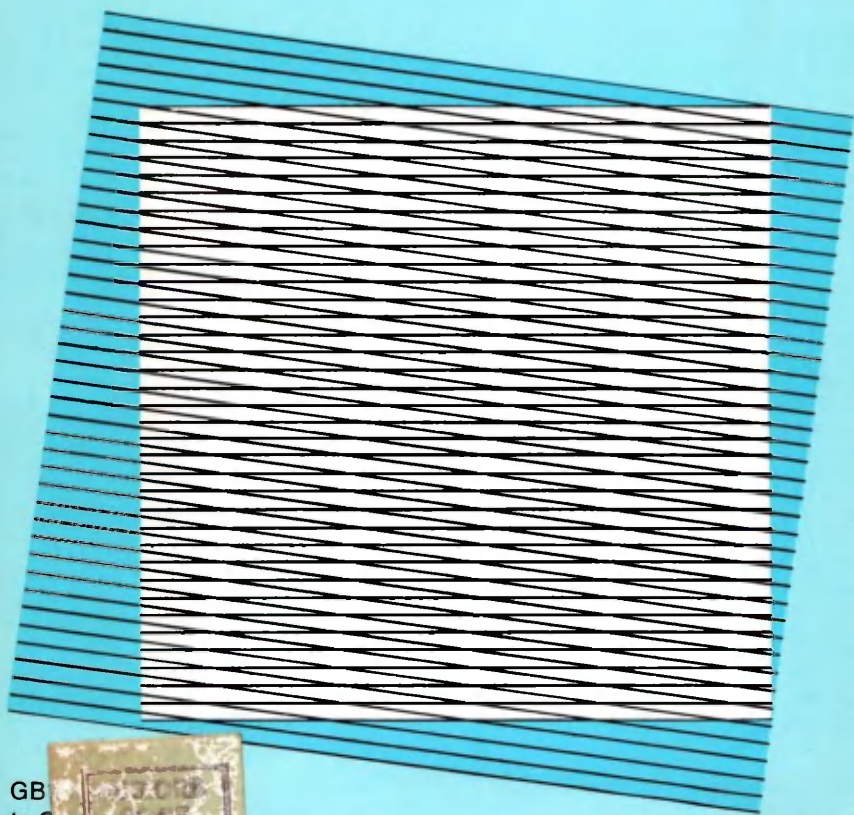


# THE STRATEGY OF CONFLICT

THOMAS C. SCHELLING



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# THE STRATEGY OF CONFLICT

**Thomas C. Schelling**

two dynamite trucks meet on a road wide enough for one, who goes up?"

strategy defined in this study is "the exploitation of potential force," the conflict situations against which it is tested are "essentially strategic situations." The strategy may be explicit or tacit, the conflict may arise between adversaries or partners, and the area of pertinence ranges from game-theory to brinkmanship.

Professor Schelling is concerned with the formulation of advantageous strategies in a conflict situation involving the interdependent actions of the participants. In the parallel conflicts between parent and child, police and criminal, world, nation and national enemy, is there a common denominator of successful action that could be charted or algebraically expressed in a general formula? A basic functional approach to the problem is outlined, the strategy of coercion, deterrence and cooperation is reviewed in the light of game theory, showing the application of that newly-emerging theory to the vital but retarded science of international strategy.

In eminently lucid and often-charming language, Professor Schelling's book opens to rational analysis a crucial field of politics, the international politics of threat, or, as the current term goes, of deterrence. In this field, the author's analysis goes well beyond what has been done by earlier writers. It is the best, most incisive, and most stimulating book on the subject."

K. W. Deutsch, *Annals of the American Academy  
of Political and Social Science*

Author: Thomas C. Schelling is Professor of Economics and an Associate of the Center for International Affairs at Harvard University. His previous works are **National Income Behavior**; **International Economics**; and **Arms and Arms Control**, written in collaboration with Morton H. Halperin.

**Harvard Book**

**HARVARD UNIVERSITY PRESS New York**

# The State of Connecticut

THOMAS C. SWAN

OXFORD UNIVERSITY PRESS  
London Oxford

# Strategy and Conflict

SCHELLING

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## PREF

This is a series of closely inter-  
variously described as "theory of b  
or "theory of strategy." Strictly sp  
the *theory of games*, but within th  
the least satisfactory progress ha  
which there is common interest  
versaries: negotiations, war and  
rence, tacit bargaining, extortion.  
that in the strategy of conflict th  
between, say, maneuvering in li  
traffic jam, between deterring th  
own children, or between the mo  
ancient institution of hostages.

The analysis is neither difficu  
matics or analytical apparatus as  
reader. A few chapters call for a  
some concepts from game theory.

The first chapter (in a longer v  
in early 1959 to a conference on  
Mid-twentieth Century," at Nor  
the occasion and the audience v  
paper represents the motivation  
Chapters 2 and 3 were originally  
gaining." It was evident, after t  
longed to the same field as the *t*  
them into the framework of gam  
work if necessary, resulted in C  
pendices B and C. Chapters 7 th  
extensions of the same method to  
tional strategy.

Appendices B and C will be of  
versant with bargaining theory o  
been treated as an appendix only



## ACE

related essays in a field that is bargaining," "theory of conflict," speaking, the subject falls within the part of game theory in which has been made, the situations in as well as conflict between ad- threats of war, criminal deter-

The philosophy of the book is here are enlightening similarities limited war and jockeying in a e Russians and deterring one's modern balance of terror and the

It nor so dependent on mathe- to be inaccessible to any serious rudimentary acquaintance with

ersion) was originally presented "International Relations in the thwestern University; although were somewhat specialized, the and theme of the entire book.

y independent articles on "bar- they were written, that they be- *theory of games*; an effort to fit ne theory, stretching the frame- Chapters 4 through 6 and Ap- through 10, and Appendix A, are o particular problems in interna-

f interest mainly to readers con- or game theory. Appendix A has because its extended preoccupa-

tion with a particular policy perspective, in the style of Chapter 4, where it was first introduced.

The essays are a mixture of 'policy' and 'theory'. To some extent the two can be separated. Some of the pieces in Part IV. In my own case, the essays are separate. Motivation for the project was largely, if not exclusively, from preoccupation with the practical problems; and the clarification of theory is dependent on an identification of the practical problem inherent either in the subject or in the theory. The two levels of theory has been clarified.

Three people have been most influential in that they realize, in my continuing work, the importance of Boulding, Bernard F. Haley, and his associates, particularly at The RAND Corporation. Their ideas and stimulated my own work. Brodie, Daniel Ellsberg, Malcolm Gladwell, William W. Kaufmann, and Arthur D. Little. Taylor gave me valuable editorial advice and a great deal of appreciation to R. Duncan Luce. The book *Games and Decisions* has been the subject of often focused critical remarks and has been the inevitable lot of a definitive statement on the subject.

During the year before this book was written, I was located to receive stimulation, perspective, agreement, encouragement, and advice from The RAND Corporation, in Santa Monica, California. The people, RAND is superb, and the work of a few whose intellectual impact on me has been more than many others, truly too numerous to mention. They affected the final shape of this book. The collection of people; it is a social and intellectual, imagination, and good will. The book for the shapes my ideas have taken. "I have expressed" — but I hope it will, and I hope it will, from its responsibility for some of the things that have happened all.

## EPHFACE

problem is in some contrast to the  
ould otherwise belong.

“pure” and “applied” research. To  
separated, as in the companion  
n thinking they have never been  
purer theory came almost exclu-  
(and fascination with) “applied”  
of theoretical ideas was absolutely  
of live examples. For reasons in-  
n the author, the interaction of the  
ontinuous and intense.

at influential, probably more than  
this work. They are Kenneth E.  
and Charles J. Hitch. Numerous  
RAND Corporation, have lent me  
; I refer especially to Bernard  
colm W. Hoag, Herman Kahn,  
lbert J. Wohlstetter. William W.  
ial help. And I owe a special word  
Luce and Howard Raiffa, whose  
of immeasurable help; if I have  
on the book, it is only because the  
urvey is to serve as a definitive

book went to press I was uniquely  
provocation, advice, comment, dis-  
education. I spent the year with  
Santa Monica. As a collection of  
I have mentioned above only the  
n me was powerful and persistent;  
us to list here, have as individuals  
book. But RAND is more than a  
cial organism characterized by in-  
humor. RAND is not responsible  
e taken — the “views herein ex-  
as a corporation, take satisfaction  
e of the ideas’ taking any shape at

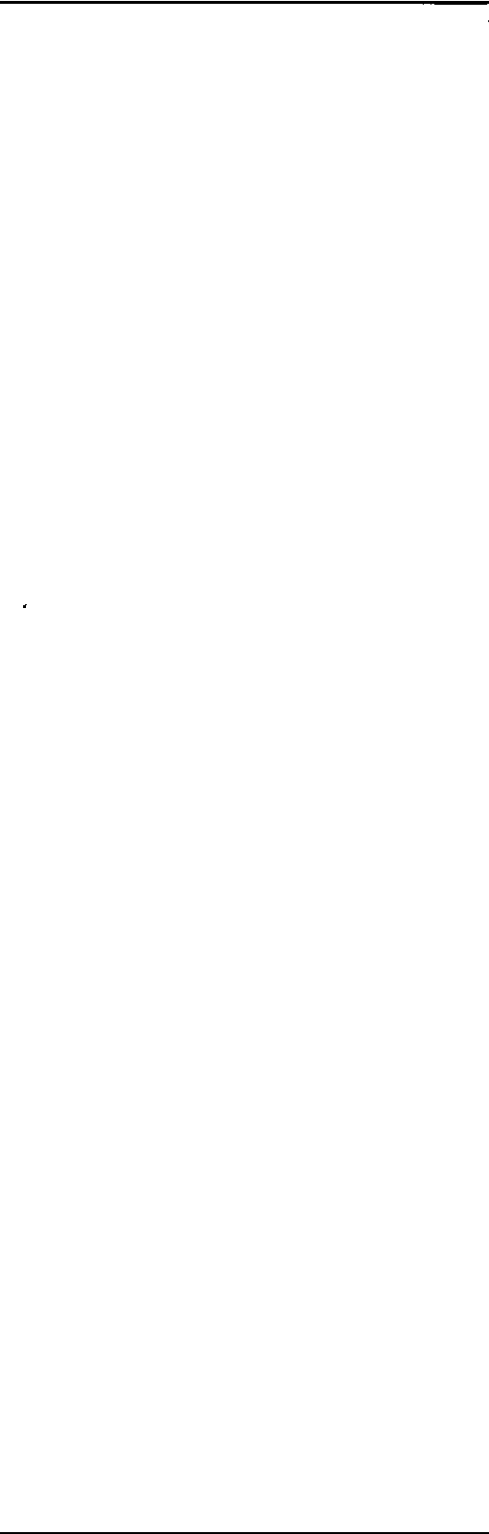
For readers who have come across the following may be of course with the same title in *The American Journal of Political Science* XLVI No. 3, June 1956. Chapter 1 in *The Journal of Conflict Resolution* Chapters 4, 5, and 6 are a somewhat "Strategy of Conflict," *The Journal of Conflict Resolution* No. 3, September 1958, with pages 1-10 and other chapters. Appendix B appeared in *Review of Economics and Statistics* 41, 1959. A longer version of Chapter 1 is contained in Klaus Knorr (ed.), *Conflict and Cooperation* (Princeton: Princeton University Press, 1960). Publishers have kindly allowed me to make some modifications to make an integrated

*Cambridge, Massachusetts*

cross some of the chapters be-  
venience. Chapter 2 appeared  
*American Economic Review*, Vol.  
3 appeared with the same title  
*Journal of Law and Economics*, Vol. I No. 1, March 1957.  
that rearranged version of "The  
*Journal of Conflict Resolution*, Vol. II  
parts eliminated that overlapped  
red, with the same title, in *The*  
*Journal of Politics*, Vol. XLI No. 3, August  
1957, with the same title, is con-  
*NATO and American Security*,  
Harvard University Press, 1959). The several pub-  
lications reprint these papers here, with  
this book.

THOMAS C. SCHELLING





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## THE RETARDED INTERNATIONAL

Among diverse theories of conflict there are diverse meanings of the word "conflict." One division is between those that treat conflict as a social phenomenon, its causes and treatment, and those that study the behavior associated with conflict. A further division is between those who study behavior in a conflict in all their complexity, "rational" and "irrational" behavior, and those who focus on motivations as well as to calculate the more rational, conscious, and calculated behavior. Speaking, the latter treat conflict as a game, the participants are trying to "win." The former is like a search for rules of "conflict" that have a meaning.

We can call this field of study "conflict studies." We can be interested in it for at least three reasons: we are all in a conflict ourselves; we all are interested in conflict, and we want to understand it; we may wish to understand how people behave in conflict situations. The study of conflict play may give us a bench mark.

<sup>1</sup>The term "strategy" is taken, here, from the military. It distinguishes games of skill, games of chance, and games of luck, being those in which the best course of action is determined by the other players do. The term is interesting in that it is the adversaries' decisions and on their behavior. This is not the military usage.

## SCIENCE OF AL STRATEGY

conflict — corresponding to the di-  
nflct” — a main dividing line is  
as a pathological state and seek  
ose that take conflict for granted  
d with it. Among the latter there  
ose that examine the participants  
xity — with regard to both “ra-  
r, conscious and unconscious, and  
culations — and those that focus  
artful kind of behavior. Crudely  
t as a kind of contest, in which  
in.” A study of conscious, intelli-  
vior — of successful behavior —  
rrect” behavior in a contest-win-

the *strategy* of conflict.<sup>1</sup> We can  
ree reasons. We may be involved  
e, in fact, participants in interna-  
“win” in some proper sense. We  
participants actually do conduct  
; an understanding of “correct”  
for the study of actual behavior.

from the *theory of games*, which dis-  
ance, and games of strategy, the latter  
action for each player depends on what  
ded to focus on the interdependence of  
expectations about each other's behavior.

We may wish to control or influence international conflict, and we want, therefore, to know what are subject to our control can do.

If we confine our study to the rational, we may restrict ourselves by the assumption that behavior is just of intelligent behavior, but not of unconscious calculation of advantage. This is based on an explicit and internal logic, and thus limit the applicability of any theory. The study of actual behavior is the study of actual behavior, and any constraint may prove to be either a useful tool or a caricature. Any abstraction of behavior have to be prepared to use judgment.

The advantage of cultivating a theory of rational development is not that, but that one that evidently stays closest to the actual. The notion of rational behavior is a part of the subject that is peculiarly of the theory. It permits us to identify actual behavior with those of the hypothetical, and thus demanding certain kinds of conditions. If we use hypothetical participants, we can compare actual behavior according to whether it is consistent of consistency. The premise of a theory is one for the production of theory, and provides good or poor insight in the matter for subsequent judgment.

But, in taking conflict for granted, we deny that there are common as well as different among the participants. In fact, the right to the fact that, in international affairs, there is as well as opposition. Pure conflict is not antagonists are completely opposite, and arise in a war of complete extermination. For this reason, "winning" has a strictly competitive meaning; it means gaining relative advantage over an adversary. It means gaining relative



## THEORY OF STRATEGY

fluence the behavior of others in order to know how the variables that affect their behavior.

In the theory of strategy, we seriously question the notion of rational behavior — not the notion of behavior motivated by a conscious calculation that in turn is based on a generally consistent value system. We question any results we reach. If our interest is in the results we reach under this theory, then we run a risk of this sort, and we question any results we reach.

Within the area of "strategy" for the theory of all possible approaches, it is the theory that is closest to the truth, but that the assumption is not the most productive one. It gives a grip on the theory conducive to the development of the theory. It gives our own analytical processes a grip on the behavior of our participants in a conflict; and by the consistency in the behavior of our participants, we can examine alternative courses of action to see if they meet those standards of "rational behavior" is a potent theory. Whether the resulting theory is translated into actual behavior is, I repeat, a

questioned, and working with an image of the theory, a theory of strategy does not work as well as conflicting interests among participants. If the richness of the subject arises from the complexity of the subject, there is mutual dependence in the theory, in which the interests of two participants are involved, is a special case; it would be a special case, otherwise not even in the theory. "Winning" in a conflict does not have a meaning that is not winning relative to one's own value system; it is relative to one's own value system;

## INTERNATIONAL

and this may be done by bargaining and by the avoidance of mutual damage, but if the finish has become inevitable conflict; but if there is any possibility of avoiding a damaging war, of conducting a war with less damage, or of coercing an advantage rather than waging it, the possibility is as important and dramatic as the event itself. Deterrence, limited war, and disarmament are concerned with the common interests that can exist between participants.

Thus, strategy — in the sense of a game — is not concerned with the efficiency of the *exploitation of potential force* but with the behavior of enemies who dislike each other but do not disagree with each other. It is concerned with the distribution of gains and losses between two or more participants that particular outcomes are worth more than certain other outcomes. In the most interesting international "games" but "variable-sum game" the number of participants involved is not fixed and the gain for one means less for the other. There are also outcomes that are mutually advantageous.

To study the strategy of conflict situations are essentially situations in which the ability of one participant is dependent to an important degree on the behavior of the other participant will be implicit, as when one offers a concession, as when one occupies or threatens, as in the ordinary haggling over a price, *status quo* as its zero point and seeking to achieve positive gains to both sides; or it may be concerned with including mutual damage, as in a situation of extortion.

Viewing conflict behavior as a game is a way of keeping us from becoming exclusivists.

ning, by mutual accommodation, ly damaging behavior. If war to e, there is nothing left but pure ssibility of avoiding a mutually arfare in a way that minimizes rsary by threatening war rather of mutual accommodation is as element of conflict. Concepts like armament, as well as negotiation, interest and mutual dependence nts in a conflict.

in which I am using it here — nt *application* of force but with ce. It is concerned not just with out with partners who distrust or ncerned not just with the division claimants but with the possibility orse (better) for *both* claimants the terminology of game theory, conflicts are not "constant-sum s": the sum of the gains of the l so that more for one inexorably is a common interest in reaching ntageous.

ict is to take the view that most *bargaining* situations. They are f one participant to gain his ends egree on the choices or decisions nake. The bargaining may be ex- ession; or it may be by tacit ma- r evacuates strategic territory. It g of the market-place, take the eek arrangements that yield posi- ay involve threats of damage, in- trike, boycott, or price war, or in

a bargaining process is useful in ively preoccupied either with the

conflict or with the common i  
neuers and actions of limited  
emphasize that, in addition to t  
variables in dispute, there is a p  
ing an outcome that is not enc  
both sides. A "successful" em  
destroys the employer financial  
takes place. Something similar o

The idea of "deterrence" has  
tive for our purpose. It is a doz  
ticulated as the keystone of o  
those years the concept has bee  
learned that a threat has to be c  
its credibility may depend on th  
fulfillment for the party makin  
the idea of making a threat cr  
mitted to its fulfillment, throug  
across the enemy's path of adv  
matter of national honor and p  
the Formosa Resolution. We ha  
fight limited war in particular a  
of massive retaliation, by presen  
the contingency arises. We have  
retaliatory threat may be more  
it out and the responsibility for r  
of those whose resolution is stro  
"nuclear sharing." We have obs  
adversary is pertinent to the eff  
men, like small children, can of  
We have recognized that the ef  
on what alternatives are availab  
if he is not to react like a trapped  
recourse. We have come to realiz  
tion gives the enemy every in  
choose not to heed the threat, to  
all-out strike at us; it elimina  
forces him to choose between ext

## THEORY OF STRATEGY

interest. To characterize the war as a bargaining process is to see the divergence of interest over the powerful common interest in reach- ing a mutually destructive of values to employees' strike is not one that is true, it may even be one that never can be true of war.

We have had an evolution that is instructive in ten years since deterrence was our national strategy, and during which it has been refined and improved. We have learned that threats are credible to be efficacious, and that the costs and risks associated with carrying out the threat. We have developed a strategy that is credible by getting ourselves committed to the stretching of a "trip wire" that will trigger a response, or by making fulfillment a matter of national prestige — as in the case, say, of the Cuban missile crisis. We have recognized that a readiness to retaliate in kind may detract from the threat by giving the choice of a lesser evil if the threat is not considered the possibility that a threat is credible if the means of carrying out retaliation are placed in the hands of the potential enemy, as in recent suggestions for a "no first use" policy. We have learned that the rationality of the threat depends on the credibility of a threat, and that madmen are not to be controlled by threats. We have learned that the efficacy of the threat may depend on the credibility of the threat to the potential enemy, who, like a lion, must be left some tolerable margin of safety. We have learned that a threat of all-out retaliation, in the event he should initiate his transgression with an eye for an eye, is not a lesser course of action and is not a lesser threat. We have learned that the

threat of massive destruction must be a corresponding implicit promise that he complies, so that we must commit ourselves to strike him by surprise and to avoid being disarmed by a first connection with the so-called "surprise attack," we have begun to prove mutual deterrence through

What is impressive is not how deterrence has become, and how care developed, but how slow the process is. This is not said to depreciate the struggle with the deterrence concept. On strategic matters of which we who have tried to devise policies had little or no help from an already have had to create their own scientific literature on deterrence, say, the literature on inflation, reading, or smog.

Furthermore, those who have deterrence, being motivated largely primarily been concerned with building a theoretical structure. The policy-makers and journalists believe. Whether it reflects the scholars the literature on deterrence and preoccupied with solving immediate methodology for dealing with p

<sup>2</sup> There are some excellent examples. "Securing Peace Through Military Tests," *Foreign Affairs*, 12:159-164 (May 1956). And Warren Amster reminds us that when problems, as so much of it currently is, it are undoubtedly, also, serious editorial affairs appeal to a dominantly nontheoretical content must often be practical problems. The recent devotion of Anatol Rapoport's magnificent essay

may deter an enemy only if there is a possibility of nondestruction in the event of a strike. We should consider whether too great a capacity for destruction may induce him to strike first to prevent us from striking him. And recently, in discussing measures to safeguard against surprise attack, we should consider the possibility of international arms control.

How complicated the idea of deterrence has become, how refined and developed it has been, how vague the concepts, and how different the current theory of deterrence from the efforts of people who have worked on this concept over the last dozen years.

As an example, those who have tried to meet urgent problems have had to draw on a ready existing body of theory, but they have not done so as they went along. There is no theory that begins to compare with, for example, Asiatic flu, elementary-school

problems. We have grappled with ideas like deterrence in the face of immediate problems, have not had time for the cumulative process of development, and this seems to be true not only of the popular press but of the more scholarly as well.

The interests of the editors, and the related concepts has been mainly with immediate problems rather than with a broader theory.<sup>2</sup> We do not even have a

theory to the contrary, like C. W. Sherwin, "Deterrence and Technology," *Bulletin of the Atomic Scientists*. Sherwin's reference there to a paper by Lewis F. Richardson is stimulated by military problems, and may not receive open publication. There are many material obstacles; journals in international relations have a theoretical audience, and articles with high technical content are urged of it and focused on immediate problems. An entire issue of *Conflict Resolution* to date has been devoted to "Lewis F. Richardson's Mathematical

decent terminology; occasional to deterrence do not begin to fill th

How do we account for this lac think one significant fact is that to almost any other sizable and identifiable academic counterpart fields of economics, medicine, p education, or criminal law, can counterpart in the academic wor trained people who are doing re pares well with the number eng ministration.) But where is th military profession?

It is not — on any great sca these are undergraduate school rather than to research. Not — in the war colleges and other no institutions within the military s veloped the permanent faculty, t value system required for susta development.

Within the universities, milita been the preoccupation of a smal ical scientists, supported on a so the Russians from a conquest of enforcing the antitrust laws. Th accomplishments, but to emphas there has usually been no direct of inquiry that can be associate and the role of force in foreign r recently become a limited except extent that they induce the orga history and political science.) T institutes now found on a numbe given to international security p a novel and significant develop

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Theory of War" (vol. I, No. 3, Septer other direction.



## THEORY OF STRATEGY

terms like "active" and "passive" are needed.

lack of theoretical development? In the military services, in contrast to the respectable profession, have no such counterparts. Those who make policy in the fields of public health, soil conservation, and so on, readily identify their scholarly counterparts in the world. (In economics the number of research and writing books commissioned in economic policy or administrative work is the academic counterpart of the

available — in the service academies; in the universities, devoted mainly to teaching and not yet on any great scale — in the non-technical advanced educational services; these have not yet developed the research orientation, and the discipline and systematic theoretical

strategy in this country has a small number of historians and political scientists that suggests that deterring the Soviet Union in Europe is about as important as deterring the Chinese. This is said not to disparage the size of the problem that within the universities there is no identifiable department or line of study related with the military professions and their relations. (ROTC programs have not yet come to this point, at least to the extent of the organization of pertinent courses in the defense-studies programs and the attention of campuses, and the attention of the problems by the foundations, are not yet adequate. New quasi-governmental

(November 1957) is a heartening sign in the

research institutions like The Institute for Defense Analysis are needed but, for our purpose, can be

One may ask whether the military cannot be able to produce a growing number of ideas like deterrence or limited war have to be developed solely by scholars. If the military services are interested in the effective *use* of military force, it may not be able to theorize about it. But here a distinction between the *application* of force and deterrence is concerned with the experience of the military and the scholar is concerned with persuading a politician to avoid certain courses of action. An important difference between the scholar and the military is in carrying out a military mission. The scholar's capability to pursue a nation's interest would be, in effect, a theory of strategy for the forces, and for this purpose the scholar's skills are broader than military skills. The military does not have these broader skills, but they do not have the result of meeting their primary responsibilities place fully.

A new kind of inquiry that goes beyond the traditional leading to such a theory of strategy is concerned with situations — situations that are like games of skill or games of chance. The theory of action for each participant

<sup>3</sup> The lack of a vigorous intellectual life in the military is forcefully discussed by Bernard Brodie in *The Missile Age* (Princeton, 1959). See also Greene's foreword to the *Modern Land Warfare* (New York, 1943): "During most of the last century the two highest schools of our Army were for a few months' duration for all officers selected for advanced study no time at either place for study of the history of strategy and theory. . . . If ever more extensive periods of two or three months of the military thinkers would surely develop" (pp. xi-xii).

RAND Corporation and the Institute are importantly helping to fill the gap. This is cited as evidence of the need.

Military services themselves might benefit from a body of theory to illuminate the conduct of war. After all, theory does not come from specialists isolated in universities. They are intellectually prepared to make effective use of it. It might seem that they are equipped to make a useful distinction can be made between the *threat* of force. Deterrence is the exploitation of potential force. It is the potential enemy that he should incur the consequences of activity. There is an imbalance between the intellectual skills required for the use of force and for using *potential* military force. A theory of deterrence requires something that the skillful *nonuse* of military force. Deterrence requires something that the military professions may have but do not automatically have them as part of their primary responsibilities, and those responsibilities are all-time demands on their time.<sup>3</sup> There is a promise, fifteen years ago, of a new theory is *game theory*. Game theory is a theory of "games of strategy," in contrast to the traditional games of chance — in which the best course of action depends on what he expects the

tradition in the field of military strategy. This is done in the first chapters of his *Strategy* (1949). Pertinent also is Colonel Joseph I. G. The Library edition of Clausewitz, *On War* (1908). In the years between the great wars, the training was limited to a single course of some ten weeks. . . . There could be no more long development of military thought. The periods of higher training become possible for three years' duration — the greatest of which is to "serve a course of study in themselves"

other participants to do. A deterrence strategy is not rational in itself; it works only because of the threat of retaliation. It is not rational for one to do in response to his choice of action because he will make the threat only because he will not retaliate on his choice. But in international relations, the concept of deterrence theory is so far unfulfilled. Game theory is so far unfulfilled. Game theory is so far unfulfilled in the formulation of problems and concepts, but its greatest successes have, on the whole, been pitched at a level that has made little contact with the elements of international relations.

The idea of deterrence figures prominently in conflict other than international relations. It presupposed the existence of a well-organized society to be exploited for international relations. It has been an important concept in international law. Legislators, jurists, lawyers, and social scientists have subjected the concept to a close analysis for many generations. To be sure, the concept is of considerable consideration involved in criminal law. It is an important concept; still, it has figured prominently in the study of crime. To suppose the existence of a theory of deterrence, the kinds and sizes of penalties applied to a convicted criminal, the potential criminal, the probability of crime, the law-enforcement system, to apprehend criminals and to get them into court, the seriousness of the law and of the punishment, the extent to which a person is deterred by conviction, the extent to which a person is motivated by rational calculation, the extent to which a person is motivated to be neither niggardly nor so far from a rational application of the concept.

<sup>4</sup> Jessie Bernard, writing on "The Theory of Conflict," gives a somewhat similar concept that the mathematics required to reduce the study of games to sociological phenomena will be a major contribution to sociology. (The American Journal of Sociology, 1954, 59, 1-11). She says that the present deficiencies are not in the theory of strategy has suffered from too great a degree of abstraction of the subject as though it were, or should be, a purely mathematical subject.

## THEORY OF STRATEGY

current threat meets this definition of what the other player expects us to do, of moves, and we can afford to do them. We expect it to have an influence on our strategy the promise of game theory has been extremely helpful in the analysis of problems and the clarification of concepts that have been in other fields. It has, however, been at a level of abstraction where it has not been able to deal with elements of a problem like deterrence.<sup>4</sup>

It has been so prominently in some areas of social and political affairs that one might have supposed that the sophisticated theory already available would have had practical applications. Deterrence has been a central concept in criminal law for a long time. The application of legal scholars might be supposed to have been rigorous and systematic scrutiny. However, deterrence is not the sole concern of criminal law, nor even necessarily the most prominent. It is not enough for one to know the law that would take into account the consequences available to be imposed on a criminal, the criminal's value system, the profit-maximizing system's ability to apprehend and convict, the criminal's awareness of the probability of apprehension and conviction, the different types of crime are committed, the resoluteness of society to impose the penalty and how well this reso-

lution is being applied. The theory of Games as a Modern Sociology is a useful appraisal but adds that "we may expect to make a fruitful application of the theory in the not-too-distant future" (p. 59:418, March 1954). My own view is that the theory is not in the mathematics, and that the theory is not a willingness of social scientists to treat it as a branch of mathematics.

luteness (or lack of it) is knowledge of mistakes in the system, the ability to exploit the system for personal gain between organized society and criminals to defeat the system,

It is not only criminals, however, who have to be deterred. Some aspects of child discipline: the importance of discipline on the part of the person who does not comprehend the threat if he hears the din and noise, of the threatened person if need be --- and, more important, the party's conviction that the threat is perhaps in child discipline than in any other. The important possibility that the threatener as much as it will threaten. There is an analogy between a person who threatens that a wealthy paternalist government of a poor country will demand "sound" military policies in return.

And the analogy reminds us that the concept of deterrence is as relevant to relations between potential enemies. (The threat of a "strategy" if France failed to ratify the Community Treaty was subject to the threat of retaliation.) There may be both conflict and common interest involved; it is as inapplicable to relations of complete antagonism of interest as to relations of complete common interest. Between an ally and deterring an enemy, however, we may have to develop a more complex strategy even say in a meaningful way with Russia or with Greece, rela-

<sup>6</sup> It may be important to emphasize that "common interest," I do not mean that they must have a similarity in their value systems. They

to the criminal, the likelihood of possibilities for third parties to gain, the role of communication with the criminal, the organization of the criminal, and so on.

However, but our own children that the threats of deterrence stand out vividly because of rationality and self-discipline to be deterred, of his ability to understand it and to hear it through the parent's determination to fulfill the threat. The important, of the threatened punishment will be carried out. Clearer in criminal deterrence is the im- pending punishment will hurt the one threatened, perhaps more. A parent's threat to a child and the threat a nation makes to the weak and poor nation in, say, extending foreign economic policies or cooperative

that, even in international affairs, relations between friends as between enemies to withdraw to a "peripheral" situation to justify the European Defense Community. Many of the same disabilities of the deterrence concept requires that a common interest between the parties leads to a situation of pure and complete deterrence. It is to the case of pure and complete deterrence between these extremes, deterring threats differ only by degrees, and in fact a coherent theory before we can determine whether we have more in common with the other than with the enemy relative to the conflicts between us.<sup>5</sup>

That, in referring to a "common interest" we have what is usually referred to as a "common interest" may just be in the same boat together;

The deterrence idea also crops up in the case of automobile drivers. Automobile drivers have an evident common interest in avoiding collision and a conflict of interests in the event of collision. One shall slam on his brakes and let the other pass about as mutual as anything can be. If one can threaten, the maneuver of mutual damage to another driver in any way are an instructive example of deterrence. A pledge to fulfill is made not by saying so, but by showing the power to do otherwise.

Finally, there is the important question of international war. Both civil war and international war have a common interest in avoiding violence, but both are continually on call. It is interesting to note that criminals, like delinquents, engage in limited deterrence, surprise attack, retaliation, and so on. They worry about "appeasement" and they make alliances and agreements. Nations are subject to — the international law is an authority in the interest of contract.

There are consequently a number of areas for study that may yield insight into the nature of the international area. Often a principle of interest is hidden in a mass of complex data, or structure, or that we cannot see clearly. It is easier to perceive in another field where the vividness or where we are not biased. It may be easier to articulate the principle in a field where

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they may even be there only because of the advantage to get in that position — to get on the boat. If being overturned together in a storm, given the array of alternatives available, the "common interest" in the sense intended in the text may seem more descriptive. Deterrence, for example, is one's own course of action with the common interest that exploits that potential common interest.



## THEORY OF STRATEGY

comes up casually in everyday affairs. A frequent common interest in avoiding collision is over who shall go first and who shall pass the other through. Collision being inevitable, and often the only thing that can be done, and by which one conveys a threat to the other, as in river aggressing on one's right of way, or of the kind of threat that is common in business, and of the threat in which the threat is conveyed by verbal announcement but by loss of face.

Another area of the underworld. Gang wars are a lot in common. Nations and outlaws use similar systems to help them govern their territories. Both have an interest in violence. Both have an interest in the threat of violence is common to both. That racketeers, as well as gangs, use similar methods of war, disarmament and disengagement, and threat of retaliation; and they use the same "loss of face" and loss of face; and they use the same disability that makes them unable to appeal to higher authority for enforcement.

Another area of other areas available for study is the one that concerns us, the principle that in our own field of interest, or in detail, or has too complicated a structure because of a predisposition, is often found where it enjoys simplicity and clarity, and is often blinded by our predispositions. It is a peculiar difficulty of constraining

When one of them perceived it a strategic interest, they couple their interests in not tipping the scales. If the same boat is a potential outcome, and if it is to both parties, they have a "common interest." "Potential common interest" might be an example, is concerned with coupling one's course of action in a way that

a Mossadeq by the use of threat attempt at using threats to keep or a small dog from hurting a child.

None of these other areas of conflict is covered by a well-developed theory used in the analysis of international relations. Those who study criminal behavior have not traditionally been much concerned with the *strategy* of conflict. Nor do criminology reveal an appreciable amount of theory on this subject. I cannot confidently assess the quality of the textbooks, or original works on this subject, circulating in the underworld; but I have seen one, showing how to use extortion, showing how to use extortion, up as "New Ways in Child Guidance" for it.<sup>6</sup>

What would "theory" in this field do? What questions would it try to answer? Would it unify, clarify, or communicate? What should it define the essentials of? What is in question. Deterrence — to coin a term — is a strategic concept — is concerned with the expectations of how we will behave, based on evidence for believing that we will behave by his behavior.

But what configuration of variables makes a deterrent threat credible? What configuration of conflict and common interests makes a "deterrence" situation? What communication means of authenticating the evidence? What "rationality" is required of the actor? What is the edge of his own value system, and

<sup>6</sup> Progress is being made. Daniel Ellsberg's "Theory and Practice of Blackmail," and one of his series on "The Art of Coercion," appeared in *Foreign Affairs*, March 1959.

s when one is fresh from a vain  
a small child from hurting a dog  
d.

conflict seems to have been mas-  
that can, with modification, be  
onal affairs. Sociologists, includ-  
behavior in underworld conflict,  
concerned with what we would  
r does the literature on law and  
e body of explicit theory on the  
ert that there are no handbooks,  
a the pure theory of blackmail  
out certainly no expurgated ver-  
n and how to resist it, has shown  
idance," in spite of the demand

field of strategy consist of? What  
er? What ideas would it try to  
more effectively? To begin with,  
the situation and of the behavior  
continue with deterrence as a typi-  
ned with influencing the choices  
and doing it by influencing his  
ave. It involves confronting him  
our behavior will be determined

value systems for the two partici-  
the language of game theory —  
e? How do we measure the mix-  
erest required to generate a "de-  
munication is required, and what  
lence communicated? What kind  
e party to be deterred — a knowl-  
n ability to perceive alternatives  
berg included a lecture on "The Theory  
on "The Political Uses of Madness," in  
ponsored by the Lowell Institute, Boston,

and to calculate with probabilities (and an inability to conceal) his own

What is the need for trust, or especially, in addition to threatening to withhold the damage if compliance depends on the configuration of the "legal system," communication structure is needed to make the necessary

Can one threaten that he will not act? Must he threaten that he certainly will act? Can one threaten that one will "probably" act? If one has retained any choice, he'd have no choice. More generally, what are the conditions for a threat to be committed to fulfillment that he would not act, considering that if a communication structure is needed enough to be effective it need not be. Is there a difference, if any, between a threat that compels action, or a threat designed to deter action from his own mistakes? Are threats that are deterrent, disciplinary, and extortionary

How is the situation affected by the existence of his own mixture of conflict and cooperation? Who is ready present, who has access to the communication system, whose behavior is rational? How does another, who enjoys trust or some form of cooperation with one or another of the participants, affect the questions affected by the existence of a legal system that prohibits certain actions, the threat of nonfulfillment of contract, or the threat of information from the participants. How do we operationalize concepts like "reputation," "trust," etc. in a real or hypothetical legal system? How do the participants' value systems, or the value systems of the players concerned to additional questions affect the

This brief sample of questions is intended to provide a starting point for the creation of "theory." The theory is intended to be like a mixture of game theory, etc.

## THEORY OF STRATEGY

...es, an ability to demonstrate (or  
...rationality?

...enforcement of promises? Specific-  
...damage, need one also guarantee  
...pliance is forthcoming; or does  
...n of "payoffs" involved? What  
...system, or information struc-  
...ssary promises enforceable?

...l "probably" fulfill a threat; or  
...y will? What is the meaning of a  
...fulfill when it is clear that, if he  
...o incentive to fulfill it after the  
...e devices by which one gets com-  
...uld otherwise be known to shrink  
...itment makes the threat credible  
...t be carried out. What is the dif-  
... that deters action and one that  
...ned to safeguard a second party  
...re any logical differences among  
...ionate threats?

...by a third participant, who has  
...common interest with those al-  
...or control of the communication  
...nal or irrational in one sense or  
...ome means of contract enforce-  
...e two principals? How are these  
...ce of a legal system that permits  
...at is available to inflict penalty  
...r that can demand authentic in-  
... . To what extent can we ration-  
..."face," or "trust," in terms of a  
... , in terms of modification of the  
...in terms of relationships of the  
...participants, real or hypotheti-

... may suggest that there is scope  
...ere is something here that looks  
...organization theory, communica-

tion theory, theory of evidence, collective decision. It is faithful; it takes conflict for granted, but it is not a theory of conflict; it is between the adversaries; it assumes a certain mode of behavior; and it is a theory of a participant's "best" choice of a course of action; it expects the other to do, and that "best" choice is with influencing another's choice of action; it is a theory of how one's own behavior is related to the behavior of others.

There are two points worth noting. First, the "strategy of conflict" sounds cold and unfeeling; it is concerned with the efficient *application* of the theory; it is not essentially a theory of war. *Threats* of war, yes, or the employment of threats, or the conditioning of behavior of others, that the theory is concerned with.

Second, such a theory is not a theory of conflict and the common interest; it is a theory of potential enemies and its application is a theory that degenerates at one extreme into a theory of accommodation, no common interest, and at the other into a theory of mutual disaster; it degenerates at the one extreme into a theory of conflict at all and no problem in common goals. But in the area between the two extremes is noncommittal about the mixture of conflict and common interest; we can equally well call it a theory of partnership or the theory of incomplete cooperation; it is pointed out that some central problems in international affairs are the problem of mutually suspicious cooperation.

Both of these points — the need for a theory of conflict and the respect to the degree of conflict — are points that the "strategy" as concerned with cooperation is concerned with.

<sup>7</sup> In using the word "threat" I have no hostile connotations. In an explicit or implied cooperation between them, the threat of non-cooperation, expressed or implied, is a sanction by which in a commercial transaction an offer is made.

theory of choice, and theory of to our definition of "strategy": also assumes common interest and a "rational" value-maximizing focus on the fact that each action depends on what he expects. "Strategic behavior" is concerned with working on his expectations and to his.

stressing. One is that, though blooded, the theory is not concerned with violence or anything of the sort, or of aggression or of resistance to threats of anything else; but it is concerned with threats and promises, or more generally with one's own behavior on the basis of what others are doing about.

and indiscriminatory as between the two, as between its applicability to potential enemies and potential friends. The theory is neutral about the possibility of mutual interest at all even in avoiding mutual destruction, and the other extreme if there is no possibility of mutual interest in identifying and reaching common ground between those two extremes the theory is neutral about the nature of conflict and common interest. It is neutral about the theory of precarious participation in mutual antagonism.<sup>7</sup> (In Chapter 9 we discuss some special aspects of the problem of survival in a world of mutual antagonism which are structurally identical with the problem of survival in a world of mutual cooperation.)

neutrality of the theory with respect to the nature of the conflict involved, and the definition of "strategic behavior" as the constraining an adversary through the use of threats, is not intended any necessarily aggressive negotiation between friends or in tacit agreement or of reduced cooperation, but rather the support their demands, just as in a market where the price is enforced by threat of "no sale."

his expectation of the consequences of his actions, we might call our subject the *theoretical actor*.

Threats and responses to them, negotiations, reprisals, limited war, arms races, bluffing, trusting and cheating can be viewed as goal-headed activities. In suggesting that the goal-headedness in the development of theory, a theory should be asserted that they are in fact evidence of a goal-headedness. It is asserted that the assumption of a goal-headedness in the generation of systemically rational, cool-headed, valid and reliable theory is easier to create than it actually is. A goal-headedness benchmark for further approximation to an adequate theory, we should manage to avoid the worst results of a biased theory.

Furthermore, theory that is based on the assumption that participants coolly and "rationally" act according to a consistent value system is not thoroughly about the meaning of the actions. They are not simply distributed along a continuum that stretches from complete rationality at one end to irrationality at the other. Rationality and irrationality are departures from complete rationality in different directions. Irrationality can be defined as a consistent value system, faulty calculation, or failure to communicate effectively. Irrationality can be caused by haphazard influences in the realization of them, or in the reception of them, and it sometimes merely reflects a lack of communication among individuals who do not act rationally and whose organizational arrangements do not cause them to act rationally.

As a matter of fact, many of the assumptions of a model of rational behavior can be viewed as types of rationality or irrationality. In a communication system, the information process, or a parameter representation of a system, the



## THEORY OF STRATEGY

ces of his actions — suggest that  
*theory of interdependent decision.*

reats, reprisals and counter-re-  
s, brinkmanship, surprise attack,  
wed as either hot-headed or cool-  
that they can usefully be viewed,  
s cool-headed activities, it is not  
ntirely cool-headed. Rather it is  
rational behavior is a productive  
atic theory. If behavior were ac-  
levant theory would probably be  
y is. If we view our results as a  
mation to reality, not as a fully  
age to protect ourselves from the

based on the assumption that the  
ally" calculate their advantages  
system forces us to think more  
f "irrationality." Decision-makers  
ng a one-dimensional scale that  
ality at one end to complete ir-  
ality is a collection of attributes,  
rationality may be in many dif-  
an imply a disorderly and incon-  
dulation, an inability to receive  
ciently; it can imply random or  
aching of decisions or the trans-  
pt or conveyance of information;  
s the collective nature of a deci-  
not have identical value systems  
gements and communication sys-  
ke a single entity.

the critical elements that go into  
can be identified with particular  
lity. The value system, the com-  
ation system, the collective deci-  
representing the probability of error

## INTERNATIONAL

or loss of control, can be viewed as a study of "irrationality." Hitler, the commander of a bomber, the radical Khrushchev, and the American president are all guilty of some kinds of "irrationality," but not all. Some of them can be accounted for by neurotic behavior. (Even the neurotic, with the proper method of reconciling them, motives can be reconciled his conflicting goals, making them as a *pair* of "rational" entities with the ability to make collective decisions through a haphazard or random element, and so forth.)

The apparent restrictiveness of neurotic behavior — of a calculating, valueless decision — is mitigated by two additional factors. I can only allege at second hand that Hitler was emotionally unbalanced, among the things often observed an intuitive approach to strategy, or at least of particular tactics that inmates of mental hospitals often display. Instinctively, value systems are susceptible to disciplinary threats and coercion themselves. A careless attitude toward injury — "I'll cut a vein in your arm . . ." — can be a genuine strategy. A motivated inability to hear or to comprehend the frequent lapses of self-control that are often used as deterrents. (Again I am reminded of the fact, one of the advantages of a study of strategic decision in situations of interest is that, by showing the strategic tactics, it can display how some of the tactics are that are practiced by the neurotic. It is not an exaggeration to say that the study of neurotic behavior suppresses sound intuitions, and the purpose of the theory may be to restore some of the "irrationality" superficially "irrational.")

ed as an effort to formalize the  
the French Parliament, the com-  
ar operators at Pearl Harbor,  
electorate may all suffer from  
it by no means the same kinds.  
for within a theory of rational  
with inconsistent values and no  
ivated to suppress rather than to  
ay for some purposes be viewed  
with distinct value systems, reach-  
a voting process that has some  
asymmetrical communications,

of an assumption of "rational"  
ue-maximizing strategy of deci-  
ditional observations. One, which  
d, is that even among the emo-  
certified "irrationals," there is  
preciation of the principles of  
r applications of them. I am told  
often seem to cultivate, deliber-  
systems that make them less sus-  
and more capable of exercising  
or even self-destructive attitude  
in in my arm if you don't let  
ategic advantage; so can a culti-  
prehend, or a reputation for fre-  
make punitive threats ineffectual  
ded of my children.) As a matter  
f an explicit theory of "rational"  
f mixed conflict and common in-  
rategic basis of certain paradoxi-  
und and rational some of the tac-  
untutored and the infirm. It may  
hat our sophistication sometimes  
one of the effects of an explicit  
intuitive notions that were only

The second observation is related to the explicit theory of "rational" decision-making. The consequences of such decisions, making universal advantage in situations that are manifestly rational in decision-making, are attributes of rationality, as in the examples earlier, are strategic disabilities. A person may be perfectly rational to wish to have the power to suspend certain laws in particular situations. And one can speak of "rationality," at least to a limited extent, in terms of the attributes that go to make up a person's character. These are deeply personal, integral attributes that include such things as one's hearing, one's understanding of the legal system, and the rationality of one's actions. In principle, one might evade these attributes by using his brain, conspicuously isolating his assets legally impounded, or by using the law in signing checks. In a theory of decision-making, defenses can be represented as impediments to representing them so. A theory of decision-making postulate is able not only to model a situation but to take its meaning but to take some of its meaning. In fact, the paradoxical role of such situations is evidence of the likelihood that a theory could provide.

And the results reached by a theory of decision-making behavior *are* often somewhat paradoxical. In the example of extortion, the theory predicts that it is variably an advantage to be rational or irrational. In the face of a legal system in good order, to be in full command of one's own assets is an advantage. Mossadeq and my small children were in full command of their assets but the same tactic is illustrated

## THEORY OF STRATEGY

ated to the first. It is that an ex-  
sion, and of the strategic conse-  
es perfectly clear that it is not a  
s of conflict to be inalienably and  
n and motivation. Many of the  
n several illustrations mentioned  
s in certain conflict situations. It  
sh oneself not altogether rational,  
ophically objectionable — to wish  
tain rational capabilities in par-  
suspend or destroy his own "ra-  
extent; one can do this because  
up rationality are not inalienable,  
utes of the human soul, but in-  
ng aid, the reliability of the mails,  
ality of one's agents and partners.  
xtortion equally well by drugging  
ng himself geographically, getting  
r breaking the hand that he uses  
of strategy, several of these de-  
pairments of rationality if we wish  
that makes rationality an explicit  
modify the postulate and examine  
the mystery out of it. As a matter  
of "rationality" in these conflict  
ely help that a systematic theory

a theoretical analysis of strategic  
paradoxical; they often do contra-  
rules. It is not true, as illustrated  
at in the face of a threat it is in-  
tional, particularly if the fact of  
not be concealed. It is not invari-  
of a threat, to have a communica-  
have complete information, or to  
own actions or of one's own assets.  
en have already been referred to;  
l by the burning of bridges behind

oneself to persuade an adversary to retreat. An old English law that tribute to coastal pirates does not seem so odd or anomalous in the light of a theory that political democracy itself requires a system in which the transaction is precluded: the mandatory secret ballot deprives the voter any means of proving whether he is of his power to prove how he voted or to be intimidated. Powerless to resist when faced with a threat, he knows that to threaten him — that any punishment will be applied in the way he actually voted.

The well-known principle that negotiators to represent him and the authority — a principle common to all — is by no means as simple as it suggests; the power of a negotiator to make concessions and while prudence suggests leaving a threatens an adversary with mutual means of escape may make the notion that it may be a strategic option deliberately, or even future actions and make his resolution a hard one to swallow.

Many of these examples involve skill, resourcefulness, rationality of choice. They are all, in principle, instances; but seeing through them the logic behind them is often formalized the problem, studied analogies in other contexts where an obstacle to comprehension.

Another principle contrary to

<sup>8</sup> The administration of foreign aid is an example, T. C. Schelling, "American Foreign Policy (1955)", pp. 614-15.

... that one cannot be induced to ...  
... made it a serious crime to *pay* ...  
... not necessarily appear either cruel ...  
... theory of strategy. It is interesting ...  
... relies on a particular communica- ...  
... smittal of authentic evidence is ...  
... ballot is a scheme to deny the ...  
... ch way he voted. Being stripped ...  
... oted, he is stripped of his power ...  
... o prove whether or not he com- ...  
... — and so do those who would ...  
... ment would be unrelated to the

... at one should pick good nego- ...  
... en give them complete flexibility ...  
... ommonly voiced by negotiators ...  
... as self-evident as its proponents ...  
... tor often rests on a manifest in- ...  
... d to meet demands.<sup>8</sup> Similarly, ...  
... open a way of escape when one ...  
... ually painful reprisal, any visible ...  
... e threat less credible. The very ...  
... gic advantage to relinquish cer- ...  
... n to give up all control over one's ...  
... esponses automatic, seems to be

... olve some denial of the value of ...  
... y, knowledge, control, or freedom ...  
... nciple, valid in certain circum- ...  
... r strangeness and comprehending ...  
... a good deal easier if one has ...  
... it in the abstract, and identified ...  
... ere the strangeness is less of an

... o the usual first impression con-

... presents numerous examples. See, for ...  
... Foreign Assistance," *World Politics* (July

cerns the relative virtues of c. Brodie has pointed out that the requirements of deterrence, in a war that one expects to fight, are a super-dirty bomb.<sup>9</sup> As remarked is not so strange if we recognize a massive modern version of an of hostages.

Here perhaps we perceive a modern students of international Machiavelli or the ancient Chinese stability, and the quiescence of good faith, and mutual respect of view actually encourages trust trust and good faith do not exist acting as though they did, we may underworld, or from ancient deserts work when trust and good is no legal recourse for breach changed hostages, drank wine from the absence of poison, met in peace sacre of one by the other, and efforts to facilitate transmittal of authentic that a well-developed theory of the efficacy of some of those old devices which they apply, and discover offensive to our taste, may be a condition of conflict.

<sup>9</sup> Compare p. 239 below.



## THEORY OF STRATEGY

clean and dirty bombs. Bernard  
when one considers the special re-  
contrast to the requirements of a  
one may see some utility in the  
d in Chapter 10, this conclusion  
the "balance of terror" as simply  
ancient institution, the exchange

disadvantage peculiar to civilized  
al affairs, by contrast with, say,  
nese. We tend to identify peace,  
conflict with notions like trust,  
. To the extent that this point  
and respect it is good. But where  
t and cannot be made to by our  
ay wish to solicit advice from the  
spotisms, on how to make agree-  
ood faith are lacking and there  
n of contract. The ancients ex-  
om the same glass to demonstrate  
public places to inhibit the mas-  
ven deliberately exchanged spies  
entic information. It seems likely  
strategy could throw light on the  
ices, suggest the circumstances to  
modern equivalents that, though  
desperately needed in the regula-

## AN ESSAY ON

This chapter presents a tactical bargaining. The subject includes bargaining of a tacit kind in which adversaries observe each other's behavior, each aware that his own behavior is observed and anticipated, each acting with a view to the behavior he creates. In economics the subject includes tariff negotiations, competition between firms, settlements out of court, and the reallocation of resources. Outside economics it ranges from the allocation of a road to taking the right of way.

Our concern will *not* be with the theory of bargaining. It consists of exploring for mutually beneficial arrangements. It might be called the "efficiency" approach. For example, can an insurance firm be made happier, by offering a cash settlement for a client's car; can an employer save money by a wage increase to employees who will buy more of their wages in merchandise? It is concerned with what might be called the "tacit" bargaining: the situations in which each party is aware of the other's behavior and less for the other. When the bus is crowded, what price does an interested buyer, what price does a seller pay? When two trucks meet on a road wide enough for only one, what price does each pay?

These are situations that ultimately resolve themselves into bargaining — bargaining in which each party is aware of the other's behavior and by his expectations of what the other will do. The bargaining is guided by expectations and knowledge of the other's expectations become compounded. The bargaining ends when one party makes a final, sufficient contribution.

## BARGAINING

l approach to the analysis of bar-  
 ooth explicit bargaining and the  
 watch and interpret each other's  
 own actions are being interpreted  
 h a view to the expectations that  
 subject covers wage negotiations,  
 where competitors are few, settle-  
 l estate agent and his customer.  
 m the threat of massive retaliat-  
 y from a taxi.

the part of bargaining that con-  
 profitable adjustments, and that  
 " aspect of bargaining. For ex-  
 save money, and make a client  
 lement rather than repairing the  
 e money by granting a voluntary  
 agree to take a substantial part  
 Instead, we shall be concerned  
 "distributional" aspect of bar-  
 a better bargain for one means  
 iness is finally sold to the one in-  
 it go for? When two dynamite  
 ough for one, who backs up?  
 nately involve an element of pure  
 ch each party is guided mainly  
 other will accept. But with each  
 owing that the other is too, ex-  
 A bargain is struck when some-  
 oncession. Why does he concede?



## THEORY OF STRATEGY

will not. "I must concede because he thinks I will. He thinks I will concede so. . . ." There is some range of any point is better for both sides to insist on any such point is pure *could* take less rather than reach one always *can* recede if retreat. Yet if both parties are aware of the outcome is a point from which at least one willing to retreat and the other will not.

and if we cannot find it in the tactics employed. It is to call attention to an important point is peculiarly appropriate to the essence of these tactics is the sacrifice of freedom of choice. the power to constrain an adversary to bind oneself; that, in bargaining, freedom may be freedom to retreat behind one may suffice to undo

### POWER TO BIND ONESELF

"bargaining strength," "bargaining skill" is to the powerful, the strong, or if those qualities are defined to be won by those who win. But, if the advantage to be more intelligent or have more financial resources, more potency, or more ability to withstand a disservice. These qualities are essential in bargaining situations; they

may find it difficult to seem as a man. If a man knocks at a door and says "I will not get off the porch unless given \$10,000" or if his eyes are bloodshot. The

threat of mutual destruction cannot who is too unintelligent to comprehend his will on those he represents. To control its balance of payments, or to control its local unity to defend itself, may enjoy it if it could control its own ample familiar from economic theory. Monopoly may be an unprofitable device for firms and assumed performance by the

Bargaining power has also been defined as bluff, "the ability to set the other man into thinking that you are bluffing. Fooling and bluffing are certainly two kinds of fooling. One is deceiving and the other is purely tactical. Suppose a man lies about his income or misrepresents his other, and each knows what the other is fool about? The buyer may say that the price is too high and the seller knows it, but the seller is not a fool. It is a tactical matter not to budge above a certain price. Was he fooled? Or was he convinced? The buyer really not know what he was doing? If the buyer really "feels" himself deceived, he may resolve on the conviction that the seller does, the buyer may say after the fact, "I was fooled." Whatever has occurred, it is not the notions of bluffing and fooling.

How does one person make a decision? The answer depends importantly on the evidence. It is easier to prove the truth of something than to prove something false. To prove the truth of something on a reputable doctor; to prove the truth of something else we may let the person look at the evidence by a reputable firm or the Bureau of Standards. To persuade him of something false we may let him see the evidence.

<sup>1</sup> J. N. Morgan, "Bilateral Monopoly," *American Economic Review*, 63:376-86 (1973).

not be used to deter an adversary  
prehend it or too weak to enforce  
ne government that cannot con-  
ollect taxes, or muster the politi-  
oy assistance that would be de-  
resources. And, to cite an ex-  
eory, "price leadership" in oli-  
distinction evaded by the small  
he large one.

a described as the power to fool  
best price for yourself and fool  
s was your maximum offer." <sup>1</sup>  
y involved; but there are two  
g about the facts; a buyer may  
sent the size of his family. The  
ach knows everything about the  
other knows. What is there to  
that, though he'd really pay up  
he is firmly resolved as a tacti-  
ixteen. If the seller capitulates,  
nced of the truth? Or did the  
ould do next if the tactic failed?  
lf firmly resolved, and bases his  
e seller will capitulate, and the  
terwards that he was "not fool-  
is not adequately conveyed by  
g.

another believe something? The  
ue factual question, "Is it true?"  
something that is true than of  
th about our health we can call  
the truth about our costs or in-  
at books that have been audited  
au of Internal Revenue. But to  
we may have no such convincing

and the Competitive Output," *Quar-*  
August 1949).

When one wishes to persuade more than \$16,000 for a house to what can he do to take advantage of the truth over a falsehood? How can a buyer make it true? Near his business, he might mislead the seller that the house is really not worth \$16,000; he is not willing to pay a higher price.

But suppose the buyer could make a forceable bet with some third party according to which he would win \$16,000, or forfeit \$5,000. The seller would simply present the truth. Unless the seller holds the house in sheer spite against him; the "objective" situation — has been voluntarily, and unambiguously, changed. The seller can take it as a challenge that if the buyer can achieve his aim in a way that is unambiguous, he will squeeze the range of indeterminacy to his favor. It also suggests that the problem is one that may or may not be solved. One can find an effective device for solving the problem on who he is, who the seller is, what the legal and institutional arrangements are. For example, whether bets are legal.

If both men live in a culture where a bet is universally accepted as potent, all that the buyer has to do is to say he will pay no more than \$16,000, and he wins — or at least he wins if he can get to it by shouting "\$19,000, cross my heart." The agent authorized by a board of directors to sell the house a cent more, and the directors of the board for several months and the buyer wins — and if all this can be made known to the seller, the buyer "wins" — if, again, the seller has committed himself to \$19,000. Or, if the



## THEORY OF STRATEGY

Is there someone that he would not pay for that is really worth \$20,000 to him, at the expense of the usually superior credit assertion? Answer: make it true.

If he likes the house because it is worth more to him, persuade him to move his business, persuading the house is now worth only \$16,000 to him. This is the better off than if he had paid the

seller would make an irrevocable and enforceable contract, duly recorded and certified, to pay for the house no more than the value the seller has lost; the buyer need not pay more than the seller is enraged and with-  
out, the situation has been rigged situation — the buyer's true intention is to buy the house conspicuously, and irreversibly for the house or leave it. This example demonstrates that without an irrevocable *commitment*, which is clearly visible to the seller, he can reduce the buyer's threat down to the point most easily available; whether the buyer's intention of committing himself may depend on the location where they live, and a number of other factors (including, in our artificial situation, the law is fully enforceable).

Where "cross my heart" is used, the buyer has to do is allege that he will pay for the house, using this invocation of penalty, which binds if the seller does not beat him with "cross my heart." If the buyer is an agent of the directors to buy at \$16,000 but not more, and cannot constitutionally meet again the seller, the buyer cannot exceed his authority, which is given down to the seller, then the buyer is not tied himself up with a commitment. The buyer can assert that he will pay

no more than \$16,000 so firmly that the loss of personal prestige or bargain and if the fact of his paying more and if the seller appreciates all that itself may provide the commitment needless surrender of flexibility unlikely and understandable to the seller.

Incidentally, some of the more commitments are not as effective as they are the self-inflicted penalty through the seller to seek out the third party consideration of the latter's release threatening to sell the house for \$16,000 coming. The effect of the bet — as commitments — is to shift the locus of action in the hope that the third party will be more or less subject to an incentive. Differently, a *contractual* commitment is a contingent "transfer cost," not a fixed cost. Parties can be brought into the negotiation if the terminacy remains as it was. But it is only at substantial transportation cost that a revocable commitment would have been made with a number of people, that the third party into the negotiation might be made.

<sup>2</sup> Perhaps the "ideal" solution to the bilateral monopoly is to let one member of the pair shift his margin to zero now at the output at which joint profits are maximized. He does this through an irrevocable contract to some third party for a royalty on his output that joint costs exceed joint profits. He does not now afford to produce at any price or output at which the entire original joint profits are maximized. The bilateral monopoly sees the contract, approves it, and the true minimum profits. The "winner" realizes the lump sum for which he sold the royalty. The incentives because it is independent of what the lump sum (minus a small discount for the second party will have to capitulate to his contingent royalty. The hitch is that the lump sum is available to the "losing member"; otherwise he would announce his royalty claim by threatening to

that he would suffer intolerable  
 ing reputation by paying more,  
 e would necessarily be known,  
 his, then a loud declaration by  
 nt. The device, of course, is a  
 ess it can be made fully evident

contractual kinds of commit-  
 at first seem. In the example of  
 the bet, it remains possible for  
 erty and offer a modest sum in  
 asing the buyer from the bet,  
 6,000 if the release is not forth-  
 of most such contractual com-  
 nd personnel of the negotiation,  
 ill be less available for negotia-  
 ive to concede. To put it dif-  
 nt is usually the assumption of  
 "real cost"; and if all interested  
 negotiation the range of inde-  
 f the third party were available  
 cost, to that extent a truly ir-  
 e been assumed. (If bets were  
 e "real costs" of bringing them  
 e prohibitive.)<sup>2</sup>

ateral monopoly problem is as follows.  
 al cost curve so that joint profits are  
 ofits originally would have been maxi-  
 le sale-leaseback arrangement; he sells  
 r a lump sum, the royalties so related  
 revenue at all other outputs. He can-  
 r output except that price and output  
 ccruer to him; the other member of the  
 reciates the situation, and accepts his  
 lly gains the entire original profit via  
 rights; this profit does not affect his  
 at he produces. The third party pays  
 r inducement) because he knows that  
 and that therefore he will in fact get  
 the royalty-rights buyer must not be  
 wise the latter can force him to re-  
 not to reach a bargain, thus restoring

The most interesting parts how commitments can be tak  
sider briefly a model in which  
a world in which absolute com  
sider a culture in which "cross  
as absolutely binding. Any o  
tion is a final offer, and is so re  
other's true reservation price, t  
offer. Complete responsibility f  
other, who can take it or leave  
to take it). Bargaining is all o  
first offer) wins.

Interpose some communicat  
by letter; the invocation becom  
be known to the other until  
writes such a letter the other  
or may yet do so before the l  
then no sale; both are bound  
must now recognize this possi  
account the likelihood that th  
signed his own commitment.

An asymmetry in communica  
(and is known to be) unavaila  
he is the one who cannot be d  
by receipt of the other's. (O  
cannot communicate can feig  
the other too may be deterred  
of the first's unwitting comm  
pend not just on words but  
ignorance of the other party's  
advantage if the ignorance is f  
other aware that only his own

Suppose only part of the p  
which "cross my heart" is (or

---

the original marginal cost situation.  
institutions that specialize in royalty  
on a reputation for never renegotiating  
appealed to in any single negotiation.

## THEORY OF STRATEGY

of our topic concern whether and when; but it is worth while to consider practical problems are absent — commitments are freely available. Commitment "from my heart" is universally recognized and is accompanied by this invocation: "I am committed." It is also universally recognized. If each party knows the other's object is to be first with a firm commitment, the outcome then rests with the party who chooses (and who chooses first); the commitment (that is, the

invocation) is a source of difficulty. They must bargain and the agreement is effective when signed but cannot be broken until its arrival. Now when one party may already have signed his own, the other's letter of the first arrives. There is a conflict of incompatible positions. Each party is in a position of stalemate and take into account what the other already has, or will have,

the situation may well favor the one who is first. It is possible for the receipt of messages, for the one who is deterred from his own commitment by the other hand, if the one who is ignorant of his own inability, is deterred from his own commitment by fear of the other's commitment.) If the commitments depend on special forms or ceremonies, the commitment ceremonies may be an important part of the game, since it makes the commitment more fully appreciated, since it makes the commitment more difficult to retract. The restraint can avert stalemate.

If the population belongs to the cult in which the commitment is believed to be) absolutely bind-

But we may imagine the development of a game of purchases, whose ultimate success depends on the commitment, and whose incentives can thus not be

ing. If everyone knows (and is known to) the other's affiliation, those belonging to this side have an advantage. They can commit themselves to a price. If a buyer says "\$16,000, cross my heart" and the seller says "\$19,000" he is (and is known to be) bluffing.

If each does not know the other's reservation price, an initial stage in which each tries to bluff or misrepresent his own, as in ordinary bargaining, of discovery and revelation becomes a part of the process of creating and discovering reservation prices. Reservations permanently change, for all parties, as the process proceeds. If one party has a strong belief in a binding ceremony, the bargaining technique of *asserting* one's reservation price proceeds to *make* his.

The foregoing discussion has tried to show that the logic of self-commitment and the logic of self-command suggest the relevance of the tactic of bluffing. It is not hard to distinguish with confidence between the intuitive, or the inadvertent use of bluffing, and the deliberate use of bluffing. It has been uncommon for union officials to bluff in the termination on the part of the management of a wage negotiation. If the union is bluffing, it expects the management to counter bluffing. The union persuades the membership not only to accept a wage of \$2 but even perhaps that the management is competent if they fail to obtain a higher wage. Rather, a plausible purpose suggests that the union make clear to the management that it will accept less than \$2 *even if they will* control the members or because the union is bluffing if they tried. In other words, the union is bluffing in the scope of their own authority and the threat of a strike that the union will accept though it was the union's own action to prevent the strike.

Something similar occurs when

known to know) everyone else's particular cult have the advantages, the others cannot. If the "heart" his offer is final; if the (as known to be) only "bargain-

is true reservation price there is a need to discover the other's and to carry bargaining. But the process sometimes quickly merged with the making of commitments; the commitment for practical purposes, the "true" reservation price, and the other has not, the latter pursues the "ordinary" reservation price, while the

is tried to suggest both the plausibility of the commitment. Some examples may be given, although an observer can select the consciously logical, the inevitable tactic. First, it has not been found to stir up excitement and demoralization during or prior to a negotiation. For example, going to insist on \$2 and exchanging with \$1.60, an effort is made to suggest that the management could not do better. The negotiators themselves are inclined to \$2. The purpose — or, as suggested by our analysis — is to suggest that the negotiators could not do better because they no longer have the power. If they would lose their own position, the negotiators reduce the offer. In the case of the union confronting the management with a strike, the union itself cannot avert, even if the management eliminated its power

the United States Government

negotiates with other governments. Foreign assistance will be put, or a branch is free to negotiate the best possible position. It is unable to make any position stick on controversial points because its partner knows that the United States would not support the negotiations. But, if the executive authority, with its position made evident that Congress will not support it within the necessary time period, it can take a firm position that is visible to the other side.

When national representatives are aware, knowing that there is a wide range of public opinion which the outcome will depend on, they are likely to create a bargaining position calculated to arouse a public opinion in favor of the position to be made. If a binding public opinion is made evident to the other side, the position can be made visibly "final."

These examples have certain characteristics. First, they clearly depend not only on the ability of communicating it persuasively to the other side, but also on no means easy to establish the position as clear to either of the parties committed. Third, similar activities are required on both sides. Fourth, the position is perhaps available to both sides. Fifth, the ability of a democratic government by public opinion may be different from that of a totalitarian government to incur such a risk. Sixth, to run the risk of establishing a position beyond the ability of the other side is to run the likelihood of stalemate or breakdown.

#### INSTITUTIONAL AND STRUCTURAL ELEMENTS OF THE NEGOTIATION

Some institutional and structural elements may make the communication process more effective.



## THEORY OF STRATEGY

nts on, say, the uses to which for-  
tariff reduction. If the executive  
best arrangement it can, it may be  
ck and may end by conceding con-  
tainers know, or believe obstinately,  
rather concede than terminate the  
ve branch negotiates under legisla-  
on constrained by law, and it is  
be reconvened to change the law  
od, then the executive branch has  
o its negotiating partners.

es go to international negotiations  
nge of potential agreement within  
d on bargaining, they seem often  
by public statements, statements  
opinion that permits no concessions  
ic opinion can be cultivated and  
, the initial position can thereby

characteristics in common. First,  
n incurring a commitment but on  
to the other party. Second, it is by  
e commitment, nor is it entirely  
ncerned just how strong the com-  
ity may be available to the parties  
ssibility of commitment, though  
s, is by no means equally avail-  
tic government to get itself tied  
rent from the ability of a totali-  
ch a commitment. Fifth, they all  
an immovable position that goes  
to concede, and thereby provoke  
breakdown.

## STRUCTURAL CHARACTERISTICS

### NEGOTIATION

tural characteristics of bargaining  
nitment tactic easy or difficult to

use, or make it more available to  
affect the likelihood of simultane

*Use of a Bargaining Agent.* The use of  
the power of commitment in at least one  
may be given instructions that  
change, such instructions (and then  
to the opposite party. The principle  
legislative from the executive branch  
the board of directors, as well as to  
the bargaining process has a time  
interposed sufficient distance between  
to make further communication  
time runs out.

Second, an "agent" may be brought  
right, with an incentive structure  
principal's. This device is involved  
private citizen, in settling out of  
effectively as the insurance company  
spicuously obliged to carry out its  
reputation for subsequent accidents.

*Secrecy vs. Publicity.* A potent means,  
sometimes the only means, is the plea  
tional representatives can arrange  
ment for every small concession  
beyond their own reach. If a union  
can arrange to make any retreat  
bargaining reputation in jeopardy  
incapable of serious compromise.  
is the basis for the universally ex-  
you I'd have to do it for everyone

<sup>8</sup> The formal solution to the right-of-  
be that the winner is the one who first  
all contingencies; since he then has no  
must yield and knows it. (The latter can  
insure him now that the first is insured  
funds among unions reduces the visible  
avoid a strike. As in the bilateral move  
is a transfer of interest to a third party  
own incentive structure.

to one party than the other, or  
ous commitment or stalemate.

use of a bargaining agent affects  
least two ways. First, the agent  
are difficult or impossible to  
(their inflexibility) being visible  
ple applies in distinguishing the  
anch, or the management from  
o a messenger-carried offer when  
ne limit and the principal has  
ween himself and his messenger  
evidently impossible before the

ught in as a principal in his own  
of his own that differs from his  
ed in automobile insurance; the  
f court, cannot threaten suit as  
any since the latter is more con-  
uch threats to maintain its own  
ts.<sup>3</sup>

means of commitment, and some-  
edge of one's reputation. If na-  
ge to be charged with appease-  
a, they place concession visibly  
on with other plants to deal with  
dramatically visible, it places its  
ly and thereby becomes visibly  
(The same convenient jeopardy  
exploited defense, "If I did it for  
ne else.") But to commit in this

way problem in automobile traffic may  
becomes fully and visibly insured against  
incentive to avoid accident, the other  
cannot counter in kind; no company will  
) More seriously, the pooling of strike  
e incentive on each individual union to  
opoly solution suggested earlier, there  
y with a resulting visible shift in one's

fashion publicity is required. Both outcomes would have to be known at the point, or if the outcome is inherently unavailable. If one party has a strong position, the latter may try to neutralize the relevant public; or if both parties are in a stalemate in the simultaneous use of force, they may enforce an agreement on secrecy.

*Intersecting Negotiations.* If a firm is about to be engaged, in many cases, management has no other plants and the union cannot convincingly argue its case while the union can. The advantage of the firm is persuasively pointed to an array of alternatives. The firm's own position would be prejudiced if the union were to win. (The "reputation value" of the firm is more important to the outcome than to the firm's position.) The firm's gaining position is adhered to.) The firm's position involves, among other things, both the firm's position and an effort to maintain a position commensurable with the initial position. The negotiation can be enlarged in terms of the wage figure replaced by fringe benefits, or a wage equivalent, an "out" is committed itself; and the available position is committed itself, to the disadvantage of the firm.

*Continuous Negotiations.* A special case occurs when the same two topics, simultaneously or in the same way, more subtle; to persuade the other party to recede, one says in effect, "If I do not revise your estimate of me in order to maintain my reputation with you I must maintain my position simultaneously the 'third party' can be pledged. This situation is a form of resistance to local aggression. The

## THEORY OF STRATEGY

both the initial offer and the final one; and if secrecy surrounds either, currently not observable, the device is a "public" and the other has not, to his disadvantage by excluding other parties fear the potentialities for use of this tactic, they may try to

union is simultaneously engaged, in any negotiations while the manager deals with no other unions, the manager stake its bargaining reputation and advantage goes to the party that can win in other negotiations in which its reputation if it made a concession in this case the bargain may be less related to the success with which some initial bargaining. Defense against this tactic may be with misinterpretation of the other party to make the eventual outcome in- favorable positions. If the subjects under the process of negotiation, or the benefits that cannot be reduced to a minimum provided to the party that has the ability of this "out" weakens the advantage of the committed party.

A special case of interrelated negotiations is when two parties are to negotiate other negotiations in the future. The logic of this case is that one cannot afford to concede to you here, you would lose your other negotiations; to protect your position stand firm." The second party is the one to whom one's bargaining reputation occurs in the threat of local negotiations. The party threatening achieves its

commitment, and hence the credibility of referring to what it would gain from a particular instance but by pointing to a fulfilled threat in enhancing the credibility.

*The Restrictive Agenda.* When the decision to negotiate them is made in forums or at separate times is by no means come, particularly when there is a threat that can be exploited only if it can be at a legitimate, bargaining situation. This depends on refusal, unavailability, or if the object of the extortionate threat is the agenda with the other topic, the latter is the

Tariff bargaining is an example. Cheese and automobiles are to be negotiated together. The outcome by threatening a purely punitive tariff. But if the bargaining representatives of the party are confined to the cheese-automobile instructions that permit them even to raise other commodities, or if there are grounds for other tariffs while cheese and automobiles are the extortionate weapon must await and the threat that would be brought to the conference is stand publicity, publicity itself means communication.

*The Possibility of Compensation.* An agreement may be dependent on the distribution of costs or gains.<sup>4</sup> If duopolists, for a way that maximizes their combined profits is thereby determined; a condition requires that one firm be able to compensate the other of compensation would be evidence of a motive for compensation would be a condition for holders, or if the two do not suffice to reach an optimum level of *joint* profits may

<sup>4</sup> W. Fellner, *Competition Among the Firms*, pp. 97, 231-32, 234.

ability of its threat, not by re-  
carrying out the threat in this  
g to the long-run value of a  
credibility of future threats.

There are two objects to negotiate,  
simultaneously or in separate  
no means neutral to the out-  
latent extortionate threat that  
attached to some more ordinary,  
the protection against extortion  
or inability, to negotiate. But  
threat can be brought onto the  
latent threat becomes effective.

If reciprocal tariffs on cheese  
ated, one party may alter the  
punitive change in some other  
representatives of the threatened  
automobile agenda, and have no  
n to take cognizance of other  
d rules that forbid mention of  
automobiles remain unsettled, this  
other opportunity. If the threat  
reference table is one that cannot  
may prevent its effective com-

As Fellner has pointed out,  
some means of redistributing  
example, divide markets in a  
ed profits, some initial accrual  
ny other division of the profits  
compensate the other. If the fact  
e of illegal collusion, or if the  
e misunderstood by the stock-  
ntly trust each other, some less  
y be required in order that the

*Law* (New York, 1949), pp. 34-35, 191-

initial accrual of profits to the with an agreed division of gain

When agreement must be inherently a one-man act, any compensation. The "agenda" in these cases, since a principal mission on some other object. If to be brought into a contingent means of compensation is available each remains an indivisible object

It may be to the advantage isolated, and to the other to join there are two projects, each with a value of two to A and a value inherently a "one-man" project. This situation is institutionally impossible entire cost of each as long as the He cannot usefully threaten no incentive to carry out either project the projects together, offering out the other, and can effectively less A carries out one of them, four and a cost of three, which half.

