that are lost through fighting or cutoff.

Some Arbitrary Geographical Rules

Where four states meet in a corner, in the southwest, a diagonal pair does not close a boundary (i.e., New Mexico, Utah, and Idaho do not form a boundary around the West Coast; New Mexico, Colorado, Utah, and Idaho do).

Upper and Lower Michigan, plus Lake Michigan, are considered a single state; thus Illinois and Indiana both border on Michigan and do not border on Canada. Ohio borders on Canada; so does Pennsylvania.