An important limitation of bargaining situations, is that they involve divisible objects and can be ditch in the back of one house costs \$1,000 and is worth \$800. They undertake it separately, but when they will get together and see that two of them gets carried out. B is a scoutmaster, and each considers have a scout troop but one man from certain that the neighbor which one puts 10 hours on the does 5 hours' gardening for him on road, the ensuing deadlock is a



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two firms be in closer accordance  
s between them.

reached on something that is in-  
division of the cost depends on  
assumes particular importance in  
means of compensation is a conces-  
two simultaneous negotiations can  
relationship with each other, a  
available. If they are kept separate,  
ect.

e of one party to keep a bargain  
oin it to some second bargain. If  
with a cost of three, and each with  
lue of four to B, and each is in-  
in its execution, and if compensa-  
ble, B will be forced to pay the  
he two projects are kept separate.  
onperformance, since A has no in-  
ject by himself. But if B can link  
to carry out one while A carries  
ely threaten to abandon both un-  
A is left an option with a gain of  
h he takes, and B cuts his cost in

conomic problems, as prototypes of  
they tend disproportionately to in-  
mpensable activities. If a drainage  
will protect both houses; and if it  
to each home-owner; neither would  
e nevertheless usually assume that  
that this project worth \$1,600 to the  
but if it costs 10 hours a week to be  
rs it worth 8 hours of his time to  
an must do the whole job, it is far  
ors will reach a deal according to  
job and the other pays him cash or  
n. When two cars meet on a narrow  
aggravated by the absence of a cus-

tom of bidding to pay for the rights. The problems that occur when logrolling is in question require unanimous agreement can often be bundled together.<sup>5</sup>

*The Mechanics of Negotiation.* A number of questions deserve mention, although we shall not attempt to answer them. Is there a penalty on the cost of making offers? Is there a penalty on bluffing? Is there a penalty on called bluffing? Is there a penalty on hiring an agent who pretends to be a negotiator but makes insincere offers, simply to delay the process? Can all interested parties be brought to a limit on the bargaining? Does the structure of an auction, a Dutch auction, or some other formal arrangement? Can the unavailability for negotiation can be a disadvantage that prefers it? Is renegotiation allowed? What are the costs of stalemate? What can be observed? What, in general, are the costs of negotiation, and are any of them susceptible to manipulation by one party or the other? If there are multiple issues, are they negotiated in one comprehensive package, or in a particular order so that each issue is taken up, or simultaneously through different rules.

The importance of many of these questions is evident when one reflects on parliamentary procedure that permit a president to veto an appropriation, or that require each amendment to an original act is voted on, or a prior question rule, or kinds of motions, substantially all of which are brought to bear on each action. Or, in a voting process, choosing second best is relieved of the burden of a vote earlier to eliminate that possibility.

<sup>5</sup> Inclusion of a provision on the Saar and the occupation of Western Germany may be added to the one in the preceding paragraph.

ht of way. Parliamentary dead-  
npracticable. Measures that re-  
often be initiated only if several

number of other characteristics  
all not work out their implica-  
onveyance of false information?  
s, that is, can one put forth an  
een accepted? Is there a penalty  
to be an interested party and  
to test the position of the other  
be recognized? Is there a time  
e bargaining take the particular  
auction, a sealed bid system, or  
Is there *a status quo*, so that  
win the *status quo* for the party  
possible in case of stalemate?  
Can compliance with the agree-  
ral, are the means of communi-  
ptible of being put out of order  
e are several items to negotiate,  
ehensive negotiation, separately  
piece is finished before the next  
rough different agents or under

se structural questions becomes  
amentary technique. Rules that  
ppropriation bill only in its en-  
ndment to be voted before the  
ity system accorded to different  
alter the incentives that are  
ne who might be pressured into  
of his vulnerability if he can  
possibility, thereby leaving only

in the "Paris Agreements" that ended  
y have reflected either this principle or

first and third choices about which is so strong that no threat will be

*Principles and Precedents.* To be have to be qualitative rather than some rationale. It may be difficult commitment to \$2.07½; why not is too continuous to provide good round numbers like \$2.00. But a "profit sharing," "cost-of-living" a numerical calculation that can a foothold for a commitment. For thing of a commitment by putting themselves in jeopardy. If in the tained the principle of, say, not posed by force, and elects to nail the present negotiation, he not claim but risks the principle it persuade his adversary that he will capitulate and discredit the prin

*Casuistry.* If one reaches the po he has to recognize two effects: it position, and it affects his oppo Concession not only may be c mark a prior commitment as a skeptical of any new pretense needs an "excuse" for accomm a rationalized reinterpretation that is persuasive to the advers.

More interesting is the use of from a commitment. If one can the latter is not committed, or t mitment, one may in fact undo ment. Or if one can confuse the his constituents or principals or compliance with the commitme ambiguous, or that "proportio meanings — one may undo it or

## THEORY OF STRATEGY

which his preference is known to be made.

convincing, commitments usually than quantitative, and to rest on difficult to conceive of a really firm commitment at \$2.02 $\frac{1}{4}$ ? The numerical scale of good resting places, except at nice points of commitment to the *principle* of "increases," or any other basis for a commitment that comes out at \$2.07 $\frac{1}{2}$ , may provide a further step. Furthermore, one may create something by citing the principles and precedents of the past one has successfully maintained. Recognition of governments implies his demands to that principle in which only adduces precedent behind his own. Having pledged it, he may not be able to accept stalemate rather than a principle.

point where concession is advisable, it puts him closer to his opponent's estimate of his firmness. Construed as capitulation, it may be a fraud, and make the adversary at a commitment. One, therefore, by outdating his opponent, preferably of the original commitment, one may vary himself.

of casuistry to release an opponent demonstrate to an opponent that that he has miscalculated his commitment or revise the opponent's commitment, so that the opponent's commitment, so that the audience cannot exactly identify the commitment — show that "productivity" is "concrete contributions" has several times lower its value. In these cases it

is to the opponent's disadvantage fully refuted by argument. But to make a moderate concession or he *can* make a moderate concession, and that if he does there to reflect on his original principles a rationalization by which to de from the opponent's concession, o be made.<sup>6</sup>

## THE TH

When one threatens to fight if a competitor does, the threat is not one's own incentives, designed to automatic consequences of his act. A deterring, it benefits both parties

But more than communication an act that he would have no in designed to deter through its prom massive retaliation against small as is the threat to bump a car tha or to call a costly strike if the wa distinctive feature of this threat

<sup>6</sup> In many textbook problems, such as ends of the bargaining range are point party; and to settle for one's minimum at all. But, apart from certain buying an limits on the range of acceptable outco that one is free to accept may be subst cases one's overriding purpose may be t by the other party. If the truth is more conservative initial position is indicated initial "advanced" position would discre the truth. Actually, though a person doe own behavior, the existence of an enfor of assistance; if one can demonstrate, fo by showing his income tax return, the value of this evidence.

Even the "pure" bilateral monopoly c the bargaining is conducted by agents dependent on *whether* agreement is rea of the agreement are.

that this commitment be successful when the opponent has resolved he may help him by proving that his position consistent with his former position are no grounds for believing it is. One must seek, in other words, to deny oneself too great a reward otherwise the concession will not

### THREAT

attacked or to cut his price if his position is more than a communication of threat to impress on the other the auto- and, incidentally, if it succeeds in

is involved when one threatens an incentive to perform but that is a promise of mutual harm. To threaten an encroachment is of this nature, it does not yield the right of way and the price is not raised a few cents. The point is that the threatener has no in-

in a bilateral monopoly between firms, the threat of zero profits for one or the other position is no better than no settlement and selling situations, there are commonly some, and the least favorable outcome is partially superior to stalemate. In these cases to forestall any misguided commitment is demonstrable than a false position, a threat, as it is if any withdrawal from an offer or a bid any subsequent attempt to convey a threat does not commonly invite penalties on his part. A credible penalty on falsehood would be a threat, for example, his cost or income position and the penalties on fraud may enhance the

case becomes somewhat of this nature if the threat is directed at employees whose rewards are more dependent on how favorable the terms

centive to carry it out either b  
 have an incentive to bind himse  
 the threat may be successful, b  
 fillment gains the end; and f  
 threat succeeds. The more cert  
 the less likely is actual fulfillm  
 pends on the credulity of the  
 effectual unless the threatener  
 incentives so as to demonstrate  
 incentive to carry it out.<sup>7</sup>

We are back again at the co  
 himself in advance to an act th  
 carry out in the event, in orde  
 the other party? One can of c  
 falsely that the costs or damage  
 or negative. More interesting,  
 pretend that he himself erroneo  
 small, and therefore would mi  
 threat. Or perhaps he can prete  
 as to overcome the prospect o  
 probably most readily available  
 he must find a way to commit

One may try to stake his repr  
 that impresses the threatened  
 reputation *with the threatened*  
 would be worth the costs and p  
 if he fails to heed the threat. C  
 commitment, perhaps through

<sup>7</sup> Incidentally, the deterrent threat  
 characteristics, reflecting the general asymm  
 It is not necessary, for example, that  
 party threatened than to the party ca  
 car with a new one may succeed if  
 damages, or to start a price war. Also,  
 there is no such thing as "too large"  
 it is not carried out anyway. A threat  
 ferer with its credibility. Atomic dest  
 pensive incarceration for overtime pa  
 orbitant unless the threatened person  
 ignored it.

<sup>8</sup> Mutual defense treaties among s



## THEORY OF STRATEGY

before the event or after. He does not intend to fulfill the threat, if he thinks that because the threat and not its fulfillment is not required if the threatener obtains the contingent fulfillment is, in fact, a bluff. But the threat's efficacy depends on the threatener's ability to deter the other party, and the threatener can rearrange or display his own interests so that he would, *ex post*, have an

incentive to fulfill the threat. How can one commit to a threat that he would in fact prefer not to fulfill? One can bluff, or one can bluff that his commitment may deter the other party. A course of bluff, to persuade the other party that the threatener would be minor if the threatener does not fulfill the threat, is the one making the threat may not seriously believe his own costs to be high enough to stakenly go ahead and fulfill the threat, and a revenge motivation so strong that he would inflict self-damage; but this option is available only to the truly revengeful. Otherwise, the threatener is bluffing himself.

One can bluff on fulfillment, in a manner that is credible to the other person. One may even stake his *person himself*, on grounds that it is worth the pain to give a lesson to the latter party. Or one may try to arrange a legal contract, or to contract with a third party.<sup>8</sup>

There is some interesting quantitative character in the relationship between rewards and punishments. The threat to inflict more damage to the other party by carrying it out. The threat to smash an old belief, or to sue expensively for small damages, as far as the power to deter is concerned, is a bluff; if it is large enough to succeed, it is only "too large" if its very size interferes with the threatener's intention to inflict punishment for small misdemeanors, like exorbitant demands, would be superfluous but not excluded. If the threat is considered too awful to be real and

strong and weak nations might best be

Or if one can turn the whole business into a salary (or business reputation) threat but who is unalterably reliable, the further costs, one may shift the

The commitment problem is nice doctrine of the "last clear chance" events that led up to an accident, the accident became inevitable as that the abilities of the two parties expired at the same time. In bargaining device to leave the last clear chance to the other party, in a manner that relinquish further initiative, having the other party must choose in one way up so that he cannot stop, and the other to yield. A legislative rider at the President the last clear chance to prevent to understand some of those cases inheres in what is weakness by other or a country — has lost the power to avert mutual damage, the other but to assume the cost or responsibility is the term Arthur Smithies uses to describe a state of affairs where one is completely exhausting one's annual budget for a year that the need for more funds

A related tactic is maneuvering so that one can be dislodged only by an offer of mutual damage because the maneuverer has lost the power to retreat. If one carries out a strategy in a manner that makes destruction of himself and for any assailant, he is better off than if he retained any control over

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viewed in this light, that is, not as undertaken in exchange for a *quid pro quo*, but rather as a liberating or embarrassing freedom of choice.

\* A. Smithies, *The Budgetary Process in the United States*, pp. 40, 56. One solution is the short tether strategy. See T. C. Schelling, "American Foreign Assistance Policy" (July 1955), regarding the same principle.

business over to an agent whose depends on carrying out the eved of any responsibility for ne incentive.

ely illustrated by the legal doc- which recognizes that, in the there was some point at which a result of prior actions, and es to prevent it may not have gaining, the commitment is a ce to decide the outcome with he fully appreciates; it is to g rigged the incentives so that e's favor. If one driver speeds other realizes it, the latter has e end of a session leaves the ass the bill. This doctrine helps in which bargaining "strength" er standards. When a person — to help himself, or the power interested party has no choice sibility. "Coercive deficiency" o describe the tactic of deliber- getary allowance so early in the s is irresistibly urgent.<sup>9</sup>

into a *status quo* from which ert act, an act that precipitates uvering party has relinquished s explosives visibly on his per- uction obviously inevitable for may deter assault much more ver the explosives. If one com-

taken to reassure the small nations nor ther as a device for surrendering an

*the United States* (New York, 1955), of an apportionment process. See also ssistance," *World Politics*, 7:609-625 e in foreign aid allocations.

mits a token force of troops the commitment to full resistance is used the analogy of the plate glass a jewelry store: anyone can break creating an uproar.

Similar techniques may be available best defense, of course, is to camouflage; in that case there is neither retaliation. If he cannot hasten self to it; if the person to be the one who would threaten can only make certain the mutually threatens.<sup>10</sup> If the person to be the threat is made to share the the insurance solution to the earlier) he may become so visible to dissuade the threatener. Or it change or misrepresent his own he would gain in spite of threat he thinks he would), the threat threat as costly and fruitless; or as either unable to comprehend it, he may deter the threat itself ignorance, obstinacy, or simple convincing to the prospective threat persuade him and he commits lose. Finally, both the threat communicated; if the threatener messages, or can destroy the cor

<sup>10</sup> The system of supplying the police and incapable of erasures makes it possible license number of the car before speaking threat. Some trucks carry signs that "to the driver's control." The time lost purpose, as does the mandatory secret invasion with a small advance force win the objective, attaches too much drawal: the larger force can then be deterrent threat. At many universities denies instructors the power to change

## THEORY OF STRATEGY

that would be unable to escape, the risk is increased. Walter Lippmann has a glass window that helps to protect the bank, but it is not so easy to break it easily enough, but not without

being available to the one threatened. His strategy is to carry out the act before the threat is realized. Whether incentive nor commitment for the act itself, he may commit himself. If the one threatened is already committed, the threat cannot deter with his threat, he can only suffer disastrous consequences that he cannot avoid. The one threatened can arrange before the act to share the risk with others (as suggested by the right-of-way problem mentioned above). He is probably unsusceptible to the threat as long as he can do so by any other means he can either avoid the threat by incentives, to make it appear that the threat will not be fulfilled (or perhaps only that the threatener may have to give up the threat). If one can misrepresent himself as a threat, or too obstinate to heed the threat. Best of all may be *genuine* disbelief, since it may be more convincing to the threatener; but of course if it fails to convince the threatener, both sides are committed to the threat, both sides are committed and the commitment have to be honored. The one threatened person can be unavailable for communication channels, even though

as with traffic tickets that are numbered and recorded. It is possible for the officer, by writing in the ticket and talking to the driver, to preclude the latter's denial. For example, "Alarm and lock system not subject to tampering." The lock on bank vaults serves much the same purpose as a ballot in elections. So does starting an alarm. It is that, though too small and premature to be effective. "face" to the enterprise to permit withdrawal without fear of inviting a purely formal investigation. The faculty is protected by a rule that the course grade once it has been recorded.

he does so in an obvious effort to threaten himself.<sup>11</sup> But the time to act is before the threat is made, that is, not just before the threat is fulfilled, but before the threatener is credulous, or out of town, when the threat is committed.

In threat situations, as in ordinary bargaining, the costs and values are not altogether clear; each party has costs and values to the other side involved in the threat; the procedure is a progressive one, the commitments are a sequence of actions. Communication is impossible nor entirely reliable. A commitment can be communicated by travel by newspaper or hearsay. In these cases the unhappy position is a result of simultaneous commitments. The recognition of this possibility becomes itself a deterrent to the threatener.

In case a threat is made and not fulfilled, the threatener is at a stage prior to fulfillment in which he can undo the commitment. Thus, the threatener's deterrence value is zero, and he is not motivated to fulfill. This feature of threat situations is a stalemate in ordinary bargaining. The threatener's parties' getting committed to in-

<sup>11</sup> The racketeer cannot sell protection to his friends or relatives. Thus, as a perhaps required the immediate confinement of a kidnapping occurred might make the threatener's deterrence value zero. The rotation of watchmen and policemen not only limits their exploitation of

<sup>12</sup> It is a remarkable institutional fact for persons or nations to assume commitments. There are numerous ways that commitments are made, but they are ambiguous, unsure, or only occasionally binding. Society adverted to earlier, bargaining is a strategy and the mechanics of communication. In the real world the topic is mainly an empirical one: how, and with what assurance o

to avert threat, he may deter the show disbelief or obstinacy is before the commitment is taken, fulfilled; it does no good to be in the messenger arrives with the

ordinary bargaining, commitments party cannot exactly estimate the side of the two related actions in-ness of commitment may be a pro-acquiring their firmness by a se-cation is often neither entirely e; while certain evidence of one's ated directly, other evidence must y, or be demonstrated by actions. ssibility of both acts occurring, as itment, is increased. Furthermore, ility of simultaneous commitment e taking of commitments.<sup>12</sup>

d fails to deter, there is a second hich *both* parties have an interest he purpose of the threat is gone, and only the commitment exists to ure has, of course, an analogy with ng, stalemate resulting from both compatible positions, or one party's

on if he cannot find his customer at home; ransom if he cannot communicate with ps impractical suggestion, a law that re- all interested friends and relatives when ne prospects for ransom unprofitably dim. men, or their assignment in random pairs, bribes but protects them from threats. act that there is no simple, universal way mmitments of the kind we have been dis- ey can try, but most of them are quite nally available. In the "cross-my-heart" ng theory would reduce itself to game nication; but in most of the contemporary al and institutional one of who can com- f appreciation by the other side.

mistakenly committing himself to what he would not accept. If there appears to be a commitment, *both* parties have an interest in undoing it is a matter on which their ways of undoing it lead to different results. "undoing" does not mean neglecting one's own reputation; "undoing," if the commitment means disconnecting the threat from one's own reputation with the threat, is therefore a subtle and tenuous situation. Both parties have an interest in undoing the commitment, but are unable to collaborate in undoing it.

Special care may be needed in the case of an act that is threatened against and against oneself. The difficulty arises from the fact that if the former has been done the incentive to do the latter has appeared. The credibility of the threat is how visible to the threatened party the threat is to the threatening party to rationalize his way of doing it. If the threat has failed its purpose. Any loopholes in the threat, if they are visible to the threatened party, are visible commitment and hence reduce the credibility. (An example may be the ambiguous Formosa Resolution and Treaty.)

It is essential, therefore, for the threat to leave little room as possible for judgment about the threat. If one is committed to a course of behavior when it reaches certain limits, the limits should be fully and objectively defined, the threat should be that when the time comes to decide whether to enforce or not, his interest and the interest of the threatened party coincide in an attempt to avoid the threat and its sequences.

In order to make a threat precise and credible to both to the threatened party and to the threatening party, attention to the whole affair is of value. It is necessary to introduce some arbitrariness into the threat, to involve overt acts rather than intangible threats, the visible deeds, not invisible ones.



## CORY OF STRATEGY

a position that the other truly  
ers a possibility of undoing the  
n interest in doing so. How to  
interests diverge, since different  
nt outcomes. Furthermore, "un-  
g a commitment regardless of  
mitment of reputation was real,  
from one's reputation, perhaps  
threatened person himself. It is  
ituation in which, though both  
ommitment, they may be quite  
it.

n defining the threat, both the  
d the counter act that is threat-  
e fact, just noted, that once the  
ve to perform the later has dis-  
hreat before the act depends on  
y is the inability of the threaten-  
out of his commitment once it  
les the threatening party leaves  
e threatened party, weaken the  
uce the credibility of the threat.  
ous treatment of Quemoy in the

maximum credibility, to leave as  
nt or discretion in carrying out  
o punish a certain type of be-  
nits, but the limits are not care-  
e party threatened will realize  
ide whether the threat must be  
at of the threatening party will  
the mutually unpleasant con-

ise, so that its terms are visible  
to any third parties whose reac-  
e to the adversaries, it may be  
rary elements. The threat must  
entions; it must be attached to  
es; it may have to attach itself

to certain ancillary actions that serves to the threatening party. It is a penalty on the carrying of weapons suspicious behavior rather than proximity to a crime rather than the threat of punishment must be one which is discernible.<sup>13</sup>

In order that one be able to carry out a threat, there must be continuity of subsequent issues that will arise. The means of making the original threat decomposed into a series of consequences opportunity to demonstrate on the threat will be carried out on the ground come more plausible, since there will fulfill them as a "lesson."

This principle is perhaps more inherently a matter of degree. In the act of terminating assistance may be sides as not to be taken seriously a small misuse of funds is to be accepted in assistance, never so large as to to provoke a diplomatic breach, will receive more credulity; or if it may be persuasive without too much

The threatening party may not act into steps. (Both the act to must be divisible.) But the principle wisdom of defining aggression, or

<sup>13</sup> During 1950, the Economic Cooperation Administration to reward Marshall Plan countries and to penalize those that did not, through allotments. But since the base figures had determination would ultimately involve would be no way afterwards to see what contractions were made, and the plan sufficient

<sup>14</sup> Perhaps the common requirement intervals, rather than in a lump sum at an analogous principle, as does the custom of a college course to avoid letting a student's grading decision after the course is finished

are of no consequence in themselves. It may, for example, have to put weapons rather than their use; on observed misdemeanors; on proximate crime itself. And, finally, the act whose effect or influence is clearly

pledge his reputation behind a bet between the present and subsequent. This need for continuity suggests a threat more effective; if it can be broken by successive smaller threats, there is an incentive to resist the first few transgressions that start the rest. Even the first few bet on the fact that there is a more obvious incentive to

is most relevant to acts that are in themselves of little value. In the case of foreign aid programs the overt threat may be so obviously painful to both donor and recipient, but if each is accompanied by a small reduction in aid, it will not leave the recipient helpless nor will it destroy the willingness to carry it out. If it does not at first, a few lessons will do much damage.<sup>14</sup>

It is, of course, not possible to divide the threat into smaller parts. The threat to be deterred and the punishment to be inflicted at least suggests the unit of transgression, in terms of some

The State Department Administration declared its intention to follow especially sound policies, though the device of larger or smaller aid had not been determined, and since their judgment rather than formulas, there is no reason to doubt whether in fact the additions and subtractions were free from implausibility.

The policy for amortization of loans at frequent intervals at the end of the loan period, reflects an intention of giving frequent examinations in a way that the student's failure hinge exclusively on a single examination.

critical degree or amount that will deter the act to be deterred is inherent in the cumulative effect is what matters. Threats may be more credible than promises either all at once or not at all when the threat is reached. It may even be impossible to make a threat with sufficient clarity to be persuasive.

To make the threatened act effective, the act may have to be modified. Parts of the act proposed may have to be left out; the act itself, even though of no interest in itself, which a threat can effectively be directed at, that are only preparatory to the act, if they cause no damage, may be susceptible of being effective objects of the threat. A dog should be threatened with more damage toward the dog, even though he is the dog himself.

Similar to decomposing a threat into a threat with a punitive act that grows in time. Where a threat of death by cutting off the food supply might be used for public relations purposes, this is a "clear chance" to the other, who is stubbornness if the threat fails. The threat gets his overt act out of the way, which is minor, rather than letting it stand as an obstacle to his resolution. And it is one in a position to know, from the catastrophe they have progressed in, that it is in real sense. Furthermore, the threat is his adversary's collapse but not his own. It may therefore transform a dangerous and costly continuous one. Tenants are more afraid of forcible eviction than by simple

<sup>15</sup> This seems to be the tactic that avoided the forces to vacate a province they had occupied after they had announced that any effort

## THEORY OF STRATEGY

will be deemed intolerable. When eventually a sequence of steps whose ends, a threat geared to the increment, an one that must be carried out when some particular point has been reached, is possible to define a "critical point" in the threat, the threat is persuasive.

If the act is divisible, the acts themselves are parts of an act that cannot be decomposed into ancillary acts that go with the main act themselves, may be objects to which the main act is attached. For example, actions are parts of a main act, and by themselves do not require a chronological division and thus are not parts of a main act. The man who would kick a dog for a modest punishment for each step in the act, the proximity is of no interest in the act.

What is starting a threat into a series is starting a threat in severity with the passage of time. The severity of violence might not be credited, but it might bring submission. For moral or political reasons the device may in fact leave the "last chance" to the victim. His demise is then blamed on his own actions.

But in any case the threatener is aware of the threat while it is still preliminary and is aware of the threat as a final, dreadful, and visible threat. If the suffering party is the only party, the threat moment to moment, how near to the end, his is the last clear chance in a threat. The threatener may be embarrassed by the threat by his discomfort; and the device of a serious once-for-all threat into a less serious threat are less easily removed by threat than a threat by shutting off the utilities.<sup>15</sup>

It was an explosion and induced de Gaulle's forces to occupy Northern Italy in June 1945, and the threat of their allies to dislodge them would

A piecemeal approach may also be possible. If he cannot obviate the threat, he may hasten some initial stage toward eventual completion. Or, if his adversary's retaliation comes only in the future, he may view it as a series of increments rather than a dramatic overt act that would

## THE PR

Among the legal privileges of a citizen mentioned in textbooks are the right to be sued. Who wants to be sued! The power to make a promise: to borrow money, to do business with someone who might arise, the "right" seems a liability. It was a prerequisite to doing business.

In brief, the right to be sued is a commitment. In the commitments discussed, it is essential that one's adversary (or to describe him) not have the power to break the commitment; the commitment was, in fact, real or fictitious. The promise was made by a party in the bargain and is required of one or of each is outside the other. However, ever an agreement leaves any in

This need for promises is more important than the importance of its own. A convincing, self-binding, promise is like to release his prisoner, and he is separately for a way to commit the captor, without finding one. If t

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be treated as a hostile act. See Harry S. (1955), pp. 239-42; and Winston S. Churchill, *The Second World War* (Boston, 1955).

<sup>18</sup> The threat may seem to be a promise to harm one's reputation with his adversary; but it is a promise that one party can unilaterally release the threat. The threat is to associate his own future estimate of the t

to be used by the threatened perpetrator by hastening the entire act, a pledge that clearly commits him to act is divisible while the threat—the large economy size, performance—may deny the threatener the trigger his response.

## PROMISE

corporations, two that are meant to sue and the “right” to be sued. But the right to be sued is the narrow money, to enter a contract, might be damaged. If suit does injury in retrospect; beforehand it is a loss.

is the power to accept a commitment—discussed up to this point, it was a “partner,” however we wish to release one from the commitment in effect, to some third party, is a commitment to the second party whenever the final action of the first party is under the first party’s control. It is required when the threatener has no alternative incentive to cheat.<sup>16</sup>

is more than incidental; it has an institutional character. It is not always easy to make a distinction. Both the kidnapper who would release the prisoner, may search despite the latter against informing on his part if the victim has committed an act

<sup>16</sup> Truman, *Year of Decisions* (New York, 1953), pp. 566–68.

<sup>17</sup> It is not a promise from which the second party is free to back out, since he cannot convincingly distinguish the threatener from the latter’s performance.

whose disclosure could lead to bankruptcy. If not, he might commit one in the future. The bond that will ensure his silence illustrates how difficult, as we shall see, it is to assume a promise. If the law will not enforce it, or if the union is unable to obligate him, or if a contractor has no assets to pledge, or if the law will not imprison debtors, or if there is no to which one can pledge his reputation, it is difficult to strike a bargain, or at least the bargain will not otherwise be struck.

Bargaining may have to concern the division of a system as well as the division of goods. It may be a "fair-trade" law; or exchange of markets; or stay out of each other's markets; or to redesign the products to be unsuitable for each other; or countries that wish to agree not to trade; or may have to destroy the usefulness of a product. A "third-party commitment" has to be made. A "second-party commitment" cannot be made.

Fulfillment is not always observable. A secret election, or a government agreement, or a parliament, or an employee agreement, or a teacher agrees to keep his politics secret, or a country agrees to stimulate exports, or a country is no reliable way to observe or enforce a promise. A servable outcome is subject to a risk of non-fulfillment which is covered by the agreement. The agreement have to be expressed in terms of something observable. What is observable is not the intention. A country may have to pay the bribed voters, or a country may have to pay the bribed voters how he voted; to pay a salesman more than on skill and effort; to reward criminals on crime rather than on attendance. A country may have to pay employees for the transgressions. If the agreement is a matter of degree, the bargaining will be limited by distinguishing performance.

<sup>17</sup> In an earlier age, hostages were exchanged.



## THEORY OF STRATEGY

blackmail, he may confess it; in the presence of his captor, to create a confession. But these extreme possibilities are as well as important, it may be to refuse to enforce price agreements; to agree to a no-strike pledge; to pay damages if he loses a suit, or if there is no "audience" for the agreement; it may not be possible to make the same bargain that would other-

concern itself with an "incentive" to gain. Oligopolists may lobby for shares of stocks. An agreement to cooperate may require an agreement to cooperate in each other's area. Two nations may make military use of an island or the island itself. (In effect, the agreement to be assumed when an effective agreement cannot be devised.)<sup>17</sup>

observable. If one sells his vote in an election, he agrees to recommend an act to its effect, such as not to steal from inventory, or to give political opinions out of class, or to vote "as much as possible," there is a measure of compliance. The observable number of influences, only one of which is the result. The bargain may therefore be something observable, even though the intended object of the bargain. One may vote for the election is won, not on the basis of a commission on sales, rather than policemen according to statistics, or to punish all of one. And, where performance is defined in terms of performance; a specification of performance.

fied loss of inventory treated as  
crease in exports considered  
samples of performance taken  
formance.<sup>18</sup>

The tactic of decomposition  
threats. What makes many ag  
recognition of future opportu  
eliminated if mutual trust is r  
whose value outweighs the mom  
present instance. Each party n  
will not jeopardize future oppo  
the outset. This confidence does  
purposes of piecemeal bargains  
tual expectations. Neither may  
prudence (or the other's confid  
so forth) on a large issue. But,  
gains can be struck on a small  
a small investment to create a  
to let each party demonstrate  
trust and that he knows the ot  
has to be negotiated, it may be n  
some minor items for "practice,  
dence in each other's awareness  
faith.

Even if the future will bring n  
create the equivalence of conti  
issue into consecutive parts. If e  
dollars to the Red Cross on conc  
tempted to cheat if the other  
anticipation of the other's chea  
if the contribution is divided int  
each can try the other's good  
more, since each can keep the c  
no one ever need risk more than  
Finally, this change in the inc

<sup>18</sup> Inability to assume an enforceabl  
activity demanded, may protect one  
tory secret ballot is a nuisance to the  
protection to the one who would fear

evidence of theft; a specified in-  
an "adequate" effort; specified  
as representative of total per-

applies to promises as well as to  
reements enforceable is only the  
ities for agreement that will be  
not created and maintained, and  
mentary gain from cheating in the  
must be confident that the other  
ortunities by destroying trust at  
not always exist; and one of the  
is to cultivate the necessary mu-  
y be willing to trust the other's  
lence in the first's prudence, and  
if a number of preparatory bar-  
scale, each may be willing to risk  
tradition of trust. The purpose is  
that he appreciates the need for  
her does too. So, if a major issue  
necessary to seek out and negotiate  
" to establish the necessary confi-  
s of the long-term value of good

no recurrence, it may be possible to  
nuity by dividing the bargaining  
each party agrees to send a million  
dition the other does, each may be  
contributes first, and each one's  
ating will inhibit agreement. But  
to consecutive small contributions,  
faith for a small price. Further-  
other on short tether to the finish,  
n one small contribution at a time.  
entive structure itself takes most  
le promise, like inability to perform the  
from an extortionate threat. The manda-  
voter who would like to sell his vote, but  
coercion.

of the risk out of the initial contribution trust is made obviously visible to

Preparatory bargains serve and only occur when at least one party bargains. A deterrent to initiative may seem to yield, about one's eagerness to expect the other to meet a history of successful bargaining, protection against the inference of c

#### AN ILLUSTRATION

Various bargaining situations involve promises, and communication procedures variants of a game in which each chooses alternatives from which to choose. East chooses either  $B$  or  $\beta$ . Each chooses of both. Each of the four choices,  $A\beta$ ,  $aB$ , or  $a\beta$ , yields a particular gain or loss for East. No choice depends on the choice the other makes.

Each such game can be quantified in a two-dimensional graph, with North's choices vertically and East's horizontally, and the values of the game denoted by points labeled  $AB$ ,  $A\beta$ ,  $aB$ , and  $a\beta$ . In the simplicity of the game there is actually four different variants, depending on the relative positions of the four points in the plane. The order of moves, possibility of commitment, means of commitment, enforceability

<sup>19</sup> Perhaps two adversaries who look for a settlement would do well to keep avenues open. For example, the number of loose ends in a settlement should be narrow down so much that nothing remains to be settled. "issue" (some final, permanent disposition of the possibility of even opening negotiations on the minor issues are not disposed of, but that willingness to negotiate on them will settle the whole settlement, the possibility of

## THEORY OF STRATEGY

tribution; the value of established both.

other purpose. Bargaining can y takes initiative in proposing a is the information it yields, or urgency. But if each has visible meet him half way, because of a that very history provides pro-overeagerness.<sup>19</sup>

## COOPERATIVE GAME

involving commitments, threats, problems, can be illustrated by each of two persons has a pair of e. North chooses either  $A$  or  $a$ ; each person's gain depends on the possible combined choices,  $AB$ , gain or loss for North and a par-compensation is payable between each person's preference may de-makes.

graphically represented in a two-axis gain measured vertically and horizontally. The four combined choices are  $A\beta$ ,  $a\beta$ , and  $aB$ . In spite of the usually a large number of qualitative factors not only on the relative positions but also on the "rules" about communication, availability of flexibility of promises, and whether

lead forward to some large negotiated settlement for negotiation of minor issues. If, a dispute between East and West should remain to be negotiated but the "ultimate fate of all territories and armaments) the latter might be jeopardized. Or, if become so attached to the "big" issue could be construed as overeagerness on preparatory bargains might disappear.

## AN ESSAY ON

two or more games between two persons. The variations can be multiplied by introducing different hypotheses about what each party guesses about the other's intentions about the "values" of the four outcomes. For convenience we assume here that the equilibrium is the obvious way to both persons. And, as a compensation, we rule out also the possibility of a "no sale" in the game. A very small sample of

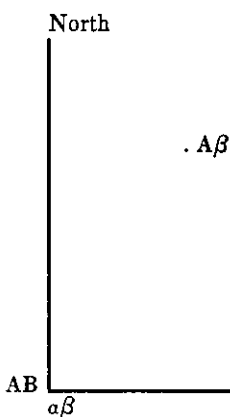


FIG.

Figure 1 represents an "ordinary" game. We adopt the rule that North and East must agree before they choose.  $A\beta$  and  $aB$  are alternative agreements that they may reach. The values for both persons, can be assumed to be equivalent of "no sale." Whoever moves first. If North can commit himself to a choice of  $A\beta$  or  $aB$  (leaves East a choice between  $A\beta$  and  $aB$ ) previously East's choice under the circumstances. If North committed himself first to  $B$ , however, East is restricted to a choice of  $aB$  or  $aA$  (or  $aA$  or  $AB$ ) and would have agreed to  $aB$  if North's commitment is a kind of "first move" in the game. The numbers but with moves in turn.

persons can be joined together almost without limit by selecting each player knows or guesses comes for the other player, and guesses about himself. For countless "values" are obvious in an ad, just as we have ruled out treats of actions that lie outside of such games is presented.

$\cdot aB$

---

East

1

ry" bargaining situation if we East must reach explicit agree-  $B$  can be thought of as alternative, while  $AB$  and  $a\beta$ , with zero interpreted as the bargaining can first commit himself wins.  $A$  he will secure  $A\beta$ , since he and  $AB$  and the former is ob- cumstances. If East could have ever, North would have been agreement (that is, of  $aB$  or . As a matter of fact, first com- ; and in a game with the same , first move would be an ad-

vantage. If, by mistake, both players move East to  $B$ , they lock themselves into a disadvantageous position.

Figure 2 illustrates a deterrent *status quo*, with North planning to move West. If East threatens a shift to  $\beta$  (removes first, East can only lose), North can commit himself to a

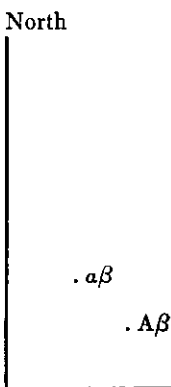


FIGURE 2

but if East can effectively threaten, he leaves North only a choice of  $a$  or  $A$ . Note that it is not sufficient to threaten in advance, as it was in Figure 1. A *conditional* choice,  $B$  or  $\beta$  depends on  $a$  or  $A$ . If East committed his choice to a disadvantage of "first move"; and in turn, North would win at  $a$  or  $A$ . (East would choose  $B$  rather than  $\beta$  or  $A\beta$  rather than of  $a\beta$  or  $A\beta$ ; with first move, would choose  $a$  or  $A$  rather than  $aB$  rather than  $A\beta$  or  $AB$ ; East would choose  $a$  or  $A$  rather than  $aB$  rather than  $A\beta$  or  $AB$ .)

Figure 3 illustrates the promise. If moves are simultaneous,  $aB$  is a *status quo* by itself, and neither can be made worse. Both would, however, prefer



## THEORY OF STRATEGY

parties get committed, North to  $A$  and East to  $B$ , resulting in stalemate at  $AB$ .

North's threat if we interpret  $AB$  as the result of a shift to  $a$  (leading to  $aB$ ) and East's threat if he does. If North moves by moving to  $\beta$ , and similarly if East moves before East can make his threat;

.  $aB$

.  $AB$

East

FIG. 2

to avert the mutually undesirable  $a\beta$ , North chooses between  $a\beta$  or  $AB$  and North chooses the one that is best for East to commit his choice to; he must commit himself to a choice depending on whether North chooses  $A$  or  $B$ . If he would obtain only the advantage of the present game, if moves were made simultaneously, North would choose  $B$  regardless of who moved first. If North chooses  $\beta$ , to leave North a choice of  $aB$  or  $AB$ , and North would take  $aB$ . North, rather than  $A$ , leaving East  $a\beta$  or  $AB$ . (North would take  $aB$ .)

Whoever goes first, or even if both go at once, either can achieve a "minimax"; either can threaten the other with anything better than  $A\beta$  to  $aB$ ; but to reach  $AB$

North

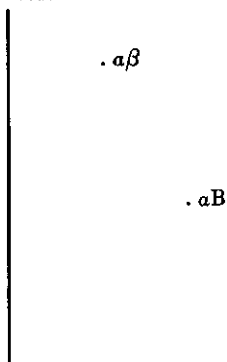


FIG.

they must trust each other or promises. Whoever goes first, the if North chooses  $A$ , East can take North can choose  $a\beta$ . If moves a incentive to cheat, and each may either deliberate cheating, or self incentive to cheat, indicates choice

North

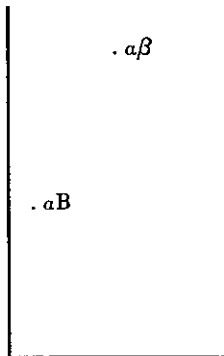


FIG.

must be able to commit himself can move first. If both must move able to make enforceable promi

.  $A\beta$

. AB

\_\_\_\_\_ East

3

be able to make enforceable  
 other has an incentive to cheat;  
 $AB$ , and if East chooses  $\beta$  first,  
 re simultaneous each has an in-  
 expect the other to cheat; and  
 f-protection against the other's  
 es of  $\alpha$  and  $B$ . At least one party

.  $A\beta$

. AB

\_\_\_\_\_ East

4

to abstention; then the other  
 ve simultaneously, both must be  
 ses.

Figure 4 is the same as Fig. 3, but with the arrow pointing leftward. Here, in the absence of any threat,  $a\beta$  is the only outcome, regardless of whether he or she moves first or simultaneously. If, however, East makes a commitment, he can force North to choose  $A\beta$ . But this commitment is some promise or a threat; it is both a promise to choose  $aB$  if North chooses  $a$ ; and he threatens to choose  $A$ . The threat alone will not be effective if  $a\beta$  is better than  $A\beta$  for North, and if East is free to choose  $B$ . East can only enforce either  $a$  or  $A$ , the opposite of what he is committed: abstention from  $A\beta$ .

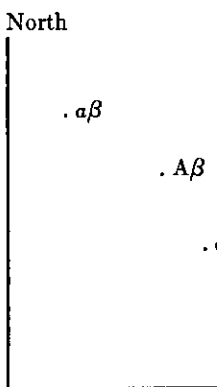


FIG. 4

Finally, Figs. 5 and 6 show two games which are of nothing of interest but together illustrate the effect of a threat. Figure 5 has a minimax solution  $aB$ , neither can enforce anything, and if both are possible, no threat can be made. Figure 6 has a similar identity of interest, but the threat is similarly devoid of any need for enforcement, or any possible threat to exploit. Figure 5 is with or without an order of moves.

But suppose the two games are

## THEORY OF STRATEGY

except that  $aB$  has been moved  
of communication, North wins at  
East moves first or moves are  
can communicate a *conditional*  
to choose  $A$  and an outcome of  
something more than either a promise  
and a threat. He must threaten  
must promise "not  $AB$ " if North  
not induce North to avoid  $a$ ;  $aB$   
and  $AB$  is what he gets with  $A$  if  
must commit himself to do, for  
that he would do if he were not  
or immolation at  $aB$ .

$aB$

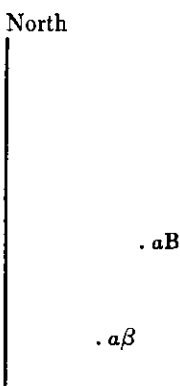
.  $AB$

\_\_\_\_\_ East

. 5

two games that separately contain  
make possible an extortionate  
solution at  $aB$ ; either can achieve  
better, no collaboration is pos-  
sible, though contrasting with  
figure 6, though contrasting with  
interest between the two parties, is  
collaboration or communication  
With or without communication,  
the outcome is at  $AB$ .

be simultaneously up for decision,



FIG

and the same two parties are in  
 can commit himself to a threat  
 East, for example, could threaten  
 game 6, unless North chose *A* ra  
 tively, North could threaten *a* in  
 game 5. Assuming the intervals  
 threat persuasively committed an  
 gains in game 5 at no cost in gam  
 he does not carry it out ; so he get  
 choice in game 5. To express thi  
 plies what was ruled out earlier  
 "outside the game." From the po  
 an extraneous act, and East might  
 house down if he does not choos  
 tionate threats are not always ea  
 an occasion, an object, and a m  
 ditionally often suffer from illeg  
 out of sheer stubbornness. The jo  
 same agenda may thus succeed v  
 would be impracticable.

If North cannot commit himse  
 desires only to prevent a threat  
 communication be impossible ; o  
 in his interest that the two gar

.  $AB$

.  $A\beta$

\_\_\_\_\_ East

. 6

involved in both. If either party  
 t he may improve his position.  
 n to choose  $\beta$  rather than  $B$  in  
 rather than  $a$  in game 5; alterna-  
 n game 6 unless East chose  $\beta$  in  
 large enough in game 6, and the  
 nd communicated, the threatener  
 ne 6. Because his threat succeeds  
 s  $AB$  in 6 as well as his preferred  
 s result differently, game 6 sup-  
 r, namely, the threat of an act  
 int of view of game 5, game 6 is  
 t as well threaten to burn North's  
 e  $A$  in 5. But such purely extor-  
 asy to make; they often require  
 eans of communication, and ad-  
 gality, immorality, or resistance  
 oining of two negotiations on the  
 where a purely gratuitous threat

elf to a threat, and consequently  
 by East, it is in his interest that  
 r if communication occurs, it is  
 mes not be placed on the same

agenda; or if he cannot prevent East, it is in his interest to turn East, whose compensation depends on the game. If North can force East to commit himself in response to his choice, North is safe. If he can commit his choice in advance, he is safe. But if he can commit to be played first, East could threaten less North assumed a prior commitment case North's ability to commit it permits him to be forced into a

Incidentally, dropping  $AB$  versus  $a\beta$  would illustrate an important one point in a manner "unfavorable" prove the outcome for him. The timing in Fig. 2 depends on the choice over  $aB$  for North; if  $AB$  is made comes immune to the threat, which at  $aB$ . This is an abstract example showing, weakness may be strengthened.



## THEORY OF STRATEGY

their being discussed together by each game over to a different agent only on the outcome of his own game 6 to be played first, and is unable to make a threat, the threat is obviated. In game 5 before the threat is made, North chooses  $\alpha$  for himself in game 5, and game 6 is threatened to choose  $\beta$  in game 6 unilaterally. North's commitment to  $A$  in game 5; in this situation, North's commitment to himself is a disadvantage, since "playing" game 5 ahead of 6. This is illustrated in Fig. 2 to below the level of the principle, namely, that moving "game 5 ahead of 6" to North may actually improve North's position. The threat that kept him from winning game 5 is comparative attractiveness of  $AB$  to  $a\beta$  he believes to be worse for him than  $a\beta$  he believes to be better. If the threat is not made, and he wins game 5, the principle that, in bargain-

## BARGAINING, COMMUNICATIVE, LIMITED

Limited war requires limits; so are to be stabilized short of war or at least some kind of mutual agreement on limits is difficult because of the uncertainties and the acute nature of the cause negotiation is severely inhibited before it begins and because cooperation between adversaries in time of war is to the advantage of one side to avoid war and to enhance the other's fear of war so that even a show of willingness to negotiate is as excessive eagerness.

The study of tacit bargaining and communication is incomplete or incomplete therefore, in connection with limited competition, jurisdiction, a traffic jam, or getting along with one another speak to. The problem is to develop a method or both parties either cannot or do not when neither would trust the other to reach an agreement explicitly reached. The present study of the concepts and principles of tacit bargaining and will attempt to draw conclusions about the problem of limited war and will also suggest that these same concepts are a powerful clue to understanding even the nature of explicit bargaining with full communication.

## MUNICATION, AND WAR

do strategic maneuvers if they . . . . But limits require agreement and recognition and acquiescence. It is difficult to reach, not only because of the divergence of interests but because of the prohibitions both during war and in peacetime. Communication becomes difficult in the presence of war. Furthermore, it may seem to require agreement on limits, in order to reach an agreement; or one side or both may fear that the other will be interpreted

as bargaining — bargaining in which compromise is possible — assumes importance, in the case of limited war, or, for that matter, in the case of tactical maneuvers, jockeying in the presence of a neighbor that one does not wish to attack. To develop a modus vivendi when one will not negotiate explicitly or when one will not negotiate with respect to any agreement. This chapter will examine some of the principles that seem to underlie tacit bargaining. It will draw a few illustrative conclusions from the study of war or analogous situations. It will show how the principles may often provide a framework for the logically dissimilar case of tacit bargaining and communication and enforcement.

The most interesting situations are those in which there is a conflict of interests involved. But it is instructive to consider a simplified case in which two or more people must face the problem not of coordinating their actions for a common purpose but of communication is impossible. This illustrates the principle that will then seem to be "bargaining" over conflicting interests.

#### TACIT COORDINATION

When a man loses his wife in a forest, he has a prior understanding on where she is likely to go. The chances are good that they will meet. Each will think of some obvious place to go. Each will be sure that the other will go there. One does not simply predict where the other will go where he predicts the other will go wherever the first predicts the other will go and so ad infinitum. Not "What would I do if I were she?" "What would she do if she were I?" wondering what the other would do. What is necessary is to coordinate their actions in the common situation. They must "mutually recognize" some common action that their expectations of each other must "mutually recognize" some common action that their expectations of each other must meet, nor would all couples reach a common point are certainly a great deal better than a long course of search.

The reader may try the problem himself (Fig. 7). Two people parachute from a plane each with a map and knowing where the other has landed. They must get together directly. They must study their maps and "coordinate" their maps suggest some particular

## THEORY OF STRATEGY

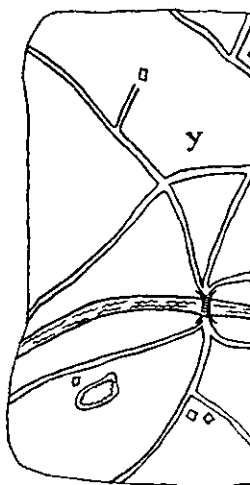
ions and the most important are  
ict of interest between the parties  
to begin with the special simpli-  
re parties have identical interests  
reconciling interests but only of  
their mutual benefit, when com-  
s special case brings out clearly  
erve to solve the problem of tacit  
preferences.

### (COMMON INTERESTS)

n a department store without any  
to meet if they get separated, the  
ll find each other. It is likely that  
us place to meet, so obvious that  
is sure that it is "obvious" to both  
redict where the other will go, since  
redicts the first to go, which is  
second to predict the first to go,  
at would I do if I were she?" but  
she wondering what she would do  
I would do if I were she . . . ?"  
nate predictions, to read the same  
ion, to identify the one course of  
f each other can converge on. They  
me unique signal that coordinates  
er. We cannot be sure they will  
d the same signal; but the chances  
er than if they pursued a random

em himself with the adjoining map  
e unexpectedly into the area shown.  
g the other has one, but neither  
dropped nor able to communicate  
er quickly to be rescued. Can they  
minate" their behavior? Does the  
meeting place so unambiguously

## BARGAINING, COMMUNICA



  
River

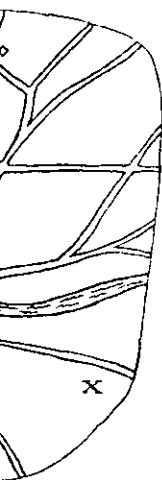
  
Road

FIG.

that each will be confident that the solution with confidence?

The writer has tried this and of an unscientific sample of respondent people often can coordinate. The typical of those that can be "solved" of those who try. The solutions are to that extent: any solution is "correct" if the reader may wish to confirm his ability to solve problems with those whose scores

<sup>1</sup> In the writer's sample, 36 persons coordinated, only 6 chose "tails." In problem 2, the first place was chosen by 10 out of a total of 41; the number 7 led in second place, and the number 3 in third place. The upper left corner in problem 3 was chosen by 10 out of a total of 41, and all but 3 of the remainder chose the diagonal line. Problem 4, which may reflect the situation at Grand Central Station (information board), showed an absolute majority in meeting at 12 noon. Problem 6 showed that six-fifths of all persons succeeded in coordinating. In problem 7, out of 41 people, 12 got together on solutions of numbers that were not a power of 10.



▣

Building

Ⓔ

Pond

the other reads the same sugges-

other analogous problems on an  
 s; and the conclusion is that  
 following abstract puzzles are  
 ed" by a substantial proportion  
 re, of course, arbitrary to this  
 f enough people think so. The  
 ility to concert in the following  
 are given in a footnote.<sup>1</sup>

concerted on "heads" in problem 1, and  
 st three numbers were given 37 votes  
 100 by a slight margin, with 13 in  
 roblem 3 received 24 votes out of a  
 er were distributed in the same diag-  
 the location of the sample in New  
 majority managing to get together at  
 oth), and virtually all of them suc-  
 showed a variety of answers, but two-  
 ng on the number 1; and in problem  
 1,000,000, and only 3 entries consisted  
 o; of those 3, 2 were \$64 and, in the

1. Name "heads" or "tails." same, you both win a prize.

2. Circle one of the numbers 7, 100, or 13. You win if you all succeed in circling the same number.

3. Put a check mark in one of the boxes below. You win if you all succeed in checking the same box.

<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 someone who has not been instructed where to meet. You are standing with the person on whom you must communicate with each other. You are to guess where to meet and then you must find out if you are right. You win if you are right and that you will just have to guess.

5. You were told the date by someone who was not No. 4; the two of you must guess the date for meeting. At what time will you meet? What date that you elected in No. 4?

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

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

8. You are to divide \$100

---

more up-to-date version, \$64,000! Prizes were \$41, who split the total fifty-fifty. Prizes were \$22 for Robinson. An alternative form of the game was used when Jones and Robinson were tied on the first ballot at 22 to demonstrate the difficulty of concealing a point. Jones surmounted the difficulty and gave the point to Robinson on the basis of Jones's earlier position. Jones's point was overwhelming the subsidiary point. Jones's point was like the one reproduced here (Fig. 1) at the bridge.



## THEORY OF STRATEGY

If you and your partner name the numbers listed in the line below. You win if you name the same number.

261      99      555

If you and your partner name the same number of the sixteen squares. You win if you name the same square.

... in New York City. You have no prior meeting; you have no prior understanding where to meet; and you cannot communicate. You are simply told that you will have a meeting and that he is being told the same thing. You try to make your guesses coincide. You do not know the hour of the meeting in advance. You try to guess the exact minute of the day. You do not know when you appear at the meeting place.

... number. If you all write the same number...

... money. If you all name the same amount as you named.

... into two piles, labeled A and B.

... problem 8 caused no difficulty to 36 out of 40 respondents. Problem 9 secured a majority of 20 out of 36 respondents. The simulation of it, in which Jones and Robinson each received 8 votes each, was intended by the author to test voting in case of tie; but the respondents voted for Jones 16 out of 18 votes (apparently on the list), proving the main point but not the process. In the map most nearly correct, 7 out of 8 respondents managed to meet

## BARGAINING, COMMUNICA

Your partner is to divide another and B. If you allot the same amount that your partner does, each of you differ from his, neither of you get

9. On the first ballot, candidate

Smith .....	19
Jones .....	28
Brown .....	15

The second ballot is about to be taken the outcome, except that you will have a majority on the second ballot and he does. Similarly, all voters are interested in a majority, and everybody knows that. For whom do you vote on the second

These problems are artificial, but people *can* often concert their intentions with others if each knows that the other knows. Most situations — perhaps every situation — practiced at this kind of game — require bargaining behavior, some focal point of what the other expects him to do. Finding the key, or rather finding a mutually recognized key, depends on imagination more than on logic, precedent, accidental arrangement, metric configuration, casuistic reasoning, and what they know about each other. A man and his wife to the “lost and found” each to reflect and to expect the other would have agreed to meet if they had to cover the contingency. It is not always possible to find an obvious answer to a problem of their doing so are ever so much more dependent on abstract random probabilities.

A prime characteristic of most bargaining problems, that is, of the clues or conditions, is some kind of prominence or conspicuity.

\$100 into two piles labeled A and B, respectively, you gets \$100; if your amounts is anything.

s polled as follows:

Robinson .....	29
White .....	9

aken. You have no interest in be rewarded if someone gets a and you vote for the one who rested only in voting with the that this is everybody's interest. ond ballot?

out they illustrate the point. tentions or expectations with ner is trying to do the same. situation for people who are provide some clue for coordi- for each person's expectation expect to be expected to do. ng a key — any key that is comes *the* key — may depend c; it may depend on analogy, , symmetry, aesthetic or geo- oning, and who the parties are other. Whimsy may send the and found"; or logic may lead other to reflect on where they ey had had a prior agreement c being asserted that they will the question; but the chances ch greater than the bare logic would ever suggest.

t of these "solutions" to the coordinators or focal points, is picuousness. But it is a promi-

nence that depends on time. Ordinary folk lost on a plane would expect to find the center to meet each other; but they would "naturally" expect to find the center of gravity of an irregularly shaped object. This is a kind of uniqueness; the map is "lost and found" if the store has many alternative maps indicating many houses and a single crossroad, while one with many crossroads would lead them to the house. Partly this conveys prominence; but it must be clear that business avoids ambiguousness. The house is more prominent than anything else on the map. Of them, none more prominent. The chance in three of meeting at the center of fact may lead to the rejection.

But in the final analysis we are dealing much as with logic; and the result is of the kind. Poets may do better than logicians, perhaps more like "puns and metaphors" — the large plurality of them. 6 seems to rest on logic — but it is not selected some clue to work out of the situation.

#### TACIT BARGAINING

A conflict of interest enters into the dislike walking. With common sense, our problem, they would have to meet, each favoring a spot particularly to his liking. In the end, an overriding interest is to conc

<sup>2</sup> That this would be "correct" result of the author's map experiments. Of the eleven crossroads, the eleven people who chose crossroads all chose different ones.

## THEORY OF STRATEGY

and place and who the people are. The circular area may naturally go to but only one versed in mathematics meet his partner at the center of the circular area. Equally essential is some man and his wife cannot meet at the center as several. The writer's experiments showed clearly that a map with many roads sends people to the crossroads, and a single house sends most of the people to the house. This may reflect only that uniqueness may be more important than uniqueness. Houses may be intrinsically more important on the map; but if there are three houses more important than the others, there is but one house, and the recognition of this uniqueness of houses as the "clue." 2

We are dealing with imagination as logic itself is of a fairly casuistic nature. Many logicians at this game, which is more like "anagrams" than like chess. Logic is applied to the number 1 in problem solving usually not until imagination has been freed from among the concrete details.

### (DIVERGENT INTERESTS)

Consider our problem if the parachutists cannot communicate, which is not allowed in the previous problem. We have argued or bargained over where to land close to himself or a resting place. In the absence of communication, their ideas are more divergent; and if a particular spot is suggested by one, it is usually not until imagination has been freed from among the concrete details. On a map with a single house and many roads, all met at the house, while the four who met at the crossroads and did not even meet one an-

## BARGAINING, COMMUN

commands attention as the "obv of the bargain is simply the one Even if the one who is farthest he is, he cannot withhold his acc division of the walking; the "p provided by the map itself — if, only extant offer; and without co proposal that can be made. The haps we should say ignored — a need for coordination.

"Win" and "lose" may not be lose by comparison with what th communication. If the two are from the lone house on the map, long walk to the house if they cou and concerted explicitly on a pla may be that one "wins" while th wins: if both are on the same side walk together a greater distance t one may still have come off bette out with the other.

This last case illustrates that one to be unable to communicate to destroy communication or to on a method of meeting if one confident of the "solution" he writer's test, A knew where B was (and each knew how much recipients of the B-type question their ignorance, while virtually ents grimly acknowledged the in to B. Better still may be to hav receive messages: if one can a that his transmitter works but will wait where he is until the choice. He can make no effectiv offer could be heard.<sup>3</sup>

<sup>3</sup> This is an instance of the general

vious" place to meet, the winner is the one who happens to be closer to it. The person from the focal point knows that the other will acquiesce and argue for a fairer "proposal" for the bargain that is in fact, it provides one — is the result of communication, there is no counter-offer — or perhaps a by-product of the dominant position.

is quite accurate, since both may have agreed on through communication. They are actually close together and far apart. If they might have eliminated the possibility of having identified their locations and a place to meet between them. Or it may be that the other loses more than the first person. If he goes to the house and walk to it, they may have walked more than they needed to, but the closer he is to the house the better than if he had had to argue it out.

it may be to the advantage of the person who is closer. There is room here for a motive to refuse to collaborate in advance. If the person is aware of his advantage and foresees it. In one variant of the game, B had no idea where A was, but B had no idea where A was (the other knew). Most of the time the person smugly sat tight, enjoying the power to send but not to receive. He announced his position and state of mind to his receiver, saying that he was not his receiver, the latter has no counteroffer, since no counter-

paradox, illustrated at length in Chap-





## THEORY OF STRATEGY

ple of conflicting-interest games on  
g games that are biased in favor of  
on the whole, the outcome suggests  
reached in the purely cooperative  
e coordination; they also, however,  
choices over which the two parties'  
all the available options, some par-  
be the focal point for coordinated  
om it is a relatively unfavorable  
simply because he knows that the  
he choices that cannot coordinate  
available" without communication.  
these games is that neither rival can  
. Each loses unless he does exactly  
o do. Each party is the prisoner or  
l expectations; no one can disavow  
he other will expect him to expect  
need for agreement overrules the  
each must concert with the other  
ese games are arrived at by slightly  
earlier, as we did for the map prob-  
g is onerous.

"heads" or "tails" without com-  
heads," A gets \$3 and B gets \$2;  
\$2 and B gets \$3. If they choose  
ing. You are A (or B); which do  
th choose at random, there is only  
coincidence and an expected value  
her \$3 or \$2.)

ers (or rivals) each have one of the  
you is to write these three letters,  
he order is the same on all three of  
aling \$6, of which \$3 goes to the  
ll three lists, \$2 to the one whose  
e person whose letter is third. If  
l order on all three lists, none of

rdinary standards may, in bargaining, be a

## BARGAINING, COMMUNI

you gets anything. Your letter is  
three letters in the order you ch

3. You and your partner (rival  
one blank and the other with an  
gets the "X" has the choice of le  
one who gets the blank sheet ha  
or writing an "X" on it. If, wh  
without communicating, there is a  
the holder of the "X" gets \$3 an  
gets \$2. If both sheets have "X's"  
gets anything. Your sheet of pa  
do you leave it alone or erase it?  
is the blank one; do you leave it

4. You and your partner (riv  
can agree on how to divide it w  
you is to write the amount of hi  
if the two claims add to no mo  
what he claimed. If the two cla  
gets anything. How much do yo

5. You and your partner are ea  
K, G, W, L, or R. If you pick  
if you pick different letters, you  
depend on the letter you both p  
same for each of you, and the  
highest prize may or may not b  
you the prizes would be as follo

K .....	\$4
G .....	\$3
W .....	\$1

You have no idea what his sch  
begin by proposing to him the  
letter. Before he can reply, the  
to say that you were not supp  
cate and that any further con  
both. You must simply write  
that the other chooses the sa

A (or B, or C) ; write here the  
 choice :

\_\_\_\_\_, \_\_\_\_\_.

) are each given a piece of paper,  
 "X" written on it. The one who  
 leaving it alone or erasing it; the  
 has the choice of leaving it blank  
 when you have made your choices  
 an "X" on only one of the sheets,  
 and the holder of the blank sheet  
 or both sheets are blank, neither  
 per has the original "X" on it;  
 (*Alternate*: your sheet of paper  
 blank or write an "X"?)

al) are to be given \$100 if you  
 without communicating. Each of  
 s claim on a sheet of paper; and  
 ore than \$100, each gets exactly  
 imes exceed \$100, neither of you  
 ou claim? \$\_\_\_\_\_.

ach to pick one of the five letters,  
 the same letter, you get prizes;  
 get nothing. The prizes you get  
 pick; but the prizes are not the  
 letter that would yield you the  
 e his most profitable letter. For  
 WS:

L .....	\$2
R .....	\$5

chedule of prizes looks like. You  
 e letter R, that being your best  
 master-of-ceremonies intervenes  
 osed to be allowed to communi-  
 munication will disqualify you  
 down one of the letters, hoping  
 me letter. Which letter do you

choose? (Alternate formulation shows schedule of  $K-\$3$ ,  $G-\$1$ , "other" party make the initial communication is cut off.)

6. Two opposing forces are at a map similar to the one in Fig. wishes to occupy as much of the other does too. But each comm. clash and knows the other does. troops with orders to take up a opposed. Once the troops are only on the lines that the two troops to occupy. If the lines ov to meet and fight, to the disadva take up positions that leave any tween them, the situation will be inevitable. Only if the troops lines or lines that leave virtual them will a clash be avoided. In cessfully the area it occupies, that has the most valuable area. You command the forces located. Draw on the map the line that

7. A and B have incomes of  $x$  and  $y$  respectively. They are notified of each other's income and that they must begin paying taxes to reach agreement on shares of the annual tax bill in whatever manner they wish. They must reach agreement without committing to a share he proposes to pay, and each will pay exactly what he proposes. If the proposals fail to add up to  $\$25$ , however, each must pay the full  $\$25$ , and the tax authority will be notified. You are A (B); how much do you propose to pay?

8. A loses some money, and B has a chance to win it back. A cannot have his money back unless B agrees to pay a suitable reward, and B cannot win the money back unless A agrees to pay a suitable reward. If no agreement is reached, the money is lost.

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for the second half of the sample  
W-\$4, L-\$5, R-\$2, and has the  
proposal of the letter R before

at the points marked X and Y in

7. The commander of each force  
the area as he can and knows the  
commander wishes to avoid an armed  
as too. Each must send forth his  
a designated line and to fight if  
dispatched, the outcome depends  
commanders have ordered their  
overlap, the troops will be assumed  
advantage of both sides. If the troops  
appreciable space unoccupied be-  
e assumed "unstable" and a clash  
are ordered to occupy identical  
ly no unoccupied space between  
that case, each side obtains suc-  
the advantage going to the side  
in terms of land and facilities.  
ed at the point marked X (Y).  
you send your troops to occupy.  
\$100 and \$150 per year, respec-  
ch other's income and told that  
totaling \$25 per year. If they can  
his total, they may share the an-  
er they agree on. But they must  
unication; each is to write down  
d if the shares total \$25 or more,  
proposed. If the proposed shares  
each will individually be required  
collectors will keep the surplus.  
you propose to pay? \$\_\_\_\_\_.

B finds it. Under the house rules,  
until he agrees with the finder on  
t keep any except what A agrees  
the money goes to the house. The

## BARGAINING, COMMUNIC

amount is \$16, and A offers \$2 as a half the money for himself. An arbitrator intervenes, insisting that each write a proposal without further communication. If the arbitrator divides the \$16 total, each will receive exactly half. If together they claim more than \$16, the arbitrator divides by the house. As they sit pondering, a well-known and respected mediator enters. He says, "Do not, he says, participate in any bargaining. Write a 'fair' proposal. He approaches A and suggests a division under the circumstances with the original owner getting two-thirds and the finder rounded off to \$11 and \$5, respectively." Without waiting, he approaches the finder, makes the same suggestion to him. He made the same suggestion to the other party without waiting for any response, he claims. What do you write?

The outcomes in the writer's study are given in the footnote.<sup>4</sup> In those problems where the conflict was between "you" and "him," that is, where the formulations were matched with the

<sup>4</sup>In the first problem, 16 out of 22 A's and 16 out of 22 C's, did, heads was the best answer for A. This was significantly better than at random; and, of course, if each had chosen heads, they would have scored a perfect zero. Problem 2, however, with a more compelling structure, showed 14 out of 16 C's, successfully co-ordinating their proposals. (Incidentally, 5 discriminated against themselves in order, all to no avail.) Problem 3, which involved a prize, 18 out of 22 A's concerting successfully won the prize. In problem 4, 36 out of 40 chose \$100 and \$49.99.) In problem 5 the letter R was chosen, and 8 out of 9 votes from those who had proposed it. In problem 6, 14 of 22 X's and 14 of 23 Y's chose the river. The "correctness" of this solution was demonstrated by the fact that the other 15, who eschewed the river, when they formed possible pairs among themselves, there were 5 out of 6 of those with incomes of \$100 concerting on a 15-10 division. In those cases where those who lost money and those who found money concerting, they unanimously concerting on the mediator's

a reward. B refuses, demanding argument ensues, and the house te his claim, once and for all, the claims are consistent with exactly what he claims; but if the funds will be confiscated g what claims to write, a well-ers and offers to help. He can-argaining, but he can make a and says, "I think a reasonable would be a 2-1 split, the origi- the finder one-third, perhaps tively. I shall make the same ting for any response, he ap- me suggestion, and says that ne original owner. Again with- departs. You are A (B); what

informal sample are given in where there is some asymmetry is, between A and B, the A the B formulations in deriving s and 15 out of 22 B's chose heads. est answer for B; given what the B's together they did substantially better d tried to win \$3, they would all have r, which is logically similar to 1 but d 9 out of 12 A's, 10 out of 12 B's, nating on ABC. (Of the remaining 7, selves in departing from alphabetical s structurally analogous to 1, showed ith 14 out of 19 B's, giving A the \$3 50. (Two of the remainder were \$49 on 5 out of 8 votes from those who m those who were on the other side. 's drew their boundaries exactly along on is emphatically shown by the fact produced 14 different lines. Of  $8 \times 7$  5 failures and 1 success. Problem 7 of \$150 and 7 out of 10 of those with vision of the tax. In problem 8 both und it, 8 and 7 persons respectively, suggestion of an even \$5 reward.

the "outcome." The general c in the footnote, is that the par in a substantial proportion of spicuously better than any cha and even the disadvantaged p himself to be disciplined by th for their coordination.

The "clues" in these games tails through some kind of co convention that dictates A, B The original X beats the bla "status quo" is more obvious because there is nothing to cor seem, in principle, as plausib variety permits a less arbitrar their variety, the map cannot discarded in favor of the uni haps in a symmetrical map would be more akin to the 50 diagonal division in half, per map rather precludes a geome

The tax problem illustrates the income figures. The abstra with that of the \$100 division follows: each party pays \$25 ir able to be divided among the t to divide it. This formulation in problem 7, and, as such, it amount of \$25 instead of \$100. just by *suggesting* their releva the problem, shifts the focal p rather than 12.5-12.5. And w perfectly *proportional* tax so grounds for graduated rates? *ticular* graduation of rates is s and if speech is impossible, b recognizable principle of propo the income figures take the ini



## THEORY OF STRATEGY

conclusion, as given in more detail. Participants can "solve" their problem in the cases; they certainly do conclude that the methods would have permitted, and the bias in the biased games permits the message that the game provides

are diverse. Heads apparently beat conventional priority, similar to the B, C, though not nearly so strong. Rank sheet, apparently because the less than change. The letter R wins contradict the first offer. Roads might be as rivers, especially since their free choice. But, precisely because of the ambiguity, say *which* road; so roads must be like a unique and unambiguous river. (Perhaps on uniform terrain, the outcome is a 50-50 split in the \$100 example — a 10-15 split perhaps — but the irregularity of the solution.)

There is a strong power of suggestion in the fact logic of this problem is identical to the one; in fact, it could be reworded as a tax problem, and a refund of \$25 is available to both parties if they can agree on how to split it. This is logically equivalent to the one in problem 4, but differs from problem 4 only in the inclusion of income figures, and making them prominent in the problem statement. Yet the inclusion of income figures, and making them prominent in the problem statement point substantially to a 10-15 split. Why, if incomes are relevant, is a 10-15 split so obvious, when perhaps there are no incomes? The answer must be that no *par-*tiality is so obvious as to go without saying; by default the uniquely simple and proportional solution has to be adopted. First the bias shifts initial plausibility away from a 50-50

## BARGAINING, COMMUN

split; then the simplicity of p only one that could possibly be c nition. The same principle is disp question 7 was deliberately clut on family size, spending habits, a tion of the income-proportiona diluted that the preponderant r and the low-income respondents the tax. The refined signal for th drowned out by "noise," and th all that came through.

Finally, problem 8 is again l the amount being \$16 available claims that do not exceed the arrangement is discriminatory; compelling equality in any mor 50-50 split seems not quite obviou provides the only other signal t coordinator is seen even in the was universally accepted.

In each of these situations the thing that is fairly arbitrary. It come, from either an observer's view of the participants. Even t reliance on a kind of recogniz if it is "fair," it is so only becau which to judge its unfairness, s the relative need of the rival c for moral or legal claims. Splitti over kidnap ransom is not par mathematical qualities of problem

If we ask what determines t answer again is in the coordinati lems requires coordination for a is rivalry among alternative lines the various choices, there is usu serve as coordinator. Take the ca The strongest argument in favor

proportionality makes 10-15 the considered capable of tacit recognition by an experiment in which entered up with *additional* data — and so on. Here the unique attractive split apparently became so reply from both the high-income was a simple 50-50 division of the income proportionate split was the cruder signal for equality was

logically the same as problem 4, for two people if they can write amount. But the institutional finder and loser do not have a realistic or legalistic sense, so the suggestion of the mediator that is visible; its potency as a rounding to \$11 and \$5, which

outcome is determined by some- is not a particularly “fair” out- point of view or the points of the 50-50 split is arbitrary in its able mathematical purity; and use we have no concrete data by such as the source of the funds, claimants, or any potential basis the difference in an argument particularly “fair,” but it has the

the outcome in these cases, the on problem. Each of these prob- common gain, even though there s of common action. But, among ally one or only a few that can use of the first offer in problem 5. of R is the rhetorical question,

"If not R, what then?" There give more than a random chance parties wanted to eschew the letter made. To illustrate the force of the master-of-ceremonies in that process already to have spoiled the game of the players by announcing the result. A will get whatever prize B would the prizes shown in A's schedule. If offerer of R have any reason to think that the master-of-ceremonies are to be the same, no matter what letter both picked the same letter. They indicated means of coordinating the beginning of this game and suppose of R never got made, we might infer "In case of doubt always choose for the players and constitutes a means by which we are back at the man and his problems whose problems are over when they say, "The management suggest separated meet each other at the top of the ground floor." Beggars can't choose of their signal, or about its attraction that they can only wish were as

The irony would be complete if your prize schedule and you did not have a variant of question 5 used in it. You have no basis for guessing his preference for him a favor or make a "fair" coordination. The only basis for concerting is to see what is read in your schedule. Your own announced choice; it is hard to see why you would pick, since you have no basis for thinking it is better for him than R itself. His preference combined with your ignorance of his preference and no objective basis for coordination, puts the result of simply choosing in your favor. (This

## THEORY OF STRATEGY

is no answer so obvious as to the possibility of concerting, even if both choose letter R after the first offer was made. At this point, suppose that the problem considered the first offer was made and thought he might confuse the reversal of their prize schedules. What would he have gotten, and B will get what he would have gotten in problem 5. Does the original offer change his choice? Or suppose it was announced that the prizes would be reversed if letter were chosen, so long as they were chosen. They will still rally to R as the only coordinating choices. If we revert to the original proposal, suppose that the original proposal was to choose R; this sign is visible to all. "This is a sign of coordinating choices." Here is a wife in the department store, and they see a conspicuous sign that says that all persons who become choosers at the information booth in the center will not be choosers about the source of their choice. Their activeness compared with others is conspicuous.

Now, if, in game 5, your rival knew your preference and could not even do anything to compromise if you wished to, then you can see what message you can both send. The preferred letter seems the indication to pick any other or which other letter is preferred for knowing what other letter is preferred. This knowledge of your preference, and the lack of any alternative, places on him the responsibility of simulating a preference. This, in fact, was the preponderant

## BARGAINING, COMMUN

result among the small sample  
when only one parachutist kne

### EXPLICIT

The concept of "coordination  
for tacit bargaining does not se  
bargaining. There is no apparen  
speech can be used; and the ac  
thoughts and influenced the ou  
the status of incidental details

Yet there is abundant evide  
powerfully present even in exp  
involve numerical magnitudes,  
strong magnetism in mathemat  
tion is the tendency for the ou  
numbers"; the salesman who  
"rock-bottom" price on the auto  
ing to be relieved of \$7.63. The  
ment is precipitated by an offer  
the same point, and the differ  
always trivial. More impressiv  
quency with which long negoti  
tive formulas or *ad hoc* shares  
ultimately on something as cruc  
proportionate to some common  
uct, population, foreign-exchan  
shares agreed on in some previo  
tion.<sup>6</sup>

Precedent seems to exercise  
its logical importance or legal  
international debt settlement o

<sup>5</sup> And it is another example of the  
was commented on in an earlier footnot

<sup>6</sup> From a great variety of formulas p  
the winner that emerged was a straight  
the simplest conceivable formula and th  
mula was, to be sure, the preferred p  
discussion; but that fact perhaps add  
from it.

tested.) It is the same situation as in the first case where the other was.<sup>5</sup>

### BARGAINING

"tacit" that has been developed here seems directly applicable to explicit bargaining. The need for intuitive rapport when following the adventitious clues that coordinated outcomes in the tacit case revert to the tacit case.

It is clear that some such influence is present in explicit bargaining. In bargaining that is tacit, for example, there seems to be a certain simplicity. A trivial illustration comes to be expressed in "round numbers." One works out the arithmetic for his car and finds the price of a new automobile at \$2,507.63 is fairly pleasurable. The frequency with which final agreement is to "split the difference" illustrates the influence that is split is by no means simple. It is, perhaps, the remarkable frequency of agreement over complicated quantities in some costs or benefits converge to a very simple as equal shares, shares of equal magnitude (gross national product, budget deficit, and so forth), or the influence of a tacit but logically irrelevant negotiation.

It is an influence that greatly exceeds the influence of force. A strike settlement or an agreement often sets a "pattern" that is followed. The power that resides in "weakness," which is the tacit case.

It is proposed for the contributions to UNRRA, that 1 per cent of gross national product — the roundest conceivable number. This proposition of the United States during the war is as much to the example as it detracts

lowed almost by default in substance. To be sure, there is a reason for this: sometimes there is enough similarity to produce plain similar outcomes; but more often, simply no heart left in the bargaining process. In the shadow of some dramatic event, in a similar fashion, mediators often bring about an agreement and a power to determine the terms. Their proposals often seem to be based on an inherent fairness or reasonableness that is shared by both participants. "Fact-finding" commissions draw expectations to a focus, but it is not the vacuum of indeterminacy that shapes the facts themselves, but the creative power of the mediator seems to exercise the influence.

There is, in a similar vein, a *quo ante* as well as to natural boundaries. States have recently exhibited the same reluctance to agree. Certainly there are no rivers as the agreed stopping places, but the boundaries, whatever their current relevance, of the landscape seem less important for their convenience than for their power to define the future.

These observations would be confirmed if bargaining results were expressed in terms of minor accommodations, a few cents or miles or people. But the ultimate focus for agreement did not depend on bargaining powers but provided the other. It often seems that a particular outcome on the basis of some suggestion contained much regard to the merits of the proposal made, or the pressures to be applied. It is an "obvious" place to compromise for

<sup>7</sup>This and the preceding paragraph are based on a number of Middle Eastern oil-royalty formulae a few years after World War II.



## THEORY OF STRATEGY

requent negotiations. Sometimes, as a measure of uniformity, and similarity in the circumstances to examine often it seems that there is something when it takes place under a certain and conspicuous precedent.<sup>7</sup> In such cases, the power to precipitate and determine the terms of agreement; is often accepted less by reason of their necessity than by a kind of resignation. "Suggestion" reports may also tend to be accepted by providing a suggestion to fill a gap that otherwise exists: it is not the presence of a specific suggestion, that

is the strong attraction to the *status quo* boundaries. Even parallels of latitude and longitude as focal points for agreement, are reasons of convenience in using them for troops or using old boundaries for convenience; but often these features are important for their practical contribution to crystallize agreement.

It is trivial if they meant only that the terms were made to round off the last part of the agreement in simple and qualitative terms. But it often looks as though the terms do not just reflect the balance of bargaining power to one side or the other; a cynic could have predicted the "obvious" focus for agreement, from the situation itself, without the aid of the arguments to be applied during the bargaining. The result frequently seems to win by some

are illustrated by the speed with which the arrangements converged on the 50-50

## BARGAINING, COMMUNI

kind of default, as though there  
tling anywhere else. Or, if the  
reflect the relative skills of the p  
important to identify that skill  
in such a way as to give promin  
that would be favorable. The ou  
spicuously fair or conspicuously  
gaining powers as just plain "con

This conclusion may seem to  
skill, if the outcome is already o  
of the problem itself and where  
what it does is shift the locus wh  
ous" outcome depends greatly on  
on what analogies or precedents  
issue calls to mind, on the kinds  
bear on the question in dispute.  
argue over how to divide the co  
whether the terms of reference re  
the "taxes" to be paid, by whether  
ing national-income figures or  
their use, by whether the person  
precedents into prominence by h  
earlier negotiations, by whether  
issues on the same agenda will g  
vance to those particular featur  
Much of the skill has already bee  
tiations begin.<sup>8</sup>

If all this is correct, as it seem  
our analysis of tacit bargaining  
standing of the influence at work  
bargaining even provides a basi  
The fundamental problem in tac  
*tion*; we should inquire, then, w

<sup>8</sup> Perhaps another role for skill is cont  
unsuccessful in getting the problem so  
is near his own preferred position, he  
multiple definitions for all the terms an  
signal contained in the original formul  
but in the variant of our income-tax pr



explicit bargaining. The answer requires, for an ultimate agreement, that participants' expectations be met.

Most bargaining situations involve a set of possible outcomes within which one party makes a concession than fail to reach agreement. Any potential outcome is one that both parties, and probably both, would prefer for the sake of agreement, and would not expect the other to insist on. Any potential outcome is therefore one that one party has improved by insisting; yet each party is unwilling to concede, since the other knows one will not concede than do without agreement. The process is guided mainly by what each party expects the other to do; yet each knows that the other has different thoughts. The final outcome must be one that each party expects the other to retreat; yet each party's expectation is what one thinks the other will do, and so on. Somehow, out of this process of mutual expectation that seemingly provides no way out, a decision is reached. These expectations must somehow converge on a single point, or the other not to expect to be expected.

If we then ask what it is that causes this convergence and bring the negotiation to a point where it is the intrinsic motivation that it is the intrinsic motivation, especially those that enjoy precedent, or some rationale that is differentiable from the continuum of positions. We argue that expectations tend not to be different only by degree from alternative positions; they have to dig in their heels at a given point of determination. One has to have a strong position on a position; and along the continuum of differentiable positions one finds no point where one can be strong at the arbitrary "focal point" itself with the argument "If not



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There is perhaps a little more identifiable resting place. If one he needs to control his advance recognizable limit to his own concession that is not to be in an obvious place to stop. A man it; or any other element that position from surrounding position 60 per cent and recedes to 50 if he recedes to 49 per cent, the the skids and will keep sliding.

If some troops have retreated will expect to be expected to retreat to which they can retreat with retreat further, while, if they y left where they can be expected larly, the advancing party can retreat to the river without having a satiable demand for unlimited river — and perhaps nowhere else.

This proposition may seem to the writer, and in any event so for the tendency to settle at a point would remain vague and somewhat somewhat more tangible logic provides not only an analogy to a necessary psychic phenomenon — is a real possibility and a reliable one. The “coordination” of the “coordination” of behavior and, in fact, they both involve intuitively perceived mutual expectations verifiable results of some of the as the more logical role of coordination prove that expectations can be based on objective details of the situation in the presence when the coordination of a *thing* is perceived by both parties.

more to this need for a mutually understood stand. If one is about to make a concession, he needs to consider the adversary's expectations; he needs a way to retreat. If one is to make a finite stand, it must be interpreted as capitulation, he needs a mediator's suggestion may provide a way to retreat. This qualitatively distinguishes the new situation from the old. If one has been demanding 100 per cent, he can get his heels in; the other will assume that he has hit

the river in our map, they will not make a stand. This is the one spot where, without necessarily being expected to yield any further, there is no place to make a determined stand. Similarly, if one expects to force the other to retreat, his advance interpreted as an in-advance retreat. There is stability at the river.

It is intuitively plausible; it does to some kind of explanation is needed for the focal points. But the proposition that tacit bargaining is essential is not so mystical if it were not for the fact of tacit bargaining. The latter is not the demonstration that the tacit coordination of expectations in some contexts a remarkably stable set of expectations is analogous to the situation when communication is cut off; it is nothing more nor less than in-advance expectations. Thus the empirically observed tacit-bargaining games, as well as the coordinated expectations in that case, are not coordinated and that some of the players can exercise a controlling influence on the other's expectations is essential. Sometimes when communication is absent;

it must still be perceptible, though when communication is possible. Communication does not make 50-50 less symmetric or A B C a less natural order for

If all we had to reason from was it would be only a guess and perhaps some kind of psychic attraction would work if all we had to generalize from were primarily "plausible" outcomes in action willing to admit the force of additional lines of evidence so strongly reinforced between tacit and explicit bargaining.

To illustrate with the problem of dividing \$100: 50-50 seems a plausible solution for too many reasons. It may balance bargaining powers; or it may simply have the power to communicate to two parties in such fashion that they appreciate it. What our analysis provides is evidence for the latter view. The subjects had to divide the \$100 without communication on 50-50. Instead of relying on intuition, the fact that in a slightly different context — our argument has an interpretation.

To illustrate again: the ability of our problems to recognize the solution, or, rather, their inability not to do so, by the evidence that if their subjects were not allowed to stabilize their bargaining *were not allowed*, they probably would stabilize the qualities of the river as a focus. The tacit analogy at least demonstrates that "bargaining expectations" is meaningful.

Perhaps we could push the analysis to those cases in which the only bargaining result is its evident "stabilization" if participants are known to appreciate



## THEORY OF STRATEGY

gh undoubtedly of lesser force,  
The possibility of communica-  
metrical or the river less unique  
or those letters.

ere the logic of tacit bargaining,  
rhaps a wild one that the same  
ed in explicit bargaining; and  
were the observation of pecul-  
tual bargains, we might be un-  
ventitious details. But the two  
orce each other that the analogy  
ining seems a potent one.

of agreeing explicitly on how to  
isible division, but it may seem  
y seem "fair"; it may seem to  
may, as suggested in this paper,  
icate its own inevitability to the  
each appreciates that they both  
of tacit bargaining provides is  
evidence is simply that *if* they  
mmunicating, they could concert  
ntuition, then, we can point to  
t context — the tacit-bargaining  
objectively demonstrable inter-

r of the two commanders in one  
stabilizing power of the river —  
recognize it — is substantiated  
rvival depended on some agree-  
their lines *and communication*  
r could perceive and appreciate  
us for their tacit agreement. So  
strates that the idea of "coordi-  
ul rather than mystical.

rgument further still. Even in  
istinguishing characteristic of a  
fairness," by standards that the  
ciate, we might argue that the

## BARGAINING, COMMUNI

moral force of fairness is greatly  
"fair" result to focus attention, i  
minacy that would otherwise exi  
of public opinion seems to force t  
"fair" or "reasonable" solution, w  
or at least misunderstand the w  
unless we give credit to its powe  
expectations. It may, to put it c  
*gestion*, working through the me  
that makes public opinion or pr  
effective. Again, as evidence for  
pose that the participants had to  
out communicating and visualiz  
nent ethical standard as providin  
to the suggestions contained in ou  
in problem 7 is a close analogy.  
force of moral responsibility or s  
constrains the participants, and  
must still look to the source of  
there, the writer suggests, the  
rationale often reflects the mecl

But, if this general line of rea  
explicit bargaining must pay at  
the "communication" that is in  
tions, the signals that the partici  
tails of the case. And it means t  
are not thoroughly separate conc  
tions from tacit bargaining up t  
or faulty or limited communica  
show some dependence on the r  
Hence all show some degree of  
themselves on their common ina  
tain outcomes.

This is not necessarily an argu  
comes as a rule to lean toward  
emerged if communication had b  
may certainly be different whe  
some of the artificial cases we ha

y reinforced by the power of a  
 if it fills the vacuum of indeter-  
 st. Similarly, when the pressure  
 the participants to the obviously  
 re may exaggerate the "pressure"  
 ay it works on the participants  
 r to coordinate the participants'  
 differently, be the power of *sug-*  
 mechanism described in this paper,  
 precedent or ethical standards so  
 this view, we need only to sup-  
 reach ultimate agreement with-  
 e public opinion or some promi-  
 g a strong suggestion analogous  
 r earlier examples. The mediator  
 . Finally, even if it is truly the  
 ensitivity to public opinion that  
 not the "signal" they get, we  
 the public's own opinion; and  
 need for a simple, qualitative  
 hanism discussed in this paper.  
 asoning is valid, any analysis of  
 tention to what we might call  
 herent in the bargaining situa-  
 ipants read in the inanimate de-  
 hat tacit and explicit bargaining  
 epts but that the various grada-  
 through types of incompleteness  
 tion to full communication all  
 need to coordinate expectations.  
 dependence of the participants  
 bility to keep their eyes off cer-  
 ument for expecting explicit out-  
 exactly those that would have  
 een impossible; the focal points  
 n speech is allowed, except in  
 ave used in our illustrations. But

what may be the *main* principle may be at least *one* of the implications of explicit bargaining. And, since bargaining includes maneuver, in for position, or speaking to be multitude of participants and convergent expectations and the power to coordinate expectations.

Perhaps many kinds of social interest groups reflect the same as the terrain and the circumstances at political conventions that often plurality into an overwhelming tional legitimacy to command power or political vacuum; the legend to bring order into the underworld depends on the expectation that of ing disobedience. The often exp in social action seems to reflect the phenomena of price leader competition, and perhaps even p able to an analysis that stress munication and its dependence fairly unambiguous signals that "Spontaneous" revolt may reflect can easily be destroyed, people coordination, a signal so unmi potent in its suggestion for action everyone else reads the same s act on it, thus providing one a goes with action in large number that such a signal might be p agent whose only claim to lead the instructions required for co

#### TACIT NEGOTIATION

What useful insight does this practical problems of tacit barg

## THEORY OF STRATEGY

le in tacit bargaining apparently important principles in the analysis ce even much so-called "explicit" ndirect communication, jockeying overheard, or is confused by a divergent interests, the need for he role of signals that have the us may be powerful.

l stability and the formation of dependence on such coordinators nces can provide: the band wagon ten converts the slightest sign of majority; the power of constitu- pular support in times of anarchy ary power of an old gang leader rld, simply because obedience de- thers will be obedient in punish- ressed idea of a "rallying point" the same concept. In economics ship, various kinds of nonprice price stability itself appear amen- es the importance of tacit com- on qualitatively identifiable and can be read in the situation itself. t similar principles: when leaders e require some signal for their stakably comprehensible and so on that everyone can be sure that signal with enough confidence to another with the immunity that rs. (There is even the possibility ovided from outside, even by an ership was its capacity to signal ncerted action.)

## AND LIMITED WAR

line of analysis provide into the gaining that usually confront us,

## BARGAINING, COMMUNICATION

particularly the problems of strategy. It certainly suggests that it is not a real war, jurisdictional war, or variation. But it gives us no new suggestions. Gas was limited in Korea, and gas was limited on the possibility of limited war. It is more persuasive than all the suggestions under discussion. If the analysis provides a better understanding of the probability of success, but a better understanding of the possibility of agreement.

If there are important conclusions, probably these: (1) tacit agreements or partial or haphazard negotiation are not easily distinguishable from the real thing; (2) when a matter is a matter of degree; (3) when there is incomplete communication, the situation itself to exercise the outcome; specifically, a solution to one party or the other or even to both of them may be the only way in which they can be coordinated.

Gas was not used in World War I without antecedents, was largely a matter of speculation on whether any amount of poison gas could have been arrived at (or even, for that matter, "no gas" raises complicated questions about what circumstances: "no gas" is only on military personnel; gas is only when carried by vehicle with warning—a variety of limits is possible, and many might have been of the war. But there is a simple almost uniquely a focus for agreement, conjecture at what rules the other failure at coordination on the first acquiescence in any limits at all.

The physical configuration of

egic maneuver and limited war? *possible* to find limits to war — whatever — without overt nego- strong sense of *probability*. War was not used in World War II; these two facts are more per- contained in the foregoing dis- anything, then, it is not a judg- ssfully reaching tacit agreement where to look for the terms of

ons to be drawn, they are prob- or agreements arrived at through require terms that are qualita- alternatives and cannot simply agreement must be reached with participants must be ready to precise substantial constraint over tion that discriminates against involves “unnecessary” nuisance one on which their expectations

r II. The agreement, though not y a tacit one. It is interesting ternative agreement concerning ed at without formal communi- c, with communication). “Some ns of how much, where, under s simple and unambiguous. Gas used only by defending forces; e or projectile; no gas without s conceivable; some may make n more impartial to the outcome icity to “no gas” that makes it ement when each side can only er side would propose and when st try may spoil the chances for

Korea must have helped in de-

fining the limits to war and in-  
sible. The area was surrounded by  
ern political boundary was marked  
ably by a river. The thirty-eight  
powerful focus for a stalemate  
"waist," was a strong candidate  
shorter defense line but because  
sides that an advance to the water  
determination to advance farther  
did not telegraph any intention

The Formosan Straits made  
tween the Communist and Nationalist  
not solely because water favored  
tack, but because an island is  
conspicuous boundary. The sacrifice  
would have made the resulting  
any part of the mainland would  
Except at the water's edge, all  
an attack across water is a declaration  
been terminated.

In Korea, weapons were limited  
between atomic and all other; it is  
more difficult to stabilize a tactical  
of atomic weapons or selection  
or target is so obvious and natural  
except for "no size, on any target."  
French forces in Indochina was  
not people; and it was appreciated  
clude, say, air participation could  
air, while it would not be possible  
of air or ground participation.  
ground intervention can be converted  
of ground forces; one cannot negotiate  
and communicate a persuasive message  
tends to commit.

The strategy of retaliation is  
cate or coordinate on limits. Limit

<sup>a</sup> This point is developed at length in A



## THEORY OF STRATEGY

making geographical limits possible by water, and the principal north-south line marked dramatically and unmistakably. The north-south parallel seems to have been a major alternative; and the main alternative, the one not just because it provided a clear line, but because it would have been clear to both sides that a retreat to the waist did not necessarily signal a retreat and that a retreat to the waist did not necessarily signal a retreat farther.

It is possible to stabilize a line between national government forces of China, and the defender and inhibited at an integral unit and water is a sacrifice of any part of the island line unstable; the retention of the line would have been similarly unstable. Movement is a matter of degree; the fact that the "agreement" has

been established by the qualitative distinction between the two sides, it would surely have been much more difficult to accept any limit on size of targets.<sup>9</sup> No definition of size is possible that it goes without saying, "no target." American assistance to the Chinese was persuasively limited to material, and it is clear that an enlargement to include other forms of aid would be recognized as limited to a certain amount. One's intentions to abstain from further aggression are betrayed by the complete withholding of aid. It is not so easy to commit *some* forces to a limited amount that one in-

is not affected by the need to communicate. Local aggression defines a place;

Appendix A.

## BARGAINING, COMMUN

with luck and natural boundaries of geographical limits or limits or both may be willing to accept the initiative in breaching the reassures the other of such will be expected because, if they are on that any new ones can be found to check the widening of the conflict the method and place of the retaliation is much more difficult to convey than the limits are, so that he has a chance of retaliation. In fact, the initial locality that provokes it may be independence that is not conducive to expectations. Thus the problem of limits on war is doubly difficult because the aggressor's own act is not tolerated.

In sum, the problem of limiting a continuous range of possibilities from available for either side; it is a limitation to recognize qualitative that is embarrassed by the multiplicity of sides to accept some dictation from the writer suggests that the same is true in every field in which it occurs.

## PRIOR ARR

While the main burden of the bargaining is possible and is susceptible is no assurance that it will succeed when it succeeds, it will yield to a favorable outcome compared with all available if full communication and assurance that the next war, if served limits in time and of a explicit negotiation can take place to consider what steps can be

es, there may be tacit acceptance  
 s on types of targets. One side  
 ot limited defeat rather than take  
 rules, and to act in a manner that  
 lingness. The "rules" may be re-  
 ce broken, there is no assurance  
 and jointly recognized in time  
 n conflict. But if retaliation is left to  
 aliator's own choosing, it may be  
 to the victim what the proposed  
 nce to accept them in his counter-  
 departure of retaliation from the  
 be a kind of declaration of inde-  
 to the creation of stable mutual  
 n of finding mutually recognized  
 t if the definition implicit in the  
 rable.

ting warfare involves not a con-  
 om most favorable to least favor-  
 ngy, discrete world that is better  
 n quantitative differences, that is  
 r of choices, and that forces both  
 rom the elements themselves. The  
 is true of restrained competition  
 s.

#### ARRANGEMENTS

is paper has been that tacit bar-  
 tible of systematic analysis, there  
 eed in any particular case or that,  
 either party a particularly favor-  
 alternatives that might have been  
 had been allowed. There is no  
 it comes, will find mutually ob-  
 sort to afford protection, unless  
 lace. There is reason, therefore,  
 taken before the time for tacit

bargaining occurs, to enhance the chance that a settlement will come.

Keeping communication channels open is a key element at this point. (At a minimum, this might mean that a counteroffer could be heard and responded to.) The technical side of this principle is that there would be facilities to send and receive messages, and that there would be intermediaries and who stood in line to do the negotiating. If the designated parties and facilities were not available, the effort to fight a restrained nuclear war would be a chaotic and busy instant in which each side would be in a state of confusion over how to make the most of the chances for stabilizing the action.

Thought should be given to the role of negotiators or referees. To settle on a negotiated basis requires some prior understanding of the rules of the tradition or a sign of welcome. Even the most basic elements for the contingency, evidence of the role of referees and the conditions for their use, might help to prepare for a situation of extreme value in an awful contingency.

But all such efforts may suffer if one side or the adversary to engage in any preparation for a negotiated settlement balks at giving signs of engagement. It is even possible that one side might have a tactical interest in keeping that war going, because of the likelihood of mutual destruction. The cause of the strategy of threats, the conditions for willingness to start a war or take steps to prevent aggression or retaliation to aggression, and the evidence with which a nation's leadership is prepared to act within limits. To be specific, the United States might retaliate against local aggression with nuclear force. The Russians know that it depends on the conditions that such retaliation could its

## THEORY OF STRATEGY

the likelihood of a successful outcome seems to be one obvious point open to discussion (it might mean assuring that a surrender would be responded to by either side.) The main problem would be identification of who would be the mediator, upon what authority, over what period of time, and whether if intermediaries were used, the job would be done in what fashion if the intermediaries were destroyed. In the event of an outbreak of war, there may be only a brief period in which the side must decide whether limited negotiations are worth just begun; and twelve hours' contact might spoil some of the gains made within limits.

The possible usefulness of mediators and influential mediators usually requires a precedent, or at least a precedent or a practice, or even if we rule out overt arrangements by each side of an appreciation of the value of mediators, even a little practice are an instrument of the most great emergency.

But the unwillingness of an adversary to take conciliatory steps. Not only may an eagerness to come to agreement; but in a potential war may have a far unrestrained and aggravating effect in case it comes. Why? Because bluffs, and deterrents. The will to fight that may lead to war, whether by aggression, may depend on the confidence that the confidants think a war could be kept within the willingness of America to retaliate with atomic attack depends — and the confidence — on how likely we consider ourselves to remain limited. That is, it

## BARGAINING, COMMUNIC

depends on how likely it is in our  
sians, when we both desperately  
which either of us is willing to  
those limits, will find such limits an  
acquiescence in them. If, then, R  
activity that might lead to the po  
our own resolution to act, they m  
for the sake of reducing the threat  
chutist in our example may know  
with the plane if he is sure they c  
so if the first abstains from discus  
will have to ride quietly for fear of  
in the terrain below.

Whether this consideration or  
serious negotiation make prior disc  
a useful idea that emerges from one  
negotiation or communication for  
expectations need not be reciproc  
provide the coordination that will s  
even an unwilling member cannot  
available for the receipt of messa  
posed the letter R in one of the ba  
partner heard — and it is obvious  
is the only extant proposal, and  
coordinate in default of any co  
as if it had been explicitly acco  
the other party might not manage  
nence but rather simply prove  
as no rival claim was made tha  
one of our parachutists, just befo  
neither of them dreamed of having  
had to meet somebody down there  
hill in sight," the other would prob  
first would be sure he recalled and  
it had been on the tip of his ton  
"Not me, climbing hurts my legs,"  
some signal is desperately needed b

judgment that we and the Russians need to recognize limits within which to prosecute the war without enlarging it, and come to mutually recognized limits. Russian refusal to engage in any possibility of limited war deters us, and might risk forgoing such limits on the part of American action. One party, knowing that the other will be careless and will not be able to meet and save themselves; by announcing the contingency, the other might be precipitating a fatal separation.

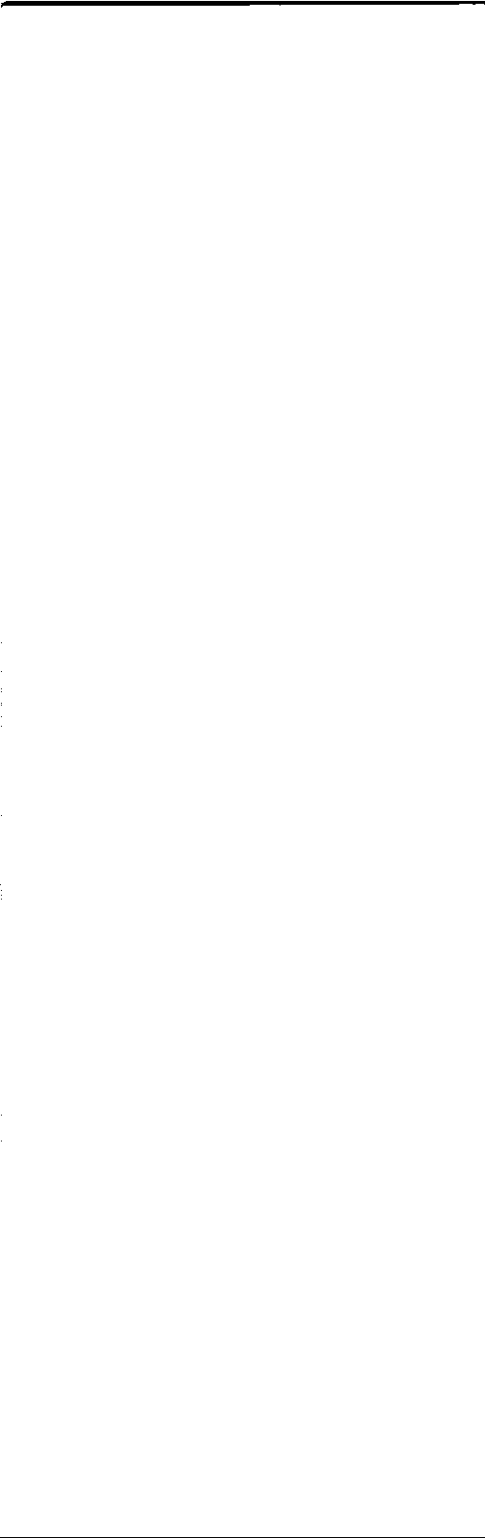
Just as the usual inhibitions on unilateral action make discussion impossible, there is still a lesson to be learned from some of our earlier games. It is that for the purpose of coordinating action, unilateral negotiation may be necessary: unilateral negotiation may save both parties. Furthermore, a party does not necessarily make himself unengaged by making a proposal. Recall the man who proposed a bargaining game: as long as the proposal was not challenged, the letter R, being unchallenged, it may be accepted nearly as well as if it had been accepted. (Even *denial* of it by the other party does not dislodge its claim to promise, so long as the other is aware of it, as long as it does not create ambiguousness.) If the man had said, "If I ever see a plane, I'd just head for the highest mountain," he probably would recall and know that the plane would go there, even though he might be inclined to say, "How stupid," or "How foolish," when the plane failed. When the plane failed, it was by *both* parties and both parties

know it, even a poor signal and  
mand recognition, in default of  
is upon them, their interests,  
play of threats and deterrents,  
perate need for a focus of ag



## THEORY OF STRATEGY

and a discriminatory one may compare with any other. Once the contingency which originally diverged in the substantially coincide in the desirability.





## TOWARD A INTERDEPENDENT

On the strategy of pure conflict, *game theory* has yielded important insights into the strategy of action where conflict and interdependence — the nonzero-sum game — are involved: of war, strikes, negotiations, crises, price war, and blackmail; or in a traffic jam; and the conventional *game theory* has no advice. These are the “games” where conflict provides the dramatic part of the logical structure and where cooperation or mutual accommodation is possible only in the avoidance of mutual damage, which, though secrecy may play a part, is an essential need for the signaling of intentions to the minds. Finally, they are games where the players do to avert mutual damage affected by their actions, so that it is not always a matter of choice, knowledge, or freedom of action.

Traditional *game theory* has been applied to these mutual-dependence games by using the methods and concepts that proved successful in the case of pure conflict. The present book is an attempt to enlarge the scope of *game theory* so that a game to be a limiting case rather than a special case. The proposed extension of the theory is in two directions. One is to identify the perceptual

## THEORY OF RATIONAL DECISION

Conflict — the zero-sum games — has provided the most important insight and advice. But on the other hand, conflict is mixed with mutual dependence in games involved in wars and threats, international deterrence, class war, race relations; maneuvering in a bureaucracy; the coercion of one's own children — and has not yielded comparable insight or advice. In these, though the element of mutual interest, mutual dependence is present, it demands some kind of collaboration — tacit, if not explicit — even in the face of disaster. These are also games in which, though a strategic role, there is some element of cooperation of intentions and the meeting of interests. In these, in which what one player *can* do affects what another player *will* do to his advantage, it is an advantage to possess initiative and the right of choice.

Game theory, for the most part, applied to the study of (nonzero-sum games) the method is not as successful in studying the strategy of these games as the chapter and the one to follow. Game theory, taking the zero-sum game as a point of departure. The study will be mainly along two lines. The first is the formal and suggestive element in the

formation of mutually consistent (the following chapter) is to identify that may occur in actual games elements that the moves depend as "threat," "enforcement," and to destroy communication.

That game theory is underdeveloped reflect its preoccupation with the inferences, threats and promises accepted theory of zero-sum games because they imply a relation between perfectly innocuous, must be to and he can destroy it by adopting necessary, on a randomizing mechanism" pursued by two players in typified by pursuit and evasion - reveal what kind of behavior is cooperation, or how mutual dependence gain.

If the zero-sum game is the limit is the other extreme? It must be in which the players win or lose preferences regarding the outcome. Where the total or shares that vary with all possible outcomes identically scales. (And, to avoid any initial the players that the preferences no conflict of interest in the information they try to convey to each other.)

What is there about pure collaboration theory or to bargaining? A part of this game is not trivial, is that inception and communication of a kind nonzero-sum games. Whenever they not permit players to divide the an explicit plan, it may not be easy course of the game. Players have

## OF GAME THEORY

ent expectations. The other (in  
tify some of the basic "moves"  
of strategy, and the structural  
l on; it involves such concepts  
the capacity to communicate or

eloped along these two lines may  
zero-sum game. Suggestions and  
, are of no consequence in the  
es. They are of no consequence  
ween the two players that, unless  
the disadvantage of one player;  
ng a minimax strategy, based, if  
hanism. So the "rational strate-  
a situation of pure conflict — as  
— should not be expected to re-  
nducive to mutual accommoda-  
can be exploited for unilateral

niting case of pure conflict, what  
e the "pure-collaboration" game  
together, having identical prefer-  
hether they win fixed shares of  
n the joint total, they must rank  
y, in their separate preference  
conflict, it has to be evident to  
s are identical, so that there is  
ormation or misinformation that

collaboration that relates it to game  
al answer, just to establish that  
it may contain problems of per-  
kind that quite generally occur in  
e communication structure does  
task ahead of time according to  
sy to coordinate behavior in the  
to understand each other, to dis-

## INTERDEPENDENCE

cover patterns of individual behaviors predictable to the other; the shared sense of pattern or regularities, and impromptu codes for responding to each other's signals and by suggestive behavior. Two people dancing together to understand a guerrilla force that become separate intentions in this fashion, as a concert audience, who must at some point press for an encore or taper off to

If *chess* is the standard example, it may typify the game of pure coordination, the zero-sum game, *rendezvous* matching game.

An experiment of O. K. Moore and M. I. Berkowitz is a nice mixture in which the two line games involves a zero-sum game between two and a coordination game involving three people. The three members of each team have different interests but, because of a special arrangement, they have as a single entity. The special arrangement is that the members of each team are separated by a telephone line so that all six telephone lines are connected to a single line so that everyone can hear both their own and their teammates. No prearrangement of strategy between the teams we have here a pure-conflict game, and between the team we have a pure-coordination game.

If in this game we suppress the conflict and the players simply try to coordinate a strategy, the game is a three-person pure-coordination game. This sort of game has been studied, both experimentally and theoretically, and there is substantial overlap at this point between the game and organization or communication.

<sup>1</sup> O. K. Moore and M. I. Berkowitz, "A Game of Coordination," Office of Naval Research, Technical Report 16 (New Haven, November, 1956).

<sup>2</sup> An extensive formal analysis of the game is given by Jacob Marschak, "Elements for a Theory of Coordination,"



behavior that make each player's action visible. They have to test each other for sincerity and to exploit clichés, conceal or signal their intentions and intentions. They must communicate by hint and by action. In a game of coordination, vehicles trying to avoid collision, a group of people listening to unfamiliar music, or members of a team trying to coordinate in combat have to concert their actions. In a game of coordination, they do the applauding members of a team. At some point "agree" on whether to coordinate together.

Example of a zero-sum game, *charades* and *coordination*; if *pursuit* epitomizes a zero-sum game, they may do the same for the coordination game.

and M. I. Berkowitz provides a number of interesting cases where coordination is both visible.<sup>1</sup> In a game of coordination, two teams, each team consisting of three members. Each member of the team has an identical role. A key feature of the game, cannot be a key feature is that the three members of the team and can communicate only by action. The three members are connected on the same network. Both the other team and his own actions are visible. A code of codes is permitted. Between the two teams is a coordination game; among the members of a team is a coordination game.

the "other team" and if the three members of the team have a winning strategy in a game of coordination with communication difficulty, we have a coordination game. Several "games" of this type have been played experimentally and formally; in fact, the coordination game is a point between the nonzero-sum coordination game and coordination theory.<sup>2</sup>

*Game Theory and Social Interaction*, Report, Contract No. SAR/NONR-609

coordination problem is developed by "Toward an Ecology of Teams," and, "Toward an Eco-

The experiments reported in C choice is possible even in the cor Further, they showed that there which the *conflict* of interest in whelmed by the sheer need for co situations, the limiting case o essential feature of the correspo

So we do have, in this *coordin* pendence on the conveyance and a phenomenon that brings out a sum game; and it stands in mu zero-sum game, namely, that of conflict-cooperation game with nated; the other is the mixed c conflict eliminated. In one the p on revelation.

It is to be stressed that the pu *strategy* in the strict technical s which each player's best choice e expects the other to take, which other's expectations of his own. tions is precisely what distingu game of chance or a game of sk the interests are convergent; i terests are divergent; but in nei made wisely without regard to on the mutual expectations of t

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conomic Theory of Organization and In *sion Papers*, Nos. 94 and 95 (New Ser and Operational Communication Probl *ussion Papers, Economics*, No. 2076. be found in Alex Bavelas, "Communi in D. Cartwright and A. F. Zander, G Heise and G. A. Miller, "Problem S Communication Nets," in P. A. Hare, *Groups* (New York, 1955), H. J. Leav of Feedback on Communication," in Hogan, and A. A. Walter, "An Experi on the Reproduction of Visually Per *Psychology*, 15:73-86 (February, 1932)

<sup>3</sup> Concerning this point, Carl Kayse

## OF GAME THEORY

Chapter 3 showed that coordinated complete absence of communication, are tacit bargaining situations in the choice of action may be overconcerting on *some* action; in those of pure coordination isolates the pending nonzero-sum game.

*ated problem-solving*, with its dependence on perception of intentions or plans, is an essential aspect of the nonzero-sum game with the same relation to it as the "limiting case." One is the mixed all scope for cooperation eliminated conflict-cooperation game with the premium is on secrecy, in the other

pre-coordination game is a *game of sense*. It is a behavior situation in which the choice of action depends on the action he knows depends, in turn, on the choice of action he knows depends. This interdependence of expectations distinguishes a game of strategy from a game of chance. In the pure-coordination game the choice of action depends on the choice of action he knows depends. In the pure-conflict game the interdependence of expectations distinguishes a game of strategy from a game of chance. In either case can a choice of action be made independent of the dependence of the outcome on the choice of action he knows depends. The players.<sup>3</sup>

information," *Cowles Foundation Discussions*), and, with Roy Radner, "Structural Problems in Teams," *Cowles Foundation Discussions*. Examples of relevant empirical work can be found in "Communication Patterns in Task-oriented Groups," *Group Dynamics* (Evanston, 1953), G. A. Miller, "Solving by Small Groups Using Various Methods," E. F. Borgatta, and R. F. Bales, *Small Groups*, and R. A. H. Mueller, "Some Effects of Language on the Performance of Small Groups," *Small Groups*, and L. Carmichael, H. P. Harter, "Experimental Study of the Effects of Language on the Performance of Small Groups," *Journal of Experimental Psychology*.

See also his review of Von Neumann and

## INTERDEPENDENCE

Recall the famous case of Holmes and Moriarty on the London Underground. They are on the same train, neither directly in touch with the other, and each must choose whether to get off at the next station. There are two kinds of payoff. In one, Holmes wins if they get off at different stations, Moriarty wins if they get off at the same station; this is the zero-sum game, in which the two players are perfectly correlated. In the other, Holmes and Moriarty will both benefit from getting off at the same station, while both lose if they get off at different stations; this is the pure-coordination game, in which the two players are perfectly correlated. In a third case, we would show Holmes and Moriarty both benefit if they succeed in getting off at the same station, but Moriarty gains more if both get off at the same station, and Holmes gains more if both get off at different stations; this is the usual nonzero-sum game, or "chicken" game, or "preferences" game. This is the mixture of the two cases of interdependence that epitomizes bargaining without particular communication and intelligence. In the first case we can enrich the game or make it a zero-sum game to one of the two players in the first case.

The essential game-of-strategy cases are: the best choice for either doing one thing or the other to do, knowing that the other will do the same; each is aware that each must try to do the opposite of what the other will do; the first will guess the second to guess the first; a spiral of reciprocal expectations.

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Morgenstern's *Theory of Games and Economic Behavior* (New York, 1953) deals precisely with such games of strategy in a situation in which all actions are interdependent. He says: "There is no possibility of what we called parametrization of the action of an agent (player) to behave as if the actions of the other players were parametrized. It is this very lack of parametrization which is the essential feature of the language is used by R. Duncan Luce and Howard Raiffa in *Games and Decisions* (New York, 1957): "Intuitively, the problem for each participant, a problem of individual risk and uncertainty, the uncertainty arising from the actions of the others will do" (p. 14). Their preoccupation is with the case of coincident preferences they deal with such players as a single

nes and Moriarty on separate  
 with the other, each having to  
 station. We can consider three  
 ns a prize if they get off at dif-  
 f they get off at the same sta-  
 n which the preferences of the  
 d inversely. In the second case,  
 e rewarded if they succeed in  
 t ever station that may be; this  
 which the preferences of the  
 positively. The third payoff  
 y both being rewarded if they  
 e station, but Holmes gaining  
 c off at one particular station,  
 t off at some other particular  
 t off at the same station. This  
 "imperfect-correlation-of-pref-  
 re of conflict and mutual de-  
 ing situations. By specifying  
 ligence systems for the players,  
 trivial or provide an advantage  
 st and third variants.

element is present in all three  
 depends on what he expects the  
 er is similarly guided, so that  
 o guess what the second guesses  
 uess and so on, in the familiar

*Economic Behavior* says: "The theory of  
 th the actions of several agents, in a  
 pendent, and where, in general, there  
 ametrization that would enable each  
 s of the others were given. In fact, it  
 h is the essence of a game." Similar  
 Howard Raiffa in *Games and Deci-*  
 problem of conflict of interest is, for  
 decision making under a mixture of  
 ising from his ignorance as to what  
 upation is with the conflict, however;  
 ispose of as trivial (pp. 59, 88), and  
 individual (p. 13).

## A RECLASSIFICATION

Before going further, we can note that the twofold division into zero-sum and non-zero-sum games, with the symmetry that we need and fairness that stands opposite to the zero-sum game, is a classification scheme for a two-person game in a two-dimensional diagram. The points of the game, for the two players, are the coordinates of a point. All points of a game would be represented by a straight line, those of a zero-sum game by a line of positive slope, those of a non-zero-sum game by a line of negative slope. A line of zero slope would denote a negative slope.

<sup>4</sup> If the nature of the game makes it difficult for a player to choose his strategy, or if there is an enforceable agreement that, like a draft, there may be room for cooperation, there is perfect disagreement over the points representing the pure-conflict game. In a game lying on a straight line, with the two players in the sense now familiar in game theory, the game is a common-interest game, since players' *outcomes* may not agree on the desired point. A fifty-fifty chance between the two players would be a "strictly pure" conflict and common-interest game. A line of zero slope would have to show the *expected value* of the game lying along the downward-sloping line, with axes measured in "utility units" and the points denoting *outcomes* measured in "utility units".

Also, the pure games cannot admit of a bribe in a pure common-interest game through a payment — assuming that the communication makes this possible — a conflict of interest. A point denoting the payment of a bribe would be a point of another point or points on the upward-sloping line of a mixed game. And if one player threatens damage or offers compensation, there is scope for bargaining; in a conflict, and the points denoting the threat would lie off the downward-sloping line. *Outcomes* must be allowed for. (Two

## ON OF GAME THEORY

### CATION OF GAMES

usefully reclassify game situations. zero-sum and nonzero-sum lacks the ability to identify the limiting case that is a pure conflict game. The essentials of a classification of a game could be represented on a graph where the values of any particular outcome for each player, would be represented by the two possible outcomes of a pure-conflict game. In some or all of the points on a negatively sloping line, a pure common-interest game by a positively inclined line. In the limiting case, at least one pair of points on the negatively sloping line and at least one pair a positive

it is not desirable for a player to use a random strategy or feasible for the players to negotiate an agreement, the drawing of lots, depends on a chance mechanism in the choice of *strategies* even when the ranking of *outcomes*. In that case the game must meet the tighter restriction of a straight line on axes measuring the players' "utilities" in the limiting case. This restriction also applies to the pure conflict game where the players who agree perfectly on the ranking of the probability of, say, one particular point over another point immediately above and below it. In common-interest games, providing no scope for disagreement in the other, the limiting case of all pertinent mixed (random) strategies is a straight line, consisting of downward-sloping and upward-sloping lines, respectively, of the kind mentioned; this in turn means that the limiting case must lie on a *straight* line.

the limiting case "side payments." If one of the partners threatens to sabotage the effect unless he is given a reward, a reward and enforcement structure of the game of common-interest is introduced; in effect, the point of the limiting case would appear to the upper left or lower right of the limiting case, producing the configuration of the limiting case of the players in a pure-conflict game can be used to induce his opponent to yield in this limiting case. If there is no longer a relation of pure conflict, the limiting case is a straight line. In other words, *all* pertinent potential limiting cases of simultaneous pure-conflict games, even if

## INTERDEPENDENT

We could stay close to traditional nomenclature for the strictly pure games, by calling *coordination* games, getting the unwieldy *coordination* as the name for all games. We could also call them perfect-negative-correlation games, relating them to their preferences with respect to outcomes. For the mixed game the rather dull title of *coordination* would be better.

The difficulty is in finding a sufficient name for a game in which there is both conflict and cooperation. It is interesting that we have no very good names between the players: in the common-interest game we call them as "partners" and in the pure conflict game as "adversaries"; but the mixed relation is a mixture of strikes, negotiations, and so forth, and has no term.<sup>5</sup> In the rest of this book I shall use the term *bargaining game* or *mixed-motive game* to catch the spirit. "Mixed-motive" refers to the individual's lack of clarity about his own interests due to the ambivalence of his relation to the other. It is a mixture of the nature of mutual dependence and competition. "Nonzero-sum" refers to the fact that the sum is not zero. The pure common-interest game is a special case of the problem and the activity involved. A better name for the perfect sharing of resources would be *coordination*.

## GAMES OF COOPERATION

While most of this book will be devoted to a discussion of the pure coordination

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they meet the restriction of straight lines, and the slopes of the two lines happen to be identical.

<sup>5</sup> It deserves to be emphasized that non-cooperation is not classed under theory of partnership as unproductive. It provides insight into problems like that of the military man. The words that bring out the common interest in the "bargaining process" involved in the military man's problem in Chapter 9, even the problem of surprise attack in partnership discipline. If *theory of bargaining* has too conflict-oriented connotation, perhaps *dependent decision* would be a neutral term for both the bargaining cases as well as the mixed case.





3, will help to show that this is right and will identify certain conditions which appear most clearly in the limit.

Recall the various pure coordination problems. Each of them evidently provides a clue to coordination, some clue to convergence of the participants' plans, there that the same kind of coordination force not only in pure coordination problems that includes conflict; and, in fact, that, in the complete absence of communication, is true. But there are a number of coordination problems — the *tacit* coordination problem — the coordination of plans with them — is an example is the formation of a crowd.

It is usually the essence of a crowd that its members have to know not only when to act so that they act together on the problem; but leadership is provided by the authority trying to solve the mob's problem is to act in a way that to find some common signal that if he acts on it, he will not be alone. This can thus be seen as a coordination problem. In leadership and communication problems, if independent, it may be difficult to get a crowd to coalesce. It requires that all know when to act and that there is no "obvious" central signal in which mobs find it difficult to coalesce. There is no place so "obvious" that it is obvious to everyone else. Bandwagon leadership or in voting behavior is "perceived" signals, when a person desires to be in a majority of a crowd, he will coalesce.<sup>6</sup>

Excessively polarized behavior

<sup>6</sup> A closely related phenomenon is the tendency of a person to blend into the crowd to avoid being singled out for "election" to some position.

## N OF GAME THEORY

is an important game in its own right. The qualities of the mixed game that we have seen in the limiting case of pure coordination.

Coordination problems of Chapter 3. We have seen some focal point for a concerted action, some rationale for the common expectations. It was argued that a coordinating clue might be a potent factor but in the mixed situation, in fact, the experiments demonstrated that without communication, this is certainly not the case. In instances in which pure coordination is required, the process of identifying partners and coordinating is a significant phenomenon. A good example is the case of riotous mobs.

In the case of mob formation that the potential exists for a mob where and when to meet but just in concert. Overt leadership solves the problem. It can often be identified and eliminated to prevent mob action. In this case, the process of acting in unison without overt leadership, the process that makes everyone confident that they are acting alone. The role of "incidents" is a coordinating role; it is a substitute for overt leadership. Without something like an incident, a mob does not act at all, since immunity requires that people act together. Similarly, the city that has a focal point or dramatic site may be one that is likely to congregate spontaneously; there is no doubt that it is evident to everyone that it is a focal point for wagon behavior, in the selection of a meeting place, may also depend on "mutually agreed upon" that each person's preference is a focal point, at least, to see some majority.

Behavior may be the unhappy result of

is not appreciated by the person who tries to act. He is called on to recite, picked on by a bully, and he has the post that everybody wants to escape.

## INTERDEPENDENCE

*Game-theory formulation of the coordination problem*  
 off matrix for a pure coordination problem like that in Fig. 8. One player chooses

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

FIG. 8

and they receive the rewards denoted in the cell where their choices intersect. For each player there corresponds a single choice. For both of them, we can arrange the cells lie along the diagonal. In the diagonal cells both players receive a reward of 1, in the off-diagonal cells to both players, in the rest we receive 0. For our purpose there is nothing lost by labeling the cells for the payoff to both players.

But we must rule out a possibility suggested by analogy with other games (we use the term of Luce and Raiffa) tacit coordination and players should make no difference.

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play with multiple equilibria. To adapt the theory to tacit coordination others requires in this case that their beliefs be symmetric about the nonparametric character of tacit coordination. The number of players.

<sup>10</sup> Labeling of the *players* is explicitly ruled out (see Schelling, 1960, p. 127) in discussing cooperative games and the symmetry assumption (J. F. Nash, "The Core of a N-person Game," *Econometrica* 18:155-162 [1950], and "Two Person Zero-Sum Games," *Econometrica* 21:128-140 [1953]). Labeling of *strategies* in coordination games is implicitly precluded by dealing with them as abstract, that is, the abstract version of them as represented by a matrix. It is itself an *analytical* device, not part of the empirical world. The right, upper-lower, or numerical ordering of the cells is ample in which the labeling of *players* is t

coordination problem. The payoff problem would look something like this: one player chooses a row, the other a column;

	0	0
	0	0
	0	0
	1	0
	0	1

8

represented by the numbers contained in the cells. If to each choice of one player there is a choice for the other that "wins" (i.e., a cell in the same row or column so that all the winning cells there are positive payoffs), then we can put zeros. (For our present purposes, let a single number stand in for the payoffs to both players.)

The axiom that might seem to be central to game theories, namely, that (to the extent of the "labeling" of rows, columns, and cells) the payoff is independent of the outcome.<sup>10</sup> It is pre-

ferred "parametrically" to the behavior of the players; that is, behavior be observable, not conjectural; coordination remains, no matter how large

is ruled out by Luce and Raiffa (pp. 123-124). In effect is ruled out by Nash in his "The Bargaining Problem," *Econometrica*, 1950, and "Cooperative Games," *Econometrica*, 1953. Theories for tacit or explicit nonzero-sum games only with games in normal form, that is, represented by a payoff matrix (which is the game, and hence provides no left-over of the actual strategies). A good example of the controlling factor is the interrupted

cisely because strategies are "labeled" and thus have symbolic or connotative content. The lack of mathematical structure of the game is not sheer chance and "win" these games is not the reason that these games are interesting.

Even the game portrayed in Figure 1, which has a minimum of symbolic significance, is not a hard one to "win," that is, to choose a better one than chance would suggest. The matrix as shown. (If we give the strategies the rows and columns, it seems to be a coordination game. In that case it is formally identical to the game "Pick a positive number," which is different, there is less tendency for coordination (e.g., 7, 13, and so forth.) Just for the sake of choice, since it focuses attention on the number so forth.<sup>11</sup> If strategies are not labeled, they are labels that can be ordered like the names of given individual names, and the game is not in a particular order, it is the names that matter.)

And here it becomes emphasized that the processes of choosing a strategy and the strategy of coordination are of the same nature. It is so if one admits the "minimax" strategy, in the zero-sum game. In the coordination game, the player's objective is to make coordination. In some imaginative process of intuition, the player seeks clues; in the minimax strategy, the player seeks strikingly so with randomized strategies, the player seeks to avoid any meeting of minds,

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telephone call mentioned earlier, with the other player and who should wait for the call.

<sup>11</sup> This point is typical of a number of experiments reported earlier, to the effect that the dependence of irrelevant alternatives on the choice of a gaining game. Potential outcomes can be chosen, though not themselves near to being chosen. For this postulate see Luce and Raiffa, p. 110.

<sup>12</sup> Randomized strategies may never

## OF GAME THEORY

labeled" in some sense — that is, characteristics that transcend the game — that players can rise above games; and it is for that same interesting and important.

Fig. 8 which might seem to have once attached to rows and columns, is, for players to do substantially suggest, if it is portrayed in a at same game an infinite series of become easier rather than harder. ical with the game mentioned ear-but, because the "labeling" is dif-for minorities to congregate at 3, rming the matrix prejudices the n on "first," "middle," "last," and t given sequential labels, that is, e numbers and alphabets, but are ese are not presented in any par-at must coordinate choice.

tically clear that the intellectual y in pure conflict and choosing a wholly different sorts. At least this ax" solution, randomized if neces-a the pure-coordination game, the ntact with the other player through ropection, of searching for shared gy of a zero-sum game — most choice — one's whole objective is , even an inadvertent one.<sup>12</sup>

h the problem of who should call back

er of demonstrations in the author's ex-ect that the postulate regarding the "in-" cannot be credited in the tacit game t be expected to hold in the explicit bar-be relevant to the coordination of choice, chosen. For a statement and discussion of

27.

theless be useful to achieve a coordinated

To illustrate, suppose that I am dealt a deck of fifty-two and you are to play a traditional game theory gives guidance under the assumption that I do not willfully select at random and defy your best chance of guessing what I name. I name a card; you try to guess correctly and you know that I will name a card that facilitates your guess, the reason being that I want to make tacit cooperation impossible. I label the stations by flipping a coin off the train; and Moriarty has a coin. But in the common-interest case, I use the labeling of the stations to my advantage; and how to use it may depend more on logic, more on poetry or human nature. It is noteworthy that traditional game theory is not so good to this game: how well people can play it is something that, though hopefully an

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*distribution* of votes, say, among a party exists and knows that it does, among candidates are congenial to it; and if the numbers of votes become the board of directors, a gerrymandered polling may concentrate too many votes in one party choice, leaving the minority two wheels. But if each member of the majority favors his party's men, the likelihood of one's success is one chance in six. If the minority, too, lacks a strategy and relies on a chance device, the majority's

A partial randomized strategy may avoid conflict. Suppose two people, seated at No. 1 and No. 2, are to move to another card table adjacent to each other without communication what seats they choose. They win prizes of \$1 apiece if they pick adjacent seats. This is a problem; but let us subvert the incentives by making the prize to the player who is on the other's right. They sit next to each other. This game has no equilibrium; there is no seating arrangement that is a best move. (Each may wish that he could move.) A random strategy yields each an expected value of \$1/2 if each decides where he would sit in advance. If each flips a coin to see whether he does sit there, the probability is one-half that they neither choose the same seat. This yields equal chances of winning the premium. This is a random strategy, worth an expected value of \$2/3.



n to name one card in an ordinary guess which one I name. Tradition on how to make my choice on want you to outguess me; I can to have a better than random. But if the game is that I *do* want know that I will try to pick one random device can only guarantee possible. Holmes can *destroy* the ng a coin to decide where to get only a fifty-fifty chance of guessing rest version they must somehow in order to do better than pure depend more on imagination than mor than on mathematics. It is e theory does not assign a "value" n concert in this fashion is some- menable to systematic analysis,

el of candidates. If a 55 per cent major- ng a hundred voters; if two out of six the three candidates polling the largest directors, there is danger that uncoordi- y votes on the first (or second) major- inning candidates with 22 votes apiece. flips a coin to cast his vote for one of e getting as few as 22 votes is only one ks an overt means of collaborating and s chances are excellent.

also be used to reduce an area of con- orth and East sides of a card table, are that is identically oriented, must choose y will take at the other table, and will acent seats. This is an easy coordination ves, by giving an additional \$2 premium ght in the event they succeed in sitting equilibrium point; interests do not con- that would not give one an incentive to promise to sit on the other's left, but h player a minimax value of \$1. But, the pure common-interest game, then ere or sits opposite, the players guaran- at nor sit opposite each other and share This is an equilibrium pair of (mixed) apiece.

cannot be discovered by reasoning; the theory is *inherently* dependent on

It should particularly be noted that the “labels” (that is, of the symbolic game) and the dependence of the theory does not involve the question of descriptive or normative — concerned with choice or the strategy of correct action — that people simply *are* affected by the game *should* be for the purpose of coordination. They must produce strategies that are effective if they can do without them. More, it must be the game that can demonstrably show that the players, consequently, share their mutual interest. Two couples on a floor or two armies jockeying for

<sup>12</sup> In cases like this we need only to consider how much they would pay for a bit of coordinating information. The patterns yield what chances of coordination are possible. See Marschak's *theory of teams*.

There is, incidentally, a version of “the game of accomplices, apprehended before their confession. Naturally, they must concert the alibis they invent. A tantalizing variant can be built by supposing that the sentence than unconfessed guilt; each player must confess and must not only consider what alibi strategy but *how good it is* (in terms of the player's) and whether they share the decision.

.5	.5	.5	o
o	.5	.5	I
o	.5	.5	o
o	.5	.5	o

(Lower left entry in each cell is the payoff to player who chooses first, upper right to player who chooses second.)

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ing a priori. This corner of game theory is supported by empirical evidence.<sup>13</sup>

and that to assert the influence of the specific and connotative details of the game theory on empirical evidence is to assert that whether game theory is predictive or not is with generalizations about actual human choice. The assertion here is *not* that the symbolic details but that they affect human choice. A normative theory of human choice is at least as good as what people actually do. It must not deny or expunge details of human life that benefit two or more players and it should not expunge or ignore in its search for space on a dance floor that a truce line may jointly suffer.

Consider the question of what *price* players will pay for information, and what different information strategies, to find ourselves in the middle of

"prisoners' dilemma" for this game: two players, each with an alibi is prepared and interrogated separately. Each may confess or be revealed in their guilt. Assuming that confession carries a lighter sentence, a player has a "minimax" strategy of confessing if and only if his particular alibi constitutes the *best* of likely coincidence with his partner's choice to try it. The matrix might be:

.5	o	.5	o
o		o	
1		o	
o		1	

(The first column is payoff to player choosing to confess, the second column is payoff to player choosing to remain silent.)

## INTERDEPENDENT

from decision processes that are a function of the contingencies of the situation.

A particular implication of this is that the game in "normal" form (mathematically equivalent to the game in "extended form") must admit the logic by which rational players take into account the actions of each other. As pointed out in the preceding section, these considerations seem to be powerful in the real world as well. A terminological implication is that "noncooperative" is a poor term for a coordination game; it is desperately cooperative and is still so when we add a self-interest motive. (In Appendix C I discuss the relationship of concepts familiar in game theory to the coordination game in terms of the coordination con-

## SUGGESTION AND MUTUAL INTEREST IN A MIXED-MOTIVE GAME

Coordination-game theory, which is interesting mainly for the light it sheds on the mixed-motive game. The coordination game is strikingly in a purely tacit game, in that there is no communication nor any sequence of moves that would accommodate themselves to each other. The problem 6 on page 62, would be a good example.

One player is "located" in California; the other in San Francisco; they have identical maps of the United States and divide the country between them. The game is to divide the United States into two parts, each of which is curved, related or unrelated to the other. If the two of them divide the map in such a way that the thing; but if they draw identical lines, they are both rewarded. The reward is what is contained in his piece of the map that contains the city in which he is located. The rewards are vague; they may depend on the location, partly on industrial wealth,

is limited to the abstract proper-

This general point is that the game (in its abstract) form is not logically "reducible" to its "particular" form, once we have actual players concert their expectations. (See in Chapter 3, these same considerations are also present in explicit bargaining theory. The application of these considerations is the name for the game of tacit cooperation in its own peculiar way of conflict and form the tacit mixed-games. It is argued that certain solutions can be given an interpretation in this concept.)

#### COOPERATIVE PERCEPTION IN THE TACIT GAME

While interesting in its own right, it is also that it sheds on the nature of the cooperation element shows up most clearly in a game, in which there is neither common moves by which the two players interact with other. An example, similar to the following.

In Cincinnati, the other in San Francisco of the United States and are to divide the land. Each is to draw a line dividing the land; the line may be straight or curved, physical or political landmarks. Each map differently, neither gets any advantage. The division lines on their maps, the advantage for each player depends on the location of the division, that is, the piece of land he is located. Let us leave these divisions partly on area, partly on population and agricultural resources,

and so forth, and may differ so in other words, while all terrain in the country are equally valuable, and of the valuation formula. (There is a perfectly symmetrical game for two players.)

In this game there is a component where each player can win only if he does what he is expected to do, knowing that the other player knows what is expected of him. They are in some fashion suggests itself to be a game of them. Neither can "outsmart" himself.

The experiments of Chapter 3 show that a player who is helpless when faced with a problem that is nowhere near so "infinitely" difficult as the division lines might suggest; some problems are difficult at all. But a successful player finds kinds of factors that are contrary to the game; in fact, some games of two players' choosing exactly the same strategy chosen if the reward system gave conflicting interests. The problem is one of rationalization that both can be solved if each party prepared to be disciplined in the event that it appears to discriminate and find their clues where they can. It happens, for example, to contain an element making it difficult to single out a line drawn as a suggestion. Both maps, might have to be accepted. The problem is substantially biased toward one side.

But this coordination element in a game of conflict, appears to be essential to the *problem*. The pure-coordination game is interesting but virtually ceases to be a game of concert with certainty, without a question arises, then, how important

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slightly different for the two players. In some cases, it is valuable, not all parts of the game are. And there is no clear specification of what the players are consequently no means of settlement or division of values between the

interesting problem of coordination; each player must do exactly what the other expects and the other is similarly trying to do exactly what the first player must jointly find a line that in some way appeals to both of them or appeals to both of them without outsmarting

we suggest that players are by no means playing this kind of game. The game is not as difficult as the infinity of possible variants of the game are not the same. The outcome does depend on the players' rolling in the pure-coordination game. Games of this sort are "won" by the two players if the outcome as they would have chosen were them identical, instead of choosing different ones. They must find some signal or clue or interpret one as the "right" one, with the other player's mind fixed by that signal or clue in the game. They must coordinate against him. They must (If the map they are using happens to be of an embarrassing richness of clues, they must choose any particular one, a fairly arbitrary one, chosen by the referee, identical on both sides. It is accepted as a "mediator," even if it is not chosen by either of the players.)

And, especially in the case without communication, the game is only related to a *communication* game not only ceases to be interesting but ceases to be a "game" if the players can coordinate without difficulty, and without cost. The interesting part of the coordination element can

be in mixed-motive games generally in the form of overt bargaining with

The pervasiveness of the coordination problem is based on two separate considerations. One is that tacit bargaining provides only an analogy but perhaps an iconic and intellectual phenomenon — coordination agreement in pure bargaining. Parties recognize that there is a way to both of them over no agreement of “mutual perception” that can be achieved in the tacit case has a role to play in bargaining. *Coordination of expectations*

Second, many of the bargaining situations that we want to analyze are at least partly like maneuvering a car in a traffic jam. In some, like developing a labor union, speech is inhibited in the bargaining, or diplomatic bargaining that is not to be sides if overheard by other coalition members. If the number of players is large, the bargaining process that determines the outcome between residential areas and political provision for explicit communication may be part of the bargaining process, and the game is one of talk.

Furthermore, if there are moves that it is an advantage to get on with negotiating, and particularly if so that the other player only after a time. It is possible that an instantaneous move is from the outset; in that case, the game is going on. If the moves had only to include them in the communication process, but, typically, moves have a tactical significance that makes the game irreversibly different from what it would be also their tactical significance raised



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h uninhibited speech.

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s an analytical model — perhaps  
identification of the actual psychic  
of the “rational” process of find-  
g situations, those in which both  
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actical significance, leaving the  
what it was before, and typically  
ses them above the level of pure

speech even in their communication. One may say that a gun is loaded without actually shooting; one may say a move is strategically important and not worth the expense or risk in its protection. This is about a player's value system or what is available to him; moves can commit him, but often cannot; and moves can often be terminated unilaterally, not dependent on a conference.

In other words, bargaining game theory is a dynamic process of mutual accommodation culminating in a cry for limits in limited war is to illustrate it by modifying the pa

*An illustrative tacit game.* Suppose two maps of the United States before and told to play a game as follows: each will distribute five chips among the states compared, and if the two players have the same state, those two chips are removed; if one player has a chip and the other player three chips, one piece is removed leaving only one chip for that player; and so forth. They do this with five chips; this time they have ten chips on states that are yet uncovered where there are already chips. I

<sup>24</sup> Since it will be proposed in Chapter 10 that research value, as well as an illustrative example, is a special problem in a non-zero-sum game. In a zero-sum game, one's immediate adversary, and the competition motivate the player toward the absolute score. But for a mixed-motive game, "winning" is not an absolute score, not his score relative to the opponent. Incentives are distorted if the play is done for a mixed-motive game. So, unless real rewards are given, the game is not a mixed-motive game. Or some such schedule that involves more than one person plays, with the final outcome dependent on the absolute score. (This is why there are no

## OF GAME THEORY

ation content. One may say and not being able to prove it until he can say that he considers an area to be believed until he incurs expenses. Thus moves can reveal information about the choices of action available to certain actions when speech progresses at a speed that is dependent on formalities of agreement.

Games quite typically involve a dynamic accommodation rather than pure commitment or crystallized agreement. The jockeying for position is a perfect example, and we might cite the parlor game described above.

Suppose our two players with their money. Here they are each given 100 chips to play with.<sup>14</sup> At each "move," each player states on his map. The moves are made. Players have put a chip apiece in the states. Chips are removed; if one player has put two chips in the same state, a chip is removed. If a player has two chips representing the one in the same state at the next move, again a chip is removed. Players have the option of placing their chips in the same state or of placing them on states adjacent to it. If A puts two chips on a state in

Chapter 6 that such games have, in fact, a positive value, it should be observed at the beginning of motivating the players in an experimental game, winning is measured relative to the intellectual challenge and bilateral competition. The correct (and only) type of winning is "winning" must be made to involve one's absolute advantage over the person he plays with; the incentive is motivated by strictly bilateral competition. The game has to be organized as a round robin tournament between more than two players in a series of two-person games decided by the relative position of one's chips in the two-person nonzero-sum parlor games.)

## INTERDEPENDENT

which B previously put a chip, A's, leaving one of A's chips placed so the game goes until the player then continues, and at each move five chips from the states in which with equal numbers of chips which both players have placed both players have notified the terminate the game.

Prizes are now distributed. For every one of his chips still on were not removed when he "t" other player. He also gets money these being the states that he chips that are in the area completely inclosed by states that he

These "rewards" for states placed attached to each of the 48 states suggestive of, say, "economic value." There is no presumption that very closely correlated, for the an important element in the "value" players and a comparatively unimportant for the other player. Neither value system — or perhaps knowledge what elements matter but not how learn what he can about the other other player's moves.

Here we have a mixed-motives process of mutual accommodation course of which the players seek accommodation is poor. They may where each other will place his in those cases where they prefer a state. Each loses at least a dollar the other; and they may lose more who loses a state attempts to return on it. And not only do they lose



but each player has fewer "chips" claiming states; and they may be completely unclaimed between them, left on the board when the game ends.

Now how do the players "bargain" with one another, they do in fact make promises, they accept, reject, retaliate, and make threats and promises.<sup>15</sup> But if we ask how they must convey their intentions and patterns of behavior. Each must be expressing in his maneuvers, and must learn to convey his intentions when he is in a player badly wants a particular state of high value for him, so that he is willing to wait it out a long time, losing several chips. If another player gives up, it is better to realize ahead of time which one is really prepared to concede as a "trade" for some other portion of the game. Not only make it conspicuously clear, but must somehow demarcate its limits.

But where do the patterns of behavior come from? richly provided by the mathematical models, particularly since we have purposely made the game too uncertain to the other to make any claim of equality, and so forth, of any general kind. Their patterns in such things as political groupings, the economic changes, and so on, enter their value systems, Gestalt psychology, and traditions that they can work out of play.<sup>16</sup>

<sup>15</sup> This has been evident in preliminary experiments.

<sup>16</sup> If my neighbor's fruit tree overhangs the line, and fruit on my side of the line, my neighbor's "possession" is, and has a good idea of what he is doing. He does not retaliate. But if, instead, I pick fruit from both sides of the line haphazardly or pick fruit from the side of my size of my family, he is less likely to pick fruit from my side of the line than if I pick fruit from the limit of my intentions.)

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"left from the point of view of have to leave some states com- if they have not enough chips ends.

gain" in this game? One way or proposals and counterproposals; even discover ways of conveying deny them any form of speech, ns and their proposals by their t be alert to what the other is each must be inventive enough e wants them conveyed. If one state, because it has especially willing to stick around and fight dollars to the kitty before the ter for both players that they wants it most badly. And if a de a large portion of the country on that he badly wants, he must available to the other side but its by his own pattern of play. come from? They are not very ical structure of the game, par- made each player's value system like considerations of symmetry, eat help. Presumably, they find natural boundaries, familiar po- characteristics of states that might t psychology, and any clichés or ut for themselves in the process

experiments with such a game.

gs my yard and I pick exactly all the or can probably discern what my "pro- ne has acquiesced in for the future if he k that same amount of fruit from both me amount that is related, say, to the erceive just what I have in mind. (He etaliate if I pick only *part* of the fruit t all, since I have failed to demarcate

## INTERDEPENDENCE

*Explicit communication.* Now let players may talk as much as they like. How does this make the game? In some ways it makes it more efficient; the efficiency of the players; particularly those that were too complex to make a simple or clumsy system. Perhaps, too, the game is more interesting; the inadvertent clashes of chips on the table; the dollars. We cannot be sure that the game is more competitive bidding for states, since the dependence on a state is great enough to make the game more even while they talk. And they talk. And they talk to each other that they mean what they say. And they play the way they play. (We let them tell us what they mean; but we explicitly make it so that the players have no written evidence of what they mean; they could show each other.)

So the introduction of uninhibited communication changes the character of the game, even though the game is different. The dependence of the game on the intentions to each other and on the intentions of each other, of behaving in predictable ways, or limits, is much the same as before.

The contrast with a zero-sum game is striking. The effacing quality of a minimax solution, a zero-sum game, is a unilateral affair. One not only does not harm his opponent, he does not even recognize his opponent. It is or whether there is one. A random game is anticomunicative; it is a deliberate game. The possibility of communication, especially in a game, is, in itself, inadvertent or otherwise. In a game the game all details except the payoff, and from the players all

In chess it does not matter whether the pieces are ecclesiastics, elephants, castles, or what. The game is called "chess," "civil war," or what. The squares are distorted to look like squares. It does not matter



Let us change the rules so that the players please. How different would the results be? In many respects, it should increase the number of possible trades that can be identified now. More proposals about under the more players can avoid some of the costs of the same state, which cost them nothing. They will avoid mutually costly trades since the advantage of being first will motivate players to keep playing. They have no way to persuade each other except by showing it in the play itself. Each other how they value the costs is unpunishable, and we provide a system of their value systems that they

Unrestricted speech may not greatly alter the results, though the particular outcome will depend on the two players on conveying their intentions and receiving the intentions of each other. The patterns and acquiescing in rules will be different before.

The game and the peculiarly self-resolving solution is striking here. With a game that is reduced to a completely abstract one, there is no need to communicate with the opponent. The need to know who the opponent is and what his randomized strategy is dramatically reduces the means of destroying any possibility of communication of intention. The game is a means of expunging from the mathematical structure of the game the communicative relations.

Whether the pieces look like horses, or hamburger buns; whether the game is "chess," or "real estate"; or whether the game is like political or geographical games; what the players know about

each other or whether they speak a common culture; nor does it matter how it came out. (It would be motivated to destroy the other player.) This is a minimax strategy, randomized.

But change the payoff matrix. This is a zero-sum game that rewards the player who captures the pieces as well as the squares they occupy, but the players have some interest in minimizing the damage with its mutual destruction of value. It is about just what squares and what pieces each player values most. And have the players know that each player can hold up the other player if he does not do to him.

Now it may make a difference if the game is "war" or "gold rush"; whether the players are soldiers, explorers, or children or whether a picture is superimposed on the board. The squares are distorted into different shapes. The story the players are told before the game begins.

We have now rigged the game so that the players can find their way to an outcome, either by making moves that they make, or both. The players, by changing their behavior, communicating with each other, or by themselves be led to some meeting of the minds. The possibility of mutual destruction of potential value is a possibility that may facilitate the players' discovery of a common ground; and the extent to which this is possible — the suggestions and connections that are made, the limits, and regulations should be set. It should, because it can be a help to the players themselves to the abstract structure of the game. It is for stable, mutually nondestructive relationships. The fundamental psychic structure is participating in the creation of a common ground out of which traditions can be created. The potential traditions can be perceived.

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ak the same language and have a matter who played the game pre- if it did matter, one of the players he influence of these details; and d if necessary, would destroy it.) in a chess game, making it a non- e players not only for the pieces they have left over at the end, as in such fashion that both players ng the "gross" capture of pieces value. Make each player uncertain what particular pieces the other oves by the clock, so that neither ver's moves for the sake of talking

to the players whether we call the ether the pieces look like horses, n an Easter egg hunt; what map the playing board and how the ent shapes; or what background e they begin.

so that the players must *bargain* er vocally or by the successive They must find ways of regulat- ng their intentions, letting them- minds, tacit or explicit, to avoid gains. The "incidental details" overy of expressive behavior pat- he *symbolic* contents of the game otations — suggest compromises, e expected to make a difference. help to both players not to limit ture of the game in their search ve, recognizable patterns of move- and intellectual process is that of *traditions*; and the ingredients reated, or the materials in which eived and jointly recognized, are

## INTERDEPENDENCE

not at all coincident with the game.<sup>17</sup>

The outcome is determined by the player forms of how the other knows that their expectations are shared. Players must jointly discover and agree on a mode of play that emerges. They must together find "rules of the consequences."

A good example of this problem is that of getting across, persuasion, retaliation for particular acts that "define bounds." Without full communication such a pattern of intentions is only a contextual material available for interpretation within limits but on the capacity of the formula (Gestalt) of retaliation. Historical and literary precedents in mathematics and aesthetics, as well as in other walks of life, may constitute a pattern to choose his recognizable pattern of interpretation of the other's intentions. In verbal communication, the situation of patterns of action may speak loudly.

Thus the influence that the situation has on its outcome and the dependence

<sup>17</sup> A good example is the question whether atomic and other weapons, the answer to which if explosive power is the criterion, the answer is there is nevertheless a difference if enough do. It is a difference constructed by a ten years' *tradition* that atomic weapons and believe others to believe so, and even undoubtedly catch their breath, whenever in any manner they cannot explain by reference to a purely conventional difference, like the "cruel and unusual" punishment or that which is in Parliament perfectly compatible with the law but not if it has to be reinstated. The difference in weapons difference is also one that, probably deliberately blurred over time, as most of the time (at length in Appendix A.)

mathematical contents of the

by the expectations that each will play, where each of them are substantially reciprocal. The and mutually acquiesce in an outcome makes the outcome determinate. of the game" or together suffer

of communicating intentions. vely, an intended pattern of re- one proposes to consider "out of cation, one's ability to convey dependent not only on the con- the formation of bounds and e other player to recognize the when he sees a sample of it. nt, legal and moral casuistry, well as familiar analogues from te the menu from which one has rn of retaliation as well as his ended pattern. Even with full on may not be greatly different ; ler than words.

uggestive details of a game may endence of the players on what ther a clear line can be drawn between o which is reported now to be negative xplosive ranges having overlappéd. But gh people think so, and they undoubt- of the pure fabric of expectations: it eapons *are* different; people believe so ven those who deny the difference will er the next one goes off in a war, in a e to the force of the explosion. It is a e one that makes imprisonment not a t makes, say, university representation English democracy if it has always ex- after a ten years' lapse. The atomic- bably, can be deliberately reinforced or traditions can. (This point is developed

clues and signals the game provides. A study of how players actually do play. It is not being argued that players use mathematical properties of the game, but that they take them into account, hence that even the theory of the *strategy* of games — must be based on what players may jointly take advantage of. If one player realizes that the configuration is against him, he may also rationally choose his course — that the other players will not submit to the discipline of the strategy of the game's concrete details and will not incur mutual damage, assume he will choose

<sup>18</sup> It should be added that the concept of the quality of particular outcomes in a bargaining problem gets some support and corroboration from a body of experimental evidence provided by work on the perception of physical form. For example, shapes were shown to people whose visual memory they often saw the shapes as complete. For familiar shapes that they "completed" for themselves with simplicity; and unfamiliar "simple" figures were not. Koffka: "but less simple, figures were not. Koffka: 'We are surrounded by simple shapes.'" We are surrounded by rectangles, not departure from a true rectangle is a better organized form than would be." Adverting to the minimum of cognitive processes, Koffka suggests that psychological properties: "For we can at least select psychological conditions and can then predict behavior in terms of simplicity. This conclusion is based on the fact that according to which characteristics of the corresponding conditions are gained a general, though admittedly subjective, principle in our investigation of psychophysical conditions can be briefly be formulated like this: psychological conditions are 'good' as the prevailing conditions allow them to be undefined. It embraces such properties as simplicity and others which we shall meet in the course of our study." *Principles of Gestalt Psychology* [London, 1935, p. 111.]

If individual perception and "organization" are to be the process of "mutual perception" and "organization" in the convergence of expectations must be a rigorous. And, since the nonzero-sum game is a "organization of form," so to speak, a normative psychology (descriptive psychology) must take these

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des are relevant not merely to the  
o behave in a nonzero-sum game.  
yers just *do* respond to the non-  
game but that they *ought* to take  
ven a normative theory — a theory  
st recognize that rational players  
hem. And even when one rational  
ation of these details discriminates  
ually recognize that he has no re-  
r will rationally expect him to  
uggestions that emanate from the  
ll take actions that, on pain of  
o-operate.<sup>18</sup>

ot of the intrinsic magnetism or focusing  
rgaining situation or in a pure coordina-  
clarification from the very substantial  
ded by the Gestalt psychologists. Their  
rms is pertinent. For example, incomplete  
sion was damaged in part of the eye, and  
rather than as partial. But the particular  
selves followed certain principles of sim-  
es were completed where very familiar,  
Koffka refers to "spontaneous organization  
by skewed rectangles; but what we "see"  
s from perfect rectangles, because "the  
figure than the slightly inaccurate one  
num-maximum properties of stationary  
logical processes will have these proper-  
ological organizations which occur under  
that they must possess regularity, sym-  
based on the principle of isomorphism,  
the physiological processes are also char-  
conscious processes." And, "Thus we have  
somewhat vague, principle to guide us in  
organization. . . . The principle . . . can  
ological organization will always be as  
ow. In this definition the term 'good' is  
as regularity, symmetry, simplicity and  
rse of our discussion" (K. Koffka, *Prin-*  
955]).

ization" of forms follow these constraints,  
"mutual organization of forms" involved  
st depend on similar restraints at least as  
ame requires some ultimate joint "organ-  
ative theory of strategy (not just a de-  
restraints into account.

## INTERDEPEND

*A hypothetical experiment.* As a has in mind, the following hypothesis is considered. (Hopefully, some such experiment is offered here as a conceptual and empirical test of the psychic phenomenon.

The first stage in the experiment is on the principle of the lie detector: a person's "recognition" or the forcefulness or his excitement. What we observe as the player scans an array of pictures in fashion, the extent to which particular pictures generate excitement in the player.

Given the machine, set up a number of trials to make it one in which there are no trials until an agreement is reached on the share of the "content" to provide some room for negotiation, alternative rationales, and so forth; then, the mathematical range with a constant.

Now have the two players conduct the experiment in a way that each can see the meter on his own machine and see the meter on the other's machine. They are aware that both can see both meters and mutually perceive that they both can see both particular outcomes as they conduct the experiment. We employ a mechanical device. We employ a mechanical device about in the range of possible outcomes or focusing on one possible outcome perhaps some regular course, perhaps some machine scan; let the players watch each other's meters, and watch each other's meters.

Finally, we go through with the experiment in various variants. An interesting possibility is to let the players bargain and simply let the players go round and round among the alternatives and watch to see whether the recorded outcomes tend eventually to converge on a particular value, their involuntary, physically identical kind of maximum for the same.



n illustration of what the author  
othetical experiment can be con-  
experiment could be carried out.)  
ual analogue or, conceivably, an  
nomenon involved in bargaining.  
nt is to invent a machine, perhaps  
tor, that will record or measure  
ocus of his attention or his alert-  
want is a machine that measures,  
ossible outcomes in some orderly  
ticular outcomes catch his atten-  
he course of actual bargaining.  
bargaining game. For simplicity,  
certain gains to be shared when  
es. Give the game enough "topical  
for argument, casuistry, alterna-  
at is, provide more than a bare  
picuous mid-point.

nected to their machines in such  
er on his own machine, each can  
hine, and each is aware that both  
th meters. In other words, they  
can see each other's reactions to  
me within view of the scanning  
al scanning device, which moves  
utcomes, pointing to, lighting up,  
tcome after another. It follows  
rhaps a random course. Let this  
atch it scan, watch their own and  
ach other's faces if they wish to.  
e game; and there may be several  
ity would be to exclude explicit  
canning proceed, back and forth  
rray of alternative outcomes. We  
led reactions of the two players  
single outcome, in the sense that  
entifiable reactions are at some  
e particular outcome among all

those to which the scanning device is used for control purposes, we might once again have a scanning session in which the other player is not in the notion of each player's reactions (and the interaction between the players.) If conversely, we have certainly identified a significant phenomenon, we can allege that this is *the* psychic bargaining situation demonstrated (a) that players in a bargaining situation and (b) that the mutual interaction that results from each player's reaction and each knowing that the other is yielding information about his own reaction. Conjectures that, like Lot's wife, players will keep their attention from being attracted to even unfavorable outcomes, and that a "focal point" may often enhance the bargaining process.

Another variant would be to let the player scan during the scanning and metering process, thereby exorably eliciting their physical reactions. In this latter case, let a player act as a reaction meter if he wished to as to his partner, for example, that he expects to hold out for, say, the \$6000. If it is clear from his blood pressure

This experiment would rest on the fact that each individual player would have physical reactions upon contemplating different alternatives.

<sup>19</sup> The following observation, quoted by Lot, is certainly to the point: "When an experimenter is actively engaged in a task, he will also notice that the goalkeeper of a large goal, is more often hit than can be expected from the kicking of the contestants, even when the goalkeeper whenever he can will try to prevent the ball from reaching a prominent point in space which is the target of the kickers. If the motor activity takes place in the goalkeeper, then the ball will generally be hit. The goalkeeper learns to reconstruct his field, to change his focus of attention from the goalkeeper to another point in space which will have the same attraction as the goalkeeper."

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vice elicits their reactions. (For have subjected each player to a er player was absent, to get some independently of any interaction gence does occur, we have cer- nomenon, whether or not we can rgaining process. We shall have do react to the content of the t their reactions are subject to a from the fact that each can see ws that his own visible reaction s own expectations. (The writer players will often be unable to drawn to particular outcomes, that a conscious effort to ignore nce the focal power.)<sup>19</sup>

et the players bargain explicitly ng, with the scanning device in- reactions in the course of the o both of them. (We could even, dduce the evidence of the visible a bargaining tactic, pointing out t the latter "obviously" cannot o he is verbally demanding when t that his mind is settled on \$40.) three hypotheses. First, that an ysically identifiable "reactions" ternatives among the range of

by Koffka, may be hard to believe but ert . . . follows a football game atten- eper, standing before the comparatively accounted for by the mere adventitious one takes account of the fact that the intercept the ball. The goalkeeper fur- ich attracts the eyes of the opposing ce while the kicker's eye is fixed on the r land near him. But when the kicker ge the phenomenal 'centre of gravity' n space, the new centre of gravity will per had before."

possible game outcomes and that conspicuously different among the that these reactions, when the play his partner's eye, would behave gaining; that is, that the reaction ble to both of them, would inte process." Third, that this measur to a bargaining process, is part of to, *the* bargaining process as def experiment of the sort described ing for the case of more than two

The experiment has not been as evidence. It has been described tional representation of the theo has in mind in referring to the "co to suggest that the convergence t gaining process may depend on th and not solely on the a priori data

*Some dynamic characteristics of* pence of a "focal-point" solut distinguishes it qualitatively from has important dynamic consider makes small concessions less lik means that the focal point is more outcome than as an approximation been unsuccessfully demanding 5 per cent is unlikely; the small co lapse. Qualitative principles are l points generally depend on qual expect to satisfy an aggressor by miles on this side of a boundary; that we both expect our side to r suasive new boundary that can be

In fact, a focal point for agreem ter to the fact that small concess small encroachments would lead draws a line at some conspicuous

t these reactions would be con-  
 different alternatives. Second,  
 yer knows that they are naked to  
 in a manner suggestive of bar-  
 as of the two players, when visi-  
 eract in a kind of "bargaining  
 ed phenomenon, which we liken  
 f, or is involved in, or is related  
 ined in the ordinary way. (An  
 might prove especially interest-  
 persons.)

carried out and is not adduced  
 here in order to give an opera-  
 retical system that the author  
 onvergence" of expectations and  
 hat ultimately occurs in a bar-  
 e dynamics of the process itself  
 a of the game.

*focal-point solutions.* The de-  
 on on some characteristic that  
 m the surrounding alternatives  
 ations. For example, it often  
 ively than large ones; it often  
 persuasive as an *exact* expected  
 a. If a bargainer has persistently  
 go per cent, compromise at 47  
 oncession may be a sign of col-  
 hard to compromise, and focal  
 itative principles. One cannot  
 letting him have a few square  
 ; he knows that we both know  
 retreat until we find some per-  
 e rationalized.

ent often owes its focal charac-  
 ions would be impossible, that  
 to more and larger ones. One  
 boundary or rests his case on

some conspicuous principle that the rhetorical question, "If not here, that concession is collapse, the is. The same point is illustrated ourselves when we try to give a little drink," is a notoriously more people give up cigarettes a stable compromise at a small principle is gone, there is no convergence of expectations converge on complete of this keeps attention focused nence.

Sometimes the focal point itself case it serves not as an outcome for the outcome. This is often true body or a "test issue" that arises players in some continuing game or an act of defiance that, by its missive response from the other drawn. It is a small piece of the game itself, setting a pattern of the substance of the point involved and constitutes a deliberate tactic issue develops an unintended system promise impossible.

Diplomatic recognition of the loyalty oaths at universities, a industry, surrender of the floor to a or the vote on some particular may all have this kind of significance outcome on this particular issue other issues would be decided, exactly how large the opposition particular issue is not represented just acquires tacit recognition as that each side is the prisoner or conditions that are created.

Often this phenomenon can be

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at is supported mainly by the  
e, where?" The more it is clear  
more convincing the focal point  
in the game that we play against  
up cigarettes or liquor. "Just one  
unstable compromise offer; and  
altogether than manage to reach  
all daily quota. Once the virgin  
confidence in any resting point, and  
ete collapse. The very recognition  
on the point of complete absti-

elf is inherently unstable. In that  
e but as a sign of where to look  
ue of a "test vote" in a legislative  
ses in the relations between the  
e. Often it is a challenge or a dare  
s nature, must either elicit a sub-  
r party or be submissively with-  
game that comes to symbolize the  
expectations that extends beyond  
ved. Sometimes it is so intended  
tic; in other cases the act or the  
mbolic significance, making com-

the Communist regime in China,  
a strike settlement in a key in-  
an interrupter at a cocktail party,  
motion at a political convention  
icance. Sometimes, it is true, the  
e simply yields evidence of how  
as when a test vote indicates  
n to a measure is; but often the  
ative of the rest of the game, it  
s a clue to all that will follow, so  
beneficiary of the mutual expecta-  
e identified as an actual signal in

a coordination game. The members can often recognize the potential of being sure that "agreement" exists and know how everyone else is going to do what he knows he ought to do in some particular simultaneous action. A protest, is often a means of "rationalization" and of demonstrating that one is willing to act in concert. But even in a situation where the dare, the phenomenon of provocation and missiveness may prove to be part of the resolution of a bargaining game.

This process, by which particular concessions achieve symbolic importance, and expectations should converge in a particular area in which experimental psychology is being tested, is a theory.

*The Empirical Relevance of Mathematical Game Theory*  
 assuming that everything the analyst does so is the participants in a game, or the suggestion on the analyst does so is a particular, game characteristics and mathematical solutions (except for those that can be reached by an alternative, let alone have this power of focusing expectations). They might have it only if they were to be mathematicians. This makes the idea of such "solutions" as those of the other. It is that the mathematical properties, the historical properties, the cultural properties, and connotative details, can seem to certain participants on certain situations themselves mathematical game theory and be powerfully affected by particular compelling mathematical properties that the other will transcend, va-



bers of an unorganized coalition  
 abilities of concerted action without  
 sts to act in concert. One wants to  
 g to act and whether everyone else  
 to. A test vote in a legislature or  
 tion among the group, like a mass  
 ifying" the existence of the coali-  
 everybody expects everybody else  
 a two-person game, as typified by  
 psychological dominance or sub-  
 psychologically identical with the  
 e.

ular moves in a game or offers and  
 mportance as indicators of where  
 the rest of the game, seems to be  
 psychology can contribute to game

*mathematical Foci.* We must avoid  
 analyst can perceive is perceived by  
 that whatever exerts power of sug-  
 on the participant in a game. In  
 that are relevant to sophisticated  
 when the same solution can also  
 ss sophisticated route) might not  
 ectations and influencing the out-  
 f the players perceived each other  
 y be the empirical interpretation  
 Braithwaite, Nash, Harsanyi, and  
 ical properties of a game, like the  
 cal properties, the legal and moral  
 ies, and all the other suggestive  
 erve to focus the expectations of  
 olutions. If two players are them-  
 ists, they may mutually perceive  
 potential solutions that have com-  
 . Each may transcend, and know  
 urious adventitious details that, to

nonmathematician game players, focusing of expectations than some of the game.

(In many cases these mathematical uniqueness or symmetry that would be conditions and nonmathematical appeal coincide with qualitatively distinguishable realized in an equally compelling manner.)

Thus mathematical solutions are influences that have the power to focus through the same psychic mechanism that is able to bring expectations into species. When husband and wife, suddenly traipse off to the Lost and mutual appreciation that it is the mathematicians in the same situation aware that both are mathematicians, a cally unique point rather than ordinary words.

The main point here is independent "rules" of game theory, a rational know as much mathematics as he is living here with the players' shared obsessions, and sensitivities to suggest that they can draw on when needed "rational agreement" is fundamental expectations — there is no presumption theory is essential to the process of basis for presuming that mathematical inspiration in the convergence procedure in Appendix B.)

One may or may not agree with a bargainer's expectations are formed process or before it and either by external forces. But it does seem clear that the process is to be described most inwardly, and most empirically in stabilized convergent expectations

## OF GAME THEORY

might be more relevant to the  
e of the quantitative properties

mathematical properties would be a  
ld have nonmathematical defini-  
d, too, or would happen to coin-  
able points that could be ration-  
nonmathematical way.)

re one species of a genus of in-  
cus expectations; but they work  
ism — this power of suggestion  
into convergence — as the other  
separated in a department store,  
Found by a tacit and jocular  
e “obvious” place to meet, two  
ion — each aware that both are  
ns — might look for a geometri-  
ne that depended on a play on

endent of whether, under the  
al player must be presumed to  
ever has need for. We are deal-  
l appreciations, preoccupations,  
ggestion, not with the resources  
ecessary. If the phenomenon of  
tally psychic — convergence of  
mption that mathematical game  
of reaching agreement, hence no  
matics is a main source of in-  
ess. (This topic is pursued fur-

a any particular hypothesis how  
rmed, either in the bargaining  
the bargaining itself or by other  
at the outcome of a bargaining  
immediately, most straightfor-  
terms of some phenomenon of  
. Whether one agrees explicitly



accepts it by default, he must, if  
 fact that he could do no better and  
 must reciprocate the feeling. Thus  
 is simply a coordinated choice,  
 rized by the notion of converging

*formation.* The role of "expressive  
 tion game of this sort is enhanced  
 xed-motive games, in contrast to  
 n to the players to be zero-sum,  
 about each other's value system.  
 tent in the mixed-motive game.  
 eral case the bargaining game in  
 dge of the other's preferences. To  
 rue" payoff matrix of the other is  
 y assumption about the institu-  
 e. The reason is that certain ele-  
 e *inherently unknowable* for some  
 there are special conditions. How  
 sians would dislike an all-out war  
 ated? We cannot; and the reason  
 Russians are necessarily unwilling  
 ntrary, circumstances may arise in  
 e should know the truth. But how  
 w can they make us believe that  
 an the prisoner being tortured for  
 now persuade his captors that he  
 d the Chinese, if they were really  
 the cost of an all-out war, per-  
 deterred in any fashion and that  
 only commit us both to all-out

the truth is the very basis of that tan-  
 nt attaches positive value to the other's  
 discuss whether or not to go to a movie,  
 er wants to do and wanting to seem to  
 ther is similarly expressing a preference

In special cases the information is a special game, in which each player's cards or chips, he may simply turn over (to permit or if he and his adversary are the referee). In a society that believes that will punish falsehood when everybody knows everybody else believes "to die" is a sufficient formula for. But these are special cases. If we must be one in which there is another's value system, or each other cause such facts are inherently un-

Von Neumann and Morgenster-cept for the nonzero-sum game was prepared to sell his house for any B and C, prepared to pay up to numbers.) The novel part of the B a share of his saving if, through C got the house for less than 15. This was inherent in their concept. B might receive from C was  $15 - 1$  the information requirement of the valuation price of 15 is something that but that in the ordinary world he communicate the truth if he wanted to concept — by its assumption of the intrusion of speculators (unless enough to give them a basis for assumes that C can discern, or B

---

that represents a guess at what one would domain of game theory involving inter-revelation or recognition of one's value system that my neighbor does not like me nor his awareness of my awareness, but if we the pain may be acute. "Social etiquette men against asking for New Year's Eve girl find it difficult to provide a gentle e  
*Psychiatry: Journal for the Study of I*

<sup>21</sup> J. Von Neumann and O. Morgenster-  
*Behavior* (Princeton, 1953), pp. 564ff.

## OF GAME THEORY

n can be conveyed. In an artificial "value system" is contained on turn them face up (if the rules y can jointly cheat against the s absolutely in a superior power asked to do so and that every- es in, "cross my heart and hope or conveying truth voluntarily. are to have a "general case" it t least some ignorance of each er's strategy options, if only be- unknowable or incommunicable. n illustrated their *solution* con- with the example of a seller, A, price above 10, and two buyers, 15 and 25, respectively.<sup>21</sup> (My solution was that C might pay n B's staying out of the market, they proposed — and this limita- pt of *solution* — that the most  $10 = 5$ . What is interesting about is solution is not that B's reser- at he might try to misrepresent, he could not convincingly com- o. Not only does the "solution" full information — rule out the they genuinely want the house sharing in the solution), but it can reveal, a subjective truth,

nts to do, etc. There is also an entire personal relations in which the overt system itself affects values; my aware- may cause me small discomfort, as does are forced to accredit the fact overtly, ce," remarks Erving Goffman, "warns dates too early in the season, lest the excuse for refusing." "On Face-Work," *Interpersonal Processes*, 18:224 (1955). ern, *Theory of Games and Economic*

## INTERDEPENDENT

one that D and E (speculators with information that B makes a pure bargain) will buy an object that he never owns before.

There are undoubtedly special cases in which that the other player is like one's self, and they frequently estimate the other's value. But in too many cases of symmetry. But in too many cases, the other player is a wholly different person. A kidnapped boy will not be very likely to estimate his own bottom price would be if he were a British officer. It may not be easy for a British officer to guess how terrible a penalty would be if he were a Mau Mau or an Algerian. It may not be easy to guess how much he would like to be a British officer, or for the customer to guess how much he would dislike a scene if he were a British officer.

This is one of the reasons why moves are made. Moves can in some way affect costs, risks, or a reduced risk. Moves can have an information content, or a different character from that of speech. They are not (except for the "talk" that is often used) threats, promises, commitments, or anything else analyzed under the heading of communication anyway). Mutual accommodation is to be efficient, that the balance with "comparative advantage" should be those that he concedes should be those that he concedes relative to the things he trades. Moves can communicate his value system, and he can also gain by deceiving. Moves are often ambiguous in their revelation of value, and they can even be deliberately deceptive, or have a different quality that mere speech does not have.

The uncertainty that can usually be expected in each other's value systems also makes the concept of mathematical symmetry a difficult principle. Mathematical symmetry is a principle.



who are attracted by the observing profit in connection with an (or after) cannot counterfeit.

cases in which one can suppose self in basic values and can con-values by the simple application exciting cases one plays an op-kind of person. The father of a successful in guessing what his had been the kidnapper instead; r French officer introspectively to uld have to be to deter him if he terrorist. It is hard for a boy to himself if he were the girl that he er in the restaurant to know how he were the waiter instead.

why talk is not a substitute for alter the game, by incurring mani-ange of subsequent choice; they *evidence* content, of a different talk can be cheap when moves are ut takes the form of *enforcible* and so forth, and that is to be *moves* rather than communica-dation ultimately requires, if the he division of gains be in accord-ge"; that is, the things a player wants less than the other player, s for. Each needs, therefore, to with some truth, although each ile one's maneuvers are not un-of one's value systems and may they nevertheless have an evi-h has not.

ally be presumed to exist about o reduces the usefulness of the *etry* as a normative or predictive *etry* cannot be perceived if one has

access to only half the relevant symmetry is helpful to the players to each other's, it would be of a qualitative sort, of the kind that is rather than underlying values.

## OF GAME THEORY

magnitudes. To the extent that  
ers in accommodating their move-  
tend to be symmetry of a more  
that depends on visible context

## ENFORCEMENT, COMMUNICATION, AND STRATEGIC BEHAVIOR

Whenever we speak of deterrence, the threat of terror, or an open-skies arrangement; when we characterize a surprise attack as a trip wire or plate-glass window of an enemy; when we provide a face-saving exit from the impotence of a threat that is so enormous that no one would obviously shrink from carrying it out; when drivers are given a wide berth because they are indifferent to dents and scratches, we are applying game theory. Yet formal game theory has contributed little to the clarification of these ideas. The author of this book believes that game theory may have missed its mark because it is pitched at too abstract a level of analysis. In the area of communication and enforcement systems, the lack of perfect symmetry between players as the special case of a zero-sum game, game theory may have missed the most fruitful work could be done. In the area of some of the essential ingredients of deterrence, Preoccupied with the solution to the Prisoner's Dilemma, game theory has not done justice to some of the most interesting game models and to the "moves" that are possible in the sum games of strategy.

What "model," for example, epitomizes the concept of massive retaliation? What conditions are necessary for a credible threat? What in game theory is the verbal situation "to have a bear by the tail"? In the payoff matrix, the communication

## COMMUNICATION, AND MOVES

atomic blackmail, the bal-  
gement to reduce the fear of  
American troops in Europe  
or propose that a threatened  
it; when we advert to the  
ormous that the threatener  
g it out or observe that taxi  
use they are known to be  
are evidently deep in game  
ontributed little to the clari-  
suggests that nonzero-sum  
ost promising field by being  
alysis. By abstracting from  
tems and by treating per-  
e general case rather than a  
overshot the level at which  
and may have defined away  
typical nonzero-sum games.  
e nonzero-sum game, game  
typical game situations or  
at are peculiar to nonzero-

mizes the controversy over  
s are necessary for an effi-  
ry corresponds to the pro-  
ne tail"; how do we identify  
n system, and the enforce-

ment system that it emboldens pedestrians to intimidate automobiles; and how do we form a system of incentives, that makes heroes and martyrs immune to threats?

The precarious strategy of the game has often been expressed in games where each is within reach of each other's poison. The poison is spread so slow that either can die;<sup>1</sup> a shepherd who has a wolf; a man who has no choice but to fight back on the beast; a pursuer who inadvertently gets too close to his weapon; two neighbors who dig into each other's basement, trying to find out the arrangement of electric switches; a man who analyzes the structures of the game through acquaintance with standard problems; and real problems by the use of the game.

To illustrate, an instructor can set up a game for robbery or ransom by using bullets. They can overwhelm a man, if they have a gun. They can defeat him without a gun, if they have a threat to do so. They can commit themselves to a *promise* to shoot if they have caught him. He can commit himself to shoot if they might make, or if he can't keep their promise. If they can't keep their promise, he understands only a foreign language verbally. Nor can they make a promise to themselves; so if he can

<sup>1</sup> Compare C. W. Sherwin, "See *Bulletin of the Atomic Scientists*, 1950, 1, 1, 1.

<sup>2</sup> Compare Herman Kahn and A. J. Wiener, *On War* (Santo Domingo, 1952), p. 1166 (Santo Domingo out a number of problems involv-

## ION OF GAME THEORY

lies? What are the tactics by which mobile drivers, or small countries large them in game-theoretical terms? communication structure, or the comes dogs, idiots, small children, fanatics, cats?

of cold war and nuclear stalemate has ne-type analogies: two enemies within arrows on opposite sides of a canyon, ether could shoot the other before he chased a wolf into a corner where it, the shepherd unwilling to turn his er armed only with a hand grenade close to his victim and dares not use s, each controlling dynamite in the o find mutual security through some itches and detonators.<sup>2</sup> If we can an- se games and develop a working ac- models, we may provide insight into our theory.

ive model is that of twenty men held y a single man who has a gun and six m him if they are willing to lose six a means of deciding which six to lose. t loss if they can visibly commit them- o, if they can simultaneously commit abstain from capital punishment, once can deter their threat if he can visibly n disregard of any subsequent threat can show that he could not believe not deliver their threat — if, say, he language — they cannot disarm him ake a threat unless they agree on it threaten to shoot any two who talk curing Peace Through Military Technology," 12:159-164 (May 1956).

Erwin Mann, "Game Theory," *The RAND a Monica*, 1957), pp. 55ff. The authors work ving dynamite, detonators, and deterrence.

together, he can deter agreement. If to divide the risk, there may be no the threat, hence no way to make t he can announce a formula for shoot move first get shot first, he can deter to move together without a "first." I overpower the remaining six and f can demonstrate that they could ove threat succeeds and the gunman su "expendables" gain through their own If the twenty could overwhelm the r ting him escape, a promise of immu if they cannot deny their capacity against him later, it may be necessar This, in turn, depends on the ability own agreement to protect, by silenc hostage . . . and so on. When we ha gredients in several games of this s position to understand the basis of p or of a well-organized dominant mi successful mutiny.

This chapter is an attempt to s moves and structural elements that c the framework of game theory. T "threat," "promise," "destruction of of decision," and so forth, and such communication and enforcement pr

## AN ILLUSTRATIVE

An example of a standard "move" at some length in Chapter 3. If th makes it possible for a potential bu offer subject to extreme penalty in the offer — to commit himself — then determined decision for the seller: to to forego the sale. The possibility indeterminate bargaining situation i



the twenty cannot find a way  
one to go first to carry out  
the threat persuasive; and if  
ting, such as that those who  
them unless they find a way  
f fourteen of the twenty can  
force them to advance, they  
erwhelm the man; if so, the  
surrenders, and even the six  
n inability to avoid jeopardy.  
man but have no way of let-  
nity may be necessary; but  
to identify him and testify  
y to let him take a hostage.  
of nineteen to enforce their  
ce, whoever is currently the  
ave identified the critical in-  
sort, we may be in a better  
ower of an unpopular despot  
nORITY, or the conditions for

uggest the kinds of typical  
deserve to be explored within  
they include such moves as  
communication," "delegation  
n structural elements as the  
rovisions.

#### THE MOVE

is the commitment, analyzed  
ne institutional environment  
yer to make a single "final"  
the event he should amend  
re remains but a single, well-  
sell at the price proposed or  
of commitment converts an  
into a two-move game; one

player assumes a commitment. The game has become

This particular move, analyzed here only as a particular move. As noted in Chapter 3 this move depends on the cost and the ability of the player to "enforce" the commitment. We have allowed the move structure to determine the "winner" is the one who can do both can, the one who can do either. In the case of a tie, but we have not made ties a foregone conclusion.

But, although we have made it seem sense that we have no difficulty in identifying which player committed himself, it remains a game like a foot race that goes to the one who achieves his goal first. The commitment does not affect the game, either physically or psychologically, on the second player, over whose control. The commitment induces the other player to choose his other player's choice by affecting his control.

The power to commit oneself is equivalent to "first move." Commitments provide no means for

<sup>3</sup>In the real estate example of earlier (p. 116) buyer B (whose top price is 20) can extract from buyer C (whose top price is 22) the right to bind himself to buy the house for 20 (free to resell it to C for a loss) unless B is committed to buy the house for 20 —  $P$ , where  $P$  is the ultimate price. If  $P$  is the "true" top price, thus raising the top price, D and E may try to do this. If D, who attaches no personal value to the house, is committed, or the one who can find a buyer. If D, who attaches no personal value to the house, is committed up to 22 for it, he is a *bona fide* purchaser. If D's top price is 22; his *bona fides* is even stronger. If D's commitment is demonstrable while sub

## ON OF GAME THEORY

nt, and the other makes a final decision determinate.<sup>3</sup>

alyzed at length in Chapter 3, is men-  
ularly simple illustration of a typical  
g, the availability and the efficacy of  
ommunication structure of the game  
er to find a way to commit himself,  
nt against himself. Furthermore, we  
ure of the game to be asymmetrical;  
o can assume the commitment or, if  
it first. (We can consider the special  
not, by an assumption of symmetry,  
sion.)

made the game "determinate" in the  
culty in identifying the "solution,"  
ch of the two players can first com-  
me of *strategy*. Though the winner  
commitment first, the game is not  
o the fastest. The difference is that  
automatically win under the rules of  
or legally. The outcome still depends  
whom the first player has no direct  
s a *strategic* move, a move that in-  
oose in one's favor. It constrains the  
fecting his expectations.

one's self in this kind of game is  
And if the institutional arrange-  
incurring an irrevocable commitment

Von Neumann and Morgenstern referred to  
op price is 15) might raise the limit on what  
se top price is 25) if he can find some means  
or 20 and keep or destroy it (that is, not be  
less he gets a specified large fraction of, say,  
rice paid by C. In effect, B changes his own  
limit on what he may extract from C. Of  
he same; and the first to get properly com-  
means if only one of them can, is the win-  
al value to the house, is committed to pay  
member of the game with a true reservation  
greater than was B's originally, if the com-  
jective valuations are not.

in a legal or contractual sense, on something by an irreversible maneuver of choice. One escapes an undesirable when he arranges a "prior" engagement liberately catch cold. Luce and Raiffa same tactic can be used by a person wants, for example, to go on a diet. "He announces his intention, or a not break his diet, so that later he will mind and to optimize his actions at time." <sup>4</sup> The same thing is accomplished by commitment when one deliberates deep in the wilds without cigarettes.

## THREAT

The distinctive character of a threat is he will do, in a contingency, what he to do if the contingency occurred, though by the second party's behavior. Like the threat is a surrender of choice, a that makes one worse off than he normally fails; the threat and the commitment possibility that a rational second player knowledge that the first player has a structure. Like an ordinary commitment the other player only insofar as it conveys at least some appearance of obligation. "I will give you both to bits unless you close the window unless I have somehow managed to solve the matter."<sup>5</sup>

<sup>4</sup> *Games and Decisions*, p. 75.

<sup>5</sup> In ordinary language, "threat" is often used to merely points out to an adversary, or reminds him of a painful to the adversary if the latter fails to do so. To "threaten" would have incentive to do so. To "threaten" is of this sort, the threat to shoot him is a different word for these cases—I suggest "warning"—because the "threat" either is superfluous, or it conveys true information and relates to some

one may accomplish the same result that reduces his own freedom of choice and invitation by commitment and irrevocability; failing that, he can defend himself. As the economists have pointed out that the person who commits himself against himself when he does not trust himself. He accepts a wager that he will not be free to change his mind according to his tastes at that time. He is committed by maneuver rather than by force. He suddenly embarks on a vacation

S

What is great is that one asserts that one would manifestly prefer not to be in the contingency being governed by the ordinary commitment, the irrevocability of alternatives, and the need be in the event the tactic of threat are both motivated by the same thing. The player can be constrained by his own choice as altered his own incentive structure. In the event, a threat can constrain the other player at the same time; if I threaten to blow us up, you know that I won't leave myself no choice in

used also for the case in which one threatens him, that one would take action to comply, it being clear that one would not call the police on a trespasser. But it seems better to use a "warning" rather than "threat" and does not constitute a move, or a commitment in situations with an information struc-

The threat differs from the commitment in that it makes one's course of action dependent on what the other player does. While the commitment fixes a course of action for the player, the threat fixes a course of action for the other player. The commitment is a move in a game in which first move can be a commitment to a strategy for the rest of the game.

A threat can therefore be thought of as a move in which the first move is up to the other player to move first. In this sense, move first or simultaneous move is equivalent of "first move" or "second move" to a demand that the other player move first — if the game has commitments that make promises feasible. A threat that cannot be destroyed in advance of the time it happens to have no more effect than nothing of his opportunity until the time he awaits payment; and even if he himself find a way to assume the role of the hostage in a manner that makes the threat a fiction or capture.

The fact that *some* kind of commitment, must lie behind a threat, must be communicated to the threatened party. This is another notion that often appears in the literature that a threat is desirable, or that the reaction threatened would cause the threatened party to be more than to the party making the threat.

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ture and communication structure which is a mutually beneficial move, preceding the second party's understanding of the first party's intention. The difficulty of conveying true information, or the difficulty of conveying an assertion that one would have, even if one will. As a matter of fact, if a threat is a move in a game, the act of commitment is not contained in the threat. The commitment precedes the conveyance of the threat to the threatened party — the first move is the "true" incentive structure, and

## ON OF GAME THEORY

the ordinary commitment, however, in action *conditional* on what the other commitment fixes one's course of action, reaction, of response to the other as a means of gaining *first move* in a carries an advantage; the threat is a *second move*.

effective only if the game is one in to the other player or one can force it. But if one must, in a mechanical means, he can still force the legal on the other by attaching his threat promise in advance how he will be communication and enforcement structurable and that the party to be threatened. The holdup man whose rich victim on him at the time can make unless he can extract a hostage while that will not work unless he can a convincing commitment to return does not subject himself to identi-

commitment, or at least appearance mind the threat and be successfully threatened party is in contradiction to answers in game theory. This is the notion admissible, or plausible, only if the cause worse damage to the threatened making the threat. This is the view of

worth keeping distinct. In this latter case it including a jointly undesired outcome by demanding. The main point of analytical similarity and that of the "threat," is in the possible action credibly, of conveying *evidence* for the post, incentive for doing as one warns he is of such nature (as it often is) that the end in the act of communicating it — if the effect of the threat, with evidence for believing it, act in the process of threatening changes the second is, in effect, a "warning."

Luce and Raiffa, who characterize will hurt you more than it hurts me depend on interpersonal utility comparisons; both players attempt to make play result becomes indeterminate, dependent on "personalities" of the players; "and to open without first having a complete analysis of the players seems foolish."

<sup>6</sup> Pp. 110-11, 119-20, 143-44. Morton A. Davis, in his book on international relations, also takes the weight to the threat positions of the players in his "comparison of utilities." (See his *System and Strategy* [New York, 1957].) Luce and Raiffa make only one of the players has a "plausible" brief discussion to  $2 \times 2$  matrices. It is a  $2 \times 2$  matrix, a game in which both players could make a threat. A threat is essentially a credible declaration of intent to make a certain move. It is profitable only if it yields a better payoff than either move alone and when one can make a threat either actually or by promise. (If second move is unnecessary; and if first move were as a result of a conditional commitment to his strategy choice, choice.) But if this preference order holds for one player it cannot hold for the other player. The point is that Luce and Raiffa in discussing the point show no "preference" for No. 2, not because the absolute size of the payoff to player 1's but for the much simpler reason that player 1 wins if he moves first; he wins if he moves second; simultaneous moves, in the games shown, a threat declaration would be to forestall his partner's move. He needs only an *unconditional* commitment to make the legal equivalent of "first move" in a game. This is the "threat" tactic of J. F. Nash, which applies to a continuous range of efficient outcomes — a threat declaration on the odds in a drawing of lots — depends on that the threatener does not demand, a particular outcome but only *some* outcome in a game. The zero point corresponding to "no agreement" is the expectation of a particular mathematical outcome. The locus is shifted by the shift in the payoffs of a game. This is the kind of threat assumed by Luce and Raiffa in their game. The implicit legal structure of the game is that of a game with no commitments (otherwise, first commitment by either player). Each player is subject to the threat of a threat by the overt act of explicit agreement with his own commitment. This being so, the result is that the zero point — the "status quo" that would be reached if some outcome is reached. The "asymmetry"



threats by the phrase, "This one," explicitly making threats comparisons. In the event that visible threats, they say, the ending on the "bargaining perspective predict what will in fact happen the psychological and economic cash indeed." <sup>6</sup>

Kaplan, in applying game theory position that "any criterion giving others involves an interpersonal communication *Process in International Politics* partly be led to their view that threat to make, by confining their impossible to show, with a  $2 \times 2$  would be interested in making threats. of a *conditional* choice for second better payoff than either first move make the other player move first move alone is as good, the threat good, one needs only an unconditional commitment to a conditional for one player in a  $2 \times 2$  matrix, actual matrices used by Luce and "plausible" threat strategy for player his gains or losses is greater than that player 2 has no use for a threat. he moves second; and he wins with . His only interest in a threatlike er's threat; and for that purpose he to his preferred strategy — that is, advance of his partner's threat. The es to bargaining games that have a or that can be made to, by agreeing differs from the threat discussed here, on pain of mutual damage, a *partial* the efficient range; that is, he shifts ment." The motive for that threat is tically determinate outcome whose corresponding to nonagreement. This Raiffa (p. 139) in the "asymmetrical" game apparently honors no irrevocable commitment would easily win the game for legal "disability" that he can always, his partner on any outcome, evade irrevocable commitments can only shift ill rule unless explicit agreement on y" that is present in the particular

But the issue is both simple and subtle. Consider the left-hand matrix in Figure 1. Column has no "first move." Without further information, he chooses strategy I, forcing Row to choose between 1 and 0; Row chooses strategy ii. But if we allow Row to

	I	II
i	1 2	2 1
ii	0 0	0 0

will choose strategy ii unless Column chooses I. Column's choice of ii, I or II is a conditional choice. If Column chooses I, Row would prefer to choose i; if Column chooses II, Row succeeds only if Column believes in the event of I.

Either he does believe this, or the "threat" is nothing at all to Column. The "best" first move, choosing I or II, follows a strategy of i, II or ii, I. But this is true of any matrix that reflects the same character of the threat more clearly than the right-hand matrix as well. The character of the threat more clearly on Row of an irrational choice, but for rational play and full information, Column's preference is clear;

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game shown by Luce and Raiffa is that which implicitly prevails. In practice, the cost of incurring of social disapproval on the part of the participants (approval constituting cost or punishment) in addition to the cost of the agreement concerned with what the agreement pro-

## ON OF GAME THEORY

der and more precise than that. Con-  
 Fig. 9, where Column is assumed to  
 threats, Column has an easy "win."  
 ng Row to choose between payoffs  
 strategy i, providing Column a payoff  
 o make a threat, he declares that he

	I	II
i	9 10	10 9
ii	0 8	0 0

FIG. 9

Column chooses II; that is, he gives  
 i,II by committing himself to that  
 a went ahead and chose I, of course,  
 ; and they both know it. The tactic  
 believes that Row *must* choose ii in

, or he does not. If he does not, the  
 him; he goes ahead and makes his  
 . If he does believe that Row must  
 , Column prefers 1 to 0 and chooses  
 numbers that we might put in the  
 order of preferences. It is true of  
 . That one dramatizes the essential  
 than the first one, since the penalty  
 e by Column is greater in this case;  
 l information, Row need not worry.  
 and, once Row has given him the

thus a feature of the particular legal system  
 it might correspond, say, to the deliberate  
 failure to reach agreement, with such dis-  
 nment (perhaps asymmetrical between par-  
 nonagreement but with the public not con-  
 vides as long as some agreement is reached.

pair to choose from — ii, I versus Column will do. If I threaten to new suit unless you give me the toast or not depending on arranged to have to do so, exact throw my scrambled eggs at you.<sup>7</sup>

The issue here is in whether it has “moves,” that is, that it is possible for players to take actions in the course of the game that change the game itself — that in the payoff matrix, the order of choices, or the rules of the game. If the game by its definition is fixed except mutual agreement and restraint, it is true that the “personalities” of the players will come, in the sense that their expectations will converge by a process that is wholly rational. Nothing more than an assertion of the power of the other player by power of suggestion can be. And it must involve some element of bluff or fake — if it is to be anything.

“Commitment” is to be interpreted as a series of maneuvers that leave one in such a position that nonfulfilment no longer exists (as a driver who has a car by driving too fast to stop in an emergency). A final decision beyond recall to a

<sup>7</sup> Edward Banfield showed me this in the case of the Rajahs and Charáns of the west of India, who were obliged to give large sums in bullion, through tracts which they were obliged to protect. They are also guaranteed to protect themselves, and even with the government.

“Their power is derived from the sanction of the government. If a man carrying a message that he will commit trága, as it is called: if he does not comply with, he issues the same threat unless it is not done. If he proceeds to gash his limbs with a dagger, the man will plunge into his heart; or he will first give different guarantees to the agreement will be made by his companions. The disgrace of these things is a bard’s blood on their head, generally. Their fidelity is exemplary, and they never lose. They keep up an ascendancy on which the imperial government. Hon. Mountstuart Elphinstone, *History of*

s i,II — there is no doubt what to blow my brains all over your last slice of toast, you'll give on whether you know that I've only as if I'd only threatened to

or not we admit that the game possible for one player or both of the game that irreversibly in some fashion alter the payoff the information structure of the game admits no moves of any sort, refusal to agree, then it may be that the players determine the outcome in a "moveless" game wholly psychic. But, if a threat is that is intended to appeal to suggestion, we must ask what more the notion of commitment — real

terpreted broadly here. It includes in a position that the option of when one intimidates the other (time), maneuvers that shift the another party whose incentive

resistible quotation about the Bháts are as bards. "In Guzerát they carry here a strong escort would be insufficient of all agreements of chiefs among

ity of their character and their des- treasure is approached, he announces or if an engagement is not complied fulfilled. If he is not attended to, he er, which, if all other means fail, he t strike off the head of his child; or cast lots who is to be first beheaded e proceedings, and the fear of having reduce the most obstinate to reason. ver hesitate to sacrifice their lives to portance of their cast depends" (*The India* [ed. 7; London, 1889], p. 211).

structure would provide an example when the authority to punish is absent when one shifts his claims and (company), and maneuvers that simulate the contingency of nonfulfillment mutually damaging fulfillment by one arranges for himself to appear fulfilled, or when he puts a plate-glass or stations women and children in front that he has threatened somewhat (at cost). A nice everyday example reminds us that "salesmen, especially that if they take a line that a reluctant customer buys, the customer's hesitancy and buy in order to save prevent what would ordinarily

There are, however, some ways in which commitment to a threat can be used. That "firm" commitment amounts to a wholly potent penalty, such that one prefers to carry out what he was threatened infinite (or at least of sufficient magnitude) irreversibly, and visibly attached to one that he is committed to do. This is supposing that the penalty is so large as to be controlling in

i	4
ii	4

Fr

<sup>9</sup> Goffman's paper is a brilliant study of status and a pioneer illustration of organized behavior structures like etiquette by implication — the law.

## OF GAME THEORY

post motive for fulfilment (as is deliberately given to sadists, or liabilities to an insurance company "worsen" one's own payoff in so that even the horror of a becomes more attractive (as when bear a public coward if he fails to glass window in front of his wares on the particular bit of territory that implausibly to defend at great is given by Erving Goffman, who especially street 'stemmers,' know will be discredited unless the re-omer may be trapped by consider-ave the face of the salesman and result in a scene." <sup>8</sup>

ays in which this notion of com-fully loosened. One is to recognizeunts to the invocation of someat one would in all circumstancess committed to. It is a penalty ofluous) size that one voluntarily,es to all patterns of action but the. This concept can be loosened byof finite size and not necessarilyall cases. In Fig. 10 Column will

### II

2	1	1
2	3	3

Fig. 10

y in the relation of game theory to games-the rich game-theoretic content of formal-te, chivalry, diplomatic practice, and —

## STRATEGIC

win if he has first move, unless (Commitment obtains "first movement means the attachment of a row ii and we show this in the matrix of Row's payoffs in ii some finiteness, then the commitment will be greater than 2. Otherwise it is a response to II will be ii, in spite of the commitment is simply a loss to himself, so he avoids it.

Similarly with a threat. In Fig.

		I	
	i	-5	-5
	ii	-4	-3
	iii	-4	-3
		-2	0
		1	

FIG.

is at iii, II whether the rules call for first, or both to choose simultaneously he can move second and confront Column would threaten I against iii,

<sup>9</sup> If a player, Column, for example, can do so in a "legal" sense, he can do so in a "legal" sense, unless Row *promises* to choose ii. Full analysis of the penalties on promises as well as on the additional arrangements for promises (that is, the party) are generally of a quite different nature. Commitments (that is, commitments that they solve), available penalties could differ from promises — just as, in general, they would differ for players. The particular payoffs shown in the matrix are at least 1 on a promise by Column or by Row. If a threat is extracted by a threat, it is an advantage to the player who imposes the penalty and a disadvantage to the player who imposes his own breach of contract, that is, to be



Row can commit himself to i. ve" for Row.) But, if commit- finite penalty to the choice of matrix by subtracting from each e amount representing the pen- e effective only if the penalty is clear to Column that Row's re- f the commitment. In this case ss that Row would impose on

II without threats, the solution

II III

-1	-2	-1
3	2	2
1	3	0

11

For Row to choose first, Column ously. Either player can win if t the other with a threat.<sup>9</sup> Col- Row would threaten i against

cannot force first move on Row in a gal" sense by threatening to choose I alysis in this case requires attention to hreats. Since the physical and institu- is, for commitments to the second nature from those for unilateral com- he second player cannot himself dis- drastically as between threats and l differ as between the first and second Fig. 4 would require penalties of at ow. Note that in the case of a promise e to the threatener to be able to in- victim to be able to invoke penalty on able to comply.

II. But if the threat is secured any persuasive penalty that Column chooses iii. The lower limit to noncompliance would be 3. If, then, penalties come in a single "size" and the outcome is at iii,II; a size either player, and the "winner" of the threat first; a size between who wins. In this latter case the more by his own unsuccessful threaten — but only through the calling a sufficiently terrible penalty.

Note that the "hurt-more" comes to whether Row or Column who threatens but to whether Row will fulfil his own threat than Column had made *his* threat. Actually shown, Row's *successful* threat in the fulfilment than it would potential *unsuccessful* threat would hurt Row.

Another loosening of the threat of rationality. Suppose the player R, and some probability make a mistake or an irrational unanticipated way because the the first player's payoffs.<sup>10</sup> This possible gains and losses in commitment take into account the possibility will not be heeded. If, then, the from having to carry out the threat for another, there could be symmetry being equal and the threat penalty in which one player may find it and the other player not, consistent. (A somewhat similar calculation

<sup>10</sup> Situations of this sort are explored

## OF GAME THEORY

by a penalty, the lower limit to Column could invoke would be 4; Column preferring II to I when Row imposes a persuasive penalty on Row's side. Then, the situation is one in which "a size less than 3 goes unused and a size greater than 4 is adequate for Column is the one who can avail himself of sizes 3 and 4 is of use only to Row, the player who would be hurt the most by a threat is the one who cannot avoid the paradox that he is incapable of imposing a penalty on his own head.

The comparison in this case refers not to Column who would be hurt more by what Row would do, but to Row who would be hurt more by having to impose a penalty. Column would be hurt if, instead, Column imposed a penalty. Col- lably, in the particular payoff matrix shown, the threat is one that would hurt him *more* if he imposed a penalty and hurt Column, while Column's threat would hurt him *less* to fulfil than it

That concept is to alter our assumption that there is some probability  $P_r$  for player R to move, or that he will act in an un- expected way, or that the other player is mistaken about the situation. This yields us a game in which the possibility of imposing one's self to a threat must be considered. It is that a fully committed threat is the potential loss that will ensue if the threat is greater for one player than for the other. In symmetrical circumstances — the P's penalties equal for the two players — it is advantageous to make the threat smaller. Considering the possibility of "error," a threat may be involved if both players are involved. See Chapters 7 and 9.

## STRATEGI

have opportunities for threats and commitment through the failure of commitment and to stop in time.

This modification in the three postulate that underlies it — goes to the “hurt-more” criterion. On this adds more insight into the strategy of the striking truth that the threatener’s having less to suffer than the other had to be carried out rather than the truth contained in the intuitive notion of price war, of damage suit; the nature of the threats of organized societies and demeanors; and the concepts of strategy generally cannot be understood except in comparison criterion. It is indeed the nature of the relation, as between the two players, is the subject for study; but the relevance of the communication system, in the nature of promises, in the speed of commitment, in the speed of expected responses, and, finally (in the nature of) damage criterion.

## PROMISES

Enforcible promises cannot be made unless they must be in enforcible terms and conditions of behavior. Enforcement depends on the existence of authority somewhere to punish or to reward. Concern whether punishment or coercion is the more efficacious discussions of disarmament proposals are predicated on how difficult it may be, even if one greatly desire to reach an enforcible agreement. The problem of the means of enforcement. The problem of the party trusts the other and each trusts the other and that neither can therefore be forced to compliance. Many of the technical problems of disarmament disappear if there were some earth

and there is danger of simultaneous  
of one to observe the other's  
to save both.)

at concept — in the rationality  
es somewhat in the direction of  
the whole, though, game theory  
y of bargaining by emphasizing  
does *not* depend on the threat-  
the threatened party if the threat  
an by exaggerating the possible  
first impression. Threats of war,  
threats to make a "scene"; most  
ty to prosecute crimes and mis-  
extortion and deterrence gen-  
ept by denying the utility-com-  
asymmetries in the threat situa-  
s, that make threats a rich sub-  
t asymmetries include those in  
e enforcibility of threats and of  
tment, in the rationality of ex-  
n some cases) in the relative-

## ISES

taken for granted. Agreements  
involve enforcible types of be-  
n at least two things — some  
or coerce and an ability to dis-  
rcion is called for. The postwar  
osals and inspection schemes in-  
ven if both sides should desper-  
e agreement or find a persuasive  
em is compounded when neither  
recognizes that neither trusts the  
ore anticipate the other's compli-  
blems of arms inspection would  
thly means of making enforcible

promises or if the nations of the allegiance to some unearthly authority may be undetectable, promises forced even if punishment could be doubled by the fact that punishment such punishment as can unilaterally be imposed by one party in its act of denouncing the other. In more, some seemingly desirable being undefinable operationally against each other will work only if the nations are capable of objective supervision.

Promises are generally thought of as commitments, given against a quid pro quo in return. But there is incentive in a promise if it provides inducement to the other party in the mutual interest. In the left-hand

	I	II
i	0 0	2 -1
ii	-1 2	1 1

FIG.

are to be simultaneous, only a promise in the right-hand matrix, Row's Column can safely choose II, yielding a win for both players. (If, in the left-hand matrix, the player who chooses *second* must choose *first*, the players are themselves to a promise only one of the two can issue a promise, the other one move first. These promises in the right-hand matrix, must be a performance. A unilateral uncoordinated move on the right-hand side but not on the left. The witness to a crime has a move

## OF GAME THEORY

the world all rendered unquestioned authority. But, since noncompliance of compliance could not be enforced and be guaranteed. The problem is that compliance cannot be guaranteed, except that it can usually be meted out by the other player in violation of the original agreement. Further agreements must be left out for consideration; agreements not to discriminate are only if defined in objective terms

might of as bilateral (contractual) quid pro quo that is often a promise for a unilateral promise when the other player to make a choice in a payoff matrix of Fig. 12, if choices

	I	II
i	0      0	2     -1
ii	0      0	1      1

. 12

A pair of promises can be effective; a promise brings its own reward: yielding superior outcomes for both. In the matrix, moves are in turn, the players do not have the power to promise. If they agree on the order of moves and the sequence of promises, they can agree that the sequence of promises, in contrast to those for which a promise is conditional on the second player's promise. (A conditional promise does the trick on the left with moves in turn.) A promise is a motive for unilateral promise if the

criminal would kill to keep him to be on the threshold of an weapon may have reason to for is any possible way to do so — last-minute attempt by an enem a chance.

The exact definition of a prom to a threat — is not obvious. It commitment (conditional or unc welcomes, one that is mutually games shown in Fig. 12. But F

		I
i	2	5
ii	1	1

FIG

Row must couple a threat and a I and promises i in the event of a payoff of 4 rather than zero, and in that sense it is favorable 1 unit to Row. But, if Row could would win 5; he would because without the promise, and the threat of ii against I by itself is to choose II, since a choice of ii,II, zero instead of 1. Row's th goes with it; the net effect of t work, yielding Column 4 instead

<sup>21</sup> This notion is celebrated in "Wet produced by Alfred Hitchcock on TV. is ordered at gunpoint to seal his lips b incriminating evidence, so that if the the murder. He should have insisted, as to share the guilt with the actual m (*Short Stories from the "New Yorker*



from squealing.<sup>11</sup> A nation known absolutely potent surprise-attack reswear it unilaterally — if there in order to forestall a desperate y to strike first while he still has

nise — for example, in distinction might seem that a promise is a (conditional) that the second party y advantageous, as in both the fig. 13 shows a situation in which

## II

	4
4	4
	0
5	0

e. 13

a promise; he threatens ii against f II. The promise insures Column once he has made a choice of II, e to him; it does so at a cost of ld not make the promise, Column e the threat would be ineffectual threat would not be incurred. A no good; it cannot force Column EI leaves him with an outcome atreat can work only if the promise he promise is to make the threat ad of 5, gaining 5 rather than 2

Saturday," by John Collier, recently re- An inadvertent eavesdropper on a murder by leaving his own fingerprints and other body is found he will be charged with however, on fabricating the evidence so murderer; as it was, he got badly cheated." [London, 1951], pp. 171-178.)

for Row. One cannot force social diseases to reveal themselves by a relentless pursuit that spares no community to those that come forward.

A better definition, perhaps, is a commitment that is controlled by the threat that the second party can make. But timing is important here. The work *after* the threat is fully carried out, the promise (Column) can renounce that Row knows that Column's threat itself is deterred. And, if the threat is carried out in such a way as to be irreversible, the promise becomes obscured. (In fact, the carrying out of the equivalent of a promise is often deterred rather than by a "legal" commitment.)

Actually, whenever the alternative of a threat and promise are likely to be "alternated" that one presents to the other, one should consider the threat and the promise as two aspects of the same tactic of self-commitment, which in certain simple terms of the second party's interests

*Enforcement schemes.* Agreements that have no outside authority exists to enforce them are inherently undetectable. The forms of agreement, or terms to which one is not free to cheat or that make noncompliance or that incur the penalties on which the agreement rests. While the possibility of "trust" should not be ruled out, it should also be noted that even trust itself can usefully be substituted for a threat. Trust is often achieved simply by the agreement between parties and the recognition of the threat.

<sup>19</sup> Somewhat related is the grant of immunity from the protective danger of self-incrimination, and the threat of contempt proceedings.

## OF GAME THEORY

es, conspirators, or carriers of  
ves solely by the *threat* of a re-  
ost; one must also promise im-  
ard.<sup>12</sup>

would make the promise a com-  
second party, that is, a commit-  
enforce or release as he chooses.  
The promise just discussed will  
ommitted; but if the victim of  
unce the promise in advance, so  
pects zero if he chooses II, the  
the threat and promise are con-  
“legally” inseparable or if they  
versible maneuver, the definition  
definition breaks down whenever  
btained by some irrevocable act  
ent.)

tive choices are more than two,  
be mixed in any “reaction pat-  
other. So it is probably best to  
mise to be names for different  
ective and conditional self-com-  
e instances can be identified in  
st.

nts are unenforcible if no out-  
them or if noncompliance would  
problem arises, then, of finding  
agree on, that provide no incen-  
compliance automatically visible  
ch the possibility of enforcement  
rust” between two partners need  
not be taken for granted; and  
studied in game-theoretic terms.  
y the continuity of the relation  
ion by each that what he might  
munity that strips a reticent witness of  
and so opens him to the ordinary sanc-

gain by cheating in a given instance of the tradition of trust that makes a future agreement. By the same token, for a single discontinuous instance of a succession of increments.

There are, however, particular games that lend themselves to enforceable agreement. One is a game on some kind of coordination or cooperation. Partners have disagreed on where to meet. Partners or accomplices have disagreed on what to do. Members of a business firm or football team have disagreed on what prices they will quote or what to do, nevertheless have an overriding incentive or urgency of their actions. Once agreement is reached, it substitutes the only possible focal point for tacit collaboration; no one has any alternative to do anything but what he is expected to do. In any other means of enforcement, the game is advised to try to find agreements that are based on dependent expectations, even to the point of an agreement certain elements whose violation is in jeopardy for noncoordination. Teamwork or letting one partner carry the game is a familiar example.

The institution of *hostages* is a game that serves to be studied by game theory. Partners drinking wine from the same glass in places so public that neither side can afford to let the other to a massacre. The reputation of a man as agents or employees in a narrow market is a forward example of a unilateral hostage game.

Perhaps a sufficient interchange of information that hate each other or an agreement between the cities of both countries to a single instance of alternate blocks of the city could be reached. If it became sufficiently desperate to reach an agreement, the principal drawback to the exchange of rational behavior, is the in-

nce is outweighed by the value  
es possible a long sequence of  
oken, "trust" may be achieved  
ce, if it can be divided into a

ame situations that lend them-  
e is an agreement that depends  
omplementarity. If two people  
for dinner; if two criminal ac-  
joint alibi to give; or if mem-  
all team have disputed about  
at tactic they will follow, they  
interest in the ultimate consist-  
ent is formally reached, it con-  
nt for the necessary subsequent  
a unilateral preference now to  
cted to do. In the absence of  
then, parties might be well ad-  
at enjoy this property of inter-  
e extent of importing into their  
sole purpose is to create severe  
aring the treasure map in half  
un and the other the ammuni-

an ancient technique that de-  
eory, as does the practice of  
s or of holding gang meetings  
de could escape if it subjected  
orted use of only drug addicts  
otics ring is a fairly straight-  
ostage.

of populations between nations  
nt to move the governing agen-  
sland where they would occupy  
d be resorted to if both sides  
avoid mutual destruction. A  
ge of hostages, on the assump-  
nherent unknowability of each

other's value system adverted daughter as a hostage to his of assuaging his enemy's fear. We could probably guarantee surprise attack by having the at the kindergarten level: if to kindergarten in Russia — structured for the purpose, design and not for cultural interchange group arrived before the graduation seem to be the slightest chance atomic destruction in Russia. Russians would be quite sure that a reciprocal program would the Russian government; unfortunately were bound by the fear seems nearly impossible for it surprise-attack situations a none; and the idea of hostage when symmetrical exchanges

Actually, the hostage idea is that a disarmament agreement be more efficacious (and provide control) if it related to *defense* eschew defense is, in effect, to relation without bothering to put possession. Thus we can put Russians and receive similar only by physically trading the breach of constitutional rights leave them so unprotected that

<sup>13</sup> The precise definition of hostage pertinent to threats as to promises: mentioned in Europe principally to deter becoming engaged in a European conflict they cannot, their wives and children have been a more persuasive commitment selves. As a general rule, invaders move in countries they covet, to avoid inadvertent hostages.

## N OF GAME THEORY

to earlier. The king who sends his enemy's court may be incapable that he really dislikes the girl. the Russians against an American equivalent of "junior year abroad" every American five-year-old went in American establishments con- signed solely for "hostage" purposes — and if each year's incoming quating class left, there would not e that America would ever initiate We cannot be quite sure that the of this. Nor can we be quite sure ould be as much of a deterrent to rtunately, even if the Russian gov- ar of harming Russian children, it to persuade us so. Still, in many unilateral promise is better than s may be worth considering, even do not seem available.<sup>13</sup>

ologically identical with the notion t between the major powers might bably more subject to technical nsive weapons and structures. To make hostages of your entire popu- t them physically into the other's our children at the mercy of the power over Russian children not m, with enormous discomfort and s, but also by simply agreeing to t the other can do them as much s is a little difficult. They seem to be as the American divisions that were sta- nonstrate that America could not avoid ict can probably be viewed as hostages; if can, and perhaps their wives and children ment or "trip wire" than the troops them- ay have to avoid the peak tourist season rooking the countries that have yielded

damage where they are as if he had a "balance of terror" that is so often it exists and is stable — equivalent to conceivable hostages. (The analog is stable, i.e., that neither side be able to destroy the other's power to strike without the surfeit of civilian agony.)<sup>14</sup>

*Denial of enforcement.* Enforcement is to the influence of a third party to the outcome more difficult for the other. The denial of banning illegal activities has often so that contracts became unenforceable. Denial of enforcing contracts or contracts in respect to the delivery of liquor during prohibition of the process of discouraging the times, of course, prohibition of this into the hands of anyone who can enforce forcible promises.<sup>15</sup> The denial of prohibition meant that only the quality of their liquor and hence the monopoly control of the business to protect brands and labels can per se facilitate business based on unwritten

## RELINQUISHING T

What makes the threat or oratory a tactic to employ and an interesting one of finding a means to commitment is to invoke against one's own nonperformance a related set of tactics that consist into a position in which one no longer has over how he shall behave or respond.

<sup>14</sup> This concept is developed at length in

<sup>15</sup> It has been argued that an important function of the Chicago garment trade was punishable by being paid by the price-fixing organization. "Function of the Racketeer," *New Republic*



had them in his grasp. Thus the men adverted to is — if, in fact, ent to a total exchange of all gy requires that the balance be able, by surprise attack, to de-back, but just able to inflict a

ent of promises is also relevant that wishes to make an efficient er two players. A potent means ten been the outlawing of them, rcible. Failure to enforce gam-strait of trade or contracts for prohibition has always been part he activities themselves. Some- is sort delivers enormous power a enforce contracts or make en- copyright liquor labels during bigger gangs could guarantee nce assisted them in developing s. By the same token, laws to haps be viewed as devices that ritten contracts.

#### THE INITIATIVE

ordinary commitment a difficult ng one to study is the problem nt, the available "penalty" to ormance. There is consequently sists of maneuvering one's self longer has any effective choice nd. The purpose of these tactics

Chapter 10.

nt function of the racketeer is some- e beyond the law. Price-cutting in the r explosion — the fee for the explosion on — according to R. L. Duffus, "The ic (March 27, 1929), pp. 166-68.

is to get rid of an embarrassing dependence on the other party.

This is the kind of tactic that Dulles was looking for in the future.

In the future it may thus be feared that the presence of vast retaliatory power. In the next decade, it may be that by the 1960's the Sino-Soviet perimeter can pose a serious scale conventional attack and thus a choice between failing or himself initiating an attack on a third country. Thus the tables may be turned so that those who are non-aggressive having to rely on their own power for their protection, would be dependent on a successful conventional aggression as the consequence of invoking nuclear war.

The distinction between the type of strategy in the 1950's and the type he is now advocating in the matter of who has to make the decision is important because the United States is not to trust, a persuasive means of deterrence, a persuasive means of massive retaliation against certain countries.

There was a time, shortly after the atomic bomb exploded, when there was some concern about whether the earth's atmosphere would be cleared by nuclear fission; the idea was that a chain reaction might destroy the earth. At that time a number of bombs had already been exploded, that, if this were true and if the atmosphere reached that critical level of tolerance, it would be destroyed for all time by a deliberate nuclear attack. It was suggested that one could deliberately explode  $n - 1$  bombs.

This tactic of shifting responsibility is a

<sup>10</sup> J. F. Dulles, "Challenge and Response" (October, 1957). Very similar language is used in *Diplomacy* [Cambridge, Mass., 1958] where he says: "A sizeable defense force in Europe: by having a large one rather than a small one, it makes him more confident because 'he would be making the decision' and 'this magnitude will pass the decision to the defense side of the offense.'"

## N OF GAME THEORY

ing initiative, making the outcome  
ty's choice.

at Secretary of State John Foster  
following passage:

ossible to place less reliance upon deter-  
. . . Thus, in contrast to the 1950  
o decade the nations which are around  
ssess an effective defense against full-  
confront any aggressor with the choice  
ng nuclear war against the defending  
rned, in the sense that instead of those  
rely upon all-out nuclear retaliatory  
e aggressors would be unable to count  
ession, but must themselves weigh the  
r.<sup>16</sup>

type of deterrence he imputes to  
mputes to the 1960's differs in the  
t final decision; and the difference  
d States cannot find, or bring itself  
commitment to the threat of mas-  
types of aggression.

fter the first atomic bomb was ex-  
e journalistic speculation about  
e had a limited tolerance to nu-  
uited about that a mighty chain  
h's atmosphere when some critical  
been exploded. Someone proposed  
we could calculate with accuracy  
we might neutralize atomic weap-  
e program of openly and dramati-

onsibility to the other player was

response in U. S. Policy," *Foreign Affairs*  
ge is used by Dean Acheson (*Power and*  
, pp. 87-88) in discussing the role of a  
requiring of the enemy a major attack,  
a believe that retaliation would ensue, be-  
sion for us. . . . A defense in Europe of  
to risk everything from the defense to the

## STRATEGIC

nicely accomplished by Lieutenant  
son B. Canyon, U.S.A.F., in us  
Chinese Nationalist surface vessel  
munist surface forces in his comic  
ized to initiate hostilities and kno  
would be credited, he directed his  
burning ring about the aggressor f  
clear chance of reversing their en  
could neither drop gasoline on the  
so he dropped the initiative inste

The same tactic is involved in th  
resistance" that might be better  
According to *The New York Times*  
down on the tracks at more than  
halting 48 passenger and 144 freight

A more dramatic instance, also  
same paper: "A public debate is  
whether to send a 'suicide sit-down'  
around Christmas Island, the sit  
hydrogen bomb experiment. . . .  
tion would be to prevent the Brit

## IDENTIFIC

An important characteristic of  
side knows about the other's value  
tion problem arises with respect  
bank employee who would like to

<sup>17</sup> "Rail Strikers Sit in Tracks," *The N*  
14L f. The appropriate countertactic seem  
sets the throttle for slow forward speed,  
cab and jumps off the moving train, walk  
on his engine when it catches up with him  
he is driving the train is that he can stop  
can get off the tracks, particularly if they  
that they could not vacate the track quick  
by locking themselves to the tracks and  
persuasively inform the engineer of this be  
trol of the engine.

<sup>18</sup> "Japan Debating Atomic 'Suicide,'"  
1957), p. 16.

Colonel (then Major) Steven-  
ing his aircraft to protect a  
about to be captured by Com-  
strip. Unwilling and unauthor-  
owing that no threat to do so  
planes to jettison gasoline in a  
forces, leaving to them the last  
engines to avoid the flames. He  
the enemy ships nor threaten to;  
lead.

those dramatic forms of "passive  
called "active nonresistance."  
s, "Striking railway workers sat  
at 300 stations in Japan today,  
at trains." <sup>17</sup>

Japanese, was reported in the  
being held here this week on  
n fleet' to the forbidden waters  
ce of the forthcoming British  
The first object of the expedi-  
ish blast." <sup>18</sup>

## ATION

any game is how much each  
system; but a similar informa-  
to sheer identification. The  
rob the bank if he could only  
*New York Times* (May 13, 1957), pp.  
ns to be the following: The engineer  
conspicuously climbs down from his  
s through the station and jumps back  
n. The weakness of his position while  
o it more quickly than his adversaries  
have arranged to crowd themselves so  
ly. They can forestall his countertactic  
throwing away the key — if they can  
efore he has relinquished his own con-

*The New York Times* (March 5,

find an outside collaborator and to rob the bank if only he could find it difficult to collaborate with each other, there being severe penalties should declare his intentions to identical interests. The boy who because she might rebuff him the kidnaper cannot operate profitably from the poor in advance; and the South may never know what of the penalties on declaration.

Identification, like communication; and the act of self-identification and sometimes not. One may be bargained for, once he decides a nice example occurs in Shakespeare's Angelo, acting in place of the Duke poses to kill. He could torture the victim has a sister, who after finding the sister attractive, proposes sister declines, Angelo then threatens the sister submits. At this point simply by the establishment of identification. Angelo's only interest is he may gain by making a threat available to whom the threat the possibility of torture has value itself, but the threatening of value out of her trip; having identified self available to receive the threat forced to suffer what she would never made her identity known into the crowd before the threat.

A nice identification game in a suburb a few years ago. Certain which identified them to police a motorist with a membership card the card to the policeman and

## OF GAME THEORY

and the bank robber who would like to find an inside accomplice may because they are unable to identify penalties in the event that either to someone who proved not to have to is afraid to ask a girl for a date is in a similar position. Similarly, properly if he cannot tell the rich and the antisegregation minority in whether it is large or small because

ation, is not necessarily recipro-  
ation may sometimes be reversible  
achieve more identification than  
shares his interest in an object. A  
akespeare's *Measure for Measure*.  
Duke, has a prisoner whom he pro-  
him, but he has no incentive to.  
rives to plead for his life. Angelo,  
proposes a dishonorable bargain; the  
threatens to torture the brother unless  
that the game has been expanded  
identity and of a line of communi-  
in torturing the brother is in what  
to do so; once there is somebody  
can profitably be communicated,  
value for Angelo — not the torture  
it. The sister has gotten negative  
identified her interest and made her-  
threatening message, she has been  
and not have had to suffer if she had  
or if she could have disappeared  
that was made.

was uncovered in a New York  
n motorists carried identity cards  
men as members in a club; if the  
rd was arrested, he simply showed  
and paid a bribe. The role of these

cards was to identify the motorist who was received, would keep quiet. The man whose promise was enforceable was the motorist only *after* he has been arrested. To identify card-carrying motorists by local police is to concentrate their arrests on card-carrying motorists unless payment were received. Identification, at the option of the motorist — pertinent to the discussion of professional identification — is described by Sutherland as "less fair in their dealings with the motorist than they would be so. They will extend favors to card-carrying motorists that they would not extend to nonprofessional motorists. They realize that it is safe to do this and that they will not be informed, as might be the case with amateurs."<sup>19</sup>

Identification is also relevant to the doctrine of self-identification that tends to be ignored in the context of identification and exchange, namely, the identification that is available and that is not available. Identification is a potent threat that could be successful. A healthy high-school graduate, of average intelligence, has to work fairly hard to earn \$4,000 of value per year; but he could earn that much if he set his mind to it, through identification. Given an institution that could generously abstain from defrauding a fraction of the value that he might earn, he clearly has a calling as an extortionist or clerk. It is fortunate that extortionists are identified and overt communication is required of them.

The importance of self-identification is attached to the doctrine that identification is permitted to know and to confront. Identification in secret testimony before a Grand Jury and reliable witnesses might be intimidated.

<sup>19</sup> E. H. Sutherland, *The Professional Thief*.



as a person who, if the bribe  
it identified the motorist as a  
le. But the card identifies the  
rested; if the police could iden-  
looking at them, they could con-  
rrying drivers, threatening a  
ived. The card is contingent  
e motorist. A similar situation  
omises as well as to identifica-  
: "Most coppers are more or  
ieves simply because it pays  
avors even after a pinch which  
professionals whom they lock up.  
his and that high officials will  
case if favors were extended to

o an important economic fact  
ventional economics of produc-  
normous potential for destruc-  
relevant because of the extor-  
pported by it. The ordinary  
slightly below average intelli-  
produce more than \$3,000 or  
could destroy a hundred times  
according to the writer's hasty  
nal arrangement in which he  
struction in return for a mere  
ight have destroyed, the boy  
nist rather than as a mechanic  
rtion usually depends on self-  
ation by the extortionist him-

ation is attested by the signifi-  
t an accused person should be  
his accuser. It is also reflected  
d Jury, in cases where identi-  
ated by potential defendants,  
*Chief* (Chicago, 1954), p. 126.

and in efforts to keep secret crime until the criminal is apprehended and of law enforcement and crime prevention, and in the application of game theory

DELI

Another "move" that is sometimes made is the shifting of part or all of one's interests for decision, to some agent who is not another player in the game. In the case of insurance, the shifting of interests; the insurance structure from the insured party to the insurer, who then threatens or resists them for that purpose on a check accomplished by a professional collecting agency. The shifting of debts is a means of accomplishing lateral communication with it. The use of a negotiable instrument is unavailable to hear pleas or threats. The use of ammunition to South Korean prisoner-of-war camps so that the release of prisoners is a tactical means of releasing the decision — embarrassing because of deterrent threats or leaves one's own threat, hence the incapacity.

The mutual-defense agreement of China is probably to be seen as shifting the decision for responsibility. The use of nuclear weapons in the hands of the United States is explicitly argued on grounds that giving the visible power to resist certain contingencies be thought of as a move by the United States.

The use of thugs and sadists in the guarding of prisoners, or the use of authority to a military command, is a common means of making

## N OF GAME THEORY

the identity of eyewitnesses to a apprehended. (The strategy of law iminal deterrence is a rich field for r.)

## EGATION

ometimes available is the delegation t, or part or all of one's initiative o becomes (or perhaps already is) nsurance schemes permit the shar- company has a different incentive ty and may be better able to make t reason. Requiring several signa- s a similar purpose. The use of a by a business firm for the collec- achieving unilateral rather than bi- ts debtors and of being therefore threats from the debtors. Providing troops or giving them access to they can unilaterally release pris- relinquishing an embarrassing power cause it subjects one to coercive or e the capacity to back out of his ity to make the threat persuasive. ent with the Nationalist govern- o be viewed partly as a means of onse to someone whose resolution more recently the proposal to put of European governments has been at it would enhance deterrence by taliate to countries that might in ht less irrisolute than the United s for the collection of extortion or the conspicuous delegation of au- der of known motivation, exempli- ng credible a response pattern that

## STRATEGI

the original source of decision might be found from or to find profitless, once that would be rational for a rational player. Rationality in certain game situations might be made against him and his rationality or to make credible a wise commit himself to, it may select irrational partners or agents.

In the matrix in Fig. 14 — discussed in these theses — if Row has second move

		I	
i	5	(2)	3
ii	0	(1)	4

FIG.

corner, Column gaining his own party without power of decision over the product, the payoff in parentheses is available for irreversibly surrendering player. The payoffs of the latter player he wins in the upper left-hand corner player a payoff of 5 as a by-product had to be financed by Row, whose payoff is accordingly reduced, it would still be a revocable assignment of portion to the third player, together with assignment of figures shown, he would still carry the upper left-hand corner, in contrast

## MEDIA

The role of mediator is another part of the theory. A mediator, whether impartial

ight have been thought to shrink  
 he threat had failed. (Just as it  
 l player to destroy his own ra-  
 ons, either to deter a threat that  
 that would be premised on his  
 threat that he could not other-  
 also be rational for a player to  
 ts.)

regarding the numbers in paren-  
 , he loses in the lower right-hand

## II

3	0	(1)	2
e	1	(0)	5

14

a preferred outcome. If a third  
 is scheduled to receive, as a by-  
 s, Row can win if some means is  
 ndering his move to the third  
 are such that with second move  
 nder, leaving the original Row-  
 ict. (If the third party's rewards  
 se own payoffs were correspond-  
 worth his while to make an ir-  
 s of his various payoffs to the  
 nment of the decision; with the  
 ry away a net value of 3 in the  
 st to  $\pi$  in the lower right.)

## ATION

er element for analysis in game  
 osed on the game by its original

rules or adopted by the players come, is probably best viewed as a third party arrangement or as a third party of his own who is given an influence over communication. But a mediator constrain communications — proposes offers, counter-offers, and so forth textual material of his own and in this way he can influence the other player alternative, in a manner that both parties recognizing. When there is no apparent mediator can create one by his power to intervene as a bystander who jumps into an impasse in traffic at an impromptu traffic cop who can discriminate among cars by being able to increase in efficiency to benefit everyone against; his directions have on the other hand coordination requires the communication of a suggestion. Similarly, the participant can be thoroughly dissatisfied with the mediator but as long as the caller has the power to do anything else. The white line mediator, and very likely it can be used to resolve one or the other before the disadvantage of denying its authority. The principle of the daylight-saving-time controversy is that we do everything an hour earlier just as if we do not less it gets legislative control of the clock by a well-organized minority that opposes the change unable to offset the change in clock time. The mediator to change the nominal hour at the end of the business.

Mediators can also be a means of resolving disputes put aside some of their rationality and to summarize certain communication alternatives for memory. (In this regard the mediator can be reproduced by a computing machine to compare two parties' offers to each other.)

## OF GAME THEORY

ers to facilitate an efficient out-  
s an element in the communica-  
l player with a payoff structure  
lential role through his control  
diator can do more than simply  
tting limits on the order of  
orth — since he can invent con-  
make potent suggestions. That is,  
's expectations on his own initia-  
ties cannot help mutually recog-  
ent focal point for agreement, he  
make a dramatic suggestion. The  
ntersection and begins to direct  
jam is conceded the power to  
ing able to offer a sufficient in-  
ven the cars most discriminated  
ly the power of suggestion, but  
on acceptance of some source of  
pants of a square dance may all  
he particular dances being called,  
e microphone, nobody can dance  
own the center of the road is a  
err substantially toward one side  
antaged side finds advantage in  
ciple is beautifully illustrated by  
versy; a majority that wants to  
ust cannot organize to do it un-  
f the clock. And when it does, a  
posed the change is usually quite  
lock time by any organized effort  
which it gets up, eats, and does

ns by which rational players can  
l faculties. A mediator can con-  
s while blocking off certain facili-  
he serves a function that can be  
hine.) He can, for example, com-  
ther, declaring whether or not the

offers are compatible without revealing the scanning device that can suppress the information into it. He makes possible certain actions beyond the mental powers of the individual, and persuasively commit himself to follow through.

The problem of persuasively demanding that one receives by the left hand what is given by the right hand, is nicely illustrated by governments to obtain accurate data through statistical programs, while another government seeking the same data in order to evade. Governments have found that by guaranteeing that the statistical data it receives to the taxing agency, the information is in the first place. An analogous implicit mediator is that of comparison to a statistical bureau that is committed to data after computing the sums and making them public for the benefit of the community. Opinion services that suppress personal data on political or sexual preferences. The use of mediators to be a common tactic when a business transaction or a right-of-way can be made without the awareness of those who are interested.

Mediators may be converted into a surrender of authority to him. Mediators have to be made deliberately incurring jeopardy, and power to punish or surrendering to their own value systems. In the process of him or to extract an enforceable price, he increases the totality of mediators. People who do not trust each other, they both trust, and let him hold the

<sup>20</sup> I have been told that in countries where morality exists, a few partners or directors are chosen from another culture where sim-



vealing the actual offers. He is a  
ess part of the information put  
in limited comparisons that are  
participants, since no player can  
forget something.

denying one's self the knowledge  
d, while actively seeking it with  
ed by the efforts of parts of gov-  
a on incomes for the purpose of  
her part of the government is  
to impose taxes or to prosecute  
d it important to seek ways of  
agency will deny the information  
in order to receive the informa-  
ogous case of relying on an ex-  
nies that turn trade secrets over  
mitted to destroy the individual  
and averages that it will make  
ributing companies, or of public  
otentially embarrassing individ-  
ractices, publishing only the ag-  
o forestall identification seems to  
yer of large resources thinks a  
be bought cheap if the owner is  
d.

to arbitrators by the irrevocable  
by the players. But arbitration  
enforcible by the players' de-  
providing the referee with the  
o him something complementary  
urn, they must be able to trust  
omise from him. But in any case  
ns for enforcing promises: two  
ner may find a third person that  
the stakes.<sup>20</sup>

where no strong tradition of business  
tors for a business may deliberately be  
ple honesty and fairness are considered

## COMMUNICATION AND

Many interesting game tactics, the structure of communication, communication and unilateral options destroy it. Threats are no good to the persons for whom they are means of conveying the alternative to the threat, "Stop crying or I'll go" is ineffectual if the child is already sometimes appears that children intimidated into giving false testimony prevents his getting instructions might infer the sanction of the threat.

When the outcome depends on the structure of communication may be man and his wife are arguing about for dinner, the argument is won or loses where she is going and is often preserved by a person who threatens, even to the extent of simply

As discussed in the earlier part depends on communication in a the authorities to obstruct mob three or more to congregate. But the authorities if they are able to communicate with them. Even a tacit or violence may be communicated to police, if the police are known to reside among them when the use of outsiders may forestall against the authorities, partly by the difficulty of tacit communication. Several troops in Little Rock may be intimidation just by being outside

---

to be common traits or where a reputation of higher value.

## OF GAME THEORY

### AND ITS DESTRUCTION

s and game situations depend on particularly asymmetries in costs to initiate communication or to act if they cannot be communicated as intended; extortion requires a threat to the intended victim. Even if you give you something to cry about," you are already crying too loud to hear it. (It is well known this.) A witness cannot be taken on testimony if he is in custody that he cannot say on what to say, even though he is under threat itself.

Coordination, the timely decision to be a winning tactic. When a person calls a telephone over where to meet a person by the wife if she simply answers and hangs up. And the status quo is maintained who evades discussion of alternatives by turning off his hearing aid.

In the context of this chapter, mob action often works in a way that makes it possible for a person to act by forbidding groups of people. Mobs can themselves intimidate people to identify them and to commit a crime under threat of subsequent ostracism from a riotous mob to the local community. They are persons who have no power once the occasion is over. In that case the effectiveness of the mob's intimidating threats is reduced by reducing the subsequent occasion for their action but partly also through the interaction between mob and police. Federal agents have enjoyed some immunity to the tacit communication structure. This immunity for them is considered of much

ture of the local populace and be the local value system than we were dramatically successful in 1943, when the local police were Sikhs, and other foreign-languages may owe some of its success to threats and promises that the enemy seek to convey. Even the isolation of military service may tend to making and perceiving threats, hence threatened, and thus deterring.

It is important, of course, when that his threat cannot be received cannot, he may make the threat obliged to carry out his threat to both himself and the one threatened the riot should not only be strategically sufficiently to avoid "acquaintance" the mob; they should behave with that no messages are getting through eye; they must not blush at the cannot tell one rioter from another himself conspicuous. Figurative wear masks; even the uniform of identification and so itself make cult.

*Conveyance of evidence.* "Communication" the transmission of messages. To to communicate the commitment with a promise; and to communicate more than communication of *evidence* that the commitment exists communicate a threat only if he something with his own eyes or authenticate certain allegations. Communication, but one cannot demonstrate bears an authentic signature; on

being patently less conversant with  
ere the local police. State troops  
quelling the Detroit race riot of  
re ineffectual. The use of Moors,  
ge troops against local uprising  
their poor capacity to receive the  
emies or victims might otherwise  
on of officers from enlisted men in  
ke officers less capable of receiv-  
e less capable of being effectively  
intimidating threats themselves.  
ether or not the threatener knows  
ed; for if he thinks it can, and it  
t and fail in his objective, being  
o the subsequent disadvantage of  
ened. So the soldiers in quelling  
ngers and not only keep moving  
nce" with particular portions of  
th an impassivity to demonstrate  
rough. They must catch no one's  
e jeers; they must act as if they  
ner, even if one has been making  
ly, if not literally, they should  
contributes to the suppression of  
s reciprocal communication diffi-

communication" refers to more than  
o communicate a threat, one has  
t that goes with it, and similarly  
nunicate a commitment requires  
words. One has to communicate  
exists; this may mean that one can  
e can make the other person see  
r if he can find a device to au-  
One can send a signed check by  
e over the telephone that a check  
e may show that he has a loaded

gun but not prove it by simply point of view, the Paris *pneum* telegraph system, and television of a mediator may be to authenticate players make to each other; identification might make it possible orally by telephone, the recipient code response that it is in fact the line assuring him that the payer that the transaction is complete. The ability of communicating evidence Eisenhower's "open-skies" proposal for dealing with the instability of local fear of surprise attack. Let us paradox that one might wish to do rather than subject them to proof only means by which the enemy of the important truth that we are barking on a surprise attack.<sup>21</sup>

It is interesting to observe that depends on a game structure in which evidence is impossible. What is the the voter of his power to sell his but the *mandatory* secrecy, that only *may* vote in secret, but he *must* be denied any means of proof what he is robbed of is not just is stripped of his power to be in to meet the demands of blackmail violence that he can be threatened gain away his vote, since the threat out anyway if it is frightening enough the voter is powerless to prove that both he and those who would threaten would be unrelated to the threat, being useless, goes idle.

<sup>21</sup> L. Szilard, "Disarmament and the Atomic Scientists, 2:297-307 (October, 1945)

## OF GAME THEORY

saying so. From a game-theory *attaque* differs from an ordinary one. It differs from radio. (One role is to authenticate the statements that the sender makes. For example, a code system for money is possible for people to transmit funds. The sender is not being assured by the bank's statements, but the bank at the other end of the line knows that the money has been identified by code and amount.) The importance and the difficulty of this problem is exemplified by President Truman's proposal and other suggested devices for the prevention of what may be caused by the recipient. Szilard has even pointed to the possibility of conferring immunity on foreign spies to avoid prosecution, since they may be the only ones who can obtain persuasive evidence of their guilt. Making no preparations for em-

ploying political democracy itself depends on the secrecy which the communication of evidence requires. It is not a secret ballot but a device to rob the voter of his vote? It is not alone the secrecy, but the threat that robs him of his power. He not only loses his vote, but *must* if the system is to work. He is forced to reveal which way he voted. And this is not only an asset that he might sell; he is also intimidated. He is made impotent by the threat of mail. There may be no limit to the amount of violence with which he is threatened if he is truly free to barter. Unthreatened violence is not carried far enough to persuade him. But when the threat is that he complied with the threat, the threateners know that any punishment will be in vain, no matter how severe. In any way he actually voted. And the

of the "The Problem of Peace," *Bulletin of the American Mathematical Society* (1955).

An interesting case of tacit agreement is that of a motorist in a busy street. If a policeman is directing traffic. If the motorist sees, the policeman's directions are unambiguous; and the policeman has no intention to give the man a ticket. If the motorist does not see the policeman, cannot see the directions that he does not see, taking advantage of this, he may be considered to have tacitly agreed to do so. If he has little incentive and no obligation to do so. Alternatively, if it is evident that the motorist has seen the directions were and disobeyed them, it is to his advantage not to have seen the directions. The reputation of the corps, to avoid the hail the driver down to give him a ticket, avoiding the receipt of a warning. If the motorist perceives it the policeman's compliance; adults are equally skilled in such a situation they suspect would be denied a sterner sanction, obliging the motorist to the observance of the transgression.<sup>22</sup>

The efficacy of the communication is based on kinds of rationality that are implied by the game situation. "The minimum requirement is that the driver must not be caught tail." The minimum requirement is that the driver must not be caught tail.

<sup>22</sup> What might be called the "legal" game is developed by Goffman: "Tact in regard to tacit agreement to do business is based on a language of innuendo, ambiguities, winks, and so on. The rule regarding this uncertainty is that the sender ought not to act as if he had been hinted at, while the recipients have to act as if they have not officially received the message. This communication, then, is deniable communication. It is participation that can occur in spoken language and others unbeknown to them; he can overrule the case and when they choose either to act or to signal to him informally that they have tacitly points out that the obligation to respect the rule that one has inadvertently overheard. If the sender has acquired "ratification" (pp. 224, 225).



and asymmetrical communication at a street intersection who knows that a policeman is looking at the motorist sees, and evidently notices, and ignores them, he is insubordinating both an incentive and an obligation. If the motorist avoids looking at the policeman's directions, and ignores the directions, he is not getting a right of way that he does not deserve. He is only stupid by the policeman, who has the obligation to give the man a ticket. It is not that the driver knew what the policeman was doing to them, it is to the policeman's advantage to give the driver a ticket, otherwise he is obliged, for the sake of his pressing business and the law, to give a ticket. Children are skilled at avoiding a glance from a parent, knowing that the parent is obliged to punish noncompliance. They are skilled at not requesting the permission, knowing that explicit denial is not a denial, and denying authorities to take cog-

nitent action. The communication structure can depend on the obligations and rights imputed to the players. This is illustrated by the well-known as "having a bear by the tail." The strategy for an efficient outcome is that

the "status" of communication is nicely defined. The policeman's face-work often relies for its operativeness through the language of hint — the well-placed pauses, carefully worded jokes, and the official kind of communication is that the policeman has officially conveyed the message he has the right and the obligation to act as if the message contained in the hint. Hinted communication." He refers to the "unratified" interaction: "A person may overhear or overhear them when they know this to be so and act as if he were not overhearing them when they know he is overhearing them." He refers, for example, to an insulting remark which may depend on whether the overhearing is (226).

the bear be able to incur an entanglement, or be able to transmit credible evidence of a penalty incurred or by a maneuver to comply (like extracting his own). The bear is of limited rationality, has a limited set of rational and consistent choices among those he perceives but lacking the capacity to determine introspectively what he would make — the communication must then be possible for him to receive a message and must then formulate the proposition to communicate it to him, in order to be able to comply by accepting the promise (now to be made) and transmitting authoritative information to his partner.

#### INCORPORATION OF MOVES

One is led to suppose that, if a game is analyzed in terms of threats, commitments, and promises, a formal analysis, it must be possible to expand the traditional form of strategy to include these moves of the original game expanded to include these various moves.

The first point to observe is that a threat can usually be characterized in the following: to make one of the moves available reduces — visibly and irreversibly — the matrix. This is what the move means. To say that one openly selects a strategy is to say that one openly selects a strategy to the other's choice; but more importantly, the player must invoke penalty on himself if he does not frequently the particular strategy of choice beforehand. And to invoke a penalty on oneself is mathematically equivalent to

<sup>23</sup> Daniel Ellsberg, some of whose work is mentioned in the lectures mentioned in Chapter 1, has a formulation of the threat or commitment to invoke a penalty on some of one's own payoffs in the strategy

## OF GAME THEORY

forcible promise and that he be  
e that he is committed, either by  
ver that destroys his power not  
own teeth and claws). But if the  
ving a capacity for making ra-  
ong the alternatives that he per-  
o solve games — that is, lacking  
ectively the choices that a part-  
ation system must make it pos-  
e from his partner. The partner  
ition (choice) for the bear and  
that the bear may then respond  
that he sees what the “solution”  
ive evidence back to his own

## ES IN A GAME MATRIX

a game has potential moves like  
mises that are susceptible of  
ible to represent such moves in  
choices, with the payoff matrix  
to allow for the choices among

at a commitment, a promise, or  
rized in a fashion equivalent to  
hese moves, a player selectively  
y — some of *his own* payoffs in  
ve amounts to.<sup>23</sup> We could also  
ategy in advance for responding  
than selection is required. The  
is own failure to pursue subse-  
f response that he has selected  
alty on failure to follow a strat-  
t to subtracting the amount of

k in the field of strategy was contained  
independently arrived at precisely this  
nt, namely, as a selective reduction of  
matrix.

the penalty from one's own payoff correspond to the strategy so selected.<sup>24</sup>

Specifically, in Fig. 15 A, Row subtracting from his own payoff large quantities — 5 in the example

		A															
		I	II														
i	<table style="border-collapse: collapse; width: 100%;"> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">2</td> <td style="padding: 5px; text-align: center;">5</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">0</td> <td style="padding: 5px; text-align: center;">1</td> </tr> </table>	2	5	0	1	<table style="border-collapse: collapse; width: 100%;"> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">1</td> <td style="padding: 5px; text-align: center;">0</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">5</td> <td style="padding: 5px; text-align: center;">2</td> </tr> </table>	1	0	5	2	i	<table style="border-collapse: collapse; width: 100%;"> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">-3</td> <td style="padding: 5px; text-align: center;">5</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">0</td> <td style="padding: 5px; text-align: center;">1</td> </tr> </table>	-3	5	0	1	ii
2	5																
0	1																
1	0																
5	2																
-3	5																
0	1																

FIG.

nant strategy, that is, a strategy which column the other player selects. The modified matrix shown in Fig. 15 B

<sup>24</sup> Threats, promises, and unconditional commitments are all special cases of the more general "reaction function" concept. If Row can attach adequate penalties to his own strategy other than those starred, he leaves Column no choice but to choose the strategy which Column solves by choosing his own favorite cell; specifically, he has secured a "commitment" among those that leave Column no lower payoff than the generalization of the tactic that, for Row, can be identified as a "commitment," "threat," or "promise." (Further generalization would be introduced in Chapter 7.)

		I	II	III												
i	<table style="border-collapse: collapse; width: 100%;"> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">1</td> <td style="padding: 5px; text-align: center;">6</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">8</td> <td style="padding: 5px; text-align: center;">9</td> </tr> </table>	1	6	8	9	<table style="border-collapse: collapse; width: 100%;"> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">11</td> <td style="padding: 5px; text-align: center;">10</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">12</td> <td style="padding: 5px; text-align: center;">4</td> </tr> </table>	11	10	12	4	<table style="border-collapse: collapse; width: 100%;"> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">10</td> <td style="padding: 5px; text-align: center;">10</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">25</td> <td style="padding: 5px; text-align: center;">25</td> </tr> </table>	10	10	25	25	i
1	6															
8	9															
11	10															
12	4															
10	10															
25	25															
ii	<table style="border-collapse: collapse; width: 100%;"> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">9</td> <td style="padding: 5px; text-align: center;">20</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">9</td> <td style="padding: 5px; text-align: center;">2</td> </tr> </table>	9	20	9	2	<table style="border-collapse: collapse; width: 100%;"> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">15</td> <td style="padding: 5px; text-align: center;">15</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">2</td> <td style="padding: 5px; text-align: center;">10</td> </tr> </table>	15	15	2	10	<table style="border-collapse: collapse; width: 100%;"> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">16</td> <td style="padding: 5px; text-align: center;">16</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">7</td> <td style="padding: 5px; text-align: center;">7</td> </tr> </table>	16	16	7	7	ii
9	20															
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15	15															
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16	16															
7	7															
iii	<table style="border-collapse: collapse; width: 100%;"> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">2</td> <td style="padding: 5px; text-align: center;">2</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">6</td> <td style="padding: 5px; text-align: center;">*</td> </tr> </table>	2	2	6	*	<table style="border-collapse: collapse; width: 100%;"> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">10</td> <td style="padding: 5px; text-align: center;">10</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">8</td> <td style="padding: 5px; text-align: center;">*</td> </tr> </table>	10	10	8	*	<table style="border-collapse: collapse; width: 100%;"> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">10</td> <td style="padding: 5px; text-align: center;">10</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">7</td> <td style="padding: 5px; text-align: center;">7</td> </tr> </table>	10	10	7	7	iii
2	2															
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iv	<table style="border-collapse: collapse; width: 100%;"> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">6</td> <td style="padding: 5px; text-align: center;">*</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">8</td> <td style="padding: 5px; text-align: center;">*</td> </tr> </table>	6	*	8	*	<table style="border-collapse: collapse; width: 100%;"> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">8</td> <td style="padding: 5px; text-align: center;">*</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">8</td> <td style="padding: 5px; text-align: center;">*</td> </tr> </table>	8	*	8	*	<table style="border-collapse: collapse; width: 100%;"> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">7</td> <td style="padding: 5px; text-align: center;">7</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px; text-align: center;">7</td> <td style="padding: 5px; text-align: center;">7</td> </tr> </table>	7	7	7	7	iv
6	*															
8	*															
8	*															
8	*															
7	7															
7	7															

ffs in all cells that do not corre-

would commit himself to ii by  
ffs in the first row sufficiently  
ble shown — to make ii a domi-

B		C	
II		I	II
-4	0	2	5
5	2	-5	1

15

that he would follow no matter  
elects. The result would be the  
5 B. (Committing himself to i

l commitments have already been illus-  
on" is illustrated in the accompanying  
alties to his own selection of any cells  
column a simple maximization problem  
ird strategy. Row has "won" almost his  
ed for himself the most favorable cell  
ver than his "minimax" value. This is  
simple two-way or three-way choices,  
'threat," "promise," or combination of  
clude randomized strategies; these are

III	IV	V
2	9	7
0	1	15
6	1	17
7	4	3

with penalty of 5 would yield to now build up a larger matrix than choices of rows and columns in in Fig. 15 A, but also the strategy and so forth? Certainly, once available and the order in which simple game in which Row has visibly in advance, and Column game, that is, chooses his column choice of row.

Originally Row, having second able. He could pick  $i$  no matter what; he could play  $i$  to column could play  $ii$  to column I and possibility of commitment, he noting himself; and to each of the one of the four strategies just mentioned, for example, he can commit himself to  $i$  and play  $i$  to column I; he can commit himself to  $ii$  and play  $i$  to column I; he can commit himself to  $ii$  and play  $i$  to column II. Altogether, he has twelve possible strategies.

Column has eight possible strategies. In three contingencies he has either I and II, the contingencies being commitment to  $ii$ , and Row's not committing himself.

If we put these strategies into a  $12 \times 8$  matrix of Fig. 16 representing a game that corresponds to the play of the original game. The eight strategies of Column, for example, can be grouped into two distinct sets of complete instructions. The first set, which would then play the original game at which he chooses whether and how Row commits himself to either player in being supported tacitly, since what would have to do with the other's prior moves is now

## OF GAME THEORY

the matrix in Fig. 15 C.) Can we that represents not only the actual the original game, such as those of *commit*, *threaten*, *promise*, we have specified what moves are h they are to be taken. Take the as the power to commit himself n has first move in the *original* mn before Row makes his *final*

d move, had four strategies avail- what; he could pick ii no matter mn I and ii to column II; or he d i to column II. Including the ow has *first* the choice of commit- ese first choices he can attach any mentioned for his final move. For to ii and play ii no matter what; d play i no matter what; he can to column I, ii to column II; or d play ii to column I, i to column possible strategy combinations.

strategy combinations: for each of er of two moves, the moves being ng Row's commitment to i, Row's oncommitment.

o matrix form, we get Fig. 16. The ents the tacit ("noncooperative") ayers' private decisions on *how to* ht possible strategies available to thought of as the eight possible *tions* that he might give an agent nal game for him — that is, play one of two columns, depending on ted himself first. There is no loss osed to play this enlarged game e been each player's *adaptations* y fully allowed for in the specifica-

## STRATEGI

		I	II	III
		0-I 1-I 2-I	0-I 1-I 2-II	0-I 1-II 2-I
i	0; I-i, II-i	2 5	2 5	2 5
ii	0; I-ii, II-ii	0 1	0 1	0 1
iii	0; I-i; II-ii	2 5	2 5	2 5
iv	0; I-ii, II-i	0 1	0 1	0 1
v	1; I-i, II-i	2 5	2 5	1 0
vi	1; I-ii, II-ii	-5 1	-5 1	0 2
vii	1; I-i, II-ii	2 5	2 5	0 2
viii	1; I-ii, II-i	-5 1	-5 1	1 0
ix	2; I-i, II-i	-3 5	-4 0	-3 5
x	2; I-ii, II-ii	0 1	5 *2	0 1
xi	2; I-i, II-ii	-3 5	5 2	-3 5
xii	2; I-ii, II-i	0 1	-4 0	0 1

FIG.

tion of strategies in the enlarged  
strategies of response or adaptatio

This is brought out in the  
Column's choices in the original  
and II; Row's choices, i and ii  
will denote Row's commitment to



IV	V	VI	VII	VIII
0-I 1-II 2-II	0-II 1-I 2-I	0-II 1-I 2-II	0-II 1-II 2-I	0-II 1-II 2-II
2 5	1 0	1 0	1 0	1 0
0 1	5 2	5 2	5 2	5 2
2 5	5 2	5 2	5 2	5 2
0 1	1 0	1 0	1 0	1 0
1 0	2 5	2 5	1 0	1 0
0 2	-5 1	-5 1	0 2	0 2
0 2	2 5	2 5	0 2	0 2
1 0	-5 1	-5 1	1 0	1 0
-4 0	-3 5	-4 0	-3 5	-4 0
5 *2	0 1	5 *2	0 1	5 *2
5 2	-3 5	5 2	-3 5	5 2
-4 0	0 1	-4 0	0 1	-4 0

16

l version of the game; they are on.

labeling of Fig. 16. As before, l two-move game are labeled I i. Additionally, the symbol "2" row ii, "I" a commitment to row

i, and "o" a decision not to commit to a single "strategy" for Column. The symbols, such as o-I, 1-II, 2-column I if he does not commit himself to row 1, and column 2." For Row, a strategy consists of a pair of symbols denoting how to choose between possible choices. For example, 1-1 means to row 1, then choose row 1. Knowing the payoffs in the original game, we can identify the payoffs in the enlarged game. We imagine Row and Column, instead of playing the game, sending their agents to play the game, instructed for all contingencies (the strategy for the enlarged game). In this case, to give, Row and Column consider the game. In effect, they play the tacit game. The agents just the role of messengers.

What is the "solution" of this game? Can we identify an evident solution? If so, how does it show up in the original game? The game clearly has a solution for Row committed to row 1, with a permitment, Column can see that the best choice is which column he chooses; Column chooses the upper row, which is the upper row. That is, that, if he commits himself to row 1, Column chooses the upper-left cell, which is 2. (B) If Row commits to row ii (subtracts 5 from his payoff), Column chooses II in preference to I; and Row chooses I. If Row remains uncommitted, Column chooses the highest row payoff in the enlarged game. If Column chooses I, Row takes 1, and Column gets 1. If Row takes ii, and Column gets 2. If Row takes I, Row a payoff of 2; and Row can choose to commit himself to row 1. The "solution" is to commit himself to row 1; it has a payoff of  $[5 \ 2]$ , a payoff of 2; I-ii, II-ii for Row, and to a

## OF GAME THEORY

mit himself. In the enlarged game, is now denoted by three pairs of I, which would mean, "Choose it himself, column II if he com- n I if he commits himself to row s of a decision on 0, 1, or 2, plus he will react to each of Column's ; I-i, II-i would mean, "Commit no matter what Column does." inal game, Fig. 15 A, the players enlarged game of Fig. 16. We can ad of meeting to play the original play for them, each agent fully s (that is, given one particular . To determine what instructions der the matrix in Fig. 16; in ef- in that matrix, leaving to their er.

enlarged tacit game? Or, rather, tion to the original game? And, he enlarged matrix? The original rational players. (A) If Row is nalty of 5 for breaking his com- row i will be chosen, no matter umn chooses his preferred cell in per left cell, i,I. And Row knows row i, he gets the payoff in that If, instead, Row commits himself payoff in row i), Column chooses knows he will get 5. Finally, (C) column knows that Row will pick column chosen; thus if Column umn gets 5; if Column takes II, 2. Column prefers I; this leaves a anticipate it. So Row's best out- ow ii. This is the evident "solu- nd it corresponds to the strategy ll four strategies containing 2-II

for Column. (What Column would do if Row chooses 0 and 1 is of no material consequence for Row's first move.) These are the starting points for Row's first move. (What effect, Row's first move is a choice between three different two-move games, in which he has second move.)

How do we characterize the solution? We can represent the "solution" in Fig. 15 A as a strategy of the kind that has been called a *maximin* sense.<sup>25</sup> It can be arrived at, with the enlarged matrix, by a process of eliminating dominated strategies. A row is dominated by another row if to Row in the dominating row is a higher corresponding payoff in the dominated row. Applying this criterion, the first, second, third, and we strike it out. (The fourth can safely eliminate the strategy because since the third is at least as good as the fourth in some.) So is the second, so is the first, except the tenth. Neither the third nor the fourth, so for the moment we are left with columns, no single column dominates all rows but the third and the fourth. Row would not choose them and we are left with a comparison between only the third and the fourth. Now it is apparent that the second, third, the fifth, and the seventh, eighth, and ninth columns that are dominated in the matrix are again at rows iii and x. Originally the first, but, with the first, third, fifth, seventh, eighth, and tenth row dominates the third. Still left with a single row, row x, in which the payoffs are the same in the four columns. It is inconsequential which of those is chosen, as long as Row plays the tenth row. If Column committed himself to the second row, the solution in Fig. 15 A, as Column can expect

<sup>25</sup> Compare Luce and Raiffa, pp. 106-09.

ould have done in contingencies  
 quence, once Row has made his  
 ed cells in Fig. 16, row x. (In  
 ice of which to play among the  
 A, B, and C, shown in Fig. 15,

ells, or pairs of strategies, that  
 16? They constitute a solution  
 a *solution in the complete weak*  
 within the framework of the en-  
 scarding "dominated" rows and  
 by another row if every payoff  
 s at least as good as the corre-  
 d row and at least one payoff is  
 e first row is dominated by the  
 e argument might be that Row  
 y represented in the first row,  
 in every contingency and better  
 the fourth; so are all the rest  
 rd nor the tenth row dominates  
 ve keep them both. Comparing  
 ates another; but, having elim-  
 d tenth (arguing, perhaps, that  
 nyway), Column can make his  
 d and tenth cells in the columns.  
 ond column dominates the first,  
 th. After striking out those col-  
 e reduced set of rows, we can look  
 y, neither dominated the other;  
 and seventh *columns* gone, the  
 riking out the third row, we are  
 intersected by four columns. The  
 intersections, indicating that it  
 e four strategies Column plays,  
 row. (That is, once Row has  
 ow of the original  $2 \times 2$  matrix,  
 t him to do, it makes no differ-

ence what instructions Column  
two contingencies that did not a

This, then, is the way that a *move game* shows up in the sta  
(tacit-choice) game. It is a solut  
nated strategies, with the criteri  
the undiscarded strategies at e  
general form of solution in the  
sponds to a sequential-move ga  
minate solution. The discarding  
be identified with the process o  
*move* for all possible sets of p  
last move would follow each m  
best next-to-last move for all p  
on back to the best first move o

While it is instructive and in  
such tactics as threats, commi  
sorbed into an enlarged, abstrac  
form"), it should be emphasize  
about those tactics by studying  
mal form. The objects of our stu  
with the communication and e  
depend on, and the timing of  
the time the game is in normal  
that systematizes the study of

<sup>20</sup> It is worth noting that the order in  
that are eligible for discard can affect  
cedure outlined in the text, we first dis  
we then observed that columns I, II,  
and discarded them; at that stage, row  
discarded; and we were left with ro  
yielded identical payoffs in that row.  
carded the four columns, that two m  
that stage, namely columns VI and  
Column, *in row iii*, than columns II a  
the process, row iii and columns VI  
but if we arbitrarily choose first to el  
columns, the two columns in questio  
sense, the contents of our "solution" o  
cedure; whether we are left with two  
four cells with identical payoffs, depen  
however, are the same in either case. T

## OF GAME THEORY

n gives his agent regarding the  
arise.)<sup>26</sup>

solution to the original *sequential-*  
tic ("moveless," or simultaneous-  
ion arrived at by discarding domi-  
ion for domination reflecting only  
each stage. This seems to be the  
e enlarged tacit game that corre-  
ame when the latter has a deter-  
of rows and columns can actually  
f first calculating the rational *last*  
prior moves, then, knowing what  
next-to-last move, calculating the  
ossible sets of prior moves and so  
of the game.

Intellectually satisfying to see how  
tments, and promises can be ab-  
ct "supergame" (game in "normal  
ed that we cannot learn anything  
g games that are already in nor-  
dy, namely, these tactics together  
enforcements structures that they  
moves, have all disappeared by  
form. What we want is a theory  
the various universal ingredients

n which we discard the rows and columns  
the form of the "solution." In the pro-  
discarded all rows but the third and tenth;  
I, V, and VII, were eligible for discard,  
iii was seen to be dominated, and it was  
ow x intersected by four columns that  
But we might have noted, as we dis-  
ore columns could also be discarded at  
VIII, which show inferior payoffs to  
nd IV. In other words, at that point in  
and VIII were all eligible for discard;  
eliminate row iii and *then* proceed to the  
n are no longer dominated. Thus, in a  
depend on an arbitrary choice of proce-  
cells with identical payoffs, however, or  
ds on that arbitrary choice. The payoffs,  
the rationale might be that at some stage

that make up the move-structure will miss them.<sup>27</sup>

The matrix representation of a phasize, however, that the forms that are resolved by tactical moves essential game-of-strategy characterizes an outcome only because choose in one's favor. The other dom of choice; and his choice st of the threatener's final choice. to threaten or not — thus depends

---

Column sees that he needn't reason any mined choice that makes it inconsequen his decision, but that the exact point at umns are left uneliminated when he does which of several alternative routes he pu were communication costs in narrowing prefer to choose strategy 2-II only, le correspond to Row's strategy 0 or 1. If, that Row's strategy will be erroneously telligently chosen, Column reduces his r latter case he, in effect, treats row iii domination by row x. And if, to take th referee has a tendency to hear "row v" he may further narrow his choice to 0- intersection of row x and Column II, inferior to that of v and II and gives h of his choice. In general, by attaching r ential costs of different ways to specif is formed, and one that can lead to differ in Chapters 7 and 9, involving certain misinformation, can produce this kind of

<sup>27</sup> Incidentally, casting a particular gam erally not a feasible technique of analy (that is, the number of sequential-mo large, even for quite simple games. To il Column to choose first; add a prior op to any partially or fully specified strat "defense" against threats, allow Column his choice of column. That is, Column m if he pleases, Row may then commit his pleases, then Column chooses a column not complicate the game by limiting siz certainty or imperfect communication s not terribly difficult to analyze in its ex than a "googol" (1 followed by a hundre



of games; too abstract a model

sequential game does help emphasize "determinateness" of games. This does not detract from their character. A threat "wins" and depends on what it induces the other player to do. The other player retains his original freedom of choice, but his choice still depends on his anticipation of the other player's choice. The threatener's first choice — depends on what he expects the threat-

to be, and whether Column further narrows his choice, which he perceives this, and what Column perceives it, depends to some extent on the choices he makes in his reasoning process. (If there is a choice of strategy, Column might choose a strategy, leaving unspecified what choice would be made if he were to take a contrary case, there are risks of error not recorded or communicated, or uncommunicated risks by specifying 0-I as well. In the case of a threat, as not wholly unlikely in spite of its character, he suspects that the other player will choose other rows are actually chosen, 0-I, 1-I, 2-II, the "solution" being the intersection of v and IV is the best choice since the intersection of v and IV is the best choice. This is grounds for this further refinement of the model. Risks of error of various sort, or different choices of strategy, a rather richer problem leads to different conclusions. The problems treated in this section are forms of random behavior, error, or uncertainty.)

When a game is put into supergame matrix form is generalization; the number of rows and columns (representing strategies) becomes astronomically large. To illustrate, consider a  $3 \times 3$  matrix, with an opportunity for Row to commit himself to a strategy of response; finally, to study the game, a still earlier opportunity to commit himself to a strategy may first commit himself unconditionally to a strategy and finally Row chooses a row. Let us use the system of penalties or by inserting any unsatisfactory system. This "simple" game, which is in extensive form, turns out to have more than one (or more zeros) of columns.

ened player to expect the threat of a change in the character of the game resulting from a conditional commitment or like "strategic function" when many choices are available, thus constraining another player's evaluation of one's own incentives.

#### THE PARADOX OF S

It is, of course, a corollary principle that a player who begins with had already shown a weakness reduced in the same pattern as a player who deliberately at the winning move chooses not to make the move overtly. (This paradox, in dramatic form, was illustrated in the preceding section and referred to as an abstract paradox of bargaining, weakness may be a result of a single principle of game theory applied to the mixed-motive game as though it were some or even all of the potentialities of a game and an improvement in none of them. It is dramatically — advantageous for a player to explain why a sufficiently severe threat of blackmail can protect the player from the burning of bridges behind one's self. It can hearten an enemy and induce a player to fight, in an earlier era, defy the odds of achieving the sought object in her battle.)

<sup>28</sup> It also explains why a "promise" to not damage the other player may not be a threat to him safely to make a particular choice. It is so that we can count on it and make a strategic move. By the same token, *adding* value to a player's position absolutely worsen his position — if we assume that. In the accompanying matrix, assuming that Row can gain 7 at Column's expense — if Column chooses Column in the event of an outcome of 7 at his own winnings. If he promises to pay 8; Column gets 3; otherwise, without a promise, choose i, and the outcome is at ii, I will choose Column obviously prefers that Row be

## N OF GAME THEORY

tener to do. The reciprocal-expecta-  
mains; the threat, like the uncon-  
the broader concept of "reaction  
of action are available, works by  
expectations through the manipula-

## STRATEGIC ADVANTAGE

principle that if the payoff matrix  
own values for one of the players  
that in which he would reduce it  
ove, he simply wins without need-  
(This is the point that, in diagram-  
the final paragraph of Chapter 2,  
example of the principle that, in  
strength.) There is probably no  
ry that epitomizes so strikingly  
is principle that a worsening of  
al outcomes for a particular player  
of them may be distinctly — even  
or the player so disadvantaged. It  
re and certain penalty on the *pay-*  
he potential victim, how the burn-  
f while facing an enemy may dis-  
e his retirement, or why a lady  
e search party by haughtily plac-  
osom.<sup>28</sup>

" to abstain from a choice that would  
welcomed by him. A promise that *permits*  
e may assure us that he *would* make it,  
some prior choice that is to his disadvan-  
ues selectively to the other's payoffs can  
e have a means of making the addition.  
; Row has first move, Row can "win" —  
he unilaterally guarantees to compensate  
at i,II, the compensation coming out of  
ay 2 to Column in such an event, he gets  
the promised compensation, Row cannot  
th payoffs of 1 and 10, respectively. Col-  
unable to commit himself to confer the

It was reported unofficially during the Treasury Department blocked assets, it also knowingly blocked a means of immunizing the owners against their relatives still in China. Located in the United States, the verbiage to Communist China enhanced the. Deliberately putting one's own assets of the law more difficult, or lobbying illegal transfer of one's own funds temporarily identified as a Communist funds would be blocked might for potential victims, to discourage advance.

A similar principle is reflected in the peace treaty, which gives the United States subsequent Japanese territorial concessions favorable. When the Japanese were freed from the Russians for additional territory, Secretary of State John Foster Dulles' article of the treaty in his press conference had recently "reminded the Japanese of the clause."<sup>29</sup> The evident intention was to provide assistance; and it may be supposed that the Russians of the same clause through the conference, Dulles helped to provide a bargaining claim, "If I did it for

"benefit." (If the blackmailer cannot scale his demands, plus the fine for paying blackmailers, he may offer to pay his victim's fine in response to the threat will be; so the threat will be a benefit to the victim.)

0	2	10	1
1	10	2	0

becor

<sup>29</sup> Transcript of the Remarks by Secretary of State Dulles at the Press Conference, *The New York Times* (August 29, 1945).

ing the Korean War that when Communist Chinese financial some non-Communist assets as ers against extortionate threats na. Quite likely, for owners lo- y penalties on transfer of funds eir capacity to resist extortion. ets in a form that made evasion ing for more severe penalties on ds, or even getting one's self unist sympathizer so that his have been an indicated tactic age the extortionate threat in

in Article 26 of the Japanese ted States certain claims if sub- ssions to other powers are more e reported to be under pressure territorial concessions in 1956, Dulles pointedly described that s conference and said that he anese of the existence of that was to strengthen Japanese re- l that by "reminding" the Rus- a the medium of his press con- the Japanese with the familiar you, I'd have to do it for every-

e down his demands to where what he ail, are less than the damage he threat- inc. This guarantees what his victim's eat is made, to the disadvantage of the

mes

0	2	8	3
1	10	2	0

tary of State Dulles at His News Con- (1956), p. 4.

one else." It was, in terms used by the penalty of a forfeit to the United States could not give bargaining gimmick unless the vated to take advantage of its

#### "STRATEGIC"

If the essence of a game of strategy is a person's proper choice of action to do, it may be useful to define a strategic move is one that influences in a manner favorable to one's person's expectations on how one's the partner's choice by constraining the object is to set up for one's self to the other player a mode of responses to the other's behavior as a maximization problem whose solution is for one's self, and to destroy the

There is probably no contrast between of the mixed-motive and the pure the significance of having one's position appreciated by the opponent. However of the zero-sum game quite so "being found out" and of employing proof against deductive anticipation anything epitomizes strategic behavior so much as the advantage of behavior that the other party will

<sup>30</sup> That one's position can be painfully suggested by one of the arguments granting hopeless incurables the right . . . would be the effect on old people suspicious that those around them were "The Patient's Right to Live — and August 9, 1959, pp. 14, 21-22.)

<sup>31</sup> Concerning this point, Von Neumann have placed considerations concerning out by the opponent into an absolute

## OF GAME THEORY

earlier, a "commitment" secured the United States. (Paradoxically, were the Japanese the benefit of this United States were patently motivated to claim if the tactic failed.)<sup>30</sup>

### STRATEGIC MOVES"

strategy is the dependence of each on what he expects the other to do. A "strategic move" as follows: A move influences the other person's choice, and influences self, by affecting the other person's self will behave. One constrains one's own behavior. The self and communicate persuasively of behavior (including conditional behavior) that leaves the other a simple choice. A solution for him is the optimum given the other's ability to do the same. It is more striking, in the comparison of a non-conflict (zero-sum) game, than one's own strategy found out and applied. Hardly anything captures the spirit of a move as much as the importance of "not allowing a mode of decision that is influenced by the other player."<sup>31</sup> Hardly a move in the mixed-motive game is being able to adopt a mode of behavior that is taken for granted.

weakened by new legal powers is poignant arguments raised against legalizing euthanasia, to authorize their own removal: "What about incurable infirmities who are already dying? What about those who want to get rid of them?" (John Beavan, "Let Them Die," *The New York Times Magazine*,

Shapley and Morgenstern say (p. 147): "We must guard against the danger of having one's strategy found out and taken for granted."

It can, of course, be an advantage to have the opponent believe firmly in one's self, but only if that belief is a motive game, one is interested in one's own behavior — if, indeed, he has his own behavior along lines that, with

Another paradox of mixed-motives games can be an advantage to a threat taken into account by an opponent either in the coordination problem or a threat, has no counterpart in zero-sum game between rational players. It can never be an advantage to make a "game" in the language of von Neumann and Morgenstern in a mixed game it certainly can.



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belief is in error. In the mixed-  
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mann and Morgenstern); in the

## GAME THEORY EXPERIMENT

The foregoing discussion suggests the methodology appropriate to the study of such phenomena. One is that the mathematical formalism should not be permitted to dominate the analysis. A somewhat more general, but equally important, is that the abstractness of the model should be changed: we change the characteristics of the game by altering the amount of communication when we eliminate such complications as the uncertainty about each other's intentions. A textual detail that can guide the analysis is that the game is stable or, at least, mutually non-cooperative. In an earlier example, the ability to get off at the same station may depend on the problem other than its focus on the train or something common to the background, or something that the speaker when the train stops; and the ability to derive scientific generalizations from the data. In the need for coordination, we have a set of things that determine the outcome of the game. The analysis may treat as irrelevant the details of the game.

A third conclusion, which is that the facilities for communication are not sufficient, is inherent uncertainty about each other's intentions, and especially when the game is played by a sequence of moves or maneuvers. The study of mixed-motive

## THEORY AND EMPIRICAL RESEARCH

suggests several conclusions about the results of a study of bargaining games. The first is that the structure of the payoff function can dominate the analysis. A second one, however, is that there is a danger in too much emphasis on the character of the game when we drastically reduce the detail that it contains or reduce the motivating factors as the players' underlying value systems. It is often conceivable that the players, in the process of their search for a nondestructive outcome. In terms of the classic story of Holmes and Moriarty to get the best deal, they depend on the presence of something that provides a normal structure. It may be something that is in the station, something in their environment, something that they hear over the loudspeaker, and though it may be difficult to identify, they know about what it is that serves their interests. It is to recognize that the *kinds* of bargaining games are what a highly abstract analysis would suggest in detail.

This is particularly applicable whenever the players are short of perfect, where there are conflicting value systems or choices and an outcome must be reached. One of the lessons, however, is that some *essential* part of the analysis of bargaining games is necessarily empirical.

## GAME THEORY AND EXPERIMENT

This is not to say just that it is a task that people do not actually perform in mixed-motive situations: too complicated for intellectual analysis. It is to say that the principles relevant to the analysis are *epistemic* principles, the propositions of which are not derived by purely analytical means.

In a zero-sum game the analysis is based on a single center of consciousness, and the analysis is unilateral. There are two players, each with his own strategy. The analysis of a zero-sum game converts the situation into a set of mutually unilateral decisions. No space is required between the two players; no messages are exchanged; no hints have to be conveyed; no comparisons of standings have to be compared. No communication is required. But in the mixed-motive game, two centers of consciousness are dependent on each other. The analysis has to be communicated; at least some communication has to pass between the players. There is a social activity, however rudimentary. The players are dependent to some extent on social perception and interaction. The players are individuals, who play with each other, without even knowing each other. The analysis is a meeting of minds.

There is, consequently, no way to analyze the whole decision process either by a single method. There is no way to analyze the action of two or more decision units without the expectations of those decision units. The analysis is a deduction. An analyst can deduce the criteria of a mind if he knows the criteria that the mind cannot infer by purely formal analysis. The analysis of two centers of consciousness. It is not a deduction. (Two analysts can do it, but only with two subjects in an experiment.) *Take* the analysis is different from deciphering a formal code. It is a mathematical problem; it involves a social activity. It has been planted within a context.

an empirical question how people play in motive games, especially games of strategy and mastery. It is a stronger statement to say that *successful* play, the *strategy* of a *normative* theory, cannot be deduced from a priori considerations. The analyst is really dealing with only a single source of decision. True, the subject is his own consciousness; but the transition from one involving two essential sources of recognition needs to jump to a new level of recognition. Meeting of minds is required; no mere impressions, images, or understandings are sufficient. No social perception is involved. The transition from two or more centers of consciousness to one is in an essential way. Something like a spark of recognition must be present. It is generally a necessity for some explicit or tacit it may be; and both are of some degree on the success of their interaction. Even two completely isolated individuals, one in absolute silence and the other in absolute silence and without any knowledge of the other's identity, must tacitly reach

an understanding that an analyst can reproduce the subject's behavior introspectively or by an axiomatic method to build a model for the interaction. The analyst, with the behavior and experience of the subject being derived by purely formal methods, can analyze the decisions of a single rational individual that govern the decisions; but he cannot analyze what can pass between two individuals. It takes at least two people to test the hypothesis, but only by using themselves as the subject. *Giving a hint* is fundamentally different from formal communication or solving a puzzle. It is like discovering a message that is hidden in a text by someone who thinks he

shares with the recipient certain cannot, without empirical evidence can be perceived in a nonzero-sum than one can prove, by purely formal joke is bound to be funny.

To illustrate, consider the question of how two people, looking at the same ink blot, can reach a different conclusion in it if each is trying to do something better than to concert on the same picture. The question can be found only by doing something that no purely formal account; they can do *better* than would predict. And, if they can do so, the limitations of a purely formal, prescriptive, strategic theory are shown. We cannot build a prescriptive theory on the basis of intellectual processes that rationalize the kind involved in "taking a joke." Whether rational players, either individually or collectively, do better than a purely formal theory should consequently ignore the existence of such a theory.<sup>1</sup>

<sup>1</sup> A good laboratory example of the strategy is the experiment reported by Flood (1958) with a  $2 \times 2$  nonzero-sum matrix for which a property of the matrix is that the players can choose a particular cell on each play, but to win the game in sequence they must cooperate on some cells. The game has more cells that discriminate differently between the two means of negotiating over the distribution of the pattern of alternating play that achieves the best make as the play proceeds. This "cooperation" occurs when one player may depart from the pattern and have to be punished by a reprisal. Flood (1958) since an uncoordinated choice is a loss. Flood, "Some Experimental Games," (1958).

The question of how to communicate and interpret the other player's proposal is independent on some mutual perception of a recognized ability to complete a pattern — not unlike the process involved in



## GAME THEORY AND EX

Again it should be emphasized of consideration does not arise in such social interaction could not players simultaneously and that ers would have both motive and communication. But in a non-zero initial uncertainty over which a in fact efficient and any need for dation to get to an efficient out absent himself in self-defense from turn off his hearing aid to avoid hears, if complete radio silence is possible. Nor can he rationally delivered, since the other party open it and have acted accordingly.

At this point a question arises ramifies indefinitely over the whole or leads into a more limited area theory. Are there some general behavior in mixed-motive games experiment or observation and the sight into the universe of bargaining is not assured, there are certain research; and even if we cannot we may at least disprove empirically. It does appear that game theory is the experimental side.

Consider a game like the one movement of counters over a m

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gists mentioned in an earlier footnote. communication may derive certain minimum communication that rational players ought whether players can do better than the what kinds of hints are most successful reception, probably amenable to experiment if two men at an auction recognize that ding against each other and try, without to concert on some pattern of reciprocating that both saves them money joint opportunities between them.)



and that the reason why this kind of behavior in the zero-sum game is that any outcome cannot be to the advantage of both players. At least one of the rational players has the ability to destroy all social cooperation in a zero-sum game that involves any coordination. Among the possible outcomes are those that require coordinated mutual accommodation. If a rational player cannot cooperate with the social process; he cannot be constrained by what he does. If he makes efficient collaboration impossible, he will fail to open a letter, once it is known that he will have assumed that he will not open it.

It is not clear whether the game-theory trail leads to the whole domain of social psychology. Game theory is particularly congenial to game theory. Propositions about cooperative behavior that can be discovered by experiment that yield a widely applicable insight into human situations? Although successful experiments in some promising areas for the discovery of general propositions, especially some that are widely held. The field is badly underdeveloped from

the experiments described earlier, involving the ultimatum game, or the modified chess game

And, while a purely formal theory of the minimum standards of "efficiency" in cooperation is to be achieved, it is an empirical question as to how well one can take a hint and act. How well one can take a hint and act are empirical questions of social psychological study. (The same problem arises in the ultimatum game when they are jointly losing money by bidding and not giving any overt evidence of collusion, and alternating abstention from bidding and distributing the savings and the

that was made nonzero-sum. To play these games in "limited war"; both in avoiding mutually destructive moves and in which the ability of the two players to win may well depend on what *meanings* intentions are provided by the moves. Such things as a configuration of pieces, the names of the pieces, the tradition of the game, and the scenario or strategy instilled into the players before the start of a sufficiently complicated game to require a strategy and the successful conveyance of that strategy at the moment that the technical problem of the game of that type has been mastered. Consider what line of questions we might test.

One such question would be to test whether that the players are any more successful in a solution, that is, a mutually non-destructive or full or nearly full communication or virtually none is allowed to be conveyed by the moves themselves. The game is asymmetrical, with one party more able to receive them? There is no general applicable answer would emerge. General valid propositions about the possibility of keeping war limited will be discovered. The enormous amount of research attested by some of the current experiments on the possibility of keeping war limited without communication between both sides, and the possibility of moving ahead of time by one side, and the possibility of virtually no overt communication.

<sup>2</sup>To preclude any possible misunderstanding that limited war can be simulated in a laboratory, the results regarding the limiting process can be applied to the world. Experiments of the kind described here are "basic research." And it would be correct to say that the communicative side of the problem, not the technical side, is content that motivations affect social perceptions.

## OF GAME THEORY

These can be taken to represent players can gain by successfully strategies. Here is a game in players to avoid mutual destruction ns for successful coordination of incidental details of the game, by of the map or board, the suggested tion or precedent that goes with connotative background that is e the game begins. It is a suffi- uire perceptive play by both sides of intentions. If we suppose for a blem of constructing a playable astered, it is worth while to con- might try to investigate or what

this: by and large, does it appear successful in reaching an efficient ondestructive solution, when (a) on is allowed, (b) no communi- ved, other than what can be con- , or (c) communication is asym- able to send messages than he is aranty that a single, universally e; nevertheless, some quite gen- he role of communication might us significance of this question is controversies about whether the ed is greater if there is good com- or if there are unilateral declara- e or the other, or if there is vir- between the belligerents.<sup>2</sup>

Understanding: the writer is not suggesting the laboratory or that experimental re- n be directly transferred to the outside ived would come under the heading of acerned mainly with the perceptual and ot the motivational—except to the ex- ception. The probability that the results

## GAME THEORY AND EX

Another set of questions, also war, international or other, would an outcome is more likely when the names and interpretations of moves and pieces and objects are recognizable or when they are likely to inspire similar notions? Can we speak of the game in a particular way that rational players can keep a using conventional and atomic an unknown adversary on the subject of bacterial weapons? These are in the very center of game theory and cannot possibly be given a concrete evidence. And there is no arguing intellectual capacity to rise above and ignore them; the importance of the game is supremely helpful to both players that they may be dependent on the course of their mutual accord.

Is a stable, efficient outcome more likely of similar temperament and culture than of quite different players? Is a stable outcome more likely with two practiced players, two unpracticed players, or one practiced player; and in the latter case, which player?

In a game of this sort, how can we discover stable patterns of behavior, that if discovered early, will they be discovered in successful play more likely if the game is to begin with "tight" rules or loose rules, or resources, loosening them a little or if each player sets himself with a goal to avoid having to establish a pattern of play goes?

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of such research would find ready application in observation that much current theorizing about communication in limited war or the types of communication seems itself to be based only on what we know of mental games played introspectively.

pertinent to problems of limited  
 ld be whether a stable, efficient  
 he connotations of the game —  
 hat are overtly attached to the  
 n the board — are familiar and  
 quite novel, unfamiliar, and un-  
 in the two players. Is it — to  
 ar extensive form — more likely  
 e war limited in Southeast Asia,  
 weapons, or in a battle against  
 rface of the moon, using strange  
 nportant questions; they are at  
 y; and they are questions that  
 fident answer without empirical  
 g that rational players have the  
 ve these details of the game and  
 the details is that they can be  
 s and that rational players know  
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 mmodation.

more likely between two players  
 ural background or between two  
 ole, efficient solution more likely  
 o novices, or one novice and a  
 er pair, who has the advantage?  
 rucial are the opening moves? If  
 is, "rules of the game," are not  
 scovered at all? Is mutually suc-  
 eneral philosophy of each player  
 r highly "limited" weapons and  
 only as the occasion demands it,  
 der limits at the outset in order  
 ractice of loosening rules as he

plication, however, is enhanced by the  
 ing on, for instance, the role of com-  
 of limitations most likely to be observed  
 might be described as implicit experi-

How much influence on a game do players have, and what kinds of mediators can help or hinder the other two? Is it in the stake of his own in the outcome? Can he discriminate in favor of one of the two? What is the likelihood of a stable, efficient outcome?

It would be interesting in a laboratory setting if players score both themselves and the other at the same time on such matters as who is the more cooperative, and who is the more forceful and thinks the other thinks so. This is in a bilateral sense (it being recognition of each other's value system and its interpretation); of when the game is at a turning point, or when an "innovative" move is made, or when a particular move by one player is perceived as "retaliation" or a new initiative.

Because a "law of reprisal" is often observed in a "limited war" because the mutually recognized norms of "limited war" are essentially based on a system of values sociologically akin to *tradition* and custom, the use of casuistry and tradition is often observed in a laboratory setting (say, graduated atomic bombing of America while limited atomic bombing of grammar schools in England, or the introduction of racial violence, or the introduction of competition in a particular industry). This is an empirical part of game theory, and is similar to that of Muzafer Sherif. He has shown that for a laboratory judgment, they will often conform when norms are created for them. Each player's developing norm is a result of a process of genuine learning which adapts its own system of values to the situation. When the supply of available "options" is limited, yielding a complete set of rules, the game will terminate, norms of some sort will be perceived, and accepted; patterns

## OF GAME THEORY

me of this sort can a "mediator"ing roles are most effective? Doeso players if the mediator has a? To what extent can a mediatorthe two players and still increaseent outcome?

a game of this sort to have theand their partners from time toplaying the more aggressively orwhat "rules" each thinks are inis are in force; of who is "winning"ecalled that the substantial ignoem makes this always a matter ofme has reached a "critical" turn-on" in tactics has been introduced,the other side is to be interpretedive.

is essentially *casuistic* in nature; and restraints in any form of "limon something psychologically and, and because the received bodyen wholly inadequate to the gameic reprisal on the U.S.S.R. andwar obtains in Europe, or thean area without recent experienceuction of new forms of nonprice(Industry), it seems likely that thewill include experimental worke finds that when no norms existare created by the subjects; andtwo parties in the same process,influences the other's. There is aith respect to *values*; each side to the other's, in forming its own."objective" criteria is incapable ofthat is, when the game is "inde-rt must be developed, mutuallyns of action and response have to

## GAME THEORY AND EX

be legitimized.<sup>3</sup> In an almost uncooperative game, the players must reach a mutually agreeable solution, which constitutes an innovation, a change in the rules, a cooperative gesture, and they must agree on the kind of retaliation regarding the kind of retaliation of the rules occurs.<sup>4</sup>

A "scenario" might, for example, be set up as a "game" with an "aggressor"; it might give the outline of the same game by other players; it might be a game that would tend to identify some particular parts of the board. These scenarios might seem to attach a kind of moral character to particular parts of the board. These scenarios might influence on the logical or mathematical solution, they would be intended to have an effect on the solution. Again, one might set up the

<sup>3</sup> A splendid example of the creation of a game theory suggests that the process is susceptible to social acceptance during the 1957 disarmament negotiations. The inspection zone ultimately agreed on had a number of possible pie-shaped zones with apex at the center.

<sup>4</sup> One may hope, as a game theorist, that the experimental psychology pertinent to the study of social psychology; this is still supposed to be in the domain of conflict behavior. But it is not always drawn in advance. "Hostility," for example, is a quality best kept out of the game. Hostility in the game is a significant condition for the other player's meaning, it becomes part of the game. The experiment by Deutsch is pertinent. He has set up games (in matrix form) tacitly for a second player, both a "cooperative" and an "uncooperative" game. The player cooperatively against a cooperative partner, to respond to the implicit offer of cooperation of the other person's choice was not his choice as being a function of indifference. He is as to how the game 'should' be played. The other person's choice, because of the need to reinforce the previous negative sentiment of the other person." See Morton Deutsch, *Conditions of Cooperation* (New York: Center for Human Relations, New York University, 1958), this monograph, not including the paper "The Psychology of Suspicion," appeared in *The Journal of Personality and Social Psychology* (September 1958].)



consciously cooperative way, adequately recognized definition of what a challenging or assertive move, or a norm must develop some common norm that fits the crime when a breach

able, identify one of the players as the outcomes of previous plays of the game might give a background story for the particular division of the territorial "status quo"; or it might be the aim of one of the players to paralyze background data would have no mathematical structure of the game; or no force except power of suggestion on the board so that on the first play

of norms in practice — and one that is the result of analysis — was the rather general content of the discussions of the notion that any norm had to be selected from among the array of norms at the North Pole.

It is not clear that a clear line can be drawn between game theory and the rest of social psychology. It is a theory of *strategy*, not the entire theory of social psychology. It is not clear just where the line can be drawn. For example, might seem to be an emotional outgrowth of game theory; but if a player's constraint on his ability to perceive the intentions of the "communication structure." An experiment let pairs of players play nonzero-sum sequential games, the game providing a "cooperative" choice. Those who played uncooperatively had an opportunity, on the second play, to cooperate. But, "when their expectations were not confirmed, they tended to interpret the situation as a basic lack of understanding of the other's intentions. . . . In this group, knowledge of the meaning attributed to it, tended to reduce the probability of cooperation regarding the intentions of the other player." (See *Factors Affecting Cooperation*, Research Center for Human Development, University of Chicago, 1957. (An article based on this experiment is quoted here, entitled "Trust and Cooperation in a Game of Conflict Resolution, 2:265-279 [De-

it corresponds to the way it stood as played earlier by two other players. The outcome can be affected by informing the lineup was in that earlier game. The "norms" based on the static context can appreciate it at the outset, it can change the norms by providing, in a complex background story that suggests a new theoretical starting point.<sup>5</sup>

It should also be interesting to see how they really discern when the other player is "daring" him, and so forth; and to study the process by which particular moves acquire symbolic importance, such that a player is establishing a role and reputation for himself at a particular point in the game.

Another dimension of the game analysis is the significance of the moves in the moves and value systems. A game involves moving pieces over a board. If players move in turn, each move is made at a time, the game proceeds at a steady pace, the situation on the board may change slowly, but it does so by a succession of moves that can be observed, appreciated, and analyzed. If for the mistakes of individual players, the game destroys value for both of them, the game is avoided in subsequent play. If the game is a time for the players to bargain, the game involves mutual destruction. But if the game can be moved several at a time in a single move and that the rules make the outcome mutually destructive for one or both players, the game is so incremental; things can happen so fast that the temptation toward surprise attacks is great. The situation is at a particular moment.

<sup>5</sup> The income-tax questions described in the text are the force of this power of suggestion.

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and in the middle of the same game with different players, and see whether the outcome is different from what the starting configuration of the game would have produced. If players tend to develop a different configuration of the game as they play, it may be possible to distort those configurations in a completely "nonauthoritative" way, and this would very likely indicate some other hypothesis.

It would be interesting to see whether each player can be "tested" as to his determination, and it might be possible to study encounters become invested with each player recognizes that he is acting in the way he conducts himself in the game.

There is some game that seems susceptible of an *incrementalism* that is involved. Take, for example, a game that involves moving a piece or troops over some terrain. The piece is moved one square at a time, at a slow tempo by small increments; the character of the game changes in the course of the game, a succession of small changes that can be adapted to, with plenty of time for the players or mutual mistakes that can be observed, adapted to, and corrected. There is communication, there is verbal communication and to avoid moves that are not possible. We suppose that, instead, the pieces can move in any direction and any distance without the risk of any hostile clash on either side. Now the game is not open abruptly. There may be a check. While one can see what the opponent is doing, he cannot project it more

in Chapter 3 (pp. 62-65) indicate the

## GAME THEORY AND EX

than a move or two ahead. They develop a *modus vivendi*, or traditional submissive roles for the two players. This brings things to a head before much or much of an understanding of the mental game make successful. It just invite a riskier mode of play. What kinds of people the players are and in the game itself? Is the critical the *moves* in the game or increase of the players (that is, of the social made commensurate with each other can be introduced into a game or lack of it in another? The relevance by the controversy over the role of war, the significance of the term situation that depends on mutual proposals to reduce the tempo of movement graphically, together with disagreement be such a thing as limited war or rope. Incrementalism may be considered analysis, once the necessary elements identified by experiment or observation.

These questions have concerned the possible role of the mediator by three or more participants, each author conjectures that — at least many of the empirical results would the larger number of players. Mediation involved in the formation lend itself to experimental study. tary, symmetrical schemes that

<sup>9</sup> "It is not only that limited war extreme violence; it must also seek to lest the rapidity with which operations lishment of a relation between political ship is lost, any war is likely to grow effort" (Henry A. Kissinger, *Nuclear War* 1957).

It seems to be less chance to detection of trust, or dominant and others, because the pace of the game and much experience has been gained reached. But does a more incremental collaboration easier, or does it depend on what suggestions we plant and on what suggestions we plant as a factor the incrementalism of incrementalism in the *value* systems (or system)? Or can these be offset, so that incrementalism in one dimension to offset the presence of these questions is attested by the use of nuclear weapons in limited adaptation to surprise attack in a mutual deterrence, and various proposals for modern war and to isolate it geographically over whether there can be an agreement over whether there can be an agreement on the continent of western Europe comparatively amenable to formal empirical benchmarks have been observed.<sup>6</sup>

In two-person games, except for the case of a single player. Similar games could be played by each on his own account; and the difference among "successful" players — which would appear in sharper relief with more generally, the kind of coordination of mobs and coalitions may be different. In contrast to the more sanitized games have sometimes been used to

we must find means to prevent the most serious slow down the tempo of modern war and succeed each other prevent the establishment of military objectives. If this relationship by imperceptible stages into one all-out war. *Weapons and Foreign Policy* [New York,

study the formation of coalition more interesting to introduce precedents, orders of moves, implications, and various connotative details in the organization of groups. Certainly the study of coalitions by various kinds of imperfect communication systems is an experimental study.<sup>7</sup>

<sup>7</sup> Alex Bavelas has described an experiment in which each of five separated players must pass a message to the next player until they reach a distribution of the pieces to form a square. The pieces are so cut that many combinations of pieces will form a square, but only one is the correct solution. The fact that a square can be formed with the remaining pieces happens when these deceptive "successful" combinations are completed a square it is understandable that a player which he can take a course of action based upon some extent upon his perception of the situation. The system of communication should have worked. . . . have revealed . . . that the binding is great, and that, with any considerable delay, a solution is improbable" ("Communication in D. Cartwright and A. F. Zander, *Group Dynamics*. Some very suggestive experimental work on the nature of what is equable," is reported by Charles L. Seasholtz, "The Real War with Communism," *Journal of Applied Social Psychology* (December, 1959).

## OF GAME THEORY

ns in game theory, it might prove deliberately certain asymmetries, perfect communication structures, s, in order to study the crystalli- nfluence exerted on the formation of asymmetrical and otherwise ns often lends itself to systematic

periment in pure coordination in which s geometric pieces among themselves until hat permits the formation of five separate ny "wrong" squares can be formed, that pieces that makes it impossible for four remaining pieces. He is interested in what ses" occur. "For an individual who has y difficult to tear it apart. The ease with 'away from the goal' should depend to e total situation. In this regard the pat- ell-defined effects. . . . Preliminary runs ng forces against restructuring are very amount of communication restriction, a tion Patterns in Task-oriented Groups," *oup Dynamics* [Evanston, 1953], p. 493). rk, especially on "the biased perception rles E. Osgood, "Suggestions for Winning *ournal of Conflict Resolution*, 3:304-05

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**GRADIENT**





## RANDOMIZATION AND THE

In the theory of games of pure randomized strategies play a central role. To say that the potentialities of randomization are the most of the interest in game theory is to say that the essence of randomized strategies in a zero-sum game is to preclude the advantage of knowing about one's own mode of play — the possibility of anticipation of how one may make up one's mind — oneself from tell-tale regularities that an opponent might discern or from inadvertent regularities that an adversary might anticipate. In the theory of games of common interest, however, randomized strategies play a central role, and the role it does play is not

<sup>1</sup> John von Neumann, speaking of "the existence of good strategies," namely the theorem that "if a finite number of pure strategies have a minimax value (and if there is no minimax value) if mixed strategies are allowed, say  $v$ , then there will be no theory of games on these bases without a saddle point in the period in question I thought there was a 'minimax theorem' was proved" ("Contributions to the Theory of Games," *Econometrica*, 21:124-125 [January 1953]).

<sup>2</sup> One can, instead, interpret mixed strategies as a way of introducing continuity of strategies in a game that has no pure-strategy saddle point, thereby creating a saddle point. In this interpretation the theory of zero-sum games is not so different from the theory of games of common interest. One can flip a coin to keep an opponent from knowing whether it will come up heads or tails; or one may choose to come up heads or tails, to create (in an expected-value sense) a saddle point in heads and tails. Both interpretations are useful. In the theory of games of common interest, the first may better catch the essence of the role of randomization itself to a game player. And the first remains

## OF PROMISES REATS

conflict (zero-sum games) ran-  
role. It may be no exaggeration  
andomized behavior account for  
y during the past one and one-  
omization in a two-person zero-  
dversary's gaining intelligence  
o prevent his deductive anticipi-  
one's own mind, and to protect  
of behavior that an adversary  
t bias in one's choice that an  
e games that mix conflict with  
imization plays no such central  
ather different.<sup>2</sup>

fundamental theorem on the existence  
that all zero-sum games with a finite  
ax-maximin equilibrium pair ("solu-  
id, "As far as I can see, there could  
ut that theorem. . . . Throughout the  
nothing worth publishing until the  
mmunication on the Borel Notes,"  
).

ategies in zero-sum games as a means  
to a discrete-strategy game that has  
onverting it into a game that does  
ion the role of mixed strategies in  
their role in the nonzero-sum games.  
rom guessing with confidence whether  
y flip a coin to "average" heads and  
e) a strategy halfway between heads  
d. If the second is somewhat more  
ne spirit of the problem as it presents  
inds us that the problem, even with









or nothing" when we cannot  
 obligation of citizenship equally  
 tery, when we want a fraction  
 of service rather than all of

vidently relevant to promises.  
 promised are larger than neces-  
 at offers a specified probability  
 scale down the expected value  
 t to the person making it. An  
 scale in a contingency is some-  
 tainty of smaller help. (There  
 at the contingency is correlated

s different from a threat. The  
 r when it succeeds, and a threat  
 l threat is one that is not car-  
 need to as an inducement, and  
 than I needed to. But a threat  
 superfluous rather than costly.  
 bits when it would have been  
 ort, you'll likely still comply;  
 us nor to kill us, the error costs  
 e to explode in our midst and  
 ht scale down the grenade to  
 nthreatening an appropriate per-  
 uld go off, killing us both, if  
 to do this is not as clear as in  
 xcess in the value promised is

problem if it costs something  
 nd if bigger threats cost more  
 reat of tear gas is enough, so  
 olusion, and if tear-gas bombs  
 and if I have to display the  
 e, it is better to threaten with  
 es may be cheaper, and then  
 For many interesting threats

the greatest cost is the risk of ordinary "cost" is not a contr

## THE RISK

The risk of *failure*, however moderate rather than excessive can be made is some horrendo it down by attaching it to a lo *specified probability* that it w is forthcoming, not by comm the jointly painful punishment

i	1
ii	0

F

To illustrate, consider the m has first choice, followed by option of making a prior th (Interpret  $X$  and  $Y$  as posi Row's strategy is clearly to t column II. If he makes no th that Row will then choose i. that Row is committed to it choice of II yields unattractiv Column can be expected to ch

The condition is that Row wrong! Maybe he completely n this particular adversary is dra everyone, but not quite everyo the matrix, and a few deviant ence system and prefer the low Alternatively, Row may get hi

## A RANDOM INGREDIENT

having to carry it out, and the more rolling factor.

## THE RISK OF FAILURE

... does give an incentive to choose ... threats. If the only threat that ... us act, one may be tempted to scale ... ttery device — by threatening some ... ill be carried out unless compliance ... tting oneself to the certainty that ... t would be administered.

I	II
0	1 0
0	-X -Y

FIG. 17

... matrix in Fig. 17, in which Column ... Row, but in which Row has the ... eat to constrain Column's choice. ... tive numbers.) On one condition, ... threaten row ii if Column chooses ... threat, Column chooses II knowing ... Given the threat — and assuming ... and that Column knows it — the ... ve outcomes for both of them, and ... choose I.

... be quite sure that nothing will go ... misjudges Column's payoffs. Maybe ... wn from a universe in which nearly ... one, has preferences as indicated in ... s have a radically different prefer- ... ver right cell to the upper left one. ... himself committed to his threat but

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fail to communicate it convincingly, Column mistakenly ignores the threat, and Column chooses the right-hand cell. Again, Column has no prior commitment through his own failure to communicate it accurately to Row. If Column takes into account, or Column may have a strategy to Row that eliminates the possibility that his own commitment will only guarantee a win for both players. Whatever the reason, there is some probability that the threat will fail. In this account we may have a reason for "punishing" payoffs in the lower right-hand cell as attractive as they are.

If Row is confined to "pure" strategy, his threat or commitment without success. If he can do nothing but wish that the threat in the right-hand cell were not so unattractive, then the threat he can in fact "scale it down" by a high cost of failure. If, for example, Row chooses to a choice of row ii in the event of a 50-50 chance between i and ii, then he can hope to frighten Column into a choice of i by the seriousness of the risk of failure.

We can be more specific. Let  $P$  be the probability that the threat will fail for any reason (for the purpose this is an "autonomous" strategy of Row's.) Let Row now threaten to choose ii with probability equal to  $\pi$ , in the event Column chooses i. If Column fails to comply there is a cost  $X$ . If Column chooses ii to their mutual discomfiture, they will choose i to their mutual relief. If Column chooses i, will they choose?

First, how large does  $\pi$  have to be to be effective at all, that is, to make it effective for any of the autonomous reasons for the randomization of Column's choice when he chooses i. If Column chooses i he gets 0. If he chooses ii he gets a weighted average of 1 and  $-X$ ,

Row to Column, so that Column  
 punishing them both to the lower  
 himself may have arranged a  
 choice of II, and failed to  
 in time for Row to take this  
 suffered a disability unknown  
 of I; in that case, Row's  
 guarantee the worst outcome for  
 as for failure, there is perhaps  
 will fail. If we take it into  
 Row to wish that the "puni-  
 and cell were not quite as un-

strategies — if he must specify  
 reference to error or chance —  
 the numbers in the lower right-  
 . But if he can randomize his  
 own" to reduce somewhat the  
 le, he can commit himself not  
 that column II is chosen, but  
 ii in that event, he may still  
 choice of I while reducing the

stand for the probability that  
 whatsoever. (For our present  
 probability, independent of  
 threaten to choose ii with prob-  
 column chooses II. In other words,  
 as a probability of  $\pi$  that Row  
 comfort, and of  $(1 - \pi)$  that he  
 . What value of  $\pi$  should Row

be to make the threat effective  
 assuming that it does *not* fail  
 involved in  $P$ ? This is a ques-  
 is confronted with the risk  $\pi$ .  
 he chooses II his expectation is  
 with weights of  $(1 - \pi)$  and  $\pi$

respectively. If this average choose I — subject to the a one reason or another he will motivation toward I. The c thus <sup>4</sup>

$$0 > (1 - P)$$

$$\pi > \frac{1 - P}{1 - P}$$

Second, assume that any t lished by the preceding form bilities  $(1 - P)$  and  $P$  respec payoff is  $+1$ . If it fails, his of 0 and  $-Y$ , the weights be expected value of the outcom enough to be effective at all, is

$$(1 - P) + P(0 - Y)$$

This value is evidently high should therefore arrange the meets the first condition. For to have an expected value gr can expect from this particula value of  $\pi$  must be arranged

$$1 - P - YP$$

or

$$\frac{1 - P - YP}{P}$$

Thus the effective range for  $\pi$  is

$$\frac{1 - P - YP}{P}$$

And there is no threat at all between these two limits, if

<sup>4</sup> Since the analysis depends only absolute valuations of the payoffs is done by adopting, for each pla preferred payoff equal to  $+1$  and interpretation, then, of the expression ference between Column's upper rig

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is less than 0, he is motivated to choose II in spite of his apparent condition for an effective threat is

$$(1 - \pi) - \pi X,$$

$$\frac{1}{1 + X}.$$

A threat with  $\pi$  above the floor established by the formula will succeed or fail with probability  $\pi$  respectively. If the threat succeeds, Row's expected payoff is a weighted average of  $(1 - \pi)$  and  $\pi$  respectively. The condition, then, when the threat is large enough to be given by

$$(1 - \pi Y) = 1 - P - P\pi Y.$$

Therefore, the lower is the value of  $\pi$ . Row will make the lowest value of  $\pi$  that he can that makes a threat to be worthwhile at all — greater than zero, which is what Row's payoff matrix if he makes no threat — a condition that meets the condition

$$(1 - P\pi Y) > 0$$

$$\frac{1}{Y} > \pi.$$

Therefore, in this example is given by

$$\frac{1}{Y} > \pi > \frac{1}{1 + X}.$$

Therefore, it is worth making if there is no room

Therefore, on comparisons of the *differences* between the two players separately, no violence is required, a scale of measurement that sets his next preferred payoff to 0. The full information game,  $1/(1 + X)$ , is: the ratio of (1) the difference between the right and upper left payoffs, to (2) the sum

## RANDOMIZATION OF PRO

$$\frac{1 - P}{PY} < \frac{1}{1 + \dots}$$

or

$$\frac{P}{1 - P} > \frac{X}{Y}$$

Only a "fractional" threat — a threat not worth making if:

$$\frac{1 - P}{PY} < 1$$

or

$$\frac{P}{1 - P} > \frac{1}{Y}$$

Here is a case, then, in which the threat is not worth making to the certainty threat, and in which the threat is not worth making at all while the form of the threat is on the risk of failure, a risk that has a probability of the size of  $\pi$  itself. This is a situation that arises. If we interpret  $P$  as the probability that the adversary and exaggerate his preference for the right cell, our assumption implies that the payoffs in the population. It implies that the payoffs whose payoffs are adequately represented in our matrix, or a man whose payoffs are not a relevant threat — within the range of values that would persuade him. If instead we suppose that the payoffs in the upper and lower right cells are shaped frequency distribution with a probability that our particular adversary had been a probability that our threat would succeed.

---

of the differences between (a) his upper right and his lower right and upper left payoffs. The parameter reflects advantage already taken of this scale parameter to characterize the relevant relationship. In a later problem that involves the lower left cell and a second parameter would be required. The problem is simplified if the lower left payoff can be taken as zero. (still illustrate the point; we get less complexity that way.) On the interpretation of these results, see "The Meaning of Utility Measurement," *American Economic Review* (March, 1953), or Luce and Raiffa, pp. 12-3.



$$\frac{X}{1 + X}$$

threat with  $\pi$  less than 1 — is

The fractional threat is superior to the latter could be not otherwise. The argument hinges on the assumption independent of somewhat special assumption. It is that we have misjudged our preference for avoiding the lower values as a bimodal distribution of values that we have either a man represented by the numbers in the cells are so different that no relevant values up to  $\pi = 1$  — will disprove that the ratio of column to right-hand cells showed a bell-shaped distribution within the population, and that if drawn at random, the probability would vary directly with

right and upper left payoff and (b) the simplicity of the formulae thus resulting convenience. It takes only one valuation among three valuations. (In the left cell, all four payoffs are relevant. That case, however, can be further taken equal to one of the others and etc knowledge but more 0's and 1's are numbers see A. A. Alchian, "The *American Economic Review*, 43: 26-50 38.

the value of  $\pi$  itself. The probability is chosen at random from the universe of all possible values of a specified probability of apprehension. The probability varies directly with the latitude of the threat. The analysis analyzed above treats burglars as a single class; those, let us say, who steal for profit. If we distinguish those who steal for fun and are apprehended in accordance with the probability  $\pi$ , the magnitude entered in the lower right-hand cell. On the other hand, if our probability of apprehension is the reason for supposing the probability of communication with the police is the reason for the probability of the particular threat being carried out.

It is interesting to notice that the magnitude of the threat is, in the lower right-hand cell, equivalent to scaling down the size of the threat. In this, interpret  $X$  in the lower right-hand cell as the magnitude of the threat to be levied on both Row and Column. If  $X$  is the magnitude of the whip or days of imprisonment, the threat is fulfilled. If  $X$  is the magnitude of the threat or days that Row can threaten, the threat is a specification of what fraction of the threat is to be exacted; if  $\pi$  is the probability of apprehension and Column receive exactly  $\pi X$ . If we interpret the matrix in the lower right-hand cell as providing the optimum threat through the same analysis as before, namely,  $\pi$  is to be as small as possible, the optimum value equal to  $1/(1 + \pi)$ . If we interpret  $\pi$  as a probability of threat fulfillment, the optimum threat is to be certainly carried out. If we interpret  $\pi$  as the probability of threat fulfillment, we come to the same thing, and it seems fair to say that *in this case*, the optimum threat is that of making divisible an indivisible threat, of making possible a threat that was previously unavailable. (It should be noted that reducing the probability of apprehension reduces the value of the outcome proportionally to the square of the

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probability that a burglar drawn at random from a population of burglars will be deterred by some apprehension and conviction presumably after a certain probability; the simple model treats burglars as divisible into two classes — those who are willing to pay for money and are certainly deterred, and those who are not. The numbers of the matrix, and those who are not, are beyond reach of any threat of the law. On the other hand, the probability of failure reflected, say, a breakdown in communication with an adversary, there might be better probability of failure to be independent of the threat communicated.

That attaching a probability of fulfillment to the threat in the above model, substantially equivalent to the threat more directly. To see this, we treat the right-hand cell as a fine that will be levied on the Column, or a number of lashes with which the Row must be content that both will suffer if the threat is fulfilled. Let  $\pi$  be interpreted as Row's probability of the maximum permissible punishment being set at 0.5, for example, both Row and Column will receive half their maximum punishments. In this way, and ask what value of  $\pi$  would be chosen from Row's point of view, we go to the Column's point of view and we reach the same conclusion as before. The value of  $\pi$  is as small as possible subject to a minimum punishment (say,  $X$ ). Thus we can interpret  $\pi$  either as the probability of fulfillment or as the scale on which the threat is levied out. Since the two formulations are equivalent, we can interpret  $\pi$  either way, it is the same. In this case the role of randomization is to make the threat otherwise too large and indivisible into smaller parts. A "smaller" threat than was otherwise possible, though, that to reduce a threat by randomization reduces the expected punishment proportionately for both players, while a

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direct reduction in size might not be worth the changes in value or utility for the

### THE RISK OF INADVE

There is another "cost" element in a threat. This is the risk that one might be hurt (even if the adversary does not comply if the threat hadn't gone through a chance). The gun that threatens to go off may go off accidentally before the dog that threatens to bite trespassers does not trespass.

If a hitchhiker pulls a gun on a driver and threatens to kill them both unless the driver gets out the window, making his threat credible by falling to the floor and creating a mania, there is some chance that the accident will occur. The driver has a chance to comprehend the threat and the risk of accidental fulfillment. The only way one can make the threat credible is until the driver speeds up the hitchhiker; once he does speed up, the time it takes the hitchhiker to get out the window at his speed. There is therefore an element of risk, that the risk is present; the driver must therefore be one that is safe during this initial interval. It is definitely safe at all speeds under 60 mph. off the road at exactly sixty and the risk is between that carried a moderate risk. The driver has no incentive to incur a danger. The driver would know it and not respond to it. It is the possibility of a "fraction" of the risk but not the certainty

<sup>5</sup> Randomization may also be integral to the threat itself, or be involved in the decision whether to wish it or not. So the interpretation of the threat manipulating the size of the threat is ap

not be restricted to proportionate (to the two parties.)<sup>5</sup>

#### IMMEDIATE FULFILLMENT

... threat that can motivate a reduced risk of death will fulfill the threat inadvertently if the victim complies with it (or would have done so had he not been off accidentally before he had been caught by a burglar or hold-up victim). The victim has a chance to comply. The threat is not applicable only in some cases.

... the driver of a car and the driver of a truck. As the hitchhiker throws his gun into the air, the driver's greatest risk is by pressing the accelerator pedal, which increases the risk of fatal accident, there is a time interval before the hitchhiker can act on the threat and comply. In this case, the time interval is an integral part of the threat. The driver's greatest threat is to start fulfilling it. The hitchhiker has no reason to believe that the driver will comply if there is some minimum length of time interval before the driver to relax the accelerator pedal, however short it may be. The risk entailed by the high speed is small enough to be tolerable to the driver during the time interval. If instead the car were moving at sixty but would certainly skid to a stop if there were no gradations between the risk of accident, the driver could not maintain the dangerous speed and the hitchhiker's threat would be a verbal threat of high speed. The driver's greatest threat, "a threat that carries the risk of death, that gives the driver a chance to comply," is related to the arrangement of the decision process whether the threatener's threat is applicable only in some cases.

anything to work with; but to use it for some finite period.

If in situations of this kind — in the hitchhiker case — that the threat is proportionate to the probability of biting if the adversary does not bite, the probability of biting is the same as before (ignoring the threat). The threat is not very dissimilar to the threat in the same matrix as before (ignoring the threat). That a potentially effective threat is present the probability of inadvertent biting of  $\pi$  is the same as before. The Row, which must exceed 0 if he bites, by the left-hand side of the form

$$\text{or } \frac{(1 - a\pi) - a}{a(1 + Y)} >$$

The optimal threat is again on the limit; there is an upper limit to the threat depending on the relative value of the parameter  $a$ , it may or may not have a value for  $\pi$  at all.

#### RANDOMIZED

Having found a rationale for the threat, we inquire whether the tactic of “unilateral commitment” — one that in certain cases can be adopted — is certain. As indicated in Chapter 10 — that is, a definite commitment — is equivalent to “first move” in a two-player game. One would otherwise have to maintain the equivalent of first move in a two-player game. Interpretation if we suppose that Row is the player in the game but who has the option to commit himself to a 50-50 chance

<sup>o</sup> Pp. 47, 122.



do this one must retain the right the right to commit oneself ahead to move first, by a definite choi ized commitment would be lost. is equivalent to a "first move" with odds set by the player, wi move known to the other player

The same payoff matrix (Fig. situation if we change the rules *unconditional* commitment prior mitting him to make his choice d mitment to ii induces a choice of the lower left cell — to which Ro no reward. Row's problem is tha umn into I, but he needs row i can be achieved by a randomize to a randomized choice. If Row i chance) to select i or ii after C choose I as long as  $X$  is greater an expected value of 0.5. If Ro choosing ii) at just above  $1/(1 +$  value consistent with Column's in the lower left cell differs from mula for optimum value of  $\pi$  dif in the lower left cell were  $-1$ , than 50 per cent chance of ii wou  $-X$  or worse, no probability m any mixture with  $\pi$  large enoug too large to yield Row a positiv

There is another rationale for case just discussed, it was Row cell in I that led him to minimize *Column's* motivation that deman a fractional value of  $\pi$ . In this ii induces Column to choose II;

<sup>7</sup> That is, as long as the payoff to Col his payoff in the upper left as much as t upper left. See the earlier footnote on



to move second, exploiting only  
 ad of time; if one had actually  
 ce, the possibility of a random-  
 . (The randomized commitment  
 determined by a random device  
 with the odds but not the actual  
 before his own move.)

r) can be used to illustrate this  
 of the game to permit Row an  
 to Column's choice but not per-  
 depend on Column's. A firm com-  
 column I but is wasted because  
 ow is now committed — contains  
 t he needs row ii to induce Col-  
 to profit from I. A compromise  
 d commitment — a commitment  
 s committed to flip a coin (50-50  
 Column has chosen, Column will  
 e than 1.<sup>7</sup> In that case Row gets  
 w sets  $\pi$  (the probability of his  
 -  $X$ ) he gets the largest expected  
 choice of I. (If Column's payoff  
 n zero, say 0.5 or -0.5, the for-  
 ffers somewhat.) If Row's payoff  
 no commitment with a greater  
 uld serve. And if that payoff were  
 mixture of i and ii would work;  
 h to induce column I would be  
 ve expected value.

a fractional commitment. In the  
 's own preference for the upper  
 ze the value of  $\pi$ . In Fig. 18 it is  
 ds some chance of row i, that is,  
 case, a firm commitment to row  
 a firm commitment to i induces

umn in the lower right cell falls short of  
 the payoff in the upper right exceeds the  
 the scaling of payoffs.

		I
i		2
ii		3

FIG

Column to choose I; no commi  
 ferring II; a threat to choose i  
 ineffective unless Row promises  
 all of these "pure-strategy" case  
 2. He can, however, do slightly b  
 He can, because he and Column  
 disagreeing only over the choic  
 offers Column a 50-50 chance be  
 an expected value of 2 in the fi  
 and chooses the first. This leave  
 Since Row has a preference for i  
 ity of that row consistent with t  
 a preference for column I. That  
 $\pi$  for which (in the matrix shown

$$\text{or} \quad 4(1 - \pi) > \frac{3}{5}$$

This particular mixed commit  
 of a fractional threat with a fra  
 "threatens" a relatively high pro  
 is chosen and "promises" it if I is

He could do even better if b  
 Column's choice. Any probabilit  
 tional on a choice of column I,  
 certain that Row will retaliate f  
 he is limited to making his thre  
 good — if he has to attach the s  
 — the upper limit to an effectiv  
 pected value to Row of 2.6 (a  
 separate  $\pi$  for the promise, the u  
 payoff of 2.75 (and only 1.0 fo

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### II

1	1
2	2

18

at all leaves Column pre-  
 unless Column chooses I will be  
 to abstain from choosing ii. In  
 es, Row ends up with a score of  
 better with a mixed commitment.  
 are both attracted to column I,  
 e of Row in that column. If he  
 between rows i and ii, Column gets  
 first column, of 1.5 in the second,  
 es Row an expected value of 2.5.  
 ii, he wants the highest probabil-  
 the need to provide Column with  
 is, he wants the largest value of

$$(1 - \pi) + 2\pi > \pi.$$

ment can be called a *combination*  
 actional promise. Row, in effect,  
 probability of i in the event that II  
 chosen.

he could make  $\pi$  *conditional* on  
 ty up to 0.75 for row ii, condi-  
 is a sufficient inducement if it is  
 for column II with row i. But if  
 eat no worse than his promise is  
 same probability to both of them  
 ve value of  $\pi$  is 0.6, with an ex-  
 nd of 1.6 for Column). With a  
 pper limit is 0.75 for an expected  
 r Column).

## THE THREAT SOMETHING

It is typical of strategic threats that the threat fails and has to be carried out to both sides. The purpose is *de facto* *post*. Making a credible threat is to have to carry out the threat, or incurring penalties that would make the acknowledged purpose of stationing as a "trip wire" was to convince that would involve the United States that the United States wanted to be free from the commitment was physical.

As a rule, one must threaten to act, if the threat fails. To say that one *may not*, and to say this is to exercise power of decision — that one is not one *may* carry out the threat, not invite the opponent to guess what he himself and his opponent or to do more, if one says that he may — if the opponent fails to heed the threat, and if he carries it out, he only confirms his intention. He has a clear choice to act or to act (consoling himself that he was not) never said that he would act for

There are threats of this kind that are effective in spite of this loophole. They are made through a process that is a degree

## THAT LEAVES TO CHANCE

ats that the punitive action — if carried out — is painful or costly. Intimidation *ex ante*, not revenge *ex post*, involves proving that one would rather create incentives for oneself or others than make one evidently want to. The presence of American troops in Europe during the war with the Russians that war in Europe was not decided whether the Russians thought they were involved or not — that escape was practically impossible.

It is not that he *will* act, not that he *may* act, but that one *may* act is to say that one can confess that one has kept the threat not committed. To say only that one will not that one certainly will, is to say that whether one will prefer to punish or to pass up the occasion. Furthermore, it is not that he will — and the opponent and the threatener chooses not to act on his opponent's belief that when he chooses to abstain he will choose to abstain if he is not caught bluffing because he is sure).

It is nevertheless that may be effective. They can work, however, only in situations more complicated than firm

commitment to certain fulfillment inadvertently and may entail reason they are less likely to be

The key to these threats is to carry them out if the threatened *decision is not altogether under t* is not quite of the form "I may o but, has an element of, "I may altogether sure."

Where does the uncertain element must come from somewhere ou Whether we call it "chance," ac perfection in the machinery of c do not entirely understand, it that neither we nor the party An example is the threat of inac

#### THE THREAT OF

The thought that general war — through some kind of accid failure; through somebody's pan a misapprehension of enemy int of the enemy's misapprehension one. As a general rule one want minimum; and on the particular strategic forces are put on extr tive to react quickly is enhance side may strike first, it seems pa against impetuous decision, erro ambiguous modes of behavior. human and mechanical reasons war rises with a crisis.

But is not this mechanism i Suppose the Russians observe t gressive action tension rises and condition of readiness for quick they have so frequently claimed

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ent. Furthermore, they may arise unintended behavior. For this recognized and understood.

hat, though one may or may not d party fails to comply, *the final he threatener's control*. The threat r may not, according as I choose," or may not, and even I can't be

ment in the decision come from? It tside of the threatener's control. ccident, third-party influence, im- decision, or just processes that we is an ingredient in the situation we threaten can entirely control. dvertent war.

## INADVERTENT WAR

r might be initiated inadvertently ent, false alarm, or mechanical ic, madness, or mischief; through entions or a correct apprehension n of ours — is not an attractive ts to keep such a likelihood to a r occasions when tension rises and aordinary alert, when the incen- ed by the thought that the other rticularly important to safeguard rs of judgment, and suspicious or It seems likely that, for both s, the probability of inadvertent

tself a kind of deterrent threat? hat whenever they undertake ag- this country gets into a sensitive action. Suppose they believe what — that an enhanced status for our

## THREAT THAT LEAVES SO

retaliatory forces and for their accident or a false alarm, theirs or accident, resulting in war. May the all-out war, then, depends on their aggress and intimidate, falling v against other countries?

Notice that what rises — as far concerned — is not the risk that t all-out war, but the risk that war not. Even if the Russians did not the particular misbehavior they h uneasy about the possibility that general war or initiate some dy only in massive war or massive not be confident that we and the consequences of our actions in an tion altogether under control.

Here is a threat — if a mecha *may* act massively, not that we credible. Its credibility stems from precipitating major war in respo limited to the possibility of our co fore extends beyond the areas ar deliberate threat is in force. It do to launch all-out war, or on our b the Russians confront us with th aggressive move. The final decisio the Russians to estimate how suc precipitating war under the circu

The threat — if we call this co “threat” — has some interesting we realize it or not. Even those massive-retaliation threat was a p sion during the last several yea Russians have not engaged in mo note that the threat we voiced w plicit threat that we might be trig of ourselves. Furthermore, even i



may increase the danger of an error on our part, or of some triggering incident which we do not perceive that the risk of our own behavior, rising when they rise and falling when they relax their pressure

as *this* particular mechanism is being considered. The United States will *decide* on whether or not it will occur whether intended or unintended. If we expect deliberate retaliation for our actions, and had in mind, they could still be precipitated by their action might precipitate a dynamic process that could end in Soviet withdrawal. They might be able to altogether foretell the occurrence of an emergency, and keep the situa-

tion like this exists — that we can certainly will. It could be most likely in the fact that the possibility of a response to Soviet aggression is not wholly deciding to attack; it therefore depends on the events for which a more or less depends on our preferring to be committed to, in the event of a *fait accompli* of a moderately serious nature is left to "chance." It is up to us to successfully they and we can avoid such circumstances.

Contingent-behavior mechanism a number of features. It may exist whether or not those who have doubted whether our deterrent is potent to *minor* aggressors, but are perplexed that the more mischief than they have, can be backed by an additional trigger which is triggered by Soviet actions in spite of the fact that if we prefer not to incur even a

small probability of inadvertent mechanism deliberately, the "t product of other actions that take. We may get this threat w (and the Russians) take precau knowing this, the Russians may Finally, the threat is not discre plish their purpose without tri mate that the chance of inadvert rises from very small to not-so they go ahead anyway, and no little reason to suppose that t and little reason to suppose th any more than a person who s roulette should decide it isn't d

## LIMITED WAR AS A

Limited war as a deterrent pretation as an action that enh war. If we ask how the Western deter a Russian attack or to usually runs in terms of a seque on a moderate scale, we could n war; it would not be a decision tion. If we can resist the Russ either give up the idea or them scale of violence. At some poin from limited war to general wa with that choice. If this is not envisaged, it at least seems typi *liberate* decisions — decisions to it, to initiate a war or not to, or not to, to respond to a challe

But another interpretation o danger of all-out war is almost rence of a limited war; it is alm largement of limited war. This

## RANDOM INGREDIENT

ent war, and would not use this threat" in question may be a by-product. We have a powerful incentive to act, whether we like it or not when the consequences commensurate with a crisis; we have to take the risk into account. It is not credited even if the Russians accomplish a major war. If the Russians estimate the risk of a particular month as small if they create a crisis, and if a major war occurs, they still have their original estimate was wrong, that repetition would be less risky, and survives a single play of Russian strategy. Dangerous after all.

## GENERATOR OF RISK

to aggression also requires interferences the *probability* of a greater force in Europe are expected to resist it if it comes, the answer is a series of *decisions*. In case of attack the decision to fight limited to proceed with mutual annihilations on a small scale, they must themselves take a step upward on the next there is a discontinuous jump, and we hope to confront *them* in the typical sequence of decisions is identical in one respect: it involves *decisions* to take an action or to abstain from taking it, to step up the level of violence or not to.

can be put on limited war. The risk is certainly increased by the occurrence of a crisis, most certainly increased by an escalation of the threat, being so, the threat to engage in

## THREAT THAT LEAVES S

limited war has two parts. One is on the other side, in casualties, expenditure of face, or anything else. The second part is the other party, together with one's own side, in general war.<sup>1</sup>

Here again is a threat that all parties certainly will occur, if the other side does not. Again, whether it does or does not, it is together controlled by the threatener. It will occur — just where the fault, initiative, or responsibility occur — is not sure. Whatever is at stake between great powers a risky thing is done, and neither side can altogether dispel the uncertainty or the critical action that initiates the war, something that should necessarily be decided together deliberately. "Chance" war occurs or not, with odds that depend on the nature of the limited war that occurs.

Why would one threaten limited war to deter an attack? First, to threaten limited war — is to threaten a certainty of it; it is consequently a retaliatory threat and more appropriate. Second, it has the advantage, in terms of intentions or commitments, of not requiring to engage in limited war, creating a situation that we threatened to create, with the price we both pay for the threat. The price we pay instead the lesser price of a general war the enemy can reduce by withdrawing.

Third, in case the enemy is irritated or misjudged his motives or his course of action has gotten up too far, the actions are being carried out by

<sup>1</sup> The same point is stressed by Glenn Feldman, "Punishment" (Research Monograph No. 1, International Studies, January 2, 1959).

the threat to inflict costs directly expenditures, loss of territory, loss second is the threat to expose the self, to a heightened risk of

all-out war *may* occur, not that it party engages in certain actions. not occur is not a matter altogether. Just how all-out war would initiative, or misunderstanding may it is that makes limited war being, the risk is a genuine one that if it wants to. The final decision, as an irreversible process, is not only be expected to be taken all helps to decide whether general are a matter of judgment based war and the context in which it

limited war rather than all-out war to often limited war — according to risk of general war, not the certainly lesser threat than the massively appropriate to certain contingencies. in case the enemy misjudges our an intermediate stage: we can precisely the risk for both of us without thereby making general war enemy's mistaken judgment. We a risk of general war, a risk that withdrawal or settlement.

rational or impetuous, or we have commitments, or in case his ag too much momentum to stop, or his by puppets or satellites that are

beyond his immediate power to threaten risk rather than war, thinking it not too late to go ahead with it or have our threaten him with a one-in-twenty event he proceeds, and he does and have nineteen-to-one odds of Of course, if we scale down the too; it may degrade the threat in cases where there is danger enemy's commitment to an act ability to control his own agents moderate risk may deter anything

If we give this interpretation corresponding interpretation to largement, of the war. The threat a limited war is not, according solely according to the immediate but also according to the deliberate it poses. Just as a moderate limit factor the likelihood of major war a progression from conventional probability by another factor.

We are led in this way to a new The analogy for our limited-war to this argument, a trip wire that if it is in working order and fail have is a graduated series of trip mechanism, with the daily *pro* as the enemy moves from wire to analogy, it should be emphasize wire detonates general war is—side our control, and the Russia

The same interpretation might argue that the Chinese or Russia of major war, not just by the or winning one at excessive cost that we would exercise every



## THREAT THAT LEAVES S

limited, and they were prepared themselves, they may simply have to bigger and bigger wars is not stand or can foresee, and that the was appreciable.

## RISKY BEHAVIOR I

If one of the functions of limit liberate risk of all-out war, in ord to make pursuit of his limited obj the usual precepts for behavior in supreme objective may not be to rather to keep the risk of all-out w *zero*. At least this may be the s danger of "losing" a limited war enemy's aggressive advances can local resistance, the more reason the deliberate creation of mutua the aggressor can design his advan seems fraught with explosive pot resistance will seem.)

Deliberately raising the risk of fits the context of limited war. C risk just by saying so. One cann that yesterday one was only abou out war but today it is 7 per cent One has to take actions that — continue to be just as concerne limited — leave everyone just a be kept under control.

The idea is simply that a limi degrees. At any point one has so much "out of control" it is. And breaches of limits, manifestation ing and assertive acts, adoption adoption of headstrong allies and assing tactics, introduction of



l to exercise skill and caution  
e felt that the process that leads  
one that they or we fully under-  
risk, though numerically small,

#### IN LIMITED WAR

ted war, then, is to pose the de-  
ler to intimidate the enemy and  
ectives intolerably risky to him,  
a limited war need revision. The  
*assure* that it stays limited, but  
war within moderate limits *above*  
strategy for the side that is in  
. The less likely it is that the  
n be contained by limited and  
there may be to fall back upon  
l risk. (Alternatively, the more  
nces so that even local resistance  
potential, the less attractive local

all-out war is thus a tactic that  
Of course, one cannot raise the  
not just announce to the enemy  
ut 2 per cent ready to go to all-  
and they had better watch out.  
assuming he and his adversary  
d and careful to keep the war  
little less sure that the war can

ted war can get out of hand by  
ome notion or sensation of how  
d various actions — innovations,  
s of "irresponsibility," challeng-  
of a menacing strategic posture,  
collaborators, spoofing and har-  
new weapons, enlargement of

troop commitments or the area in anyone's judgment of how much risk. To share such an increase in risk is an overpowering incentive to lay down shared risk by irreversible means, only the enemy's withdrawal can save, otherwise it may turn out to be a cor

## REPRISAL AND

Limited local war is not the only risky behavior may be used as a threat of massive retaliation. The possibility of less-than-massive retaliation. Few serious analyses of war of this kind have been published.<sup>2</sup> The idea that one might retaliate if Soviet troops invade a country, and fight day until they quit, has been occasionally but not systematically explored. Hostile action on a small scale, such as jamming communications

There are a number of Russian actions of hostile sort that might provide a model, or the dramatic act to trigger retaliation: harass, blackmail, or blockade of allies, a peacetime campaign to jam radar, tricks with nuclear weapons, instigation of sabotage in NATO countries, insurrection, or even the use of provocations within their own spheres. In combat these actions by like means. It is not wise to insist that we are not retaliating. If something were to happen of a small but appreciable share of risk should be considered. (Or, if not, at least

<sup>2</sup> A recent serious discussion is Morton Halperin's "Retaliation" (Policy Memorandum 1959, Princeton, April 9, 1959).

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of conflict — tend to raise almost an “out of control” the situation is. Work with an enemy may provide him a way off. Preferably one creates the maneuvers or commitments, so that one can tranquilize the situation; otherwise, it is a test of nerves.

## WAR OF NERVES AND HARASSMENT

The only context in which deliberately to use a type of threat. Between the kind of limited war there is the possibility of retaliation, of graduated reprisal. If limited reprisal have been publicly threatened “take out” a Russian city if they do and keep “taking out” one every now and then, occasionally adverted to journalists and the public. Similar in spirit is the idea of a limited scale — sinking ships, blockading ports, or whatever it may be.

The Russian actions of an aggressive or defensive nature are neither locale for a limited war nor a threat of massive retaliation: efforts to use the actions of neutral countries or American actions to jam our early-warning and other systems as part of a war of nerves, or the actions of neutral countries, flagrant support of unaccustomed violence in quelling rebellions in satellite states. It may do little good to take measures of our own; it may also be about to boil over into massive war. To be done, the deliberate creation of a calculated risk of general war might be the purpose and significance of

from A. Kaplan, “The Strategy of Limited War,” *Journal of the Center of International Studies*;

## THREAT THAT LEAVES SO

the Russians, providing them with the risk by acting or to withdraw

This is not the only interpretation. It may be that we could win military on a small scale, and that for the Russians to make a continuous jump that they would not fear of provoking a discontinuous jump. A limited war would contain a "decisive" element of the war. Even so, an immediate outbreak of even small-scale war might be profitable. It promises a small but appreciable gain. In an enormous war, the probability becomes small. The Russians believe the West could bring a war to make it unprofitable for them.

It is worth noting that this is a threat of limited war may be potential. The expectation that we would win it. A limited war is not just local military action. It is "retaliation" on the Soviet homeland. It is a small *probability* of a

## BRINKMAN

The argument of this paper leads to a concept of the "brink of a cliff" view, the sharp edge of a cliff where one must decide whether or not to step down, and decide whether or not to step down. The slope that one can stand on with a certain degree of safety gets steeper and the risk of slipping increases. But the slope and the risk are not regular; neither the person standing on the edge is quite sure just how great the risk is. The risk increases when one takes a few more steps.

<sup>5</sup> In the author's opinion the dispatch of the 1958 was not only both risky and successful but also a risk — a risk that the Communists would not respond to their response.

the option either to terminate or to meet our objectives.

of such action, of course. It is likely if the fight stays on a small scale to enlarge it would require a decision to be deterred from taking any response. In that case the initial "deterrent" threat against enlargement is an important reason why the threat is effective is that such a war increases the probability of an escalation small enough that the Russians might create it, large enough to let it occur.<sup>5</sup>

This interpretation suggests that the threat is effective even when there is little escalation. In these terms, a limited local war is a war; it contains an element of escalation — not a small *bit* of retaliation — massive war.

## BRINKMANSHIP

leads to a definition of brinkmanship as "the brink of war." The brink is not, in this sense, where one can stand firmly, look back, and plunge. The brink is a curved surface where some risk of slipping, the slope of which is greater as one moves toward the edge. The risk of slipping are rather irritating there nor onlookers can be sure how much it increases as one slips downward. One does not, in

the case of United States troops to Lebanon in 1958, the withdrawal was successful precisely because of the fact that it could lessen or aggravate according to

brinkmanship, frighten the adversary by getting so close to the edge that he must do so before anyone can stop him, slide onto the slope where one may fall, and try to save himself, dragging his adversary with him.

Brinkmanship is thus the deliberate risk of war, a risk that one does not take as a tactic of deliberately letting the adversary take the lead, just because its being out of his hand, just because its being out of the other party and force his acceptance, and intimidating an adversary by showing that he may disturb us so that we slide to or not, carrying him with us.

The idea that we should "keep our feet on the ground" in response, particularly about *what* we do, is an interpretation along these lines. We need not threaten the enemy with the certainty of resistance, but only that we may strike back. This means confronting the Russians with the main question for us to decide on, one may guess that after the event they will strike back, particularly if they perceive our bites; and if we are unwilling to strike back, and are even unwilling to retaliate, they may seem to confirm their understanding of us. It would be if we left ourselves an open door, an absolute commitment to the possibility of striking back, and commit us to an action to retaliate. If we do not, there may be little to salvage from the situation that we just might decide to do.

But the situation is different. It is clear to the Russians that we are not committed, while we probably have a way of striking back, may or may not retaliate for an attack, depending on how it suits us as a

<sup>6</sup> Children understand this perfectly.

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versary who is roped to him by  
at if one *decides* to jump one can  
m. Brinkmanship involves getting  
all in spite of his own best efforts  
lversary with him.<sup>6</sup>

iberate creation of a recognizable  
s not completely control. It is the  
ne situation get somewhat out of  
of hand may be intolerable to the  
ommodation. It means harassing  
by exposing him to a shared risk,  
that if he makes a contrary move  
p over the brink whether we want

ep the enemy guessing" about our  
*whether* we shall respond, needs an  
. It is sometimes argued that we  
with the certainty of retaliation or  
just scare him with the possibility  
s idea may be misconceived if it  
with a possible response that re-  
way or the other. The Russians  
t we should prefer not to strike  
orm their aggression in moderate  
o arrange so that we *have* to strike  
o *say* that we certainly shall, we  
erstanding of what our preference  
y escape. So, if we are afraid that  
e threat might fail in its purpose  
we prefer not to be committed  
e by trying to persuade the enemy  
do it anyway.

t if we get into a position where  
we are sufficiently involved that,  
out, we *may* not. To say that we  
invasion of some neutral country,  
t the time, and that we shall not

## THREAT THAT LEAVES S

let the enemy make this decision what to expect, may confront the a bluff. But to get so involved in troops or other commitments that selves about whether we could even may genuinely keep the enemy gu

In sum, it may make sense to as long as we are not trying to ke motivation. If the outcome is pa processes that are manifestly son sion and control, we create *genuine*

## THE IMPERFECT PRO

Underlying this threat that on war — the decision being somew notion that some of the most mor are taken by a process that is no "under control," not altogether c tion can get even into a major wa decision process that might be cal the response to particular contin told by any advance calculations, contingency may depend on cert esses, or that there will be faulty tion, misunderstanding, misuse o mechanical failure.

This idea does not reflect an ur sion process. In the first place, d the basis of incomplete evidence is unreasonable to deny *in princ* cable action taken on a false ala be obsessed with the likelihood there may be levels below whic be pushed without incurring oth

Second, war can occur becaus to irreconcilable positions from down, particularly if backing do



for us, nor let him know just what our enemy is, or what our enemy will do with what appears to be our help, or near a neutral country with our aid. If we are not altogether sure our own country will invade a fight in case of invasion, we are guessing.

Let us try to keep the enemy guessing about our own intentions. Let us keep him guessing about our own intentions, which are partly determined by events and partly by our somewhat beyond our comprehension of the risk for him.

#### THE PROCESS OF DECISION

The "may" retaliate or precipitate a war that is beyond his control — is the result of the momentous decisions of government which are not entirely predictable, not fully deliberate. It implies that a nation may act somewhat inadvertently, by a mistake, or what is called "imperfect" in the sense that the agencies cannot exactly be foreseen. It implies that the response to a particular situation may contain random or haphazard procedure, faulty information, faulty communication, faulty authority, panic, or human or

an unusually cynical view of the decisions that do have to be taken on the basis of an ambiguous warning; and it implies the possibility of an irreversible decision. (Furthermore, one need not be warned of false alarm to recognize that a warning of this particular danger cannot be ignored if the dangers that outweigh it!)

When both sides become committed to a course of action which neither is willing to back down, the situation requires assuming, even mo-

mentarily, a condition of military cynicism to recognize that two groups are aware of each other's commitments.

But in the third place, even a responsible, comparatively cool-headed, imperfect decision system, especially for a number of reasons, one of which is the completely centralized dictatorship of a few men in a decision, and they do not have the means of enemy intentions, and they are not. A decision taken quickly in crisis is often based on whether particular studies have been made, and the initiative and forcefulness shown by the decision maker who are reacting to a quite unpredictable situation. The decision may be taken on the spot, or to whom the decision is delegated, or the decision that would have been made by the premier or cabinet in consultation with the parliamentary leaders. There may even be variations in the decision process, such as the decision cannot be settled in advance but is made only fully for certain contingencies based on past experience or precedent can be accepted or rejected, or compared for. Finally, the need to have a certain amount of advance preparation and the amount of advance preparation carried out.

For this reason there is no such thing as a fixed policy of a government, or a fixed policy, even all important foreseeable conditions add up, what interests are involved, and the collective decision procedure will be different, and not fully determinable in advance.

If on top of this we recognize the limitations on the intellectual and moral decision makers during the crisis, and the leaders on the brink of war, it ought to be a thing as getting into a situation where the nation may successfully extricate itself.

## RANDOM INGREDIENT

ry vulnerability. And it takes no governments may misjudge each

an orderly government with re-headed leaders is necessarily an especially in crises. This is so for a h is that in anything but a com- a number of persons participate ave identical value systems, judg- estimates of military capabilities. is may depend on who is present, ave been completed, on the initia- particular leaders and counsellors ecedented stimulus. Some parts of elegated authority, and the person ted cannot necessarily reproduce een reached by a president or ion with congressional or parlia- ren be some necessary contradic- uch as constitutional issues that t that make it difficult to prepare ecause the necessity to break law nly implicitly, not explicitly pre- keep secrets puts limits on the n for contingencies that can be

uch thing as a "firm" plan, inten- at to cover every contingency — ontingencies. How the considera- e brought to bear, and how the vorks in future crises is simply nce.

e that there are ordinary human and emotional ability of govern- the conduct of dangerous maneu- ght to be clear that there is such on from which it looks as though ricate itself but in which there is

## THREAT THAT LEAVES S

some appreciable risk that, try a  
lows itself, it may not succeed.

One does not expect a governm  
failings in this regard and to com  
incomplete mastery of its own a  
strategy. There are also powerful  
pointing out to an enemy that or  
disastrous errors in judgment an  
little unsure how to escape from  
standable, too, that a governmen  
not state that it has been attracte  
possible risk of all-out war that i  
things go without saying.

But the basic idea of a threat  
is important even if we do not c  
tacitly. In the first place it may b  
place, we may misjudge some of  
to recognize the presence of a r  
may be a significant part of our  
we have never appreciated it. If  
an important part of the role o  
our analysis of that role may be  
recognize it. The usual idea that  
does not work, that the Russia  
expect it not to work, is mistak  
more complicated range of probal

as it does within the limits it allows. It is not meant to call attention to its own weakness or to communicate to an enemy that this is a risky situation. It is undertaken for public-relations reasons for not one reason: that one is even slightly susceptible to false alarms, or that one is a risk-taker in a risky situation. It is undertaken by a nation engaged in limited war does not lead to this military action by the enemy. The point is that these

are tactics that leaves something to chance. We should not consciously use it ourselves, even if it can be used against us. In the second place, the tactics we do use if we fail to include the risk-of-total-war ingredient that has a strong influence on the enemy even if it is not — to take an example — this is not a trip wire either does work or does not work. It is seriously mistaken if we do not expect it to work or do not expect it to work. It is making two simple extremes for a middle ground.

PART

SURPRISE

A STUDY IN MUT

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**IV**

**ATTACK:**

**TUAL DISTRUST**

## THE RECIPROCAL SURPRISE

If I go downstairs to investigate my hand, and find myself face to gun in his hand, there is danger as we desire. Even if he prefers just to talk, there is danger that he may *talk* first. Worse, there is danger that he wants to shoot. Or he may think to shoot. And so on. "Self-defense" is trying to preclude being shot in

This is the problem of surprise advantage, it is worth while to avoid if the other may be about to strike. The knowledge that the other is about to strike gives us a motive for attacking. But, if the gains from attacking are less desired than no war at all, this is a basis for an attack by either side. A modest temptation on each side, a temptation too small by itself to become compounded through a series of actions, with additional motive for successive cycles of "He thinks we think he'll attack; so we think he thinks we think he'll attack; so we must."

It is interesting that this problem occurs automatically in situations that would otherwise be conflict, like that between the burglar and me, is logically equivalent to a situation where more partners who lack confidence



## AL FEAR OF ATTACK

e a noise at night, with a gun in  
face with a burglar who has a  
of an outcome that neither of  
to leave quietly, and I wish him  
*think* I want to shoot, and shoot  
he may think that *I* think *he*  
that *I* think *he* thinks *I* want to  
s ambiguous, when one is only  
self-defense.

e attack. If surprise carries an  
rt it by striking first. Fear that  
in the mistaken belief that we  
ive for striking, and so justifies  
s from even successful surprise  
all, there is no "fundamental"  
Nevertheless, it looks as though  
e to sneak in a first blow — a  
o motivate an attack — might  
rocess of interacting expecta-  
attack being produced by suc-  
think he thinks we think . . .  
he thinks we shall; so he will;

em, though it arises most dra-  
ld usually be characterized as  
ussians and us or between the  
alent to the problem of two or  
e in each other. If each is under

some temptation to abscond with a little suspicion that the other is doing something; if each realizes that the other will suspect himself the object of surprise, the situation is identical with that of a surprise attack. For some members of the mob, the temptation to rub them out to keep them from squealing may be tempted to squeal in self-defense. The notion of "preclusive self-defense" is a form of confidence."

The intuitive idea that intuition becomes larger — may generate the result of this compounding of each other's fears, is what I want to analyze. I want to analyze whether an explosion through a *rational* calculation of strategy, by two players in a predicament. The intuitive idea may be a real phenomenon and motivation. I think they perceive that the situation responds by exploding. But what is this phenomenon of "compounding" as a rational process of decision-making of this predicament in which the logic that governs their explosion?

#### INFINITE SERIES

We might begin by trying to analyze a player's decision. A player operates on a set of probabilities. A series of them. First is the probability that the other party "really" prefers to attack even if he does not fear. The probability,  $P_2$ , that the other party will prefer to attack him, that is, the

<sup>1</sup> Game theorists will recognize this as a form of what, for zero-sum games, has been called a "sum version" considered here involves a decision when to shoot.

## THE ATTACK

with the joint assets; if each has a gun, each may be contemplating the same action, and the other may suspect too, and may act accordingly; we have a pay-off matrix for the attack problem. If the heat is on, the rest of the mob may be tempted to squeal, and those in danger may resort to self-defense. So the game structure is the same as that of "partnership

with initial probabilities of surprise attack. This has a "multiplier" effect — as a result of each person's fear of what the other will do, as in this chapter. More particularly, we want to see how this phenomenon can arise from initial probabilities or a *rational* choice of action by those who appreciate the nature of their situation, even if misconceived, may influence private behavior; people may vaguely sense that the situation is inherently explosive, and that what I want to explore is whether "fear and expectations" can be represented in a game. Can we build an explicit model of a situation where two rational players are victims of their mutual expectations of each other? <sup>1</sup>

## THE GAME OF PROBABILITIES

Let us set up the problem as follows. Suppose each has a probability,  $P_1$ , that the other will attack, that is, that the other will shoot at an attack himself. Second is the probability that I "really" pre-emptively attack I will attack him even if I do not. This is the nonzero-sum counterpart of the game often called a "dueling game." The nonzero-sum game raises the question of whether to shoot, not



is the probability,  $P_3$ , that *he* fourth is the probability,  $P_4$ , *Y* "really" would. Fifth, sixth, *Y* lengthening the train of "he separate probability attached to over-all probability that he will

$$P_2)(1 - P_3) \dots$$

is that nothing generates the *ad hoc* estimate, reflecting additional information structure of the partitioning with a few terms in the infinity, or however far it goes, the whole series. The number of terms as much as a player has time and stamina to keep in mind, since the series by an independent mathematician might set up particular games would yield a formula for the expected gains of a roulette wheel determined by my "true" value system, if I had been told, whether he is told or not, was told, and so forth — but this might not illuminate much to come to grips with. What is the problem that permits us to work with a few parameters, representing probabilities in a series, in a context that is free of any additional probabilities, although the indefinite reiteration of the problem to formulate the problem in terms of expectations a function of the

#### NONCOOPERATIVE GAME

For each of the two players a basic assumption is that *he would attack if*

*he should not.* The values of  $P_r$  and  $P_a$  are known and known to be known by both players. The value of  $P_a$  by "should not" is contained in our behavior hypothesis.

The first part of our behavior hypothesis is that both players both perceive that a joint decision is made of all possible outcomes for both players. This is the "solution" and elect to abstain from attack. This is as shown in Fig. 19, each with a probability of  $\frac{1}{2}$ .

i	0
ii	-

confidence and will elect the safe side as the best possible outcome. This is based on the rationality of the two players. I suppose, mainly if the surprise attack is small, that both players are completely confident that the safe side is the best possibility — that somebody will not attack — just to be on the safe side, or to be on the safe side — is allowed by our behavior hypothesis, immediately.

The second part of the hypothesis is that the probability,  $P_r$ , for player R, and  $P_a$  for player A, in fact attack when he elects to abstain from attack, that is, that his decision is based on the hypothesis. This is what we call a "solution" player might attack even when he elects to abstain.

<sup>2</sup>In the terminology of Luce and Raiffa, "solution in the strict sense," that "solution" is a solution and Decisions, p. 107. Actually the solution is jointly preferred by both players not just over all other equilibrium points.

## NO-ATTACK

If these parameters are to be fully known by both players. What I mean in the following two-part behavior

hypothesis is that, if the two joint policy of no-attack is the best for both of them, they will recognize this. If, for example, the pay-off matrix will have confidence in their mutual

I	II
0	-.5
.5	1
5	1

FIG. 19

strategy that yields both players the seems to be a fairly modest demand for both players.<sup>2</sup> (It is a questionable one, the priority of joint no-attack over unilateral, too small to make both players fully understand each other. And this player will be tempted to break discipline for fear that the other may try to be rewarded for in the second part of the strategy following.)

The hypothesis is that there is some probability for player C, that the player will choose (or should elect) a strategy of no-attack will contradict the first part of the strategy that was meant by the notion that a player should not. Just what this

Raiffa, if the noncooperative game has a "solution" is here assumed to prevail. *Games and Information* condition is somewhat stronger here, since the two players over all alternative outcomes, and the

## RECIPROCAL FEAR OF

parameter represents we shall leave the probability that the player is that the pay-off matrix is misconceives unilateral surprise attack, or that will make a mistake and inadvertently. This parameter, for each decision model: it is a datum produced by the interaction of the

These two parameters,  $P_c$  and  $P_a$  are visible to the two players; there is uncertainty about them. This assumption might be what they are trying to answer, but it does not answer the question: how do the conditions of attack do not by themselves generate uncertainty. The problem is to see whether the conditions of uncertainty, the interaction of the two parameters, generate additional motive to attack. We need *some data* into the problem for experimental work on. The only way to hold the level is to make these two parameters explicit. Each player must state what each guesses about the other to guess about them, what he himself guesses about them. This has the infinite series of *ad hoc* adjustments, the difficulty of dealing with probability distributions. The only way to provide a point of departure for calculation, the other to fear, is to make the parameters explicit. Each player a matter of record. We need an "objective" source of basic uncertainty of subjective anxieties about

We now have a situation that looks like the compound self-defense situation. Each player must consider whether the other's attack is serious; he must also consider whether he is reciprocally worried. Even a player's "irrational" attack is known to be serious. The second may attack not only irrationally



is open: it may be taken to be irrational, or the probability is given and that he "really" pre- the probability that somebody tently send off the attacking player, is "exogenous" in our provided from outside. It is not e two players.

$P_r$ , are assumed to be plainly nothing secret or conjectural t seem to beg the question we t. These two exogenous likeli- es indicate what the probabilit- t attack. They are only one ther, given these basic sources the two players' expectations t. We have to put at least pectations and conjectures to arbitrary inputs to a minimal ers fully visible; otherwise we ut them, what he guesses the he guesses the other to guess n, and so on. Again we would specifications, with the extra ility distributions of proba- to break clean, and to pro- ulating what each should fear is one basic uncertainty for hat we want to see is how an ainty generates a superstruc- each other's anxiety.

ks as though it would generate n that we spoke of. The first e other player's likelihood of nsider that the other player is er whose own probability of e zero must consider that the nally but also out of fear that

the first, fearing the second's forestall it. Thus it does see pounding of motives.

But we do not. We do not get effect out of this. The probabilities do not interact to yield a higher certainty. That is, the outcome probabilities of "irrational" attack is a largement of those probabilities. It is either joint attack or no attack, *decisions*, not a pair of *probabilities*.

We work this problem by modifying the original matrix, using the two probabilities of "irrational" attack. The matrix stays as it was. The lower right cell is as a weighted average of the two. We choose the strategy of no-attack with probability  $(1 - P_c)(1 - P_r)$  that no attack occurs, to  $P_r(1 - P_c)$  that R will attack, and  $P_c(1 - P_r)$  that C will attack, and  $P_cP_r$  that both will attack. The pay-offs in the lower left cell are the same as in the lower row; for if C elects to attack while if R *elects* not to, he attacks with probabilities  $P_r$  and  $(1 - P_r)$  respectively. The probability of irrational attack equal to 0.2 would yield a modified matrix

i	0
ii	-

<sup>3</sup> In effect we view the players as choosing between one "pure" strategy and another by an autonomous parameter. (They are using mixed strategies, but in the present i

## PREEMPTIVE ATTACK

...s attack, may try to strike first to  
...m as though we might get a com-

...get any regular kind of "multiplier"  
...ilities of attack by the two sides do  
...probability, except when they yield  
...ne of this game, starting with finite  
...attack on both sides, is not an en-  
...ies by the fear of surprise attack;  
...no attack. That is, it is a pair of  
...ibilities about behavior.

...y recomputing the pay-offs in the  
...parameters representing the proba-  
...The upper left cell in the matrix  
...ght cell has its pay-offs recomputed,  
...ne four cells. For, if both players  
...ack, there is a probability equal to  
...ack will occur, a probability equal  
...ack and C will not, a probability  
...ll attack and R will not, and a prob-  
...h will attack. In the same way, the  
...re a weighted average of the pay-offs  
...s to attack, he certainly does attack,  
...tually does or does not with proba-  
...ectively. Thus with probabilities of  
...for each player, our original matrix  
...like the one in Fig. 20.<sup>3</sup> With proba-

	I	II
0	0	-.4
.4	.4	.64
.4	.4	.64

FIG. 20

...choosing — in the language of game theory  
...one "mixed" strategy the mixture specified  
...could, of course, further mix the pure and  
...instance there is no reason to.)

## RECIPROCAL FEAR OF

		I	
	i	0	0
	ii	.4	-.4

FIG. 21

bilities of irrational attack equal to .4, we get Fig. 21. And with probabilities of irrational attack, we get Fig. 22.

		I	
	i	0	.3
	ii	.1	-.1

FIG. 22

The probabilities of irrational attack in the modified matrices, namely the probabilities of irrational attack, prove to be innocuous. That is, they do not affect the *strict solution* of the game with respect to the choice of strategies. That is, the game that still has a "strict solution" in the value of the game is reduced for each player to escaping those two basic probabilities. The probabilities has not led to the *strict solution* has fully taken them into account. The *strict solution* is a jointly preferred solution at no-attack hypothesis has chosen that strategy.

The last of our modified matrices, where the probability of irrational attack for each player, is symmetrical and where the probability of irrational attack is now rather attack than hope for joint attack, that the other would too. This is a modification of the "prisoner's dilemma" where the only efficient solution would be a no-attack (which still leaves them

II

	-.1
1	
	.46
	-.14

1

o 0.8 for C and 0.2 for R, we  
es of 0.8 apiece for irrational

II

	-.1
1	
	.04
	.04

2

attack in the first of our modi-  
ies of 0.2 for each of the play-  
is, they are innocuous *with*  
they yield a new pay-off matrix  
n the lower right corner. The  
each player, since there is no  
ies; but the *contemplation* of  
eir aggravation. Each player  
, has seen that there is still a  
attack, and by the original  
egy.

es, with a 0.8 probability for  
unstable; each player would  
int no-attack, and each knows  
perverse situation, correspond-  
familiar in game theory; the  
a binding agreement to elect  
n suffering the reduced value

of 0.04), if binding agreement if play were forcibly postponed reach such an agreement.<sup>4</sup>

The second of the modified not in a symmetrical way. Player R to anticipate it by a knowing this, attacks too.<sup>5</sup>

\* "Prisoner's dilemma" refers, in g that gives both players dominant inc agreement to the contrary — to ch players a less desirable outcome than name derives from the problem of t may confess to a moderate crime in crime, an accuser going free unless receiving heavy sentences. See Luce ar

<sup>5</sup> A somewhat different, and rather to 0.2 and  $P_c$  equal to 0.6. The mo

0
-

R still has a "dominant strategy" o matter what C does. But in this ca Fig. 19, he is worse off than if nei knowledge of R's dominant strategy "irrationality," expressed in  $P_c$ , pro "self-defense"; but an element in tha defense motive — is R's possibility better than just meeting an incoming C, even when he tried, his pay-off in would be zero, not 0.5, and the modi

0
-

This "worsens" both pay-offs for R more than the lower. It therefore knows it, so the outcome is at join both players if the more "irrational even help them both if the "victim"

## SELF-DEFENSE ATTACK

... were institutionally possible and ... to give the players a chance to

... matrices is also unstable, though ... player C's likely irrationality requires ... attacking in self-defense; player C,

... game theory, to a configuration of payoffs ... incentives — in the absence of an enforceable ... loose strategies that together yield both ... if both had made opposite choices. The ... two prisoners, separately interrogated, who ... common or accuse each other of a heavy ... himself accused, the accused one or ones ... and Raiffa, pp. 94 ff.

... interesting, case occurs if we put  $P_r$ , equal ... modified matrix (for R only) is then:

	.2
4	.12

... of attack; he does better by attacking, no ... se, as distinct from the case portrayed in ... other side had elected to attack. It is C's ... r that causes them both to get zero. C's ... vides R with a motive for attacking in ... t motive — a small "impurity" in the self- ... of achieving surprise and thus of doing ... g attack. If R were incapable of surprising ... the upper right cell of the original matrix ... fied matrix for R would be:

	0
4	.08

... in the right-hand column, but the upper ... eliminates R's motive to attack, and C ... t no-attack. Not only, then, may it help ... " member is incapable of attack; it may ... is incapable of achieving surprise even in

## RECIPROCAL FEAR OF

The limits to the values of our  $P_c$  and  $P_r$  beyond which they make the situation unstable to attack, are — letting  $h$  stand for the cost of a surprise attack,  $-h$  the value obtained by attacking,  $0$  the value obtained by not attacking,  $1.0$  the value of joint no-attack, for

$$P_c < 1 - h$$

$$P_r < 1 - h$$

Figure 23 illustrates what happens for each player, and for each strategy, as  $P_c$  and  $P_r$  vary from  $0$  to  $1.0$ . Putting  $P_r$  equal to  $P_c$  in the game against  $P_c$  (based on the values for  $C$  and  $R$  as diagrammed in Figure 23)

“self-defense.” The condition for this special case, used in the next paragraph in the text, is

$$1 - h < P_c < 1$$

This point can be made more general. Suppose  $h$ , denoted by  $h$ , may exceed  $1$ ; if it does,  $1 - h$  is negative, and to attack when the other does not, both players gain. “Attack.” They both gain zero, when they have abstained. Suppose, now, that the value of a unilateral attack is only  $Qh$ . If  $Qh$  is less than  $0$ , a strictly preferred solution at joint no-attack is “irrational” attack, the game is stable. Suppose that  $P_c$  and  $Q_c$  meet the first of the conditions of advantage, as well as  $C$ 's, that the second condition,  $R$  should wish that  $Q_r$ , his own surprise capacity, should be less than  $(1 - P_r)/h$ . Only then can  $R$  be zero. If  $R$  can, at his own expense, improve his own surprise capacity in any limit, he should do so. The principle is that of the fox and the grapes: what distrustful, who keep two separate vaults, should do at his own expense; only then can they do so.

<sup>6</sup> A more general formula, covering the case where  $R$  has two strategies,  $R_{12}$ ,  $R_{21}$ ,  $R_{22}$  to denote the pay-offs to  $R$  if

$$\frac{P_c R_{12} + (1 - P_c) R_{21}}{1 - P_c} < \frac{R_{22}}{R_{12}}$$

The numerator is the “cost” of erroneously failing to attack. The denominator is the “cost” of erroneously failing to attack.  $P_c$  is the probability of a departure from, and adherence to, a “rational” strategy.



two parameters,  $P_r$  and  $P_c$ , be-  
 ion unstable and provoke joint  
 he value obtained by unilateral  
 tained by being attacked while  
 ed by simultaneous attack, and  
 or each player —

$$- h_r,$$

$$- h_c.^6$$

ens to the “value of the game”  
 ategy, as one of the  $P$ 's varies  
 0.2, and plotting the values of  
 the matrix of Fig. 19), yields  
 ed. At  $P_c = 0.5$ , the game be-

cial case, in terms of the parameters

$$1/(1 + h).$$

suppose the value of “winning” a war,  
 and if it is always a winning strategy  
 a players have dominant strategies at  
 y might have had more if they could  
 probability of achieving surprise, and  
 expected value to be achieved through  
 than 1, we are back to a matrix with  
 tacked; and, allowing for the probability  
 e if  $P_c < 1 - Q_c h$  and  $P_r < 1 - Q_r h$ .  
 these conditions: then it is to R's ad-  
 ondition also be met. If  $P_r$  is beyond  
 own capacity for surprising an enemy,  
 hen can he, and C, gain more than  
 ove his “enemy's” alert system, or if  
 a visible way, to hold  $Q_r$  below the  
 e same as that of two partners, some-  
 private padlocks on the partnership  
 the other should provide it to him at  
 business together.

e nonsymmetrical case, and using  $R_{11}$ ,  
 n row 1 col 1, row 1 col 2, and so on,

$$P_{22} - R_{12}$$

$$P_{11} - R_{21}$$

sly attacking; the denominator is the  
 The criterion is the same, it may be  
 obabilities rather than probabilities of  
 ional” behavior pattern.

comes unstable, and the value of the game to both players.

That this game does not quit being a game of "compounded probabilities"

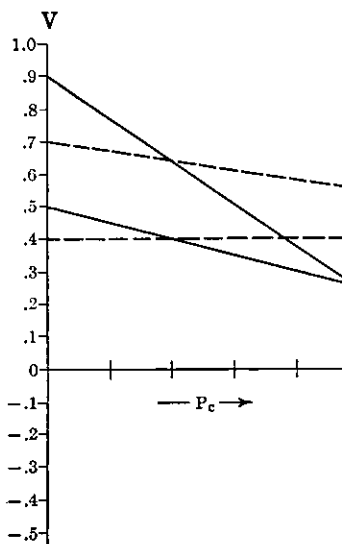
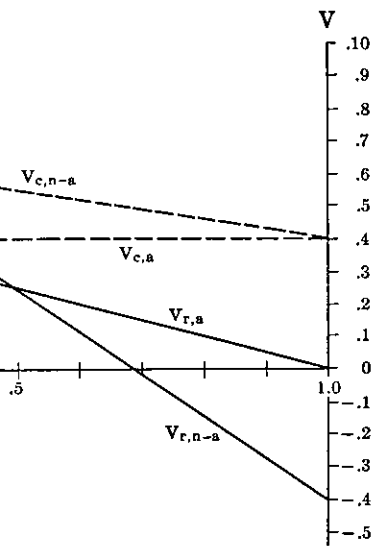


FIG. 23. Value of the game to R.  $V_{r, n-a} [= 0.9 - 1.3P_c]$ : value of game to R, no attack;  $V_{r, a} [= 0.5 - 0.5P_c]$ : value of game to R, attack;  $V_{c, n-a} [= 0.7 - 0.3P_c]$ : value of game to C, no attack;  $V_{c, a} [= 0.4]$ : value of game to C, attack.

can ignore the lesser of the two values. If both are below the critical limit, the game is a game of attack; if one is over the limit by even a small amount, whether the other is 0 or 1.0, the game is a game of defense. What they do to the value of the game is to cause the players to shift from a strategy of attack. But they do not change the *likelihood* of attack either is confidence or becomes certainty.

## THE ATTACK

of the game goes to 0 for both  
 correspond to the original notion  
 is exemplified by the fact that we



and C, as a function of  $P_c$ ;  $P_r = 0.2$ .  
 game to R, joint strategy of no-attack;  
 e to R, who attacks while C elects not  
 of game to C, joint strategy of no-  
 e to C, who attacks while R elects not

o parameters if they are unequal.  
 mit, it does not matter what they  
 ver so little, it makes no difference  
 They can thus be potent beyond  
 joint nonattack, because they can  
 om a strategy of no-attack to a  
 so in an all-or-none way. The *like*-  
 ned to the exogenous likelihoods,



## ANCE OF MOVES IN TURN

try a game with *moves-in-turn* have been using. Suppose R is or not, while C is constrained to *after* R has had an opportunity to and only *if* R has not attacked. game, by letting C have a still that C gets a turn, then R, then R a still earlier turn, so that R chooses, then C chooses (as long

At his last move, C will *elect* not Fig. 19; he actually will attack, his own last move, R knows what dictable choice that depends on how what R will choose, takes  $P_r$  dictable choice. At the move before se to do on both subsequent occa- probability,  $1 - (1 - P_c)^2$ , that C t two moves, and makes his own and so on. If each player has  $n$   $P_c$  of irrational attack *at each* whether  $\bar{P}_c = 1 - (1 - P_c)^n$  and conditions derived earlier. If so, r will not subsequently choose to to at all turns. But if  $\bar{P}$  exceeds ll prefer to attack and the other urn attacks at once.

pounding probabilities, but still without either player having to ity parameters in the compound- ility for at least one of them is enough to cause the first player ks. And, if we make the over-all ck independent of the number bility at each turn be equal to

$1 - (1 - P)^{1/n}$ , so that the com  
 the outcome of this game is *inde*  
 If we think of this game, then, a  
 think situation, with each turn s  
 of suspicions, we have a model in  
 fears of what each other fears n  
 is "objective" basis for one of  
 abstain.

#### RECONSIDERATION

The same seems to be true no  
 downstairs. If he behaves "ration  
 hypothesis above, he must cons  
 shoot him out of sheer preferenc  
 may shoot him if I think there is  
 shoot me out of sheer preference.  
 two basic (exogenous) "likelihoo  
 further. Either these basic probab  
 least one of us shoot to forestall s  
 shoot, so that the second and hig  
 or else they are insufficient by t  
 shoot in self-defense, and we kn  
 beyond the exogenous likelihood  
 plainly see that neither would b  
 out of fear of the exogenous pro  
 wants to shoot, then we ought  
 needs to fear preclusive action,  
 that the other fears it, and so on.<sup>7</sup>

But a different situation obtai  
 but by nervousness. Suppose th  
 how frightened I am, and my  
 think it that he may shoot me; an  
 Then when I consider the exog  
 shoot me out of sheer preferen

<sup>7</sup> For example, if the two could just  
 understanding, they could reach an inf  
 that would leave no incentive to cheat  
 parameters are clearly evident to both

## ATTACK

compounded total is just  $P_c$  or  $P_r$ , independent of the number of turns. As an *analogy* of the he-thinks-I-symbolizing a cycle in the spiral in which the successive reciprocal make no difference: either there are the players to attack, or they

## OF THE PROBLEM

Now if we go back to that burglar "really" as defined in our behavior consider the likelihood that I will be caught; and he must consider that I have a strong likelihood that he will be caught. But, if we both know what these "goods" are, we need not go any further. If the probabilities are sufficient to make it a surprise, and hence to make both our degree fears are superfluous, they themselves to make either of us know it and have nothing to fear towards themselves. If we both can be quite induced to shoot solely on the probability that the other "really" will be able to see that neither of us can, that neither then needs to fear

means if I shoot not by calculation but that my nervousness depends on how likely I am to be caught; and suppose he acts the same way. The nervous probability that he may be caught, it makes me nervous; this

we can communicate and check each other's formal agreement not to *elect* to shoot — assuming, still, that the two basic conditions of them.

## RECIPROCAL FEAR O

nervousness enhances the likelihood of shooting, though I prefer not to. He sees that I am shooting at himself; that scares me more, and I shoot. He sees this increment in my nervousness as one of his own, scaring me further, and my will shoot goes up again. Now we have nervousness as a function of the other's shooting as a function of nervousness, and simultaneous differential equations to describe this kind of phenomenon we started with.

And the reason they do is that we lack the *criteria for decision*; that is, a hypothesis that tells us which strategy to select. Instead, our "nervousness" makes us respond to the fear of attack by attacking, so they will themselves attack. On the *probability* of a player's decision to shoot — that is, not with a normal distribution — relates his best strategy and follows a "mutual aggravation" phenomenon described in the beginning of this chapter.

Now, does this mean that our "nervousness" can be displayed by rational, decisive players? Can a player reacting to a change in information, by *deciding* to shoot "what more probably" than before, be nervous, in which case our theory is not purely intellectual; but can we conceive of a player taking another look at the burglar's strategy on his roulette wheel? <sup>9</sup>

<sup>8</sup> There is an important asymmetry in the model we have allowed for the possibility that one player knows it — the "nervousness" of the other. (One may *not* shoot when he ought to, but there will be some chance that the burglar has won, and I may know that there is such a chance, and so forth.) This possibility would appear to increase the likelihood of a *decision* to attack as a result of an advertent or irrational attack.

<sup>9</sup> Note that the usual rationale for a





Of course, individual and group behavior in this regard. We could think of a group of different members having different thresholds of reaction to surprise, so that the size of a vote to attack is a function of the estimated likelihood of being attacked, and is heavily on chance factors, such as the *probability* of the required majority. We could also have a rising function of the probability of being attacked, which in turn is a function of the probability of surprise. So we can get the phenomenon of surprise players if we deem rational a cost-benefit analysis and values and a voting system.

There is, however, a way to avoid the problem of a single, decisive, rational game player. It is a generalization in partnership and surprise, which directly involves a significant partnership surprise, namely the dependence of the warning system, and the possibility of errors in the decision process.

#### PROBABILITY-BEHAVIOR IMPERFECT WARNING

Presumably the danger of surprise is reduced by the use of a warning system, but it is not infallible. A warning system may cause us to identify an attack as nothing, or it may cause us to identify an attack as something, and provoke our inadvertent response. The possibilities of error can presumably be reduced by more money and ingenuity on the part of the defender. If, in expenditure, it is generally true of a warning system that the criteria with respect to the warning are with respect to the other. To re-

---

readjusting one's roulette wheel for de-  
case.

## THE ATTACK

Group decisions may be different in a collective decision by vote, with different value systems and hence different probabilities of being attacked, an attack would be a function of the probability of being attacked. If the vote also depends on the presence of absentees on voting day, the probability in favor of attack becomes a function of the enemy's own decision, and the first collective player's probability of being attacked. The phenomenon we want for "rational" collective player that has divergent

to adapt our model even to the individual player. It may be of fairly wide applicability to surprise-attack problems. And it is a part of the actual problem of military decision on an imperfectly informed enemy of both "type-1" and "type-2"

## THE PROBLEM GENERATED BY AN WARNING SYSTEM

Offering a surprise attack can be a function of a warning system. But the warning system may err in either way: it may identify an attacking plane as a seagull, and do so by identifying a seagull as an attacking plane, or it may identify a seagull as an attacking plane, and do so by identifying an attacking plane as a seagull. Both errors may be reduced by spending more on the system. But, for a given expenditure, a tightening of decision criteria that a tightening of one kind of error loosens them may require less evidence of incoming attack. The probability of a decision — has no relation to the present

## RECIPROCAL FEAR OF

attack before "retaliating" is to retaliate. We are really seagulls for holding back.

But now we can have a model that corresponds to an estimate of the probability by an overt *decision* to act or abstain. The *likelihood that he may mistakenly attack* increases in the probability of being attacked. For decision that are used in the world of lesser likelihood of a failure to retaliate, of greater likelihood of a false "retaliation." If each player's response to a surprise attack is to enhance his own deterrent attack, the *probability* of each is a function of the other's.<sup>10</sup> Such a model is a mechanical counterpart of our nervous system.

To build such a model (symmetrical) again let  $h$  denote the value of "losing" a war,  $o$  the expected value (50-50 chance of winning or losing) at all. (This time we can let  $h$  exceed  $o$ .) The matrix below remains below  $o$ . For a Pyrrhic victory,  $h$  will be a small positive number. A successful surprise wins the war; "surprise" one attacks when the other does not. The system fails him. Let  $R$  denote the probability of a winning system, that is, the probability of a system that can be identified and surprise forestalled. The matrix is as in Fig. 24.

The probability that a player will attack, that is, that he will attack when his ratio of attack to defense is greater than one, is denoted by  $A$ . One, denoted by  $A$ , is the exogenous probability of an attack; it excludes the possibility of a surprise attack. The probability of an attack

<sup>10</sup> As noted below, this is not necessarily true. A player who is attacked is associated with reduced vulnerability. It is possible for one's response to be in the opposite direction from that in the text.

require more evidence that they  
 k our own planes.

of a rational decider who re-  
 bability of being attacked *not*  
 tain, but *by adjusting the like-*  
*attack*. One's response to an in-  
 attacked is to shift the criteria  
 warning system in the direction  
 respond, and hence in the direc-  
 alarm that provokes one's own  
 onse to an increased danger of  
 own proclivity toward inadver-  
 n player's attack is now a rising  
 warning system is the rational,  
 viousness in facing the burglar.  
 trically, for simplicity) we can  
 "winning" a war,  $-h$  that of  
 value of simultaneous attack  
 g), and 1.0 the value of no war  
 ceed 1, as long as  $(1 - R)h$  in  
 1. But if "winning" gains a  
 fraction.) We assume that suc-  
 successful surprise" means that  
 ot *and* that the other's warning  
 e reliability of a player's warn-  
 that an attack, if it comes, will  
 lled. Then the pay-off matrix

will attack when he should not,  
 onal choice "should" be against  
 er), will consist of two parts.  
 eous likelihood of irrational at-  
 of an attack provoked by false  
 ack through false alarm is de-

riety so; if increased danger of being  
 ability of the enemy to surprise attack,  
 he direction opposite to that described

noted by  $B$ . Thus the two types are represented by  $B$  and  $(1 - R)$  is that  $B = f(R)$ ,  $f'(R) > 0$ . Thus, as a source of error, the more

	I
i	0
ii	$(1 - R_r)$ $-(1 - R_r)h$

F

Each player's strategy choice is  $B$  and  $R$  that will minimize his expected value of the game. Player  $R$  is to choose the pair of values  $B = f(R)$ , that maximizes<sup>11</sup>

$$\begin{aligned}
 V_r &= (1 - P_c)(1 - P_r) + P_r(1 - P_c) \\
 &= (1 - A_c)(1 - B_c)(1 - A_r) \\
 &\quad + (A_r + B_r - A_r B_r)(1 - A_c) \\
 &\quad - (A_c + B_c - A_c B_c)(1 - A_r)
 \end{aligned}$$

Additionally, pursuant to the model, we examine the resulting "modified" game using these "optimal" values of  $B$  and  $R$  observed (or expected optimal) values. A joint no-attack is still the joint preference for a joint preference at the time of warning systems, would be:

<sup>11</sup> It is assumed for convenience of the model that the cost of a false alarm is the same kind of a cost as the cost of a surprise. The cost of  $B$ , which probably ought to be the cost per unit of time, while  $(1 - R)$  is the cost of a false alarm, and  $A$  might have some of both elements fixed in this model.

## SE ATTACK

s of error in the warning system are  
 ; and the main feature of the model  
 that is, the more we reduce  $(1 - R)$   
 we increase  $B$ , and vice versa.

### II

0	$-(1 - R_c)h$ $(1 - R_c)h$
$(R_r)h$	1 1

FIG. 24

ce concerns the pair of values for  
 s expected losses, that is, maximize  
 e for him. Letting  $V_r$  denote the ex-  
 $R$ , the warning-system problem for  
 lues for  $R$  and  $B$ , consistent with

$$\begin{aligned} & (1 - P_c)h(1 - R_c) \\ & (1 - P_r)h(1 - R_r) \\ & (1 - B_r) \\ & (1 - A_c)(1 - B_c)h(1 - R_c) \\ & (1 - A_r)(1 - B_r)h(1 - R_r). \end{aligned}$$

earlier matrix analysis,  $R$  should  
 d" pay-off matrix that results from  
 of  $R_r$  and  $B_r$ , together with the ob-  
 values of  $R_c$  and  $B_c$ , to see whether  
 tly preferred outcome. The condi-  
 no-attack, with optimally adjusted

illustration that an inadvertent attack due  
 attack as a premeditated attack, with the  
 Also, we are ignoring the time dimension  
 ought of as the probability of false alarm  
 e probability of error per incoming attack,  
 ments. Thus the time horizon is assumed

## RECIPROCAL FEAR C

$$P_c = (A_c + B_o - A_c)$$

$$P_r = (A_r + B_r - A_r)$$

With symmetry, the denominator is just 1.

Actually, as will be seen below, it is unnecessary; for certain beliefs about the adjustment of  $R$  and  $B$  (for any given  $P$ ) that the conditions for stability are satisfied.

It remains to be specified how the players are speaking, we can make either one player more or less to the difference between the "tacit game," and a "bargaining game."

## DYNAMIC ADJUSTMENT

First we may try supposing that the probability of being attacked as given is a variable in his own loss function, and the reliability of his opponent's war effort. *observes* the values of his opponent's  $B$  and  $R$  pair of values for own  $B$  and  $R$  and his losses. This assumption tends to make  $B$  a rising function of the probability of attack. (It only "tends to," since a corresponding change in the other's behavior, as mentioned below.) Each player is continually adjusting their value of  $B$  on the other's  $B$  and  $R$ , but always using the current probability of being attacked as a function of the other's behavior as a function of the current probability of being attacked. "multiplier" system — stable equilibrium. parameter values and shape of each player's optimum value of  $B$  and  $R$  solve the two equations, and determine the equilibrium. We can also consider



$$B_c) < \frac{1 - h(1 - R_c)}{1 - h(R_r - R_c)},$$

$$B_r) < \frac{1 - h(1 - R_r)}{1 - h(R_c - R_r)}.$$

ers in the right-hand terms become

ow, this second examination may behavior hypotheses, "optimal" ad- value short of  $R = 1$ ) requires of the modified matrix be met.

ow the players behave. Broadly of three hypotheses, corresponding between "parametric behavior," a g game."

#### (PARAMETRIC BEHAVIOR)

that each player takes the prob- en, that is, as a parameter and not tion, and does the same with the rning system. That is, he directly onent's  $B$  and  $R$ , and selects the d  $R$  that minimize his expected to make each person's choice probability that the other will ace there is a possibility that the her's  $R$  provides an offsetting in-

If we think of the two players as es of  $B$  and  $R$ , each with an eye ways responding parametrically to g attacked and not projecting the his own, we get a simple dynamic or explosive depending on the f the  $f$  function. We can express f  $B$  as a function of the other's, educe the stability conditions for mpute "multipliers" relating each

player's changes of  $B$  and  $R$  to changes in the  $A$  parameters.

Explicitly, to find the "par" player  $R$  we maximize  $V_r$  with  $f(R_r)$  but treating  $B_c$  and  $R_c$  as earlier for  $V_r$ , we get

$$f' = \frac{P_c h(\dots)}{(1 - P_c) [1 - h(\dots)]}$$

and, for  $h(1 - R_c) < 1 > h(1 -$

Since  $f'$  is presumed positive, the if  $V_r$  is to be maximized with  $R$  denominator be positive is precisely meet in order that player  $R$  still both players have optimal adjustment values of  $R$  and  $B$  are also perfect reference at no-attack.

The relation of  $B_r$  to  $B_c$  under is, the slope of the resulting function value for given values of  $B_c$ , is the sides of the above equation:

$$\begin{aligned} \frac{dB_r}{dB_c} \text{ (along player R's behavior)} &= \frac{f'}{f''} \frac{df'}{dB_c} = \frac{f'}{f''} \left( \frac{\partial f'}{\partial B_c} + \frac{\partial f'}{\partial R_c} \frac{dR_c}{dB_c} \right) \\ &= \frac{f'}{f''} \left( \frac{\partial f'}{\partial B_c} + \frac{\partial f'/\partial R_c}{\phi'} \right) \end{aligned}$$

where  $B_c = \phi(R_c)$  denotes the cost  $C$ .

Since  $\partial f'/\partial R_c$  is negative, small  $R$ 's  $dB_r/dB_c$  negative; it does so to prevent attack enough to outweigh being attacked. In other words,  $B_r$  but of  $\phi(B_c)$  as well;  $B_r$  tends to be lowered for a rise in  $R_c$ , while consider moving out the  $B_c$  axis.

## ATTACK

shifts in the  $f$  function or to  
 "symmetric-behavior" function for  
 respect to  $R_r$ , subject to  $B_r =$   
 fixed. Using the formula given

$$\frac{(1 - B_r)}{(1 - R_c)] - P_c h(1 - R_r)}$$

$$R_r), f'' > 0.$$

The denominator must be positive  
 $< 1$ ; but the condition that the  
 is precisely the condition that  $P_c$  must  
 prefer joint no-attack. Thus, if  
 arguments with  $R < 1$ , those optimal  
 force consistent with joint pref-

er this behavior hypothesis, that  
 function that yields  $R$ 's optimal  $B$ -  
 obtained by differentiating both

$$\text{or function)} = \frac{dB_r}{dR_r} \frac{dR_r}{df'} \frac{df'}{dB_c} \\
 + \left( \frac{\partial f'}{\partial R_c} \frac{dR_c}{dB_c} \right) \\
 )'$$

corresponding function for player

All values of  $\phi'$  may make player  
 by raising the "cost" of inad-  
 though the increase in the risk of  
 $B_r$  is a function not just of  $B_c$   
 to be increased for a rise in  $B_c$   
 the  $B_c$  and  $R_c$  rise together as we

## RECIPROCAL FEAR OF

A stable equilibrium requires that  $dB_c/dB_r$  should have a product less than one, measured vertically and  $B_c$  horizontally, to intersect  $R$ 's from below. The general effect of changes in the  $B$ 's and  $R$ 's to changes in the values of the  $A$ 's) is to increase the value of  $A_r$  in the denominator.

As remarked earlier, the denominator of the matrix disappears, and  $R_r$ ,  $B_r$ , and  $f'$  rise, a condition for an unstable matrix. (Stability of a game, as distinct from stability of an equilibrium, is not a relevant concept for this hypothesis; to contemplate the matrix of a player's action is to project his behavior, and to project his behavior is to project his behavior, and so on.)

It may also be noted that play is not a concern of calculations. It drops out of the formal analysis. Intuitively, this is because the only concern is the value of  $R_r$  or the value of  $B_r$ , and the contingency that  $R$  not launch "i" and  $R$  are irrelevant to him. (How can  $R$  be irrelevant for a stable matrix, since it does not meet the condition? So in projecting  $C$ 's action,  $A_r$  into account. But "projecting"  $A_r$  into account, observing  $B_c$  and  $R_c$  continuously, is a parametric, contradicting the present hypothesis. If we were considering the value of  $A_r$  in a warning system,  $A_r$  would affect the probability that the system is in a state of consideration is outside the present hypothesis.)

## A TACIT

We can make another behavior hypothesis that yields the same result. Instead of supposing that the other's  $R$  and  $B$  are adjusted to his, he responds to them; we can suppose that the technological opportunities of the

that player R's  $dB_r/dB_c$  and C's less than 1, that is, that with  $B_r$  constant, C's curve should intersect horizontally, C's curve should intersect "multiplier" expression relating shifts in the functions (or to contains 1 minus this product

denominator in the expression for  $f'$  rise sharply, as  $h$  approaches the (Actually, stability of the matrix of a parametric-behavior equilibrium for the parametric-behavior matrix and to anticipate the other's not to observe it and adapt to

player R may ignore  $A_r$  in his calculation for optimum  $B_r$  and  $R_r$ . Only contingency in which *either*  $A_r$  can make any difference is the "irrational" attack; if he does,  $B_r$  never,  $A_r$  does affect the condition enter into the condition that  $P_r$  adjustment, R would have to take account of C's behavior, rather than just  $A_r$ , would make R's behavior non-rational hypothesis. If player R spends money to improve his calculation since it affects  $A_r$  makes any difference; this conclusion.)

## GAME

the hypothesis, which may lead to assuming that each player sees how the other behaves, takes them as given, and realizes that each player knows the behavior of the other player — the functional

relation between  $R$  and  $B$  for each to reliably observe how the other chooses  $B$ . That is, each understands the other's strategy in the system, but can never be sure just what the other is given on how to interpret the other's strategy in the system — the other's decision to cooperate in a noncooperative game, in which each chooses  $B$  (that is, for  $R$ ), not knowing what the other has chosen but knowing the other's strategy.

In this case, we have a "Nash equilibrium point" at precisely the point, where the behavior hypothesis yielded a stable outcome. What was the "solution" under the behavior hypothesis is still a candidate for being the "solution" under the rational hypothesis. (The point is not necessarily unique. If it is, the outcome depends on initial conditions and tends to complicate the identification of "solution" strategies.)

This solution, of course, is in the nature of an example of "prisoner's dilemma." As the reciprocal increases in the value of  $B$ , the likelihood of attack by each player increases for the two  $B$ 's that would maximize the probabilities of deliberate attack. If the  $A$ 's are equal, an attempt at a bargain at all, that is, no possibility of a preferred bargain for the two players. (The bargains that gave them identical

<sup>12</sup> An *equilibrium point*, in game theory, is a point where each player's strategy is optimal, given the strategies of the other players such that each is optimal vis-à-vis the other (such points.)

<sup>13</sup> Economists may find the situation where each player allocates their limited productive resources between "security against false alarm," "security against surprise," involves a trade-off.

<sup>14</sup> If the  $A$ 's,  $B$ 's, and  $R$ 's are equal, the value of  $V$  has a maximum at  $B = 0$ . (If  $B$  has a maximum, it can attribute it to  $A$ .) If  $B$ 's and  $R$ 's are equal,

$$dV_r/dB = -2(1 - B)(1 - A)$$

## THE ATTACK

or the other player — but cannot  
has adjusted the values of  $R$  and  
the mechanics of the other's warning  
just what instructions the other has  
evidence that comes in over the  
rule. This hypothesis yields us a  
each player must choose a value  
knowing what value the other has  
pay-off matrix.

pay-off matrix with an "equilibrium  
if any, where the parametric-behavior  
equilibrium.<sup>12</sup> In other words,  
the parametric-behavior hypoth-  
esis is called a "solution" in the non-  
(In neither case is the equilibrium  
is not, the first hypothesis makes  
conditions and "shocks"; the sec-  
ond is the intellectual problem of identifying

inefficient for the two players. It is  
lemma," mentioned above (p. 214);  
values of the  $B$ 's have simply raised  
each side.<sup>13</sup> There are lesser values  
that make both parties better off; and if  
a sneak attack by the two players  
in agreement to have no warning sys-  
tem, with a possibility of false alarm, would be the  
best for both parties if they were restricted to  
local warning systems.<sup>14</sup>

theory, is a pair of strategies for the two  
players à-vis the other. (There may be several

one reminiscent of two producers who both  
produce between two commodities. One com-  
modity "involves external economies; the other,  
external diseconomies.

Let  $V_r$  and  $V_c$  be equal to  $(1 - P)^2$ , which  
is some minimum value greater than 0, we  
know that  $V_r$  and  $V_c$  are equal but the  $A$ 's are not,

$$V_r = (1 - A_r)(1 - A_r) + (A_c - A_r)(h/f'),$$

If we consider the possibility of reducing the sensitivity of their mutual reductions in  $B$  at the cost of increasing that enforcement of such an agreement is no very convincing way of determining further specification of the bargaining has to be symmetrical and the game they negotiate over a *common*  $p$  result is as just mentioned —  $0$  or  $0$  for  $R$ , no warning system at all. If identical, there is some critical difficulties of deliberate sneak attacks ( $A_r$  and  $A_c$ ) beyond which a side can reach an agreement on the abolition of

But, in general, this becomes a wider open than the present. It is even wider open than the present. The players may not only manipulate the course can now threaten direct additional arrangements that determine

There is an enforcement difficulty in the reduction of values of  $R$  and  $B$  in each other's values of  $R$  and  $B$  must depend — at least to an important degree will govern future decisions, not the technical mechanics of an alert system. One will wait to be "sure," and on an emergency. Furthermore, failure to do anything, leads to war itself; suits are out of the question if

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which can be positive with  $A_c$  greater than that of the players — the one with smaller  $A_c$  is the system even if it must be common to both but it involves lesser values for  $B$  and  $A_r$  (a cooperative game) would lead to, as can be seen if equal to  $0$  and comparing the resulting behavior to parametric behavior.



## ING GAME

of the two players' negotiating to alert systems, in the interest of most of smaller  $R$ 's, and assumption were possible, there giving a unique solution without bargaining framework. If the *solution game* is symmetrical, that is, if *pair of values for  $R$  and  $B$* , the values for  $B$ , even if this means 1. If warning systems are to be difference between the basic problem for the two people (between payment would be required for warning systems.

wide-open bargaining problem. present formulation suggests, since calculate values of  $R$  and  $B$  but of attack, or operate on the institution the values of the  $A$ 's.

ultly with any agreement on re- the mutual interest; it is that may not be observable. They depend extent — on the criteria that solely on the observable, physical. They depend on how long one that risks one will accept in an to keep the agreement, if it leads so recriminations and damage our model represents all-out war

than  $A$ , and  $f'$  small. In this case one — has a preference for *some* warning of them, compared with none at all;  $R$  than parametric behavior (or a non- be seen by putting the above expression formula for  $f'$  with that corresponding

rather than a border scrape or a war against another.

It might be that  $R = B = 0$  is a physical "absence" of any system, or that  $B$  is unavailable, as an enforceable agreement with  $R = 0$ , that is, with  $h > 1$ . A form of  $B$  is necessary to put  $h(1 - R)$  is less than 1.

It may also be difficult to have a system that recognizes the  $A$ 's, since it may be that one's  $A$  is above 0.

The players may be driven to either observably blunt their own attack force or observably improve their own attack force. Curves relating  $R$  to  $(1 - B)$ .  $B$  is to spend more on the alert system. The richer side may prefer to fire its own alert system, rather than leave it to the other's sense of insecurity or alarm. An agreement to design for a common potential, but instead have imbalanced attack themselves, would seem to be a possibility. Making  $R$  and  $B$  the terms of an agreement forced by the unobservability of the functions themselves, considering that both one's own alert system and attack force. (It should be noted that the warning systems — shifts of the reaction of less  $B$  for a given level of  $R$  in all cases stabilizing. Those that may lead to higher values of  $B$  for a given  $R$  from the point of view of the other player is analogous to an "improvement" in the other player's attack force. This raises each player's pay-off for a given level of  $R$  and  $B$ .)

The bargaining-game formulation is a bargaining-tactic analysis. For example, if one player knows it and the other knows it and ta

## THE ATTACK

a minor transgression of one part-

is qualitatively observable — the  
them at all. Even this possibility is  
system, if the matrix is unstable  
. In that case, some “risk” in the  
the  $R$ 's safely in the range where

have an agreement that explicitly  
y be politically difficult to admit

then to rely on arrangements that  
own capacity for surprise or ob-  
and each other's transformation  
Both sides may, for example, agree  
em, to make it more efficient; and  
nance improvements in the other's  
it in a form that either aggravates  
or makes him susceptible to false  
forces that have no surprise-attack  
proved vulnerability to surprise  
to be indicated. That is, instead  
of an agreement, they might be  
of  $R$  and  $B$  to work on the  $f$  and  $\phi$   
ng each of these functions to in-  
tem and the enemy's (partner's)  
ed, however, that “innovations” in  
f the  $f$  and  $\phi$  functions in the di-  
vel of  $R$  and vice versa — are not  
that raise the *marginal* cost of  $R$   
; these would be perverse innova-  
f the two players together, analo-  
ne prisoners' dilemma matrix that  
noncooperative strategies.)

ation also lends itself to bargain-  
, if one player acts parametrically  
akes it into account, the first dis-

plays a "reaction function"<sup>15</sup> w for  $V$  which the latter tries to n of "strategic moves" of the kin 7, are relevant to this version o discipline game.

MORE THAN

An interesting variant of the ber of players were increased, in as an autonomous agent. To quarters must be anticipated, duction of alert systems is reduc any two players in a larger ga jointly modifying their alert syst ger of false alarm, by taking int mies" for each other that they le parametrically. Two armed wat ing, each subject to some tempt better off if they could find som agreement to be a little less reac likelihood of shooting each oth problem is a representation of original parameters,  $P_c$  and  $P_r$ , that a man met in darkness is watchman. We have to introdu glar's behavior — that is, to let third participant trying to anti order to add complications to wh

<sup>15</sup> Compare the note on p. 151 regard

<sup>16</sup> Arthur Lee Burns, of the Austr some interesting problems of a thre provocation of war between two par possibility when an overt act of ambi the reciprocal-suspicion model; and t when one considers warning systems of joint custody, permit one or both coming in on the other's radar screen (Center for International Studies, Re University, 1959).

which goes into the other's formula maximize. In general, the analysis and discussed in Chapters 2, 5 and of the surprise-attack, partnership-

## TWO PLAYERS

problem would occur if the number or if a third player were brought to the extent that attack from other the incentive toward mutual reduced. It remains true, however, that some can find some advantage in terms, in the direction of lesser danger to account the "external diseconomies" leave out of account when behaving like watchmen patrolling the same building to shoot on sight, would be one way of reaching an enforceable agreement to shoot on sight, to reduce the danger. (Actually, the two-watchmen model, our original model, if we let our probabilities represent the relative likelihoods of a burglar rather than the other, and give some uncertainty about a burglar, would let him join the game as a rational player who anticipates the others' decisions — in the way that we already had.)<sup>16</sup>

Regarding the concept of "reaction function," the Italian National University, has discussed the two-or-more person world. The deliberate introduction of a mischievous third party, or ambiguous authorship can be introduced into the analysis takes on additional richness that, for technical reasons or by reason of the central players to witness what is going on. See his "Rationale of Catalytic War" Research Memorandum No. 3; Princeton

## SURPRISE ATTACK

"Disarmament" has covered a generous and some sentimental, friendly enemies to reduce the likelihood of violence. Most proposals have taken in the quantity and potency of "offensive" weapons and of weapons which incidentally cause great civilian casualties for this purpose. Some schemes have sought to identify particular areas of interest is conspicuous, where the where a significant start might be made would be a first step toward more comprehensive. Among these less comprehensive proposals against surprise attack have, since the "open skies" proposal in 1955, come in

The focus on surprise attack has been of interest in a more ambitious direction represents the philosophy of piecemeal, most likely, in order to establish a peaceful operation. The search for safeguards has generally been considered, in our view, as an *alternative* to disarmament and a possible step toward more.

Nevertheless, though schemes tend to be in the tradition of disarmament, they represent innovation. The original open-skies proposal has its basic idea that arms themselves are held as they are clearly held in reserve as a deterrent rather than aggressive.

## AND DISARMAMENT

a variety of schemes, some in-  
for cooperation among potential  
of war or to reduce its scope and  
taken as a premise that a reduction  
weapons, particularly of "offen-  
that either deliberately or in-  
gony and destruction, promotes  
ve been comprehensive; others  
ar areas where the common in-  
need for trust is minimal, and  
be made which, if successful,  
re comprehensive disarmament.  
schemes, measures to safeguard  
nce the President's first "open-  
creasingly into prominence.

as not reflected an abandonment  
ismantlement of arms; rather it  
cking an area where success is  
some tradition of successful co-  
ards against surprise attack has  
government and elsewhere, not  
, but as a *type* of disarmament

to avert surprise attack may be  
they represent something of an  
ies proposal was unorthodox in  
ves are not provocative so long  
ve — so long as their stance is  
The proposal was also unortho-

## SURPRISE ATTACK AND

dox in its dramatic reminder that, secrets from an enemy and in some about what our plans are, it can that the enemy is *not* left to spearward surprise attack against him *in such attack*. We are interested not our own eyes that he is not prepared interested as well in assuring *him* are preparing no deliberate attack.

The importance of not keeping analogue in our alleged political general Leslie R. Groves remarked in won't attack first, the Kremlin will attack us. . . . Our reluctance to advantage to us; but it is also, paradox a world conflict today." <sup>1</sup> We live centive on either side — perhaps total war with a surprise attack is for not going first. "Self-defense" if we have to worry about his striking him to keep him from striking us. lem, when viewed as a problem aggravated "self-defense," suggests we prefer not to keep, but militarily not to have.

Of course, it is even better if the either. So there may be advantage attack problem as one suitable for

The innovation in the surprise It has to do with what the scheme what armaments it takes for the scheme has as its purpose not just but to reduce or to eliminate the must assume that if the advantage nated or severely reduced, the income duced.

<sup>1</sup> *The New York Times*, December 29, 1946



important as it may be to keep the matters to keep him guessing be even more important to see that we do not speculate about our intentions too much. *In fact we are not planning any attack* only in assuring ourselves with respect to the possibility of an attack against us; we are not to be taken through *his* own eyes that *we* are not attacking *him*.

It is that particular secret has an ability to attack first. As General Eisenhower said in a speech, "If Russia knows we will be very much less apt to attack first is a military disadvantage. Paradoxically, a factor in preventing surprise attack in an era in which a potent incentive — to initiate attack — is the fear of being a poor second — becomes peculiarly compounded in making us to keep us from striking first. . . . The surprise-attack problem is one of reciprocal suspicion and aggression. . . . that there are not only secrets but also the military capabilities we might prefer

the other side does not have them. . . . It is in thinking of the surprise-attack or negotiation.

The surprise-attack approach goes further. The surprise-attack is designed to protect and prevent surprise attack. An anti-surprise-attack strategy is to make *attack* more difficult by making the advantage of striking *first*. It is the possibility of striking first can be eliminated. . . . The incentive to strike *at all* will be re-

It is widely accepted that the *power* virtually to obliterate the other is widely accepted that, if either side is hit with a clear blow, the nation so hit will strike back with equal or greater force, or will obliterate the other, what does the answer, of course, is that we are not counting on outliving the Russians by a day. A surprise attack might have the *power to retaliate* as to be unavailing. It is not our existing deterrents that deter a Russian attack against us after being attacked ourselves. Our deterrent, first-strike, if it came, would be our ability to rely upon for retaliation.

There is a difference between a deterrent that can obliterate the other and a deterrent that no matter who strikes first. It is the equality or symmetry in the deterrent that provides deterrence; it is the *stability* of the deterrent that is only when neither, in striking first, is able to strike back.

The difference between a deterrent and a deterrent is illustrated by another offensive deterrent that was ever devised.<sup>2</sup> The deterrent is that it is possible for *either* man to kill the other, but *both* would be killed. The deterrent system can be seen on TV almost always. A man striking first aggravates any incentive to strike first. I put it, "He was about to kill me and I killed him in self-defense." Or, "He, too, was about to kill me in self-defense, was about to kill me and I killed him in self-defense." But if he

<sup>2</sup> A military historian, commenting on the deterrent that has never yet been a weapon against a deterrent, a counterweapon or a defense, reminds us that "hand arms with fire-propelled missiles are found for the bullet" (Bernard Broderick, [1946], pp. 30-31).

## THE ATTACK

The United States has the military capacity to strike the USSR, and vice versa. And it is not the USSR that has been side struck the other a major nuclear power. It would have a powerful *incentive* to strike first. But, if either side can strike first, it matters who strikes first? The Russians are not particularly concerned with who strikes first; we are worried about whether the Russians are deterred by the threat of our capacity to destroy Russia that we have, but our capacity to retaliate. We must assume that a Russian nuclear attack will be aimed at the very power that

maintains a balance of terror in which *either* side can do it and one in which *both* sides can do it. This is not the "balance" — the sheer situation — that constitutes mutual deterrence. The balance is stable only if neither side can destroy the other's ability

to retaliate. A stable and an unstable balance is maintained by the weapon against which no good "equalizer" of the Old West made possible. It did not assure that the consequences of this weapon system were equal. The advantage of shoot-first is to shoot. As the survivor might be in self-defense, so I had to kill him thinking I was about to kill him in self-defense, so I had to kill both. Both were assured of living long

because of the alleged "historical truth" that there is no equalizer which man has been unable to devise against nuclear weapons. As the author says that "after five centuries of the use of nuclear weapons . . . no adequate answer has yet been devised," *The Absolute Weapon* [New York,

## SURPRISE ATTACK

enough to shoot back with unimpaired advantage in jumping the gun and the other would try it.

The special significance of surprise is the possible vulnerability of retaliatory forces themselves invulnerable — if each side's forces could survive an attack, but the other's power to strike back creates the temptation to strike first. And the temptation quickly to what might prove to be a costly mistake.

*Thus schemes to avert surprise attack have as their immediate objective the safety of the people.* Surprise-attack schemes, disarmament proposals, are based on the idea of total protection against attack. To stabilize mutual deterrence — to ensure the survival of weapon systems. And it is precisely the fear of people that an anti-surprise-attack scheme — the weapons of retaliation, to punish rather than to fight, to disarm him beforehand. A weapon that cannot possibly damage the other side is foundly defensive: it provides its own security first. It is the weapon that is designed to strike "military" targets — to seek out and destroy bombers — that *can* exploit the vulnerability of the other side and consequently provide a temptation to strike first.

In identifying the surprise-attack vulnerability of each side's retaliatory forces, we find the point where measures against surprise attack differ from more conventional notions of disarmament. At the source of a number of anti-surprise-attack schemes to be faced if we are to recognize the particular schemes and to comprehend their significance. At this point, also, that we begin to see that measures against surprise attack can be more comprehensive disarmament proposals. These measures instead are incompatible with other

impaired aim, there would be no and little reason to fear that the

surprise attack thus lies in the pos- forces. If these forces were them- side were confident that its own out also that it could not destroy k — there would be no powerful here would be less need to react e a false alarm.

*se attack have as their most im- weapons rather than the safety es, in contrast to other types of d on deterrence as the fundamen- They seek to perfect and to sta- enhance the integrity of particular ely the weapons most destructive attack scheme seeks to preserve he weapons whose mission is to hurt the enemy afterwards, not to on that can hurt only people, and her side's striking force, is pro- s possessor no incentive to strike designed or deployed to destroy out the enemy's missiles and e advantage of striking first and on to do so.*

ack problem as the possible vul- tory forces to surprise, we are at t surprise attack differ drastically s of disarmament. We are also omalies and paradoxes that have ze the virtues and defects of par- nd the motives behind them. It is gin to question whether schemes viewed as "first steps" toward nt in the traditional sense, or in- her forms of disarmament. Can

measures to protect SAC be viewed as a mantlement? Can we initially take steps to protect and safeguard each side's capabilities in the interest of mutual deterrence and the elimination of the threat of massive nuclear attack in a troubled world?

Or should we instead recognize that a surprise attack as a compromise — "mutual deterrence" as the best solution — is the most likely to find — and a recognition that it is possible to replace the balance of terror with a balance that may be much that we can do to make the world more stable than unstable.<sup>3</sup>

Once we have identified the possible vulnerability of either side to a surprise strike by the other, it becomes a matter of strength, defensive measures, and limitation of armament, with pre-emptive vulnerability in mind. We do not, for example, count Soviet strategic forces by counting their submarines, and aircraft carriers on the Atlantic coast to see who could put on the most powerful strike. "Who is ahead" in the arms race is not the *first*. And if we have to plan on the possibility that the other side will strike first, 2000 strategic warheads may be worth as much as 2000 tactical warheads in terms of survival.

An assessment of defensive measures for SAC is not if we put primary reliance on detection and concealment, buried in a blast-proof cavern, or on alert are meaningful defenses in the event of a surprise attack. An active air defense of Chicago

<sup>3</sup> In case the reader feels that the argument is a principle but uninteresting in fact because the possibility of retaliatory forces is assured beyond any doubt, see Albert Wohlstetter's cogent discussion in *Foreign Affairs*, 37:211-234 (January, 1959).

## ATTACK

ved as first steps toward its dis-  
like cooperative measures to per-  
capacity to retaliate massively, in  
ce, and do it as a step toward  
ve retaliation from a tense and

e measures to safeguard against  
— an implicit acceptance of “mu-  
rce of military stability we are  
on that though we may not be  
rrior with anything better, there  
make that balance stable rather

surprise-attack problem as the  
side's retaliatory force to a first  
necessary to evaluate military  
l proposals for the inspection or  
cisely this type of strategic vul-  
or example, assess American and  
g up the bombers, missiles, sub-  
both sides, as though we wanted  
st impressive peace-time parade.  
will usually be: *whoever strikes*  
he conservative assumption that  
oo bombers safe against attack  
at have only a 10 per cent chance

asures also comes out differently  
terrence. Chicago cannot be hid-  
vern, or kept 10 miles off the  
rsal, hard shelter, and airborne  
preserving the deterrent force.  
o that has only a 50-50 chance

ument presented here is correct in prin-  
the continuous invulnerability of our  
worry, I should like to refer him to  
in “The Delicate Balance of Terror,”  
(9).

## SURPRISE ATTACK

of saving the city from a multi-couraging prospect, and we have even do that well; but an active survival of a large fraction of could be more than enough to guarantee in retaliation. Similarly, a defeat enemy to triple the size of his army may mean only that he invests defense of our retaliatory force the size of his attack may substitute the difficulty of sneaking past our walls change his likelihood of success.

The same kind of calculation applies to arms limitations. If we look on an attack on American cities, it matters whether he shoots his ICBM's accuracy may not make much of a bomb fired at metropolitan areas a missile or bomber that has been with reinforced concrete, accurate average aiming error of two or shooting at a large metropolitan hard-sheltered retaliatory weapons get a direct enough hit. Thus *zomb* ICBM's might seem an ineffective conventional sense; but in states the vulnerability of each side's forces — the separation of each other's, by reducing accuracy, more unsheltered planes or missiles, is unfortunately pertinent.)

On some questions, emphasis may lead to a downright reversal from more traditional "disarmament case of a limitation on the number allowed to both sides (if we ever with Russia where an agreement were pertinent and inspection s



i-megaton bomb would be a dis-  
ve little promise that we could  
defense that could guarantee the  
our strategic striking force might  
ee the Russians a prohibitive cost  
nse of Chicago that requires the  
ttack may be a poor prospect; it  
in a larger initial attack. But a  
that requires the enemy to triple  
ntially increase the enemy's dif-  
arning system, and appreciably  
fully precluding retaliation.

is pertinent to an evaluation of  
ly at the problem of a Russian  
ay seem immaterial to the enemy  
from close up or from afar; ac-  
difference with a multi-megaton  
as. But if he is trying to destroy  
een sheltered deep underground  
acy is no longer superfluous. An  
three miles may be nothing in  
area; an attempt to knock out a  
on may require several missiles to  
*real limitations* on the placement of  
tual form of disarmament in the  
bilizing deterrence — in reducing  
retaliatory forces to the other's  
ch side's missile sites from the  
might make a real difference. (For  
of course, the city-target analogy

s on the surprise-attack problem  
l of the answer that one would get  
ment" considerations. Consider the  
ber of missiles that might be al-  
reached the point in negotiations  
t limiting the number of missiles  
eemed feasible). Suppose we had

decided, from a consideration of incentives, that we would need missiles left over after his first carry out an adequately punitive deter him from striking in the first his accuracies and reliabilities and has a 50-50 chance of knocking out 200, he needs to knock out just over 200, he needs to fire just over 200 times than 100. If we had 400, he would of ours; at a 50 per cent discount would need to fire more than twice. If we had 800, he would have to and to do it with 50 per cent reliability times that number, or more than initial number on the "defending" required by the attacker in order supply to below some "safe" number.

From this point of view, a limit would appear to be more stabilizing. *mitted*. This would be so for the number on both sides, the greater missiles expected to be left over for either side should strike first, a deterrence to an attempted first number of missiles on both sides and proportionate increase in have to achieve in order to be carried probability, that the other's than some specified number after difficulty of one side's cheating, by missiles, or breaking the engagement dominant number, is more than any increase in the starting figure numbers to begin with are high.

<sup>4</sup> This assumes that he fires his missiles in salvos, he has no means of reconnaissance salvos, which particular missiles have a

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of population targets and enemy  
a minimum expectation of 100  
counter-missile strike in order to  
retaliatory strike — that is, to  
first place. For illustration suppose  
are such that one of his missiles  
out one of ours. Then, if we have  
ever half; at 50 per cent reliability  
to cut our residual supply to less  
need to knock out three-quarters  
nt rate for misses and failures he  
twice 400, that is, more than 800.  
knock out seven-eighths of ours,  
iability he would need over three  
n 2400. And so on. The larger the  
ng" side, the larger the *multiple*  
er to reduce the victim's residual  
mber.<sup>4</sup>

mitation on the number of missiles  
izing, *the larger the number per-*  
two reasons. First, the larger the  
er is the absolute number of mis-  
for retaliation in the event that  
and therefore the greater is the  
st strike. Second, the larger the  
, the greater must be the absolute  
missiles that either side would  
pable of assuring, with any speci-  
s left-over missiles would be less  
er being attacked. Thus the dif-  
y disguising and concealing extra  
gement and racing to achieve a  
n proportionately enhanced by  
res on both sides. In fact, if the  
enough to strain the budgetary

s all together or that, if he fires successive  
ance that lets him know, on successive  
already destroyed their targets.

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capacities of the two enemies, and ties the number of missiles is high by the economic limitation on what to what it would have to do to achieve

Here is a case, then, in which a surprise lead to a more and more un- like equal numbers on both sides, wiping out the other side's missile missiles on both sides increase. An increase too. For small numbers of to 1 may provide dominance to the ing first and leaving the other side striking back. But if the initial number it may take a ratio of 10 to 1 ratio good chance of striking with im- panic if it falls behind a little bit, that it could draw far enough ahead nance it would need.

This greatly simplified view of specialized to be a strong argument disarmament. But it does demonstrate stable deterrence, and of schemes attack, the question of more vs. fewer on its merits in individual cases. that disarmament, in the literal sense

Our attitude toward missile submarine of devising submarine-detection affected by whether we are worried *surprise* attack. If the submarine fairly invulnerable site for anti- perhaps view it not as an especially as a reassuring one. If in fact the deterrence and we only want the polaris-type missile carried by a and endurance may be the kind of like to see in adequate numbers of to be both undetectable and high advantage of not needing to strike

within these budgetary capacities, stability might be imposed at either side could do relative ease mastery.

An "arms race" does not necessarily create an unstable situation. For anything, the likelihood of successfully striking becomes less and less as the ratio of the *tolerance* of the system on both sides, a ratio of 2 or 3 to 1 on the larger side, a chance of striking with a small absolute number of warheads on both sides are higher, rather than 2 or 3 to 1 to have a chance of striking. Neither side needs to have a great hope of striking and neither has any great hope of striking to have the kind of domi-

nant position a "missile duel" is much too unstable for arms races rather than a strategy that, within the logic of deterrence for the prevention of surprise attacks, nuclear weapons has to be analyzed. It is *not* a foregone conclusion that a nuclear arms race leads to stability.

Submarines, and toward the problem of detection techniques, should be much more concerned about enemy attack or enemy defense. It proves to be for many years a major development in population missiles, we should be much more concerned about this terrifying development but the best we can hope for is mutual deterrence. If the balance to be stable, then the development of a submarine of great mobility as a weapon system that we should have on both sides. If it should prove to be highly reliable, it would have the potential to be the first in order to strike at all,

of not fearing that an aggressive force that were supposed to be more reassuring if we had to have missile subs while he did not have them, but if the power already exists to destroy each other be itself sufficient side is in fact deterred. From this we should not even wish that we have a nuclear-weapon submarine; if we have or no political capacity for a submarine is helpful if the enemy were convinced of our manifest invulnerability to our advantage if it relieved him of a motive to try striking first. The posture of *his* strategic force to worry about it too.

These thoughts also affect our submarine detection. The Navy's system of defense against submarines is that we have to devote ourselves to perhaps we ought simultaneously to solve. If it were insoluble technical problem can ever be solved, destined to be comparatively stable deterrence might be technically prove to be vulnerable themselves than we hope. We have to *try* cannot afford to let the Russians know, and because we have to make our submarines less detectable has entered into an agreement of trust, we may search like the way our partner is searching just a hole is to found.<sup>5</sup>

<sup>5</sup> This paper being about principles is excused for pretending here that undetectability is equivalent to invulnerability.

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...sor might hope to knock out the  
...d to deter him. True, it might seem  
...he power to destroy the enemy's  
... have the power to destroy ours;  
... on both sides, and we cannot wish  
...n hope for is that this capacity to  
...ufficiently indestructible that each  
...n that point of view, we perhaps  
...lone could have the "invulnerable"  
...in fact we have either no intention  
...a first strike, it would usually be  
...nfidently assured of this. His own  
...ur first strike could be to our ad-  
...principal concern that might moti-  
... If *he* has to worry about the ex-  
...a surprise attack by *us*, *we* have to

...our attitude toward the search for  
...y is urgently seeking a better sys-  
...rines, and there is no question but  
...elves intently to the problem. Yet  
...sly to *hope* that the problem is in-  
... (in the relative sense in which a  
...e insoluble) and submarines were  
... safe vehicles for a decade or so,  
...nologically possible. If submarines  
...lves, arms technology is less stable  
... to detect submarines, because we  
...ns find a technique that we do not  
...o learn all we can about detection  
...detectable; but like a person who  
...nt with a partner that he cannot  
...devil for a loophole, knowing that  
...s hard, while hoping that no loop-

... not about submarines, I can perhaps be  
...etectability on short notice in the open sea

## SURPRISE ATTACK

Once we have pressed the argument to carry it all the way. If our problem is that we have the ability to strike first and struck ourselves — and to assure the enemy knows it so that we are under no illusion of our own deterrence and strike capability — technological discoveries that enhance the efficacy of our retaliatory weapons. We want to guarantee that a larger proportion of our population could survive a first strike on the part of the enemy. We welcome an increase in the power of our weapons. As Bernard Brodie has said, "We have the requirements of deterrence, with its emphasis on the threat of retaliation, we may find a new way to do it. Since the emphasis must be on the threat, the enemy will fear even the smallest number of weapons. In retaliation, one wants these before the event, as horrendous as they are."

The novelty of this reasoning is to recognize that the "balance of terror," which is a primitive and modern version of an ancient device of hostages. In older times, one nation would deliver its hostages physically to the other, a trustful "partner"; today's military strategy is to have the lives of a potential enemy within one's grasp while he keeps his weapons thousands of miles away. As long as one has the power to destroy a nation and is threatened by attack by the other, the "balance of terror" is understood backed by a total threat of hostages. We may not, of course, want to deliver hostages in support of this particular enemy. But in a law of deterrence course to damage suits for breach of contract, hostages may be the only device by which two and antagonistic partners can strike

<sup>6</sup> Bernard Brodie, *Strategy in the Missile Age*.

<sup>7</sup> It should be emphasized that I am not



argument this far, we may as well  
blem is to guarantee to an enemy  
like a punitive blow after being  
re him that we know that he  
temptation to doubt the potency  
e first — we should find virtue in  
enhance the anti-population po-  
t. If it is logical to take measures  
portion of our retaliatory forces  
em, the same logic should make  
potency of those that do survive.  
When we consider the special re-  
s emphasis on the punitive aspect  
eed even for super-dirty bombs.  
making certain that the enemy  
ber of bombs that might be sent  
ombs to be, and thus to appear  
as possible.”<sup>6</sup>

disappears as soon as we recog-  
' if it is stable, is simply a mas-  
ncient institution: the exchange  
committed himself to a promise  
cally into the hands of his dis-  
ary technology makes it possible  
l enemy's women and children  
eps those women and children  
g as each side has the manifest  
ts population in response to an  
e of terror” amounts to a tacit  
exchange of all conceivable hos-  
ant to exchange quite *that* many  
ticular understanding with this  
less world that provides no re-  
ach of this unwritten contract,  
e by which mutually distrustful  
like a bargain.<sup>7</sup>

*Missile Age* (Princeton, 1959), p. 295.

discussing only the problem of major

This line of reasoning is not a justification for an arms race. It does indeed point, in the literal sense, aimed in different directions — or even selectively aimed at different kinds — or even selectively aimed at different kinds of mass destruction — could probably, and might have to be considered, to be disastrous. Nevertheless, the limitations that is not only compared but is suggested by it.

It suggests making a distinction between weapons that are peculiarly suitable to surprise attack and weapons that are peculiarly suitable to surprise defense. At one extreme is the "pure" surprise attack weapon, a relatively inaccurate vehicle with a high probability of kill just about everything in the target area. At the other extreme is the "pure" surprise defense weapon, a well-protected or well-hidden retaliatory weapon that the other side might not know of. In between would be a weapon that would suffer no disadvantage in striking first and gain no advantage in striking first. It would be a weapon that is itself so vulnerable that it would lose most of its usefulness if the enemy's retaliatory force had already started. These weapons give their possessor a powerful incentive to jump the gun in the event of a surprise attack rather than to wait and make absolute retaliation to the enemy that one expects. They frequently invite the enemy to strike with haste in the event he thinks he can do so quickly.

Between the extremes of the "pure"

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surprise attack here. The implications of this defense policy depends on its relation to limited war, mischief by a third party, and the nature of these interrelations between surprise attack and surprise defense. This is touched on in the final pages of this

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simply an enormous rationalization. It would suggest that "disarmament" indiscriminately at weapons of all kinds and at the most horrifying weapons would produce instability rather than stability. It is *completely* successful in order not to be. There is an important area of arms control compatible with the foregoing analysis.

Comparison between the kinds of weapons and the exploitation of a first strike is suitable to the retaliatory role. A "strike-back" type of weapon: the "super-dirty" bomb that can destroy the enemy's country *except* a well-protected force, and that itself is so invulnerable to any attack that it might possess. Ideally, this weapon is waiting to strike second and not first. At the opposite extreme is a weapon that it could not survive to be specialized for finding and destroying targets before they are launched that is not successful if it were held until the other side's "strike-first" weapons not only provide an incentive to strike first, and an incentive of ambiguous warning rather than a warning that is sure; they are a tacit declaration of intent to strike first. They consequently induce a little before *that* and to act on the basis that we think it's time to act on the basis of a "pure" strike-first weapon and the

of the "hostage" concept for, say, civil defense to other contingencies as well — e.g., nuclear, less-than-massive retaliation, etc. One attack and other military contingencies are discussed in chapter.

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"pure" strike-back weapon, there are first but do not need to, that can serve the purpose but that also might have a side's retaliatory forces if used first in this category if reasonable precautions. So we cannot make a nice and second-strike weapons, extolling the other in our approach to the surprise to consider eliminating all weapons against the other side's retaliatory advantage in being used first, there which to promise retaliation.<sup>8</sup> But might usefully concentrate on the other

The most obvious candidates are weapons. It might seem anomalous they cover any nakedness of their suggest that we protect better so would be suggestions to abandon actively exposed to the other side. Not would be from the "ban the bomb" propaganda implications of such a of viewing deterrence as something mantled.

Second, restrictions on the deployment of their counter-force potency rather than potency might be sought. They will there is candid recognition that such be deliberately aimed at protecting strike-back capability. The discussion range on missile requirements, which suggests that this class of limitations

Third, there may be some useful measures, or mutually accommodated to reduce the danger of war by misapprehension change of information might help to unilaterally pick modes of behavior

<sup>8</sup> Furthermore, we are taking nothing into account here.

are the weapons that can strike survive and serve the retaliatory an important effect on the other st. Perhaps most weapons fall cautions are taken for their pro- distinction between first-strike ng the one and disparaging the ise-attack problem. If we were as that had any possible effect y forces, or that enjoyed any e might not be enough left with ut surprise-attack negotiations pposite extreme.

would be exposed, vulnerable s to insist to the Russians that strategic forces, or for them to ome of our own. More likely weapons that were provoca- ote how different in spirit this mb" orientation. Whatever the topic, it at least has the merit ing to be enhanced, not dis-

ployment of forces that affect than their counter-population l not be sought, however, until surprise-attack schemes are to ng, not degrading, each side's sion above of the effect of atever its specific merits, sug- is not an empty one.

ful exploration of cooperative ted modes of behavior, that re- prehension. Even voluntary ex- o, if we and the Russians can vior that, when the truth is but the surprise-attack problem into

known, are reassuring. This is a proposal for inspection of air targets; there may be some other type of arrangement that would be mutual benefit from some other type of agreement about these measures — as about the development of strike-first weapon systems. It is possible some understandings that are not formal agreements, and may be reached on both sides.

Fourth, there may be arrangements for dealing with emergencies that threaten to arise. A later section of this chapter discusses this.

Fifth, there may be measures that would make a first strike less likely, or that would lead back to the open-skies type of arrangement.

Most public discussion of arms control in the last few years has reduced the likelihood of surprise. It has shown what weapons could do if surprise was achieved. A proposal was based on the idea of mutual inspection of each other's military forces, and, lacking the advantage of surprise, it was rejected.

The technical problem of developing a system that could yield each side adequate information about the other has become much more difficult since the proposal was made. With hundreds of aircraft that might be launched, and with missiles promising to reduce the time for the initial actions in readying weapons on target, and with submarines that can keep under surveillance, the idea of inspection unaccompanied by a system of things to be inspected would be almost completely ineffectual. The idea of mutual inspection of strategic forces is obsolete. The problem now is how to maintain surveillance of strategic forces.

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is presumably the idea behind proposed traffic rules in the north polar area, and areas of activity in which there could be no traffic rules. What is attractive about a candid discussion of the evils of surprise attacks — is that they may make proposals that do not have to be embodied in international law to facilitate unilateral accommodations and arrangements to cope with crises and prevent them from exploding into an unintended war. The author discusses this point at some length. He argues that, by making surprise less attractive, the surprise attack becomes less attractive. This point brings us to the author's proposal.

The author discusses the surprise-attack problem in relation to measures that might reduce the chance of surprise, rather than measures to limit the damage if surprise were achieved. The open-skies concept, that with sufficient observation by both sides neither side could achieve surprise, would be deterred.

Providing a practical inspection scheme to give adequate warning of an attack by the other side is difficult since the first open-skies concept, hydrogen weapons reducing the number of warheads needed in a surprise attack, with the total time available between launching a strike and the explosion of nuclear mobile systems like missile submarines, it looks as though pure inspection would have many limits on the behavior of the other side. It would be enormously difficult or enormous to examine photographs for strategic movements and concentrations is simply not feasible. It would seem to be one of intensive surveillance by a vast organization that could

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transmit authentic messages report at most a few hours, and eventual way that is not intolerably susceptible. There is no practical assurance that this can be done.

This does not mean that inspection and surprise attack have no prospect of success. A scheme providing for *nothing but* inspection has no prospects. But if one cannot send out aircraft, missiles, and submarines, one can still consider calling the aircraft, submarines, and assemble where they are more easily inspected. If the deployment of forces are used to make them more manageable, something may be done. There may be promise in the idea of inspection. In view of weapon limitations, there are also

One is a possible incompatibility between inspection and the need for concealment. If inspection is sufficiently accurate, it may become almost impossible to protect one's own retaliatory forces. Concealment, or, if not impossible, except for inspection, concealment may then have to be used to protect retaliatory forces; if the enemy can find and kill anything he can hit, he has won. To the extent that he can have his forces under continuous surveillance he has won. To the extent that he can find their location.

In other ways an inspection scheme can provide protection against surprise attack. The lack of information about the disposition of the forces makes one more vulnerable. It is widely known that during a time when hurricane winds impeded the movement of a portion of the B-36's that then constituted a retaliatory threat. The implications for the future event are evidently very different. If the enemy knows only in a general way where our forces are, or if it happens to happen to us, or instead has definite information and knows exactly whether or not we are there, the days. Imagine the state of tension that



ing suspicious activity within  
ly within a few minutes, in a  
tible of false alarms. There is  
ould be done.

tion schemes against surprise  
ss. What it means is that a  
*inspection* may have very poor  
observers out to follow all the  
wherever they go, one can  
missiles, and submarines to  
ly watched. If restrictions on  
to make the task of inspection  
be accomplished. But though  
of combining inspection and  
serious problems.

y between the need for inspec-  
. When missiles become suffi-  
most physically impossible to  
es by the sheer provision of  
eedingly costly. Mobility and  
the source of security for the  
an hit anything he can locate,  
as to be made unable to locate  
e our own retaliatory weapons  
as continuous information on

eme on the scale required for  
might yield excessive informa-  
other's forces and make them  
n, for example, that there was  
mobilized an extremely large  
mprised our principal retalia-  
surprise attack of such an  
t, depending on whether the  
ay that this kind of thing can  
ite information when it occurs  
he has clear sailing for a few  
hat could occur if *either* side's

strategic-force personnel began to be threatened to immobilize them to prevent the other side's inspection. Much more difficult is to land in a very unorthodox way — impossible to prevent — that means to know too much about the other side.

Finally, while there may be a certain probability of providing warning of an attack, the value of the system is to do get warning. We can send out a warning hoping to get in first; but the warning is ambiguous. A false warning precludes any last-minute action.

At the other extreme we can do the things we can do to get ready for the possibility that his attack will succeed and that we can retaliate severely. A demonstration to the enemy that our improved posture will deter him is a possibility.

The important question is whether we are ready. If the answer is simply "no," are we more alert in the first place? More alert would do if he had warning of an attack. He probably would like to do perpetual surveillance of an attack. And if our system is continually doing its best to reduce the number of ready and off the ground in the air, the doors tightly shut on sheltered aircraft in the air in combat-ready condition, they can do on short notice.

Nevertheless, there are things we can do of imminent attack that it could be done. One can evacuate or destroy the target. One can get his retaliatory force ready if they are no longer targets for attack. One can stay in the air forever. One can be on duty, but not for many days if

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to suffer a severe epidemic that temporarily before the eyes of the better — if we and they are occasionally alert for reasons that are neither of us should be in a position to overcome the other's occasional disabilities.

The arrangements that have a high probability of the enemy's preparation for an attack depends on what we can do if we launch off our own anticipatory strike, which is an unattractive course if the false alarm then leads to war. And a minute deterrence.

Just wait and "get ready." And if this ready appreciably reduce the likelihood of an attack — if they raise the likelihood of an attack — we may want to make a quick show that we are ready, in the hope that this will influence the enemy's final decision.

What we do that constitutes getting ready, "Be more alert," why weren't we more alert? Most of the obvious things that one does in the face of an attack are things that one probably does in view of the ever-present possibility of an attack. Our Strategic Air Command is concerned with the time it takes to get aircraft into the air in the face of warning, or to keep the aircraft on the ground, or to keep aircraft safe in the event of an attack. In addition, there may not be much more

that a nation can do in the face of an attack. One could not do continuously and indefinitely underground, but not forever. One can put forces safely off the ground, where they are safe from enemy bombs; but they cannot be put on twenty-four-hour duty in a row. One can ground all com-

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mercial aircraft to raise the reliability, but the economic loss might be great if private flying were foresworn for making enemy aircraft more recognizable, things that one can do to prevent an unexpected attack that one cannot prevent.

But there is another question. Suppose we cannot physically keep the number of aircraft aloft at the same times, as is true, and that it may be (accidents as well as fuel and crew) that they are lost in the sky on the average, so that the number aloft can be affected only after a warning is received. This might well not be deterred by our ordinary measures, but by the posture we can adopt will it mean that he quits as soon as he is warned, or might he just wait until the gas is used up and the planes have to come down and be destroyed in a surprise strike in anticipation?

This problem of "fatigue" is a question of the distance that one can take. The solution is that one must try to design a super-aerobically resistant endurance and little fatigue, recognizing its peak effectiveness. Second, on the present subject, one may have to consider disarmament negotiation with the Russians. One has in fact taken measures to deter a surprise attack of retaliation. If we can keep up the pressure for a few days during which to negotiate to some degree of Russian "disarmament," we might be able to reassure them and sufficiently reassuring to make them "normal" rather than to proceed to a surprise attack. This means devising and instituting a set of anti-surprise-attack measures that were not done during the earlier period. It would be a matter of the ordinary pressure of knowing that there is a long-term danger, but doing it with confidence.

ability of the warning system, exorbitant if commercial and for all time in the interest of recognizable. There are, in other "get ready" in the face of expected to do continuously. How long can we keep it up? Keep all aircraft in the air at all may be too costly in all respects (costs) to keep as many as half of but that a substantial increase could be maintained on short notice if a serious crisis well mean that the enemy would adopt a similar posture, but would be deterred if we get warning. Does this mean we see that we are ready? Or if the fuel is gone, the pilots are tired, and the system fails again? And if so, must we not

likely to plague any super-alert solution is in two parts. First, a super-alert response that has good engineering and organizing that this means compromise, and most pertinent to the problem is to engage in a kind of crash disengagement with the enemy during the period that we are super-alert to insure his own invulnerability. If we are super-alert for a few days, we might attempt to demand or negotiate "disarmament" that is both tolerable to the enemy and to us to permit us to return to a normal posture before we are faced with total war. This might be a much more ambitious scheme of disarmament than had been politically feasible. It might mean negotiating not just under the threat of a sneak attack is a long-term solution. It is clear notice that if measures to

make successful first-strike im-  
agreed upon, and taken by a qu-  
sent has become inevitable.

These reflections do not imp-  
either useless or embarrassing.  
ing by itself may not be eno-  
*opportunity*, but the opportuni-  
And preparations for what one-  
have to be made well ahead of-  
liver an ultimatum to the Russ-  
ing to attack. Deciding what-  
needs and be tolerable to the E-  
difficult, it is technically diffic-  
procedures to verify complianc-  
effective ultimatum only if we-  
time on what it might contain.

There are two quite distinct-  
of an inspection system, or for e-  
how well the system gets at th-  
ceal it; the other is how well it-  
vincingly when it is in his inter-  
that between a scheme for disc-  
for permitting the innocent to es-  
ing, one system arrives at a pre-  
tive way, by an absence of po-  
the other scheme relies on posi-  
the particular situations in whi-  
the truth be known.

The difference between these-  
distinction between a scheme t-  
surprise attack and a scheme to-  
or "accidental," or unintended-  
a false alarm, or from a mistaken-  
to a false alarm, or to a wron-  
accident, or to the catalytic mi-  
in promoting war, or to a situat-  
each side that the other may b-

## THE ATTACK

impossible have not been devised, quick deadline, war by mutual con-

ply that extra warning would be  
What they indicate is that warn-  
ough. Extra warning provides an  
ty has to be exploited with skill.  
would do in the contingency may  
time. There is barely time to de-  
sians when we catch them prepar-  
ultimatum would both meet our  
Russians is not only intellectually  
ult, depending on such things as  
ce. We could probably deliver an  
e had planned carefully ahead of

criteria for judging the efficacy  
designing the system itself. One is  
e truth in spite of efforts to con-  
helps one to reveal the truth con-  
est to do so. The difference is like  
covering the guilty and a scheme  
establish innocence. Roughly speak-  
presumption of innocence in a nega-  
positive evidence to the contrary;  
tive evidence, and is pertinent to  
ch one's own interest is in letting

two situations is pertinent to the  
o minimize the fear of *deliberate*  
o minimize the fear of inadvertent,  
war — the war that results from  
n evaluation of the other's response  
g interpretation of a mechanical  
schief of a third party interested  
tion in which the apprehension by  
be about to pre-empt explodes by

## SURPRISE ATTACK AND

feedback into a war by mutual p  
deliberate, surprise attack, the ag  
guise the truth. But in the case o  
have a strong interest in convey  
in fact be conveyed in a believa  
other side's mistaken decision.

## MISAPPREHENSION

Consider this question: how v  
Union that we were not engaged  
fact we were not but they thought  
prove to us that they were not in  
fact they were not but they knew  
be.

Evidently it is not going to be  
There may indeed be some situat  
fact is enough to allay each side'  
just to take a wild example — su  
plosion on one of their own bases,  
if they could simply reassure us q  
accident, that they were not inter  
attack by us, and so on. But, in  
imagine, it is insufficient simply to  
in a strategic strike or that one  
There has to be some way of a  
facts presumably involving the d  
have to prove not only that we w  
position, but that our actual posi  
exploited to doublecross the ener  
word and restrain his own forces.

## MISAPPREHENSION DU

Especially in the course of a li  
may take an action that might b  
strike. Suppose, for example, tha  
that would alternatively be used in



panic. In the case of a planned, aggressor has every reason to dis- of "inadvertent war," both sides ing the truth if the truth can ple way in time to prevent the

## ON OF ATTACK

would we prove to the Soviet in a surprise attack, when in we might be? How might they initiating a surprise attack, if in that we were afraid they might

e enough just to tell the truth. ions in which sheer verbal con- s suspicions. If the Russians — ffered an accidental nuclear ex- it might be helpful to both sides uickly that they knew it was an rpreting it as a harbinger of an most of the cases that one can o assert that one is not engaging is not in a menacing posture. authenticating certain facts, the isposition of forces. We would ere not *intending* to exploit our tion was one that *could not* be ny if he should take us at our

## URING LIMITED WAR

imited war one side or the other e misinterpreted as a strategic t we used the kinds of aircraft n a strike against Russian bases,

and flew them in directions that pointed directly at the Soviet Union itself — a fleet of bombers flying from North African bases in the United States, countries near the southern border of the Soviet Union. Alternatively, suppose that the Soviet Union had launched a force that could be interpreted, on the basis of the evidence we might get, as a strike force of nuclear carriers, but that was actually a general effort to destroy United States cities.

The question arises whether such a move would reduce the likelihood of misinterpretation, or whether misinterpretation might lead to a pre-emptive or retaliated retaliation, to pre-emptive action, or into a super-alert status that heightens the state of alarm. One might wish to benefit from the fact that complementary actions — such as the launching of other parts of the world, that would be taken, if this were an all-out counter-attack, would be being taken.

#### RECIPROCAL M

Consider another case that would be discussed at a press conference.

After all, meteors and electronic signals are detected on radar screens, too. If in such cases the United States and hydrogen bombs, were to proceed to launch nuclear attacks and its bases in other states, the attack would be directed at each other somewhere over the Atlantic Ocean. This would draw the natural conclusion that a nuclear war was taking place, and mankind would find itself in the midst of atomic war.

Assuming for the moment that such a situation might conceivably arise, how might the possibility of hostilities of both sides be slowed down, or perhaps some way of reversing motion or of preventing further and authenticated way, a kind of truce or agreement of consent might be possible.

## E ATTACK

at might be interpreted as aimed  
s might be the case if they were  
ses or the Mediterranean fleet to  
rder of the Soviet Union. Alterna-  
aircraft flew a limited war mission  
the basis of the momentary evi-  
e at all of our overseas bases and  
a limited strike and not part of a  
d States retaliatory power.

there are any means by which to  
nterpretation in this case, where  
ne side either to take off in antici-  
as quickly as it could, or to get  
ad a high proclivity toward false  
d over backwards to demonstrate  
actions involving other forces in  
would almost certainly take place  
r-force strike — were in fact not

## DISAPPREHENSION

was described by Gromyko at a

c interference are reflected on Soviet  
es Soviet aircraft, loaded with atomic  
ed in the direction of the United States  
air fleets of both sides, having noticed  
ctic region, under such circumstances  
that a real attack by the enemy was  
nd itself involved in the whirlpool of

at a situation like that described  
ight the interacting misapprehen-  
down and reversed? If there were  
n both sides, in a properly phased  
of balanced withdrawal by mutual

## SURPRISE ATTACK A

The bargaining environment is such that there would be only hours in which to act, and at worst no time at all. The outcome can analytically be divided into two parts. The first part has to be discovered some "solution" that reverses the trend toward mutual non-compliance. It requires a plan that institutes a dynamically stable without any further status, one that yields neither side a net gain in the bargaining process, and that is within the plans of both sides concerned. The second requirement is that the plan be observable, verifiable, and part of the bargain unless we have some way of monitoring the other side's compliance. Conceivably we would have an arrangement that is overwhelmingly more probable than the current circumstances for a cheat-proof negotiation. Each side would submit to, so that if we did comply with the plan, the other side would have no doubt as to our compliance. Essentially one of contract enforcement in this case, for each side, is to comply with the plan, in fact it complies with the plan.

This example not only makes an arrangement for observation and a short time available for bringing the plan into effect, it demonstrates how important it is to have a plan about what kind of proposal to make. It is about own flight plan in a way that could be verified by any means we might have for monitoring the other side's true information in the event it does not do so.

This case also may illustrate some criteria for reliability of an inspection. It is difficult to design radar that would be reliable by which he could always catch a surprise attack; it is quite another question whether we could if we both wished to invite voluntary compliance in a convincing way. In one sense, the other side's radar surveillance as best we

is not a propitious one. At best which to conduct the negotiations, the requirements for a successful divided into two parts. First there "action" — some pattern of action mutual attack, and that consti- drawal to a less menacing alert le a dangerous advantage in the physical capabilities of the forces ent is that compliance somehow vable. We cannot carry out our ve trustworthy means for moni- e, and the same is true for them. interest in cheating; but it is that we should wish in these monitoring system that we could ply with our part of the bargain oubt about it. The problem is cement. And the motivation in nvey the truth as best it can if

clear the need for some *prior* verification, in view of the very inspectors to the scene; it also s to have thought ahead of time nake, and to have designed one's could take maximum advantage r deliberately giving the enemy becomes desperately necessary

the difference between the two ection system. It might be very d *always* catch the enemy — and n us — in an attempt at sneak ion how to design radar so that ntary surveillance we could sub- e case we are, in effect, evading e can. In the other we may de-

liberately "parade" in front of him. This is the nature of long-distance recognition, as

#### LONGER-TERM

The difference between these and the longer-term problems of the kind of evidence that is required and the motivation to provide it. The motivation is generally viewed as *deductive*, that is, the *absence of evidence*, that is, the *absence of evidence* of missing such evidence from the system; and one supposes that in a crisis one requires more certainty to get leads and follow the system out and enlarge it or to reach an understanding of it. Consequently, a crisis agreement is *evidence*. Instead of looking for what a party is *not* doing, one demands that a party is *doing*. And the reason why such a crisis is that the motive to reach an understanding of it — may be enhanced in such an

#### OVERBUILDING

For the purpose of being at least ready for and unforeseen situations, there is some flexible stand-by arrangement for potential enemies and inspectors. This is a good argument for overbuilding a system. It is not alternative to such use as has been agreed to enlarge or intensify the system's facilities and inspectors, may be useful. The usefulness of the system in time of crisis. Differently, we should not judge the system solely in terms of the motivation for "normal" operations; we should

## THE ATTACK

is radar, or submit to other means long as he does the same for us.

## SURVEILLANCE

crises and emergency situations of policing arms limitations is inquired and in the strength of the more "leisurely" process of inspecting mainly on *negative evidence*. One reduces the probability by enlarging and intensifying the the evasion is made difficult by when over a long period. But in a in evidence; one does not have m up; there is no time to try the intensify it if it does not work. t would have to rely on *positive* r evidence about what the other ds evidence that shows what he ch evidence might be forthcoming provide it — the greater urgency or an agreement that depends on n emergency.

## FIXING THE SYSTEM

at least somewhat prepared for crises is a good argument for instituting arrangements for communicating with each other. In particular there is building an inspection system related on. Having standby capacity on, or to augment it with additional have a good deal to do with the time of crisis. To put the point differently the reliability and usefulness of a motivations of the participants during should recognize that occasions may

## SURPRISE ATTACK

arise when there is a powerful arms limitations, at least momentarily available for setting up observations *ad hoc*.

To be specific: in the event that a detection system to monitor arms tests, we should consider carefully the advantage of the inspectors and the acute military crisis. The mobility, their communication facilities, surveillance equipment, there truly should be evaluated and designed with detection in mind, but with some very critical need for a means of communication, in a crisis that threatens with inadvertent war.

From the foregoing considerations, the stability of the balance of terror, to liberate surprise attack, and the false alarm — will be greatly affected. It is our hope that we try to work out a system that reveals her scientific and technological progress, we may find that each side does and does it rapidly enough) the vulnerability of its own retaliatory force, and assure it in a fully stable mutual deterrence relationship. We have planted mischievous seeds, the Russians continually find more forces at a faster rate than we. There is only a hope — no present ingenuity and the best of diplomatic find cooperative measures to achieve. So we may get stability without it even with cooperation. Still, the Russians, or mutual restraint explicit, may prove to make a significant



motive for crash negotiations on arbitrary limitations, with no time and communication systems

There should be established an international agreement to suspend nuclear activities, and how both sides might take care of their facilities in the event of an emergency. The identity of the inspectors, their locations, their technical training and their trustworthiness, and their numbers, should be agreed not just with nuclear-test debarment, but with their serving a desperately needed inspection, verification, and control system that threatens both us and the Russians

In these conditions, it is not at all clear that the United States — the lack of temptation to debarment, the immunity of the situation to be affected by the military arrangements with the Russians. As nature reveals, the technological secrets over the coming decade (if it does what it ought to do) can substantially assure the integrity of our forces irrespective of what the Russians do in a convincing way, so that a power balance results. Alternatively, nature may lead us ahead of us, so that we and the Russians find new ways to destroy retaliatory forces and find new ways to protect them. The assumption — that even with great power parity we and the Russians could arrest a trend toward instability. Without cooperation, or we may not find some kind of cooperation with the Russians, a significant difference in the stabil-

ity of the balance of terror; a high. So although we cannot of collaborating to make each invulnerable would make any difference might and to ask ourselves whether a perfectly stable balance of deterrence is possible. Would we really be interested in an anti-surprise-attack scheme if we thought the Russians would accept it?

Although it would be comforting to know that they could not be tempted into a deliberate attack, it is also comforting to know that they would never need to attack. Nevertheless, it can be argued that our major assault on ourselves depends on the Russian belief that we might attack. The Russians might not believe that we were substantially invulnerable. It can be argued that except under the most extreme circumstances we would shrink from any retaliatory strike. The idea of eliminating or softening the threat to this argument, a pair of *invulnerable* SAC's; and while that might be a completely bi-polar world, it is a lot different from the existing world — a world with a "no man's area" in which we wish to deterrence. Is this more credible than that of mutual

Can we threaten to retaliate? The Russians unquestionably possess the capability to deliver us a blow of any size they please. What is the role when each is invulnerable? Can we threaten each other and to guarantee, by mutual agreement, to disuse?

There is a role. Strategic forcing out "retaliation" in the punishment of Russian or Chinese cities. It is a potent because of the sheer pain and humiliation that would be

## THE ATTACK

and the stakes of course are very high. We must be sure that a deliberate policy of mutual deterrence, with each side's retaliatory forces invulnerable, we have to consider that it is not clear whether in fact we should want a first strike if we had the option before us. It is not clear that a first strike would be a far-reaching and effective deterrent if we knew of one, and if we thought

that we were starting to know that the Russians were planning a deliberate sneak attack, and that we were so sure we wouldn't try it that we would not jump the gun in panic, it can be a deterrent. Our ability to deter anything but a first strike depends at least somewhat on the ability of the Russians to be goaded into deliberate attack. It is not clear whether we have this if their retaliatory forces are invulnerable to a first strike by ours. It can be argued that the most extreme provocation we would like to have is one that had no significant chance of being followed by a Russian return strike. According to the venerable SAC's is a pair of *neutral-light* might be the best kind in a complex situation that we could not afford in a situation in which there is a large "third party" interest. Russian aggression by a threat of mutual suicide.

It is not just to resist locally, if the Russians have the military capacity to return a first strike? Have the strategic forces any other role, except to neutralize the threat by their joint existence, their joint

existence would still be capable of carrying out a deterrent in some sense. If the threat of knock-out blows was originally thought to be a deterrent, economic loss, disorganization, and other factors involved, and not mainly because

## SURPRISE ATTACK AND

the military posture of the enemy. If the threat of aggression would be greatly affected, the threat would still be present even if we were invulnerable.

The threat of *massive* retaliation, which does not mean unlimited retaliation, does not mean the loss of our hope that a skillfully planned attack might succeed in precluding counter-retaliation. We should consider limited or graduated reprisals as a means of pressure on the Russians to desist from their present course. To consider extending a limited retaliation as a means to consider extending a limited retaliation in a way that maintained the pressure but was really intended to work to our advantage, in pain and the threat of more, this might be the threat of it, might enjoy increased pressure in the vulnerability of both sides. Paradoxically, for the same reason that we might become less inhibited as the possibility of massive retaliation became unavailable. The risk in the initiation of massive retaliation should be less than that of an *all-out* strike in return should we be forced that our limited retaliation would be a deterrent in the initiation of all-out war should we be forced to have to believe that we were likely to be annihilated. Do not mistake our limited retaliation for a bluff or for obliteration.

This is not to argue that limited retaliation is attractive if not the certainty, of limited counter-retaliation or total destruction, either slowly or gradually, or even greater retaliatory strikes, or would be a deterrent plate even if kept limited. The pressure of a surprise attack may be no easier than the pressure of a surprise attack may be harder. The argument here is that making an exchange of limited reprisals is more attractive compared with limited retaliation, if the threat is attractive enough compared with the threat (and not a called bluff) in which we do not rely on the threat of retaliation.

y in the immediate area of his  
ted, the main ingredient of the  
n if the other side's SAC were

n, if "massive" is interpreted to  
s indeed lose credibility with  
y conducted all-out strike might  
aliation. But if we were ever to  
isals as a means of putting pres-  
om actions intolerable to us, or  
ocal war inside Russian borders  
etence of local military action  
through the sanction of civilian  
kind of retaliatory action, and  
ased credibility with a reduction  
' strategic forces. It does, para-  
*t all kinds of limited war might*  
*bility of all-out surprise attack*  
nvolved in a bit of less-than-  
than it is now because the fear  
ld be a good deal less. The fear  
ld be mistaken for the first step  
uld be less; the Russians would  
terally prepared for suicide to  
for the initial step in mutual

d retaliation, entailing the risk,  
unter-retaliation, cannot lead to  
r by explosion into greater and  
uld not be frightful to contem-  
problem of limiting a war of re-  
ut of limiting local war, and it  
e, however, does not depend on  
punitive blows appear safe and  
*local war*, but safe enough and  
n all-out war to be a credible  
*any case where we may have to*

The strategic forces would threaten each other with potential attacks on each other. The active role that provides some balance is the threat of *all-out* punishment. The achievement of invulnerability is the threat of limited retaliation. The net effect, we cannot deprecate simply by reference to the need to be demonstrated that one party (the active one) is more potent than the other (the passive one).

Only an extreme optimist can see a clear choice of accepting or rejecting the idea to make both sides' retaliation invulnerable. But this question of area deterrence, and the limits of retaliation, are pertinent to our own hopes for ourselves.<sup>9</sup>

<sup>9</sup>For further discussion see T. C. Schelling, *Arms and Arms Control, The Twentieth Century*.

## SE ATTACK

us be "neutralized" only in respect  
er; they would still possess a puni-  
basis for a deterrent threat. While  
ent may lose credibility with the  
by both sides' retaliatory forces,  
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te a world of invulnerable SAC's  
d for third-area deterrence; it has  
rticular deterrent threat (the mas-  
the other (limited) one.

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APPE



# INDICES

## NUCLEAR WEAPONS

With the development of small nuclear weapons suitable for local use by ground forces and with the development of nuclear rockets for air-to-air combat, nuclear weapons have ceased to be treated as weapons in the conduct of limited war. There are political disadvantages in limited war, particularly in our present situation. To consider a nuclear fireball as merely a weapon of mass destruction must recognize as a political argument against nuclear weapons.

This Appendix is about the relationship between nuclear and other weapons in the process of limited war. The interest of limiting war or of understanding the limits is necessary to recognize that a distinction between nuclear and other weapons even though nuclear weapons are more powerful but is psychic, perceptual, legal, and moral. The yield of nuclear weapons delivered with the form of artillery, and consequently the limits in war, is an argument about the effects of nuclear weapons, not on an analytical basis where limits originate in limited war or unstable, what gives them a character and modes of behavior are consequences of the recognition of limits. The present argument is that, if there is no

## APPENDIX A

### NUCLEAR AND LIMITED WAR

small-size, small-yield nuclear weapons and troops with modest equipment, nuclear depth charges and nuclear mines — the technical characteristics of these weapons do not provide much basis, if any, for distinguishing them particularly different from other weapons. It has, of course, been argued that the advantages in our using nuclear weapons are offset by the disadvantages of using them first. Even those who regard the use of nuclear weapons as morally equivalent to napalm for burning a man, regard the use of nuclear weapons as a political fact a worldwide revulsion.

Another basis for distinguishing nuclear weapons is the possibility of limiting war. In the understanding of limited war, it may be possible to distinguish between nuclear and conventional weapons. Although the distinction is not physical or technical, it is realistic, or symbolic. That small-yield nuclear weapons and "pinpoint" accuracy are just a technical detail do not prejudice the issue of limiting war. It is based exclusively on an analysis of the limiting process — of limited war, what makes them stable, what makes them unstable, what authority, and what circumstances conducive to the finding and mutual restraint of the "just-another-weapon" basis.

for a distinction between nuclear and conventional weapons on a basis at all that is pertinent to the issue.

Is not the same point involved in the distinction between users of weapons? There is no more difference between Americans and Chinese than there is between Americans and British, or similarly for the difference between Americans and French, or between Americans and Nationalists, or between Americans and Danes, Egyptians and Algerians. There is an important distinction in the procedure of nuclear war, within its limits. Similarly, there is little difference between a hundred miles north of the Sahara and a hundred miles south, or between a hundred miles above and below it, or the two sides of the equator. Boundaries like these play an important role in the process, quite aside from any political considerations of rivers or the scaling of mountains, or anything else with them.

One could reply that these are legal distinctions and that other weapons are fictitious. But they are "legalistic." There is no legal distinction between participants in limited war to restrict the use of nationalities; the Russians are not to be allowed a modest penetration of their border, while the Chinese are to be allowed the war — as a dramatic act of defiance — to cross their border. The Chinese were not to be allowed (rather than just to resist) if we crossed the Yellow River; they did not lose any legal rights by permitting occasional thoroughfare. The Chinese do not take cognizance of Russian pilotless aircraft in a war, or Russian "volunteers" in a war, or Russian fighting against our side. The issue is not a border, or on the introduction of nuclear weapons into conflict, is like that on the introduction of nuclear weapons, it is the risk of enemy response. The risk of enemy response is his approval of our action, or acquiesced in if he fails to respond. The risk of enemy response, to our symbolically di-

## APPENDIX A

... and other weapons, there is no  
... the limiting process.

... in discriminating among the  
... more difference between Russians  
... between nuclear and other weapons;  
... between Chinese and North Koreans,  
... Nationalist Chinese, British and Jor-  
... ns. Yet nationality has been an  
... cess of limiting war or destroying  
... le difference between the terrain  
... Soviet-Iranian border and the ter-  
... what lies above the Yalu and  
... the Greek-Yugoslav border. Yet  
... important role in the limiting  
... physical difficulty in the crossing  
... untains that happen to coincide

... are "legal" distinctions and that  
... while those between nuclear and  
... t they are not really legal; they  
... al authority that forces the par-  
... cognize political boundaries or  
... not legally obliged to treat a  
... rder as a qualitative change in  
... discontinuous with action up to  
... not legally obliged to retaliate  
... ve deliberately crossed the Yalu  
... al right to deny trespass by ad-  
... We are not legally obliged to  
... s if they participate in a limited  
... n a Near Eastern ground army  
... nhibition on the penetration of  
... n of a new nationality into the  
... roduction of a nuclear weapon;  
... . And an important determinant  
... eciation of what he has tacitly  
... ad, or makes only an incremental  
... discontinuous act.

## NUCLEAR WEAPONS

What makes the Soviet or Chinese a compelling place to draw a line in the sand is principally that there is usually no physical barrier. For Western troops to cross the border is not physically but symbolically — a violation of the USSR, and to demonstrate or attempt to proceed. Unless one can find some geographical border, such that it would be clearly intended to stop in the event that the line is crossed, that it would be obvious to us that the Russians would let us advance, the Russians knew that we knew it, and that there was a place that can be tacitly acknowledged as a geographical circumstance for the USSR to draw a border without a dramatic retaliation. It is to admit that Soviet territory is fair game in a war. The political boundary is not a geographical place, not legally mandatory; it is a line of any plainly recognizable alternative. It is an interest in finding some limit. The line makes it a plausible limit. It is not the only line, but certainly one of the most obvious in the region that could be tacitly acknowledged as a "obvious" geographical limit that has a compelling *power of suggestion*. The denial of which might seem — in the absence of any alternative — to be a denial of the obvious.

But, if political-boundary and geographical-boundary seem to be legal, and therefore not subject to the same conditions that are significant in the case of a geographical boundary, much equipment but no manpower is possible. It is provided equipment, leadership, and support, during the guerrilla war, but no conventional support to the Nationalist forces. It has been thought that the Nationalist forces to the French and Vietnamese is a significant force to the Chinese and Russians to be a significant force on the ground forces in.

nese border a pertinent or com-  
the event of war in that area is  
no other plausible line to draw.  
Russian border is to challenge —  
— the territorial integrity of the  
at least to imply an intention to  
some “obvious” limit inside that  
far to the Russians where we in-  
t we cross the border, and such  
that there was a limit to how far  
ce if we did cross it and that the  
there is just no other stopping  
ledged by both sides. Under the  
accept the penetration of that  
iation of some sort would be to  
game for a gradually expanding  
therefore *useful* as a stopping  
is useful to *both* sides in default  
native, since both sides have an  
he border has a *uniqueness* that  
one of the few lines — perhaps  
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y recognized by both sides as the  
at both sides might observe. It  
*question*, a claim to attention, the  
default of any plainly recogniz-  
of any limitation.

l nationality considerations still  
real, consider some other distinc-  
e limiting process. We provided  
ver to the war in Indochina; we  
and advice to the Greek troops  
combat troops. We provide direct  
t Chinese in the Straits of For-  
we might have given air support  
n Indochina, without appearing  
e as “involved” as if we had put

An economist can argue — with those who argue that “pinpoint” power are just another form of artillery power are fungible resources in intervention is not “really” different that military intellect is as important that lack leadership and planning redefinition of service functions is and about the usefulness of defense in terms of the means of locomotion distinction or a naval-ground distinction tradition. But the point of all this is that tradition matters.

In fact, what we are dealing with in war is tradition. We are dealing with the force of suggestion. We are dealing with written law — with conventions which is the need for mutual forbearance and whose sanction in each individual breach a rule may collapse it and to a jointly less favorable limit or weaken the yet unbroken rules by “authority” cannot be taken for granted.

What makes atomic weapons different that they *are* different. The real rhetorical question — why we do not use them on the grounds that they too, like nuclear people, is that there is a tradition of a jointly recognized expectation that it is expedient to use them. There is no tradition of atomic weapons. There is instead a jointly recognized expectation in spite of declarations of readiness that there are tactical advantages in their use.

Traditions or conventions are not unique in war, or a curious aspect of the convention is the essence of the characteristic of any limit in a limited



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with the same persuasiveness as air-delivered small-yield weapons — that equipment and man-power in a military campaign, that air power is different from ground intervention, that air power is as important as leg muscle for troops and as important as skill. The controversy about air power in the light of modern weapons, and the changing military-service functions of air power, suggests that an air-ground distinction rests on nothing but tradition. It is that, in limiting war, tradi-

tion is with in the analysis of limited war, with precedent, convention, and custom, and dealing with the theory of unprovoked war whose sanction in the aggregate is to avoid mutual destruction, and in the individual case is the risk that to refuse to fight that to collapse it may lead to none at all, and may further weaken by providing evidence that their demands are granted.

What is different is a powerful tradition of non-use — in answer to the usual question — not ban bows and arrows on the use of nuclear weapons, kill and maim with nuclear weapons, for the use of bows and arrows, that they will be used if it is not used. There is no such tradition for the use of nuclear weapons — a tradition for their nonuse — that they may not be used in spite of the fact that they may be used, even in spite of

It is not simply an analogy for limits on nuclear war; tradition or precedent or custom limits. The fundamental character of nuclear war is the psychic, intellectual,

## NUCLEAR WEAPON

or social characteristic of both sides as having some kind of basis mainly from the sheer perception of a "tacit bargain." And a part from the lack of confidence that alternative limits may be found. The rationale behind the limit is moral, or physical. The limits are not differences or to moral distinctions to correspond to something that has a distinctive character and that provides converge on. But the authority is not in the thing that expects to.

Whether limits on the use of a particular limit of no use at all a way is made more dubious, notwithstanding the character of atomic weapons that there is a rather continuous range of atomic-weapon effects, a range of forms in which they can be used, and the targets they can be used on. Consequently to be no "natural" limit and others. If we ask, then, whether we wished to limit somehow the conveyance, the situations in which they can be used, the answer is that we are free to draw a line anywhere for any reason for drawing it at any one or another. But that is precisely the problem for any particular line. There is no limit on the number of miles, the other degrees, sizes, or distances that are for both sides' expectations. It is tentative and discrete, rather than continuous. This is not just a matter of making it easier or of making adherence easy.

ing mutually recognized by both authority, the authority deriving from mutual acknowledgement, a particular limit gains in authority that either side may have in what and if the limit is not adhered to. This is legalistic and casuistic, not legal, and may correspond to legal and physical functions; indeed, they usually have what gives them a unique and qualitative focus for expectations to which is in the expectations themselves, and expectations have attached themselves

of atomic weapons, other than the total, can be defined in a plausible way, and less so, by the increasingly versatile weapons. It is now widely recognized that there is a continuous gradation in the possible sizes of weapons rather than a continuous variation in the means of conveyance, in the means of conveyance, in the means of conveyance, and so forth. There seems to be a break between certain limited uses of weapons where we might draw a line if we consider the size of the weapons, the means of conveyance, or the targets on which they are used — in a purely technical sense where we please. There is no cogent reason for the particular gradation rather than another, and why it is hard to find a rationale for the degree of use, or size of weapons that is so much more plausible than another is that it provides a focal point for legalistic limits have to be qualitative rather than quantitative and continuous. This makes violations easy to recognize, and difficult to enforce on one's own com-

manders; it concerns the need of evident symbolic character, such as a ritual and dramatic act that exposes boundaries. Alternative limits will not easily be

The need for qualitatively distinct limits, some kind of uniqueness is especially true. Limits are generally found by a process of negotiation. They are jockeyed for position implicitly. But if the two sides mutually agree on explicit communication, the particular quality that distinguishes it from alternatives; otherwise there is little to be said that the other acknowledges the existence of latitude, or an international datum. Limits have this quality when no other point or line is available for expression.

A test of this point with respect to the use of nuclear weapons is to pose the following problem.<sup>1</sup> Let us suppose for a prize: we are to sit down right now, without any prior arrangements, and work out a plan on the use of nuclear weapons, in any way we please, allowing ourselves limits of our own appeals to us — size of weapons, use of them, what rate or frequency of use, offensive versus defensive use, tactical versus strategic, with or without warning — to see whether we can reach a *same* specification of limit. If we agree on limits we specify, we get a prize; if we do not, we get no prize. We are doing this only to see whether we can in fact agree on a limit, and to see — for those of us who do not — what proposals tacitly — what kinds of tacit joint recognition. We are not to set limits at all on the one hand, or to set them on the other, and any gradation or variation is possible, please.

My argument is that there are p

<sup>1</sup> Compare Chapter 3, especially pp. 58–60.

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f any stable limit to have an  
that to breach it is an overt  
both sides to the danger that  
found.

tinguishable limits that enjoy  
ally enhanced by the fact that  
process of tacit maneuver and  
or, rather than negotiated ex-  
st strike a "bargain" without  
cular limit has to have some  
he continuum of possible alter-  
asis for the confidence of each  
he same limit. Even a parallel  
te line, or the north pole, may  
natural, plausible, "obvious"  
pectations to converge on.

t to atomic weapons might be  
et any of us try to cooperate  
ght now, separately and with-  
write out a proposed limitation  
as little or as great detail as  
cations of any description that  
se of weapons, who gets to use  
se, clean versus dirty, offensive  
s strategic, on or not on cities,  
whether we can all write the  
re in perfect agreement on the  
if our limits are different, we  
nly for the sake of the prize,  
tacitly on a statement of limits,  
do manage to coordinate our  
limits appear to be susceptible  
permitted the extremes of no  
no atomic weapons at all on  
riation defined in any way we

particular limits — simple, dis-

## NUCLEAR WEAPONS

crete, qualitative, "obvious" limits of a concerted choice; those who speculate, can find few partners or none with theirs. (Since our object is to isolate in the other virtues of exercise the main consideration in the likelihood that if we chose to decide exactly with the limits of the trying to coordinate theirs with our

I do not allege that this exercise are capable of possessing stability strate that certain characteristic simplicity, uniqueness, discreteness definition, and so forth, can be given that is at least pertinent to the purpose suggests that certain kinds of limits expected by both sides, of focusing on a limited number of alternatives, organized as qualitatively distinct from other alternatives.

The first conclusion to be drawn is that there is a distinction between nuclear and other weapons, a distinction relevant to the question of the distinction that to some extent may be clarified or blurred. We can strengthen the symbolic significance of this distinction by acting in a way that is dramatic and does not erode the distinction — but not in a way that, as though we do not believe in the distinction, "another-weapon" argument and behavior in fact have little compunction about the policy we should follow depends on the distinction between nuclear and other weapons. We share with the USSR, a useful policy helps to minimize violence — or at least to reduce the stigma liability, a diplomatic obstacle to our decisive action and delegation of authority. That atomic weapons ought to be used

its — that are conducive to a  
 fy other kinds of limits, I pre-  
 ne at all whose limits coincide  
 o agree, we are to take no con-  
 ur proposed limits; in this ex-  
 choosing any particular limits is  
 ose limits in an effort to coin-  
 others, knowing that they were  
 urs, we would succeed.)

se proves what kinds of limits  
 and authority. It does demon-  
 s of limits, particularly their  
 ss, susceptibility of qualitative  
 ven an objective meaning, one  
 process of tacit negotiation. It  
 its are capable of being jointly  
 g expectations and being recog-  
 om the continuum of possible

n from this line of argument is  
 a nuclear and nonnuclear weap-  
 process of limiting war. It is a  
 we can strengthen or weaken,  
 en the tradition, and enhance  
 distinction, by talking and act-  
 ly consistent with it; we can  
 readily destroy it — by acting  
 it, by emphasizing the “just-  
 by making it evident that we  
 out using nuclears. Which pol-  
 whether we consider the dis-  
 er weapons to be an asset that  
 ul distinction, a tradition that  
 instead a nuisance, a propa-  
 struction, and an inhibition to  
 of authority. Those who believe  
 used at the earliest convenience,

or whenever military expedients recognize the distinction that erode the distinction during t

This is not just a matter of European allies feel about the between us and the Russians — between us whether we like it the Russians think we share w there is a limit against the use of limiting war, we should want to believe that our initial use were a challenge to the whole that we would not be bound b want them to interpret our use with the concept of limited wa ness to collaborate tacitly in limits; we should want our u charged with excessive symboli distinction does exist in the s war, and if nevertheless we wan weapons, we ought in the intere erode the distinction as best w program for early and extensi earth-moving projects, especia might help to erode the distinc program for training friendly t in how to survive nuclear weap weapons for the purpose in th trary we wish to enhance the our enemies that nuclears are a reservations, agreement on nuc extensive discussion of such a tribute to the purpose.<sup>2</sup>

A second conclusion is that of atomic weapons in limited v

<sup>2</sup>On the symbolic significance of a "Nuclear Testing and the Problem of" (1958), especially pp. 12-13.



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... demands, should nevertheless exist so that we can take action to the interim.

... of what the Asian neutrals or our distinction. It concerns a relation — an understanding that may exist or not. It has to do with whether with them a tacit expectation that of nuclear weapons. In the interest of the Russians or the Chinese not of atomic weapons in a local war — idea of limitations, a declaration by any kinds of limits. We should of nuclear weapons as consistent and consistent with our willingness — the discovery and recognition of use of atomic weapons not to be content. So, if I am right that a sense pertinent to the limiting of at maximum freedom to use atomic — est of limiting war to destroy or to we can. (For example, a deliberate use of “nuclear dynamite” in ally in underdeveloped countries, tion; the same might be true of a troops in underdeveloped countries — ons explosions, using some actual their own country.) If on the con- tacit understanding we have with — class apart and subject to certain clear test suspension (or even just an agreement) will probably con-

... the principal inhibition on the use of war may disappear with their first

... test agreement, see Henry A. Kissinger, “The Search for Peace,” *Foreign Affairs*, 37:1-18 (Oct.

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use. It is difficult to imagine that weapons are different would be a occasion of the *next* limited war affair in one. We can probably not, therefore use nuclears in a particular war to our advantage to us and *subsequently* realize that we and the enemy might both destruction of war will be substantially shatter the tradition and create a new one. There also be some limits or sanctuary clauses that should be reexamined to see if they are by-products of the assumed nuclear war with it. We may want to look again at the for example, partly to anticipate enemy actions to avoid misinterpreting enemy intentions differently after nuclears are brought in.

A third conclusion is that once we decide we should perhaps be at least as careful about precedents that we establish, and the precedents we adopt, as with the original objectives. For example, if nuclear weapons were used, we probably ought to be much less concerned about Quemoy than about the character of the precedents that it establishes, the role of ourselves, and the role the enemy might play. (We be not only using them *ad hoc* for a specific purpose, but importantly shaping the limited war tradition. A boy pulls a switch-blade knife open and we have to feel, whatever the point at issue, that the overriding policy question now is his intention to use the blade challenge.)

Fourth, we should recognize that the tradition of limited war when nuclear weapons are used too will really be engaged in at least as much as war activity at the same time. Our objectives over the original objectives; the role of the tradition or gamesmanship over the role of the enemy. To illustrate, we might in connection with the

the tacit agreement that nuclear weapons powerfully present on the occasion they had already been used before, ignore the distinction and where their use might be of advantage on the distinction in the hope they will abstain. One potential limitation is discredited for all time if we set a contrary precedent. (There may be concepts that we take for granted whether they were originally a clear ban and might disappear again at the role of naval vessels, enemy treatment of them, partly intentions if he treats them differently into play.)

On the occasion of their first use we are concerned with the patterns and precedents with the "nuclear role" that we projectives of the limited war. For example, if used in defense of Quemoy, we are concerned about the outcome on the occasion of the nuclear exchange, the role we manage to assume for ourselves and what we assume in the process. We shall not be concerned with the little war in question, but with the nuclear wars to come. (When a student asks his teacher, the teacher is likely to say the answer originally was, that the over-reaction is behavior in the face of a switch-

that — at least on the first occasion — used in limited war — the enemy will have at least two different kinds of limited-war. One will be the limited struggle and the second will be the tacit negotiation with the use of nuclear weapons themselves. The decision with Quemoy decide to use

nuclear weapons; ordinarily it would do this only if it were quite necessary and that we should use them in support of our objectives. But, in considering what the Chinese would use them in return, we are concerned mainly about what they think they should do for the invasion of Quemoy. The nature of the Chinese initiative seems, would be the nature of the Chinese initiative. They would be interested in a nuclear role, but in demanding a kind of nuclear role of their own. And, unless we are prepared for a nuclear showdown in which we either win or lose, we are not as willing to "negotiate" (by our own standards) in terms of nuclear dominance, nuclear use, and the "rules" we join in. We are not interested in any other types of objectives in

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would be supposed that we should  
essary to the defense of Quemoy,  
a manner that achieves our Que-  
ring whether the Chinese or Rus-  
n, we should perhaps not worry  
their use of nuclear weapons would  
Much more important to them, it  
their "response" to our nuclear  
sted in not assuming a submissive  
"parity" if not dominance in their  
e are ready for some kind of deci-  
er win all or lose all, we must be  
ur actions) for limited objectives  
traditions and precedents of nu-  
ntly create for future wars, as for  
limited war.

## FOR THE ABANDONMENT OF SYMMETRY IN COOPERATIVE GAMES

The first part of this appendix analyzes a bargaining game analyzed by Nash and others,<sup>1</sup> which may not exist or, if it does, may differ from what has been generally supposed. The point of departure for this argument is the operation of the concept of symmetry, which is almost invariably left unexamined. In the paper the paper argues that symmetry in bargaining games cannot be supported on the grounds of "fairness"; the point of departure for the argument is the identification of irrational expectations.

A nontacit ("cooperative") non-cooperative game — is not *defined* by its payoffs, which choices are made must still be specified. The operations are sketched in by reference to "agreements" and the notion of freedom of reaching agreement. Thus to say that two players will split \$100 as soon as they can agree or that they may discuss the matter fully will be considered sufficient to define a game.

<sup>1</sup> John F. Nash, "The Bargaining Problem" (Econometrica, 1950), and "Two-Person Cooperative Games" (Econometrica, January 1953); John Harsanyi, "Cardinal Welfare, Interpersonal Ethical, and After the Theory of Games: a Critical Examination of Nash's Theories," *Econometrica*, 1955; Luce and Howard Raiffa, *Games and Decisions*, 1957.

<sup>2</sup> Luce and Raiffa, in effect, *define* cooperation as reference to a payoff matrix and the following: "The messages formulated by one player are

## DIX B

# ABANDONMENT OF GAME THEORY

argues that the pure "moveless" Nash, Harsanyi, Luce and Raiffa, does, is of a different character proposed; the point of departure is the meaning of *agreement*, a concept undefined. The second part of the solution of bargaining is the notion of "rational expectations" — this argument is the operational basis.

nonzero-sum game — a bargaining payoff matrix; the operations by which the game is played will be specified. Commonly these refer to the notion of "binding" or "communication" in the process. It may be said that two players may divide a resource, and that they agree on how to divide it, and that they agree with each other, is generally correct.<sup>2</sup>

problem," *Econometrica*, 18:155-162 (April 1950); "The Bargaining Problem," *Econometrica*, 21:128-140 (January 1953); "A Critical Discussion of Zeuthen's, Hicks', and Luce's Solutions to the Bargaining Problem," *Econometrica*, 24:144-157 (April 1956); R. Duncan Luce and Howard Raiffa, *Games and Decisions* (New York, 1957), pp. 114ff. The solution of cooperative two-person games by reference to the notion of "communication" is based on three stipulations. (1) All preplay information is transmitted without distortion to the

A game of this sort is symmetric though it may be asymmetric. The two players have identical refusing offers, and of reaching \$100 the players are to agree on a boundary, the payoff function move structure is. Harsanyi, to explicitly the postulate of symmetric parties follow identical (symmetric) because they follow the same path because they are subject to the same

What I want to do is to look at the assumption of *perfect symmetric game*, paying close attention to the bargaining process. We must also look at the game itself. Since any well-defined game must terminate, let us look at the

If we are to avoid adding a value matrix, in the form of discount rate, a game is terminated soon enough a discount rate enters the picture. We do not know the *time* at which agreement is reached. This is more than a matter of being "moveless," except in very special stipulation. For, if the players are allowed to change the game itself by failing to agree, the game itself changes with the passage of time. The change of the game itself by failing to agree is a continuously uniform discount rate. To treat as a *necessary* condition

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other player. (2) All agreements are subject to the rules of the game. (3) A player's evaluation is not disturbed by these preplay negotiations.

<sup>3</sup> John Harsanyi, "Approaches to the Theory of Games . . .," *Economic Journal*, 70 (1960), 309-21.

<sup>4</sup> The model discussed here is quite simple. It does have the advantage of helping to clarify an abstract model it is fruitful to postulate and to treat asymmetry as a special case.



## ENDIX B

metrical in its move structure, even  
al in the configuration of payoffs.  
al privileges of communication, of  
g agreement. If instead of dividing  
n values X and Y contained within  
n may not be symmetrical but the  
to emphasize this, has even added  
nmetrical moves: "The bargaining  
etric) rules of behaviour (whether  
principles of rational behaviour or  
e same psychological laws)." <sup>3</sup>

ook at this notion of "agreement" on  
*metry in the move structure of the*  
o the "legal details" of the bargain-  
at the meaning of "nonagreement."  
must have some rule for its own  
rules for termination first.<sup>4</sup>

whole new dimension to our payoff  
it rates, we must suppose that the  
gh so that nothing like the interest  
not want to have to consider the  
ched, in addition to the agreement  
er of convenience; the game ceases  
y special cases, unless we make this  
' time preferences take any shape  
uniform discount rate, the game  
of time and a player can, in effect,  
ng to reach agreement. The notion  
ount rate is probably far too special  
on, and anyway has not been made

binding, and they are enforceable by the  
valuation of the outcomes of the game are  
tiations. *Games and Decisions*, p. 114.

he Bargaining Problem Before and After  
*metrica*, 24:149 (April 1956).

re abstract, artificial, and unrealistic; but  
ng to test whether *even in an artificially*  
late perfect symmetry in the move struc-  
pecial case, symmetry as the more general

## FOR THE ABANDONME

an explicit postulate in the model must assume that the game is son

Perhaps the simplest way to ter bell ring at a time specified in ac such as having the referee roll dice the game whenever he rolls boxca terminate after a specified number but this would change the charact tain kinds of communication "rea different from what it was before, tactics as the exhaustion of offers.)

For simplicity, suppose that the time specified in advance to the p us call the final moment "midnig the midnight bell rings, the playe they have agreed; if no agreeme nothing.

Next, what do we mean by "ag pose that each player keeps (or m offer recorded in some manner tha when the bell rings. Perhaps he ke that the other player can see; per velope that is surrendered to the r haps he keeps it punched into a his current offer in the referee's r blackboard is photographed, the keyboard locked, so that the refere "current" offers as they exist at m compatible or not. If they are cor in accordance with the "agreeme jointly claimed more than is avail the players get nothing. (Defer, happens if the two players toget total available, whether they get or get nothing for lack of proper a it will not matter whether an ex fore midnight — that is, compatib ring before midnight — terminate

els under examination; so we somehow gotten over with.

terminate the game is to have a advance. There are other ways, e every few minutes, calling off rs. (We might have the game er of offers have been refused, er of the game by making cer- l moves" that leave the game and perforce lead us into such

e game will be terminated at a players, and for convenience let ht." If agreement exists when rs divide the gains in the way ent exists, the players receive

reement"? For simplicity, sup- may keep) his current "official" at will be visible to the referee eeps it written on a blackboard haps he keeps it in a sealed en- e referee when the bell rings; per- private keyboard that records room. When the bell rings, the envelope surrendered, or the ee needs only to inspect the two midnight to see whether they are mpatible, the gains are divided ent"; if the two players have able, "disagreement" exists and for a moment, ruling on what ner have claimed less than the as much as they have claimed greement. And, in what follows, naustive agreement reached be- ility of the current offers occur- s the game.)

There are other ways of describing operations by which it is reached to the notion of a *perfectly symmetric* game, generally, I think, have the property of being out for attention. That property is the minimum length of time that it takes to make his current offer. (For simplicity's sake, let the same operation either makes a decision or may always assume that a "critical moment" then be some critical moment, like the midnight bell rings, that is the moment when they begin the operations that receive the offer. Some last moment before the bell rings to change one's existing offer. The operations postulate both players have the same symmetry this moment must be reached.

From this follows the significance of the moment is mechanically and legally possible for a player that he necessarily makes without knowing his final offer is going to be; and that the moment is one that the other player cannot know the course of the game. Prior to this moment there has any finality; and at that moment they may or do not change their current offer. The decision is done in complete ignorance of the other player's final.<sup>5</sup>

This must be true. If either player has a final offer in time to do anything, then the other a glimpse of his own offer, then he can respond, it is not — and is known.

But now we have reached a point where

<sup>5</sup> Incidentally, the argument is unconvincing because one can change his offer "instantaneously" as long as the other both can do it "equally instantaneously."

<sup>6</sup> There is a mechanical assumption that one offer one can stop and start over. The time from the offer started one and one-half minutes before the offer because the process cannot be stopped. The offer and by then the critical point has been reached again below.

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defining "agreement" in terms of the  
made or recorded; but if we adhere  
*symmetrical move structure* they will  
property that I am trying to single  
is this. There must be some mini-  
takes a player to make, or to change,  
city again, let us suppose that the  
an offer or changes it, so that we  
current offer" exists.) There must  
in time, a finite period before the  
last moment at which a player can  
make his final offer. That is, there is  
a bell rings, beyond which it is too late.  
Under the rules of the game and the  
players know this. And by the rule of  
it must be the same for both players.

A significant feature. The last offer that it  
is possible for a player to make is one  
made without knowing what the other player's  
last offer that a player can make  
cannot possibly respond to in the  
that penultimate moment, no offer  
at the last moment players either change  
their offers, and whatever they do is  
dependent on what each other is doing, and is

could get a glimpse of the other's  
intentions about it, or if either could give  
his final offer in time for the other to  
respond to — a final offer.<sup>6</sup>

An important conclusion about the  
game is unaffected by supposing that a player can  
make an offer as long as we keep the symmetrical rule that  
the game ends "as the final bell rings."

There is here that in the process of making a new  
offer the case is slightly more complicated if an  
offer is made before midnight is necessarily the last  
offer made until a minute has passed  
has been passed. This case will be looked at

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perfectly move-symmetrical bargaining game necessarily gives way, at some definite moment, to a (noncooperative) bargaining game.

The most informative way to think about this is not that the players must reach an agreement before the final bell rings or forego the reward if they do not. They must reach overt agreement by a certain moment — the penultimate moment — when they are required to *play the tacit variant of the same game*.

Each player must be assumed to know what he wishes, by simply avoiding overt agreement in the tacit game instead. So, if we assume that the tacit game has a clearly recognizable equilibrium that is *efficient*, each player has a clear incentive during the earlier stage. Either by reaching an agreement or by abstaining from agreement until the final moment, he can achieve anything better from the tacit game than bargaining.

From this it follows that the solution of the tacit game must be identical with that of the cooperative game. The latter has a predictable and identifiable equilibrium because the tacit game comes as a necessary consequence to the cooperative game.

At this point it looks as though the cooperative game is irrelevant. The players do not need communication 11:59; in fact they do not need communication and ability to reach an agreement were intended to characterize the cooperative game. The tacit game is the cooperative game as a distinct entity does not exist.<sup>7</sup>

But this conclusion is unwarranted.

<sup>7</sup>In his 1953 article, "Two-person bargaining model that is explicitly tacit in its final stage," the cooperative game was heuristic: it was a heuristic device to introduce "rational expectations" (and hence a corresponding cooperative game). The relation is likely to be mechanical rather than logical. The structure is strictly adhered to, and the tacit game, perhaps impossible, to define the correct ultimate subject of study.

aining game. It is that it neces-  
 penultimate moment, to a *tacit*  
 ne. And each player knows this.  
 characterize the game, then, is  
 overt agreement by the time the  
 vards altogether. It is that they  
 particular (and well-identified)  
 "warning bell" rings — *or else*  
*the game.*

to know this and may, if he  
 rt agreement, elect to play the  
 ume (for the moment) that the  
 ized solution, and that the solu-  
 pure minimax behavior strategy  
 an enforce this tacit solution by  
 the warning-bell rings; neither  
 n a rational opponent by verbal

solution of the cooperative game  
 he corresponding tacit game (if  
 efficient solution). It must be,  
 an inevitable, mechanical sequel

gh the cooperative feature of the  
 really need not show up until  
 to show up at all. The preplay  
 each binding agreements, which  
 e game, prove to be irrelevant;  
 ct game from the tacit game does

nted. First, a tacit game may not

Cooperative Games," Nash presents a  
 nal stage. The model's relation to the  
 to help to discover what might consti-  
 the indicated rational outcome) in the  
 rgument of the present paper is that the  
 r than intellectual if a symmetrical move  
 hat with strict symmetry it is difficult,  
 esponding nontacit game that was the

have a confidently predicted effect on certain details of the cooperative solution to be innocuous from the point of view of affect the character of the tacit communication that has no binding force may also affect the character of the solution. Consider the following variant of the game.

Instead of saying that the players agree if they can reach agreement on a division that the players may divide a sum of money they have reached agreement on a certain portion of the available reward. The agreement on by the time the bargaining has one hundred individual objects in dispute. The agreement on how to divide eight of the twenty items in dispute reveals the agreement on which agreement was reached with the agreement.<sup>9</sup>

<sup>8</sup> It should be emphasized that bargaining solutions (Nash and Harsanyi solutions) depend on that is, on an unambiguous outcome of the bargaining — cannot necessarily be applied to a matrix of choices. A matrix (unless perfectly diagonal) does not have a zero point. Frequently no "normal form" consisting of a point unless there is available a fully cooperative game (and does so in a manner that may, following Luce and Raiffa (for "security levels" (maximin values) as arbitrary or based on the hypothesis that they succeed in doing no better than this in bargaining especially where there are pure-strategy bargaining game, and as in the Luce-Raiffa matrix hypothesis that can be empirically revealed. They are incapable of correlating strategies. This is something they often can do even in bargaining. (This point is taken up again in note 9.) The point is the issue between Harvey Wargentin and "Rejoinder on the Bargaining Problem" 482 (April 1958).

<sup>9</sup> In the case of a single divisible object the agreement might be that they divide the money equally. Each house has removed the "overlap." Each player implicitly accords him; if one is dem.



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icient solution.<sup>8</sup> More than that, ve game that might have seemed f view of explicit negotiation may t game; similarly, preplay com- effect on the players themselves the tacit game. For an example, the cooperative game.

ayers may divide a set of rewards an exhaustive division, let us say set of rewards *to the extent* that a division; they may divide such ls as they have already reached ll rings. If, for example, there are s and the players have reached hty of them when the bell rings, ert to the house while the eighty ed will be divided in accordance

argaining-game solutions that (like the l on a clearly recognized zero point— hat reigns in the absence of overt agree- o a cooperative game that is based on a rhaps all payoffs are zero except in the t defined by the rules. There is conse- of a convex region and associated zero adequate theory that "solves" the tacit the players can take for granted). One r example, page 137) take the players' the zero point; but this is either arbi- t, left to themselves, the players could n the tacit game. The latter hypothesis, gy efficient points (as in Braithwaite's k discussed in note 18 below), is a weak futed; it assumes that rational players without communicating, while in fact en in the face of conflicting preferences. 18.) The potential ambiguity of the zero gner and John Harsanyi in the former's, a," *Southern Economic Journal*, 24:480-

object like money, the corresponding rule in accordance with their offers after the ch player obtains as much as the other anding 65 percent of the money at the

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Now, in the explicit-bargaining already concluded there was an element that is, that the players would in agreement — we should probably have of the problem inconsequential. That only that bargaining should take in ing down the totality of his claim in the form of each player's deletion with full agreement being reached conflict on the lists of claims. In case, the game is drastically altered; the tacit game now has a perverse incentive: a rational reason for either player to give up part of the available reward; each knows it, the other knows it. There is no incentive to give up any residual dispute costs the player if he reduced his claim to eliminate the equilibrium point yields zero for both players, which seemed to differ inconsequentially from the original game; but it does identify the terminal tacit game.

To take another example, suppose the objects to be divided and that, although as value is concerned, the agreement is that *individual items* go to which individuals require that full and exhaustive agreement. In the tacit game the players are dependent on each other to divide the total value of the objects

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end of the game, and the other 55 percent and the first 45 percent; these are the items and constitute the "agreement."

<sup>10</sup> It might seem that we can draw a lesson, namely, the observation that in order to avoid the (tacit) game, the legal definition of agreement is ultimately tacit game perverse, so that the players must give up part of the reward before the warning bell or suffer complete loss. The players themselves must now define their own agreement prior to the final bell. If this can be accomplished is to make the perverse coordination game shorter, which is equivalent to a modification of the original.

g (cooperative) case, if we had efficient solution to this game — fact reach an exhaustive agreement considered this reformulation. The reformulation says, in effect, the form of each player's writ- and that concessions shall take g items from his list of claims, ed when no more items are in But, when we look at the tacit red by this reformulation. The incentive structure. There is no to demand less than the whole nows this and knows that the ve to reduce one's claim because yer no more than he would lose ate the dispute. The single equi- players. Thus the variant game, entially, is drastically different es not appear so until we have e as a dominating influence.<sup>10</sup>

ose there are 100 individual ob- hough they are fungible as far ent must specify precisely which ividual players. If the rules re- reement be reached, then in the lent on their ability not only to cts in coordinated fashion but to cent, the second has been accorded 35 ounts are outside the range of dispute

a by-product from the analysis here, to set up a "truly" cooperative (non- reement must be such as to make the players must reach binding agreement. ete loss. But there is still a problem. ne "agreement" for purposes of their it is like our earlier definition, all they perative game into a benign one, one a tacit game two minutes shorter than

sort out the 100 individual offers in this fashion. If, then, one of the players offers a division worth 80 percent of the total amount, the other player, if the former has an advantage in the game, will accept. The proposal for dividing the 100 objects into two parts of 80 that would satisfy him; that is, he will not agree to anything else. Similarly, on any other division of the 100 objects between them, may be so small that the player with the offer of agreement into accepting the offer. Thus preplay communication can affect the means of coordination in a game that has been reached.

If now, in considering the game, we insist on a rule of symmetry, we conclude that if either player opens his mouth, the other was about to say, he also with his mouth open, both players would be found to be symmetric. In other words, the rule of symmetry of behavior as a recognition of the fact that it precludes the very kind of action that would enrich the game at the stage of preplay communication.

But by now we have certain conclusions about the symmetrical game as far as is wor-

<sup>21</sup> One detail may be worth pursuing. Suppose that it takes one minute to make a final offer (the earlier version) that the process cannot be stopped before it is completed. If the final offer is initiated during the next to last minute of the minute, the game is essentially over. If the final offer is made within a minute of each other, the players can see the other's final offer as he makes it. If during the final minute the offers are made simultaneously, the offer into a visible board which remains visible. If the offer is recorded, so that the other player can see it, one cannot initiate a change until the other has made his. (Neither can make himself visibly in a position to do so.) In this case, if the two offers are simultaneous, the player who moves first has the edge of the other's; and since his only way of winning is to accept it, he must accept whatever the other offers.

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objects into two piles in identical  
player has demanded *specific* items  
and the other player has refused, the  
tacit game. The only extant pro-  
posal is the one player's specification  
of the chances of their concerting iden-  
tification of the 100 objects, equal or unequal  
proportions, and that they are forced for the sake  
of the only extant proposal in spite of its  
ambiguity has tactical significance in that  
it is the only extant proposal once the tacit stage of the

tactical implications of this last  
asymmetrical behavior, we must con-  
sidered his mouth to drown out what  
he would always find the other player  
in knowing that if either spoke the  
truth, neither able to hear the  
other speaking, the assumption of complete sym-  
metry foregone conclusion seems to  
be the only one that might have seemed to en-  
able replay communication.

only pressed the perfect move-sym-  
metry while.<sup>11</sup> We could go on to ana-

lysis, in line with an earlier footnote. Sup-  
pose one can make or change an offer and (in contrast to  
the procedure of recording a new offer, once started,  
it is not deleted. Under this procedure, any offer in-  
made during the course of the game is one's final offer. If this  
offer is made to the other player before the expiration  
of the time limit, the offer is the same as before; "simultaneous" now  
means simultaneous for practical purposes, and again neither  
player initiates his own, no matter what time  
the offer is initiated. But suppose one punches his  
fingers locked for one minute while the offer  
is being made. Can one see one's offer in a few seconds although  
the minute's delay is up. (And suppose that  
one is unable of seeing the other's offer once it  
is made. Two offers during that final minute are not  
made. The second makes his final offer in full knowl-  
edge of the other's offer. His only chance of winning anything is to accept  
the offer the other has offered. Thus "second move" loses

lyze this game in more detail, consider alternative ways of terminating the game and so forth. It seems more worthwhile to ask the question of whether the "perfectly symmetrical" game is a profitable one in a more general, move-symmetrical game away from "special cases"? Or is it possible that the most interesting aspects of the game have vanished?

It should be emphasized that the assumption of symmetry is not the assumption of asymmetry. It is possible to admit both symmetry and asymmetry, being committed to either as a foregone conclusion.

An illustration may help. Suppose a race in which there is \$100 at the end and the first person to get there first. This game of speed money goes to the fastest, barring a tie. We can predict rational behavior (money to the fastest). Ties will occur at the end of a race and not at the outset. We need an auxiliary rule that need not dominate either the game or the race.

Consider the same game played by two people who can run exactly as fast as each other knows it. Now what happens? Even

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if the first mover knows that the other is also a runner, the game can be characterized as follows: the players wait for a certain number of minutes and then play a game lasting one minute. In this game, each player offers one and only one offer which he can demand within one minute. This game offers, in effect, three possible outcomes: (1) assume the other will wait, and demand the money; (2) make simultaneous offers, and demand what you want; (3) wait. If both wait, the game is still to be played. In the case of potential waits, we have strategies of wait-once-demand-tacit-solution; wait-twice-demand-tacit-solution; and so on. This game is a tacit solution of all strategies for playing the one-minute game. If we wish to accept it, its own "solution" is the tacit solution of all strategies (all lengths of waits) that exist. This is the tacit solution of the tacit game. (For the definition of a tacit two-person game, see Appendix C.)

considering such things as alternative of defining "agreement," and, however, to raise at this point directly "moveless" or "move-symmetry" to study. Is the nondiscriminatory "general" game, one that gets it a special, limiting case in the cooperative game have

the fruitful alternative to symmetry, but just *nonsymmetry*, symmetry as possibilities without a definite conclusion.

if we were to analyze the game of the road for the player who is not hard to analyze: the accidents and random elements. (running) and the outcome occasionally occur; but they will not be taken for granted as a rule to cover ties, but it is for the analysis.

in a population in which everybody else, and everybody every race ends in a tie, so the

is waiting. We now have a game that players dally around for 23 hours 58 one minute, this game allowing each can make at any time during the strategies to a player, namely, (1) 99 per cent; (2) assume both will whatever is indicated by the tacit game; to be played. If there is a finite number of wait-once-then-demand-99-per-cent, twice-demand-99-per-cent, wait-twice-game (the "tacit supergame" consisting of the game) is then *the* game; and it has, in the strict sense" which consists of demands that correspond to the solution of a solution in the strict sense in

auxiliary rule is all that matters. In conclusion, why would they both

The perfectly move-symmetric little like that foot race. Bargaining as leg-work in the other; even all moves and tactics are fore-symmetrical potentialities available. Elements that we might find meaningless if perfect symmetry by both players, are imposed on

What should we add to the game if symmetry is dropped? There are many available, but not necessarily equal in an actual game situation. "Move threats, promises; tampering with the invocation of penalties on promises; conveyance of true information; omission of contextual detail—particularly when communication is involved—were discussed in detail in Chapter 10.

To illustrate, suppose in the foot race that permits a player to make a current offer as he goes through the turnstile until the bell rings. Now we have a "final" offer, a "committal" offer favorable to himself and the other player. The player who is in the room, has the winning tactic. Of course, this may mean that the player who is in the room, has the winning tactic, and the one closest to the turnstile, has the winning tactic, and its institutional arrangements determine who can make first move.

We have not, it should be noted, turned the game into a game of skill by letting the player choose. It remains true that one wins when one chooses through the other's cooperation. The player's choice of strategy. He can win by going through the turnstile first, or by letting the other player choose in his



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ers. But since a tie is a foregone conclusion, is it worth the effort to run?

A non-cooperative game seems a more interesting one in the one case is as unavailing as the other. Every player knows in advance that the game is doomed to neutralization by the other player. The interests of the players in the bargaining game are the same, and its acceptance as inevitable is a part of the game by its definition.

It would be interesting to enrich it if the assumption were that there are many "moves" that are often equally available to both players, in addition to the "moves" would include commitments, promises, and threats; and the information that may constrain expectations, is incomplete. Such "moves" are discussed in chapters 2-5.

In an earlier cooperative game there is a player who can leave but not to return; his interest in the turnstile remains on the books. There is a means by which a player can make a "commitment"; whoever can record an action known to the other, and leave the turnstile. Of course it may win for either of the players. But we end up with something like a game where the player who gets to the turnstile wins. By analyzing the game in terms of legal or physical arrangements, we may see the use of it.

Finally, converted the game of strategy into a game where they race for the turnstile. It remains that the player who gets to the turnstile first only wins, only by constraining the other player. The player who does not win legally or physically; he wins *strategically*. He makes a tactical move in his favor. It is a tactic in a game of strategy.

*strategy*, even though the *use* of it is a tactical advantage.

We can even put a certain kind of asymmetry in the game now, without destroying it; we can have one player nearest the turnstile when the game begins, and another similarly located and similar of status when the game ends. To determine who gets to the turnstile first is now *nondiscriminatory*, the *outcome* is asymmetric because each player has an incentive to stand behind a standing offer in his own favor.

We can include some risk of "ties" between the turnstiles and the players might get to the turnstile. This constitutes "symmetry" as an outcome, but as a foregone conclusion; stalemate and ties become interesting possibilities in a game where the structure are in fact conducive to a unique outcome. In our philosophy, we do not need to have a game of ties.

Again, if one player can make a standing offer, he may thereby win the entire game. Provided the only extant offer that is made is the one when they badly need to concert their efforts in the final tacit stage. To be sure, we can have identical capacities for destruction and both players must recognize that they can destroy communication without getting caught. An interesting case seems to be a special case of this.

In summary, the perfectly "mutually beneficial" cooperative game is not a fruitful one. A game that may degenerate into an ordinary game is rich and meaningful when the players have much of the significance of the move in their availability to the game. The definition of the game. It is the move that matters.

<sup>12</sup> It could be argued at this point that the game is symmetrically divided between the players. However, we frequently still view the game as asymmetric because if he does so he commits himself to a move. The way the game will be played.

it may depend on skill or loca-

nd of symmetry into the game  
 can flip a coin to see who is  
 me begins, or let the players be  
 peed but with random elements  
 nstile first. Though the *game* is  
*ome* would still be *asymmetrical*  
 ive to run to the turnstile, leav-  
 s own favor.<sup>12</sup>

tie," especially if there are two  
 o through them simultaneously.  
 n interesting possibility, but not  
 ate and the anticipation of it  
 f the actions and information  
 ties. But, with nonsymmetry as  
 be obsessed with the possibility

n offer and destroy communica-  
 uing tacit game by having pro-  
 both players can converge on  
 t their choices later during the  
 an consider what happens when  
 n of communication are present,  
 that they may simultaneously  
 etting messages across; but this  
 cial one, not the general case.

oveless" or "move-symmetrical"  
 general case, but a limiting case  
 ary tacit game. The cooperative  
 en "moves" are admitted; and  
 ves will vanish if complete sym-  
 e players is stamped into the  
 ves that are interesting, not the

the expected value of the game is still  
 ers, and that the analyst may conse-  
 cal in terms of average outcomes. But  
 minimum of insight into the game and

game without moves; and it is moves that makes them most in

Symmetry is not only commure of games but adduced as solution of the game or of the solution must be consistent. In cooperative game explicitly po sanyi's. The symmetry postula permits one to find a "solution wishes to — within the realm similarly potent concepts that ing a game. But the justificatio not been just that it leads to ni grounds that the contradiction tradict the rationality of the t ning that I want to attack.

What I am going to argue sistent with the rationality of strated that asymmetry is in while the inclusion of symmet begs the question. I then want ment in favor of symmetrical to make symmetry but one of outcome with no *prima facie* c.

Explicit statements of the re tionality have been given by J gaining problem has an obvious one special case: viz., in situati with respect to the two bargai ural to assume that the two p gain equally since neither wou better terms than the latter wo he refers to the symmetry axio

<sup>13</sup> Harsanyi, 147. He goes on to s that two duopolists with the same co tal resources, personalities, etc., will to each of them."

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s the potential asymmetry of the interesting.

only imposed on the move-structure a plausible characteristic of the rational behavior with which the Nash's theory of the two-person postulates symmetry, as does Harsanyi is certainly expedient; it often "n" to a game and to stay — if he of mathematics. There are few compete with it as bases for solution for the symmetry postulate has nice results; it has been justified on of symmetry would tend to con- two players. This is the underpin-

is that, though symmetry is con- the players, it cannot be demon- consistent with their rationality, ry in the *definition* of rationality to offer what I think is *an* argu- solutions, an argument that tends many potential influences on the claim to pre-eminence.

relation between symmetry and ra- John Harsanyi. He says, "The bar- as determinate solution in at least ons that are completely symmetric ning parties. In this case it is nat- parties will tend to share the net ld be prepared to grant the other ould grant him." <sup>13</sup> In a later paper m as the "fundamental postulate"

ay, "For instance, everybody will expect st functions, size, market conditions, capi- reach an agreement giving equal profits

and says, "Intuitively the assumption is that a rational bargainer will not grant him larger concessions than he would under similar conditions."<sup>14</sup>

Now this intuitive formulation is that one bargainer will not concede to get if he himself were in the other's position. The only basis for his expectation of what the other will do in the other's position is his perception of what the other will do.

The intuitive formulation, or the psychological terms, of what it is that one bargainer expects in relation to another rational bargainer is a scientific description. Both players expect that the only kind of "rational" bargainer is one who has a fully shared expectation of an *outcome* that is as accurate — as a description of the *outcome* — as to say that one expects the second to accept something; the second's response is only an expression of what he expects the first to concede, which in turn is what he expects the second to expect the first to expect. This is the "infinite regress" in the descriptive process. In this sense a shared expectation of an *outcome* is a belief that both identify the *same* *outcome* in the situation, hence as virtually identical. They accept a common authority — the *outcome* — as their own solution through their intelligence.

<sup>14</sup> The full quotation deserves to be given. The theory of bargaining essentially proposes to do this: that two rational bargainers can consistently agree on bargaining strategies if they know each other's strategies. A postulate of the theory is a symmetry of strategies. In defining the two parties' optimal strategies, the functions defining the two parties' strategies in mathematical form, except that, of course, the two parties have to be interchanged. Intuitively, the axiom is that a rational bargainer will not grant him larger concessions than he would expect the other to grant him (Harsanyi, "Bargaining in Ignorance," *Journal of Economic Theory*, Cowles Foundation Discussion Paper No. 18, 1955, by permission of the author.)

ception underlying this axiom is not to expect a rational opponent to concede what he would make himself under

the game involves two postulates. First, that a player will concede more than he would expect if he were in the other's position. Second, that the player will not concede what he would concede if he were in the other's position. This conception of symmetry.

Even a careful formulation in terms of "expectations" that a rational player "expects" the other player to do, poses a problem in sheer logic. A player, being rational, must recognize that the expectation they can have is a *best* outcome. It is probably not quite correct to say that the psychological phenomenon — the willingness to concede something or to accept something — is the readiness to concede or to accept something. A player expects the first to accept or to concede something, and so on. To avoid an "ad hoc" process, we have to say that both players have the same *best* outcome; one's "expectation" is that the other will have the same *best* outcome as being indicated by the game. Both players, in effect, are constrained by the power of the game to dictate its outcome. Both players, in effect, have the same intellectual capacity to perceive it —

given: "What the Zeuthen-Nash theory is to specify what are the expectations that players currently entertain as to each other's bargaining power's utility functions. The fundamental axiom, which states that the functions are symmetric in terms of the data (or, equivalently, the parties' final payoffs) have the same meaning, the variables associated with the two players are symmetric. This is the assumption underlying this theory: not to expect a rational opponent to grant something that he would not make himself under similar conditions." "The Opponent's Utility Function," *Journal of Economic Theory*, No. 46, December 11, 1957, quoted by

and what they expect is that the solution.<sup>15</sup>

In these terms the first (explicit) hypothesis might be rephrased: the game situation (with perfect information) has a particular outcome such that a rational player would recognize that any rational player would expect it as the indicated "solution." The second hypothesis is that the particular solution is determined by mathematical symmetry. The "rational-solution" postulate; it is the "symmetry" postulate.

The question now is whether the solution is derived from the players' rational expectations — or must rest on other grounds, what are they and how are they derived?

To pursue the first question,

<sup>15</sup> Viewed in this way, the intellectual process of arriving at "rational expectations" in the full-communication game is identical with the intellectual process of arriving at a solution in the tacit game. The actual solutions might be different, with different suggestive descriptions, but the process seems virtually identical since both depend on tacit consent. This is true because the full-communication game corresponds to the tacit game (or in theory could have been reached by the players before the bargaining started). In this sense that both can hold confident rational expectations that both accept the indicated solution, the tacit game is both known and expected.

There is a qualification to this position. It requires that the players have similar value systems and a homogeneous set of interests. There may be an infinity of equivalent solutions, but the players, but no difficulty in agreeing on a common set. But tacit bargaining often requires a coordinated choice even among multiple solutions. Negotiation over a boundary line in a game of simultaneous dispatch of territorial claims (as in Question 6 on page 62) is a tacit game even though the terrain values are different; and there is no difficulty in reaching a solution to the tacit game (or to games with simultaneous information, and so forth) would be in a fully explicit game.



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they both perceive the same solu-

explicit) part of the Harsanyi hypothesis (that there is, in any bargaining situation with full information about utilities), a rational player on either side can expect that a rational player on either side would recognize the same outcome so recognized is determined by the symmetry postulate. The first we might call the explicit part of the symmetry postulate is the second that constitutes the

the symmetry postulate is *deducibility* — the rationality of their expectations on other grounds. If it rests on other grounds, what is the support?

whether symmetry can be de-

the process of arriving at "rational expectations" in a bargaining game is virtually identical to the process of arriving at a coordinated choice in the tacit agreement game. The only difference is that the game contexts might be different; but the nature of the two solutions depends on an agreement that is reached by explicit agreement that is reached in the tacit agreement game. *a priori* expectations that were reached jointly but independently by the two players. And it is like a tacit agreement in the tacit agreement game only if both are aware of the agreement in advance as *the* outcome that they

point. With full information about each player's set of gains to be divided, there may be many solutions all yielding the same values to the two players. An arbitrary choice among this indifference set requires a further degree of coordination, among equivalent divisions of the gains. A homogeneous territory is thus different from a heterogeneous one; such claims may overlap and cause conflicts if the claims are consistent. Thus the coordination requires no *a priori* assurance that the solution is unique. In somewhat incomplete communication, in the set of equivalent solutions to the

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duced from the rationality of the theory. We consider the rationality of the theory, not whether a jointly expected nonsymmetrical outcome is the rationality postulate. If two players share, and do share, the expectation that that outcome is not symmetrical, we demonstrate that their expectation is not a rationality postulate. If two players may have \$100 to divide explicitly on how to divide it; and if A shall have \$80 and B shall have \$20, these amounts in this particular case are the amounts the players do too. Can we demonstrate that they have been irrational?

We must be careful not to make a *rejection* of rationality; to do so would be to reject the theory and simply make sense. We must have a plausible definition of rationality, mention symmetry and show that the expectations would be inconsistent. For the present purpose we must suppose that A shall have \$80 and \$20 by agreement and that this is a kind of intellectual error, misguidance, or self-interest, on the part of one or the other, to pick a symmetrical point.

Specifically, where is the "error" in the theory? A? He expected — he may tell us that he means to check his veracity (a mention of utilities is already assumed) — he expected \$80; he expected A to expect to yield \$80; that he, B, expected to yield \$80; he knew that A knew that he knew that he would get \$80, knew that B was psychologically correct, knew that A confidently expected to yield \$80, is, they both knew — they tell us that they knew, that the outcome would indeed be \$80 for B. Both were correct in every sense. If each were internally consistent,

the players' expectations, we can have two players jointly and inquire whether a symmetrical outcome contradicts what the players confidently believe they expect. In the event of a particular outcome, and in a mathematical sense, can we show that the players' expectations are irrational, and that the outcome is expected? Specifically, suppose that the players divide as soon as they agree except for a small amount. They quite readily agree that A should get \$20; and we know that dollar amounts are proportionate to utilities, and we can demonstrate that the players have

made symmetry part of the *definition* of rationality and destroy the empirical relevance of symmetry as an independent axiom. We can also find a definition of rationality that does not require that there be no asymmetry in the bargaining process. For our purposes, let us suppose that two players have picked a strategy. We can identify any order of expectations, or disorderly order, or both of them, in their failure

to "demand" in B's concession of \$80 to A, and suppose that we have a modest supposition if full informed!) — that A would "demand" to get \$80; he knew that A knew that B would be content with \$20; he knew this; and so on. A expected to be psychologically ready because he, B, expected B to be ready, and so on. That is, each knew that both would reluctantly be \$80 for A and \$20 for B. The expectations are consistent with the other's.

We may be mystified about *how* but the feat claims admiration. The "rational-solution" postulate is being used, it seems to have dictated a particular solution confidently perceived. If, at this point, we wouldn't have perceived the same solution, one of four hypotheses is false: (1) the rationality of A and B, (2) the identity (in all essential respects) of the two players, (3) the fact that they respectively play with the game that we are playing, (4) — the rationality of A and B.

Note that if B had insisted on demanding \$50, claiming to be rational, we would have been in "error" and would have had to decide which one was irrational or which one made symmetry the definition of rationality. To conclude that at least one of the players was irrational, the rational-solution postulate did not provide a single *necessary* condition for irrationality; jointly, we have no sufficient condition that can be applied to a single player.

Nor can we trip them up if we change their expectations. Any grounds for irrationality since any grounds that each player has adopted are grounds that he cannot be held to. The stories are all they need; and the blackboard said A-\$80, B-\$20, or that there were two other players, named A' and B', who confidently perceived that this was the rational outcome — that they were confident of what to expect — that the rational outcome — we cannot catch them if they are irrational. They may be irrational; but we cannot catch them.

There is, however, a basis for irrationality. Since I have not actually applied the rationality to two players, given them the 80:20 split that I just mentioned,

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they reached such expectations; as much as contempt. The "ra- beautifully borne out; the game particular outcome that both players point, we feel that we ourselves the outcome, we can conclude that (1) the rational-solution postulate, (3) our own rationality, (4) the (2) facts) of the game that we intro- at A and B have just played. But are the second to be the false one

\$50, or if A had been content to onal and arguing in terms of con- of that outcome, both players we could not tell, on the evidence, whether they both were. Unless we of rationality we could only con- players was irrational or that the ot hold. What we have is at best the irrationality of both players ndition, and no necessary condi- ngle player.

we ask them how they arrived at s that are consistent would do, xpects the other confidently to ot rationally eschew. Consistent if they say that a sign on the that they saw in a bulletin that B', split \$80-\$20, and that they was clear indication to both of this was the only "expectable" n in error and prove them irra- out the evidence will not show it. denying my present argument. d an independent test of ration- the game to play, and observed ned, but have only posed it as a

## FOR THE ABANDONMENT

possibility to see whether it would occur, one might object that the argument would rest on the problem of focal points that follows.

If two players jointly expect a particular outcome and confidently recognize it as their common focal point, the intellectual power to pick a particular outcome from the whole \$100 can be divided into 9,999 relevant divisions to consider. Each division can be picked simultaneously but separately by the two players, and their expectations of the outcome. But their selections of one item out of the 9,999 divisions focus or converge on a particular outcome to 1 against them? The answer is no. There is no trick, or clue, or coordinating device that can lead to a unique outcome. They must, consciously or unconsciously, use a procedure that leads to unique results. The procedure is the point they pick that distinguishes the outcome from the reasoning, at least in our consciousness, of all possible alternatives.

Now, is it possible for two rational players to converge on other than sheer coincidence or chance on the same particular outcome? Can they be confident that the other is focussed on the same outcome? Can they have the same appreciation that it is mutually expected? Can they?

The answer is that they can, and they do. They may use any means that lead to a unique choice, suggestion, any rule of elimination, a high probability of choice or a high probability of coordination. Rules, or clues, or suggestions, is

<sup>16</sup> The basic intellectual premise, or view, in this game seems to be the premise that there is to exceed coincidence, and that the rationalization, is consequently a rationalization. For example, Nash's model that views the limit of a "smoothed" game as the smoothed game is in no sense a suggestive one that can, in the absence of a single point, command the attention of

ould imply irrationality *if* it could not occur. And the argument of coordination; it would run as

*a priori* the same outcome, and common expectation, they must have a particular point in common. If to the nearest penny, there are a million, one of which would have to be chosen separately by both players as their common point. But how can two people concert on a point of 9,999, in the sense that their common point is 9,999, except with odds of 9,999 to 1? It must be that they utilize some common device that presents itself to them. They unconsciously, use a selection procedure. There must be something about the game which suggests it — if not in their conscious analysis — from the contin-

uous players, through anything like a magic, to focus their attention on a point and each “rationally” be converging on the same outcome with the probability usually expected? And, if so, how

is this demonstrated in Chapter 3. The answer is available: any clue, any suggestion that leads to an unambiguous concerted choice. And one of these is mathematical symmetry.<sup>16</sup>

Working hypothesis, for rational players is that *some* rule must be used if success is to be the best rule to be found, whatever its name. This premise would support, as an “unsmoothed” tacit game as the limit of something approaches zero. While this view is logically necessary, it is a powerfully suggestive better rationale for converging on a common choice of players in need of a common choice.

In a game that has absolutely no structure, in which no inadvertent advantage is itself appreciated by a player and no advantage is appreciated too, there may be no equilibrium of numbers. And all the numbers are equally likely whether they correspond to symmetry or not. If all numbers but one represent a symmetry, then mathematical symmetry is a sufficient condition for a useful one in concerting on a common strategy. To set up a game in such sanitary conditions for a group of players and all contextual conditions is another visible basis for concerting.

In other words, mathematical symmetry is a sufficient condition of two rational players being able to concert. If assumed features of the game, like symmetry and utility systems — provide one reason for concerting. Whether it is a potent means may depend on the means available.

That there are other means of concerting may substantially outweigh the reasons demonstrated by the experimental results. It is probably possible to set up games

The limiting process provides a clue for finding equilibrium points that actually exist in the world. It equally supports any other procedure for finding equilibrium among the infinitely many potential choices.

<sup>27</sup> In this view, the theory of Nash (and Harsanyi's solution) is a response to the fact that there are offhand too many types of unique equilibria. A rigorous rule for selection, hence a need for a rule sufficient to yield an unambiguous selection. The fact that mathematicians may not have a sufficient condition to satisfy the first part of the Harsanyi procedure (expectations on the same outcome). (R. A. Luce and R. D. Raiffa, *Game Theory: A Tool for the Moral Philosopher* [Cambridge, Mass.: Harvard University Press, 1957], p. 121). The solution is described in Luce and Raiffa's construction of the problem as a limiting process. Luce and Raiffa's reformulation of Nash's theorem on strategy (pages 121-154), seem to be at the heart of the theory. A legalist's search for a unique outcome; pure casuistry is



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y no details but its mathematical  
tent contextual matter can make  
as something that the other can  
thing to work on but a continuum  
bers can be sorted according to  
metrical or asymmetrical divisions.  
an asymmetrical split, then sheer  
efficient rule and a supremely help-  
on choice. And it may be possible  
y fashion, suppressing the identity  
details, that there is literally no  
g unless impurities creep in.<sup>17</sup>

symmetry may focus the expecta-  
cause it does — granted the other  
ke full information on each other's  
means of concerting expectations.  
y depend on what alternatives are

f concerting, including some that  
notion of symmetry, seems amply  
ts in Chapter 3. So it is demon-  
es in which mathematical sym-

r picking one of the infinitely many equi-  
unsmoothed game. Of course, the premise  
that produces a candidate for election  
oices.

(leading to the maximum-utility-product  
even in the realm of mathematics there  
ness or symmetry to provide an unam-  
ed to adduce plausible criteria (axioms)  
ction. Braithwaite's theory can be char-  
t the two solutions conflict implies that  
ently common mathematical aesthetic to  
postulate, that is, to coordinate their ex-  
B. Braithwaite, *Theory of Games as a*  
mbridge, England, 1955]; Braithwaite's  
ia, *Games and Decisions*, 145ff.) Braith-  
s a one-person arbitration problem, and  
h's theory in terms of arbitration rather  
emphasize that *intellectual coordination*  
ic solution requires *some* rationalization  
s helpful if the alternative is vacuum.

## FOR THE ABANDONMENT

metry does provide the focus for what is demonstrably possible to set up in the course of the game focusses expectations that are not only not contained in the mathematical structure but are part of the "topical content" of the game on the "labeling" of players and actions. Luce and Raiffa mentioned in Chapter 1.

I have no basis for arguing with the value of a range of interesting games, mathematical or otherwise, "rational expectations." But I think that the symmetry postulate is qualitatively different from symmetry has competitors in the field. For, if it were believed that rationality could be brought into consistency only by a modification of the payoff function, then symmetry is a disputed claim, particularly if one has a definition of symmetry that meets the requirements if one has to admit that other parts of the mathematical structure could do what symmetry does, then the hypothesis that what symmetry does is not its job. The appeal of symmetry is not retrospective; and further argument is needed to appeal of particular focussing devices to a *player*, or else to empirical observation.

Thus a normative theory of game playing on intellectual coordination is inherently empirical; it depends on actual expectations. It depends therefore that a rational player must address himself to the question how, in the particular context of the game, players might achieve tacit coordination in the game a basis for sharing a common outcome with his partner. The identification of rationality rests on the assumption of actual processes that rational players are making choices on the basis of actual information, symmetry, and that rational players

or coordinated expectations, and games in which some other aspects. (These other aspects are complementary structure of the game "ent"; that is, they usually depend strategies, to use the term of chapter 4.)

What force, or in what percentage of mathematical symmetry does dominate think that the status of the symmetry is changed by the admission that the role of focussing expectations. Personal players' expectations could be by some mathematical property of symmetry might seem to have unit it is possible to find a unique set of certain attractive axioms. But these things — things not necessarily of the payoff function — can there is no *a priori* reason to suppose 99 percent or 1 percent of the is no longer mathematical, it is in-ent is limited to the personal ap-ces to the game theorist *as game* vation.

Games, a theory of strategy, depend-ly, has a component that is in- how people can coordinate their re on skill and on context. The self to the empirical question of of his own game, two rational ination of choices, if he is to find n *a priori* expectation of the out- tification of symmetry with ra- n that there are certain intellec- ers are incapable of, namely, con- anything other than mathematical ayers should know this. It is an

empirical question whether rationality is such a theory denies they can be. The strategic principles produced by

An introspective game, which may illustrate the point. Imagine a square consisting of all the points on the upper-right quadrant relative to

<sup>18</sup> It is interesting that in demanding a symmetrical tacit game, Luce and Raiffa didates. They consider (*Games and*

i	2
ii	-1

and note that it has pure-strategy lower-right corners. These are ruled out by condition I give for either i or ii there is, no similar rationalization for player 2, and so (I have substituted i and ii for their original numbers) of maximin strategies, which are unstable. An equilibrium point, and a minimax point. But the important question is whether these intuitive arguments are quite as impotent as they appear. Late strategies without communication. Experiments of Chapter 3 give an affirmative answer. In particular cases the answer may be yes. In concert on a nonsymmetrical pair of strategies, just recognizing that they have to; this is a practical matter. They must jointly choose one of their choice. Of course, a nonsymmetrical game is discriminatory one; it quite arbitrary. A smaller gain than the other for reasons that are incidental. But we have to suppose that a player will accept the lesser share if the clue can point to a concerted choice; the premise that a clue can be jointly formed. The existence of an outcome that is jointly far superior. Luce and Raiffa conclude their discussion with the statement that "although this seemingly innocuous observation is difficult to see how to exploit them." The important question is that it may, particularly with respect to *asymmetries*; and the object is to exploit

## ENDIX B

ional players can actually do what do and should consequently ignore ed by such a theory.<sup>18</sup>

n could be submitted to experiment, gine a game's potential payoffs as a or within some boundary in the o a pair of rectangular coordinates.

ng a symmetrical solution to an ostensibly aiffa dismiss the two most promising can-

*Decisions*, 90-94) a matrix,

I	II
1	-1
	-1
-1	2
	1

equilibrium points in the upper-left and ut on grounds that "whatever rationaliza- by the symmetry of the situation, a simi- so it seems inevitable that we both lose." (designations.) They then look at a pair satisfactory because they do not produce x strategy which they find even inferior. her players who are both rational and Luce and Raiffa insist. Can players corre- g? This an empirical question; the ex- native answer, or at least indicate that in es. Offhand it may seem hard for them to strategies. But much the hardest part is e question of how to do it then becomes and tacitly find a clue to the concerting metrical solution in the above matrix is a rily condemns one of the players to a ons that may seem purely accidental or hat a rational player can discipline him- e points that way. Only a discriminatory to deny the discrimination is to deny the und and jointly acted on in the interest perior to any symmetrical outcome. Luce of this particular game with the remark ous game possesses some symmetries it is But the real key to this seemingly innocu- when presented in a context, possess some bit them. See also pp. 298 ff.

## FOR THE ABANDONMENT

Let us — whether or not we are symmetry postulate, and whether or not to the particular symmetry of the game in a frame of mind congenial to a rational outcome of an explicit bargaining some variants of this game.

<sup>10</sup> The solution proposed by J. F. Nash for two players who have perfect knowledge of their own (subjective) valuations and whose utilities are linearly independent is the outcome that maximizes the product of the players' utilities. If all possible outcomes are plotted in a plane whose angular coordinates measure the utilities of the two players, then, if they are linearly independent, the solution is a unique point on the line segment connecting the two players' utility points. (The point is unique because, if there were two, a straight line representing available alternatives with various odds, the probabilities of which are given on the line connecting them would yield the same utilities. In other words, the region is the convex hull of probability mixtures, and a unique point is the utility-product point, or "Nash point.")

A distinguishing feature of this particular solution is that the exchange rate between the two goods is invariant with respect to any change in the players' utilities. And it meets the condition that for any pair of fixed utility scales relating the two players' utility scales that the right midpoint is the solution; that is, the two players' utility points is the solution. (It is the only solution that meets the specified conditions; Nash showed that any solution must lead to the outcome that entails the maximum product of utilities.) For our present purpose we note the generic characteristic of the solution (axioms) as serving to refine the crude idea that a unique solution is guaranteed. See the work of Harsanyi, and Luce and Raiffa; see also the book "The Theory of Arbitration," with criticism, by Robert B. Gauthier, "Monopoly and Duopoly," to be published by the University of Chicago Press. "Nash point" to the theory of arbitration, see "A Proposed Application of the Theory of Arbitration," *Yale Law Journal*, 65:660 (April, 1956).

Incidentally, it may deserve to be mentioned that there is just one that does not *need* a means for comparing utilities — one that, being independent of inter-comparability, can go along without them. Rather, since it is based on the exchange rate as a fundamental principle, it is based on the inherent incommensurability of utilities. If scales could in principle be compared, the solution would not seem an attractive means of arbitration. If principle utilities were commensurable,

strongly attracted to the sym-  
 not we are especially attracted  
 e Nash solution — put ourselves  
 cepting the “Nash point” as the  
 bargaining game.<sup>19</sup> Consider now

sh for bargaining games in which both  
 own and each other’s utility systems  
 that maximizes the *product* of the two  
 es are plotted on a graph whose rec-  
 ies that the two players derive from  
 the upper-right boundary of the region.  
 vere two, the two could be joined by a  
 native outcomes achievable by mixing,  
 the original two outcomes; and points  
 ld higher products of the two players’  
 resumed convex by reason of the possi-  
 convex region has a single maximum-

ular “solution” is that it is independent  
 players’ utility scales; it is, in other  
 fixed weights that we might attach to  
 some other conditions, notably including  
 ed weights (or any exchange rate) re-  
 yields a *symmetrical* region, the upper-  
 the best point symmetrical as between  
 the only solution that does meet all of  
 hat any solution meeting his conditions  
 e maximum product for the two players’  
 may take this symmetry requirement as  
 on, and think of the other conditions  
 notion of symmetry to the point where  
 e earlier references (p. 267) to Nash,  
 o the excellent elucidation of the Nash  
 hop, “The Nash Solution of Bilateral  
 ed. And for an application of the “Nash  
 Layman E. Allen, “Games Bargaining:  
 y of Games to Collective Bargaining,”

emphasized that the Nash theory is not  
 or comparing two players’ utility scales  
 erpersonal utility comparisons, can get  
 uses the arbitrariness of the utility ex-  
 e, the theory must be taken to *depend*  
 f utilities. If the two players’ utility  
 though with difficulty, the Nash theory  
 of obviating difficult comparisons. If in  
 there would be little virtue in a theory

First, we are to play the same game as before. Each of us picks a value along his own axis, on or within the boundary, we pick a point noted by the coordinates we pick. In my mind I have asked for — a free point appeal to us in the explicit game. We probably pick the Nash point. Now let us go on to another variant of the game, but it differs in that we get no prizes. The coordinates we pick is *exactly* on the boundary unless we exhaust the available options. Each must choose exactly as the other. That is, that in our present frame of reference, the Nash point.

Finally, consider another variant of the game that has just been described. We are to be perfect partners, winning together. The fact that our present game is a coordination game we are to pick, without communication, a point that lies exactly on the boundary — the same prizes no matter what we pick together — and if we fail to pick a point on the boundary, we get nothing. In this pure coordination game, we should (would) in our present frame of reference pick the Nash point.

Why? Simply because we need a unique point; and in the present game, it provides it. Unless there is a solution, the Nash point is to be the Nash point anyway);

---

that relies, in reaching a solution, on the fact that the present-day conceptual bases of economic theory seem incompatible with interpersonal arbitration may not be. Economic theory is based on utility that makes utility theory correct. We get "welfare economics" as a free by-product. But if one were to forego this correspondence, one might be led to "arbitration" in some psychological or physiological sense. Some convention for making a comparison, arbitrary, were compatible with the social



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the game in its tacit form. Each of  
axis, and if the resulting point is  
we get the amounts (utilities) de-  
ck. I conjecture that, in the frame  
frame of mind that made the Nash  
tacit-bargaining game — we should  
Without asking precisely why, let  
the game. This variant is tacit too;  
nothing unless the point whose co-  
n the boundary. We get nothing  
gains. Caution gets us nowhere;  
the other expects him to. I propose  
mind we ought to take the Nash

variant. We are shown the diagram  
played and told that we are now  
and losing together. Conscious of  
is modeled on a bargaining game  
communicating, coordinates of a point  
ry. If we do, we both win prizes  
what point we succeed in picking  
k a point on the boundary we get  
ion game, I conjecture again that  
ent frame of mind pick the Nash

ed some rationalization that leads  
context, the bargaining analogy  
sharp corner (which is then likely  
or a simple mid-point as when the

the principle of incommensurability. And,  
s of game theory and of economic theory  
utility comparisons, the notion of *arbi-*  
finds it convenient to use a notion of  
spond to choice theory, so that one can  
product of a theory of economic choice.  
pendence, for purposes of deriving prin-  
l either to an attempt to measure “util-  
logical way, or to establish legalistically  
rison — a convention that, though arbi-  
l purpose of arbitration

boundary is a straight line or circle (with the Nash point); or some other curve seems to point towards a particular point of impurity (such as a dot on the boundary or a single point whose coordinates are given forth), we may be led to search for a solution geometry to fall back on. And Nash's solution, as any I can think of — not as a solution obtained by section with a  $45^\circ$  line from the origin (or something of that ilk), but less ambiguous on the whole.

And, if the Nash point appeals to us in a coordination game, it must do so because it is equally to our partner who in turn has the same view of our views coincide. It must therefore be the unique solution of a coordination game as a unique point of equilibrium to be obviously obvious.

What does this prove or suggest about the Nash point. I am arguing rather than pointing to a game theorist (as in the reverse of the sequence I have just described) the focal quality of the Nash-point is the unequivocal usefulness of a concept, when no nonmathematical considerations — that makes it a controlling influence in a non-cooperative boundary-line variation of the game makes it a reliable guide in the area variant of the game; and that any player in the explicit bargaining process could focus anywhere.

In other words, by postulating rational *expectations*, we seem to have a solution like the Nash axioms. What a simple premise that a solution exists; in the absence of tacit coordination that provides a focal point (times) rational expectations can lead to a unique (and perhaps efficient) outcome that the same may be possible in a non-cooperative game but mathematical properties to

ular arc (which again coincides especially suggestive form that lar point; or unless there is an boundary, from a printer's error, tes are whole numbers, and so or a "unique" definition of sym- a-type symmetry is as plausible simple as some (like the inter- igin of the diagram and others of its own level of sophistication. to us powerfully in the bargain- we are confident that it appeals rn we believe to be aware that efore appeal to us in the pure- oint that the partner will con-

ggest? I am not arguing for the r that the appeal of the Nash (rospective game player) may be e just run through. It may be the n the pure coordination game — uniquely defined symmetry con- impurities are available to help fluence in the tacit and terribly nt of the game; that in turn e less demanding tacit bounded- at in turn takes the heart out of ning game who might hope that ere else.

ng the *need for coordination of* e theoretical basis for something theory like Nash's needs is the it is the observable phenomenon es empirical evidence that (some- be tacitly focussed on a unique e, and that leads one to suppose in a game that provides nothing work on. The Nash theory is

vindication of this supposition -  
nates all competing mathemati  
mical esthetics. The resulting  
verse of mathematics, however,  
the universe of game theory.

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— complete vindication if it domi-  
cal solutions in terms of mathe-  
focal point is limited to the uni-  
which should not be equated with

## RE-INTERPRETATION CONCEPT FOR "NONCOOPERATIVE"

The pure common-interest game theory adds insight into the reasoning behind the "noncooperative" game. By "concepts" I mean the reasoning of players to whom the concepts should

		I
i	1	1
ii	0	0

FIG.

The tacit games represented in a *solution in the strict sense*. (In or third strategy for each player definition of such a solution, given follows: "A non-cooperative game is *strict sense* if: (1) There exists jointly admissible strategy pairs. Equilibrium pairs are both interchangeable

<sup>1</sup> "Noncooperative" is the traditional communication. Unfortunately it may suggest communication is absent. As indicated reciprocated and taken for granted by a dominant element, in many tacit nonze

<sup>2</sup> *Games and Decisions*, p. 107f. This

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# N OF A SOLUTION "COOPERATIVE" GAMES

me, or coordination game, may  
hind certain solution concepts in  
*solution in the strict sense* for  
reasoning that lies behind these  
that is imputed to the rational  
ould appeal.<sup>1</sup>

II

	0
0	
	3
3	

25

Figs. 25 and 26 are said to have  
Fig. 26 a choice of either second  
r constitutes the solution.) The  
en by Luce and Raiffa, is as fol-  
is said to have a *solution in the*  
an equilibrium pair among the  
(2) All jointly admissible equi-  
geable and equivalent." <sup>2</sup>

name for the game without overt com-  
uggest that cooperation is absent when  
in Chapters 3 and 4, cooperation—  
each side—is an essential element, even  
ro-sum games.

particular solution concept is akin to,

		I	
i	1	1	
ii	0	0	
iii	0	0	

FIG.

An *equilibrium pair* is a pair (I, II) such that each is the player's best response (to the other) that can be coupled with a strategy pair is a pair that is not an equilibrium pair; that is, it yields a pair of payoffs to the payoffs in some other cell. If, for each player separately, two equilibrium pairs are *interchangeable* if the corresponding strategies are also equivalent, therefore equivalent and interchangeable. If the corresponding strategies are equivalent, the pairs (ii, II), (iii, III), (ii, III) are equivalent, interchangeable, jointly

Luce and Raiffa, immediately following comment, which can be summarized as follows: "The second condition prohibits a unique jointly admissible equilibrium."

It is precisely this problem that was at the heart of the confusion. The game in Fig. 27 does not have a unique equilibrium. The second and third strategies are interchangeable and equivalent—equilibrium pairs in all four combinations. The confusion between the two players in the game is simply cause for confusion. In

but distinct from, that proposed by J. Nash. Several related solution concepts see O. Nash, "Non-cooperative Games," *Ann.*



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II      III

	0	0
0	0	0
3	3	3
3	3	3

Fig. 26

of strategies for the two players  
 best strategy (or as good as any  
 the other's. A *jointly admissible*  
 not jointly dominated by another  
 payoffs that are not both inferior  
 . Equilibrium pairs are *equivalent*  
 they yield equal payoffs; equilib-  
 of all pairs formed from the corre-  
 equilibrium points. (They are there-  
 able only if all pairs formed from  
 e equivalent.) Thus the strategy  
 ), and (iii, II) in Fig. 26 denote  
 ntly admissible equilibrium pairs.  
 ly after this definition, add the  
 serve as our point of departure:  
 s *confusion* in the case of non-  
 brium pairs." (My italics.)

of *confusion*, or *ambiguousness*,  
 coordination game in Chapter 3.  
 ave a *solution in the strict sense*.  
 s for the two players are not in-  
 —they do not yield equivalent  
 There is no difference of interest  
 eir choice of strategies; there is  
 Fig. 25 they know exactly what

J. F. Nash in 1951. For a comparison of  
 Chap. 5 of Luce and Raiffa, and J. F.  
*Annals of Mathematics*, 54:286-295 (1951).

## RE-INTERPRETATION OF

		I	
i	1	0	
ii	0	3	
iii	0	0	

FIG.

strategies to choose; in Fig. 26 they do, in Fig. 27 they do not. Failure to choose leads to zero apiece, and without further information they be supposed to have a fifty-fifty chance of choosing, with an expected value of 1.5.

Why is it that (ii, II) is the more likely choice than (i, I)? An offhand answer is that the payoff for (ii, II) is greater than for (i, I). But this is not the whole story. Another part emerges if we look at

		I	
i	9	9	
ii	0	0	

FIG.

in preference ordering but different in preference. In Fig. 28 it looks as though they would like to achieve 10 rather than 9, but if they choose 9, speaking, the two equilibrium points are not interchangeable; and though they are concerned about whether they get 9 or 10, they are concerned not to get zero. Their motivation is different.

They need to find some clue, some information to guide their choices. In a game a

	II	III
I	0	0
II	3	0
III	0	3

27

they know as well as they need to; to coordinate in Fig. 27 condemns a clue to coordination they may chance of winning 3 apiece, for

indicated solution in Fig. 25, rather is that the payoff is better for is only part of the answer. Another Fig. 28, which is like Fig. 25

	II
I	0
II	10

28

ent in absolute strengths of preference though the important thing is not 0 or 10 rather than zero. Roughly pairs are nearly equivalent but when the players may be little concerned or 10 they are very much concerned main interest is to avoid "confu-

or rule, or instruction to coordinate as abstract as the matrix in Fig.

28, there is little to guide them in choosing between the alternative rules of picking between  $i$  and  $ii$ ; the latter probably has more value for them, but much it is worth to the players to choose  $i$  over  $ii$  to (ii, II) by comparison with  $i$  over  $i$  as a signaling device and just a difference between 9 and 10 that makes a difference in choices. In Fig. 29, if we suppose

		I
i		10
		10
ii		0
		0

FIG. 29

for coordination, their expected payoffs are:

(Actually the game in Fig. 29, as *shown* may not cause difficulty. The fact that the two strategies in the first column imply that it need not. A signaling device in upper-lower, first-last-middle display form, we must suppose that the players are actually incapable of ordering the strategies. Foolproof or geniusproof clues to have scrambled labels and payoffs. Incidentally, a tacit game apparently has no "pure" form and can only be presented to the player in a formula, and any generating formula requires some means of ordering the strategies.)

The situation may not be very different if the strategy pair (ii, II) is unattractive, or has arrows pointing toward it, or has some other source of confusion the management suspects. The signal the players need is *some* signal that they cannot find it in the mathematical

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but the numbers; and between the lesser pair or the greater, plausibility. We might ask how to have an extra dollar attached (i, I); it is worth a great deal a little as extra money. It is the that makes it possible to coordinate those that they can find no rule

II

0	0
0	10
0	10

. 29

value is presumably 5 apiece. 9 if presented in the matrix as

The empirical results of Chap-specific matrix permits left-right, distinctions. For our present pur-strategies occur to the players in that rational players are intellec-om unambiguously. A completely s game would presumably have a perfectly symmetrical set of ne with infinitely many strategies; an infinity of strategies could s by means of a generating for-ula is likely to offer the players tegies.)

ery different if we suppose that derlined, printed bold face, has as a footnote saying that in case ggests a choice of (ii, II). What to coordinate strategies; if they cal configuration of the payoffs,

## RE-INTERPRETATION OF

they can look for it anywhere else in such fashion, or with such labels as a potential basis for ordering the players find useful.<sup>3</sup>

The suggestion of this appended property enjoyed by a "solution" is why rational players might select means of tacit communication, rather than to facilitate their tacit cooperation, choices would be serious. This is an important property of such a solution as part of the rationale for a player.

Another way to make this possible is like those presented in this paper: arrangements with certain communication games to see whether communication what messages sent over what "solution." The "clues" under consideration then appear to be so much free communication of; and it is an empirical question a rational player should be able to solve. Just as esthetic or syntactic considerations eliminate garbles in a badly translated dramaturgical constraints, casuistic help to eliminate ambiguousness where a concerted choice is required.

The point can be pressed further. 30. Again assume that the strategy of ordering them intellectually is specifically, not in the form of a

<sup>3</sup> The type of "rationality" or intelligence something like that required in solving a problem where one is invited to search for a clue, the clue is not too hard to find nor too easy. (One might say he should have got it, when it is pointed out in a two-person problem; the methodology is that another person has planted a message which is not too hard. In principle one can solve it without empirical experience; one cannot decide whether one can take a hint. "Hint theory" is an interesting

se. And strategies may occur in  
s or connotations, as to provide  
m or sorting them that rational

lix, then, is that an important  
in the strict sense" — a reason  
ct it — is a signaling power, a  
that is available to the two play-  
ation when failure to coordinate  
s of course not the only signifi-  
; but it may be an important  
r's choosing it.

int is that we could, in games  
aper, prescribe communication  
unication costs and analyse the  
ication is worth the cost and  
channels would constitute the  
discussion in this paper would  
mmunication to be taken advan-  
estion what free communication  
e to find and take for granted.  
straints on a language help to  
ansmitted message, esthetic or  
tic or geometric constraints, can  
in a situation where tacit con-

her. Consider the game in Fig.  
gies occur in a way that makes  
ossible for rational players, spe-  
particular square matrix, not

ectual skill required in these games is  
riddles. A riddle is a context in which  
rules being that the clue must not be  
must at least be able to recognize that  
ed out to him.) A riddle is essentially  
y of solution depends on the fact that  
that in his judgment is hard to find  
neither make up nor solve riddles with-  
duce *a priori* whether a rational partner  
nerently empirical part of game theory.

	I	II
i	10 10	0
ii	0	10
iii	0	0
iv	0	0

FIG.

labeled with numbers or letters, the labels scrambled separately would appear that if no better discerned, the "solution" may be payoffs of 9 apiece. This is the least points, but it enjoys uniqueness it provides a clue to concert structure alone (that is, without cated matrices, or any other distinctive structure of the game), it is much less, if at all less, com

	I	II
i	9 9	0
ii	0	9
iii	0	0
iv	0	0

FIG.



NDIX C

	III	IV
	0	0
10	0	0
	9	0
	0	10
		10

g. 30

, or — if they are labeled — with  
 y for the two players. There it  
 r means of coordinating can be  
 e the strategy pair (iii, III) with  
 ast desired among the equilibrium  
 while the others offer confusion;  
 choices. In terms of the *payoff*  
 ut introducing “labels,” prefabri-  
 etails outside the pure quantita-  
 is hard to see that this solution  
 pelling than the one in Fig. 31,

	III	IV
	0	0
9	0	0
	10	0
	10	
	0	9
		9

. 31

## RE-INTERPRETATION OF

although the latter meets the former contradicts it.<sup>4</sup>

		I
i		10
	10	
ii		0
	0	

FIG.

The games in Figs. 32 and 33, in the strict sense, seem to represent "though" the players have an argument in Fig. 33. One argument might be of knowing whether to aim for (i) or (ii). Consider what insurance he can fall back on if he wrongly chooses the lower row, or if he wrongly chooses the lower column, to rendezvous with his partner for the lower row arguing that he does so if he does not get 10, and his chance with this choice. Perhaps this is of him; but it might be more p

		I
i		10
	10	
ii		0
	5	

FIG.

"Comparing just (i, I) and (ii, I) is a way of concerting our choices. However, so let's look for it. The difference is in the cells (ii, I) and (i, II). Do

<sup>4</sup> Empirical evidence for these and similar games is left to himself by any reader who wants to pursue it.

Luce-Raiffa definition and the

II

	0
0	
	10
10	

32

neither of which has a solution  
 ent the same point. It "looks as  
 gument for choosing (ii, II) in  
 that, in the absence of any way  
 i, I) or (ii, II), one should con-  
 back on. The row chooser gets  
 the upper row, he gets 5 if he  
 "wrong" meaning that he fails  
 or 10. He might then choose the  
 so because he will at least get 5  
 ances of getting 10 are no worse  
 s all that "rationality" requires  
 perceptive to reason as follows.

II

	5
0	
	10
10	

33

II) my partner and I have no  
 There must be some way, how-  
 only other place to look is in  
 they give us the hint we need

imilar games can readily be obtained for  
 rsue the point.

to concert on 10 apiece? Yes, toward" (ii, II). They provide believing or pretending that (ii) we need an excuse, if not a relieving, that one of the equilibria distinguished, or more prominent, and since I find no competing clue to pursue, we may as well a meeting of minds."

In this case the players are not because 5 is preferable to 0. They are of getting 5. They are *using* the as a *clue* to coordinating action and each recognizes that the other take note of where the fives are, of coordinating intentions. The to "converge" on (ii, II) is in a matrix had arrows pointing toward with no logical role or authority tion and hence the ability to co

#### CONFLICTING

We can consider now the case of conflict. Figures 34 and 35 portray points, two of them both jointly in the strict sense" because they are equivalent nor interchangeable.

The coordination problem in "insoluble" in its purely abstract on the strategies; there appears

<sup>5</sup> Assuming that a player does choose an operational way of discriminating between only to make sure that the concept is mentioned — the "insurance" motive we might distinguish as follows. We offer that differ only in substituting values in the matrix, leaving the 10's and zeros as the games for us — to indicate how to play the game with a live partner

## NDIX C

they do; they seem to "point either a reason or an excuse for (i, II) is better than (i, I); since reason, for pretending, if not be- equilibrium pairs is better, or more dis- or more eligible, than the other, rule or instruction to follow or I agree to use this rule to reach

not choosing their second strategies They have no serious expectation the configuration of fives and zeros ns. It is *useful* to the players — er recognizes that it is useful — to but only as a step in the process tendency for the matrix in Fig. 33 principle the same as if the printed ard the lower-right corner, arrows y other than the power of sugges- ordinate expectations.<sup>5</sup>

## NG INTEREST

e of coordination mixed with con- ay games that have equilibrium y admissible, without a "solution ne equilibrium pairs are neither

the first of the two is apparently act form, that is, without labels s to be at best a random chance

e ii or II, it may be worthwhile to find between motives for choosing it, even if operational. As between the two motives and the "coordination-clue" motive — er a player alternative games like Fig. 33 ranging from 0 to 9 for the 5's in that they are. We then ask him to "value" much he would pay for the opportunity and real money payoffs. (Alternatively

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