

①

c/80-15

Generalized Precedent Logics for Resolving Insecurity Dilemmas*

50 pp.

by

Hayward R. Alker, Jr., James Bennett, and Dwain Mefford

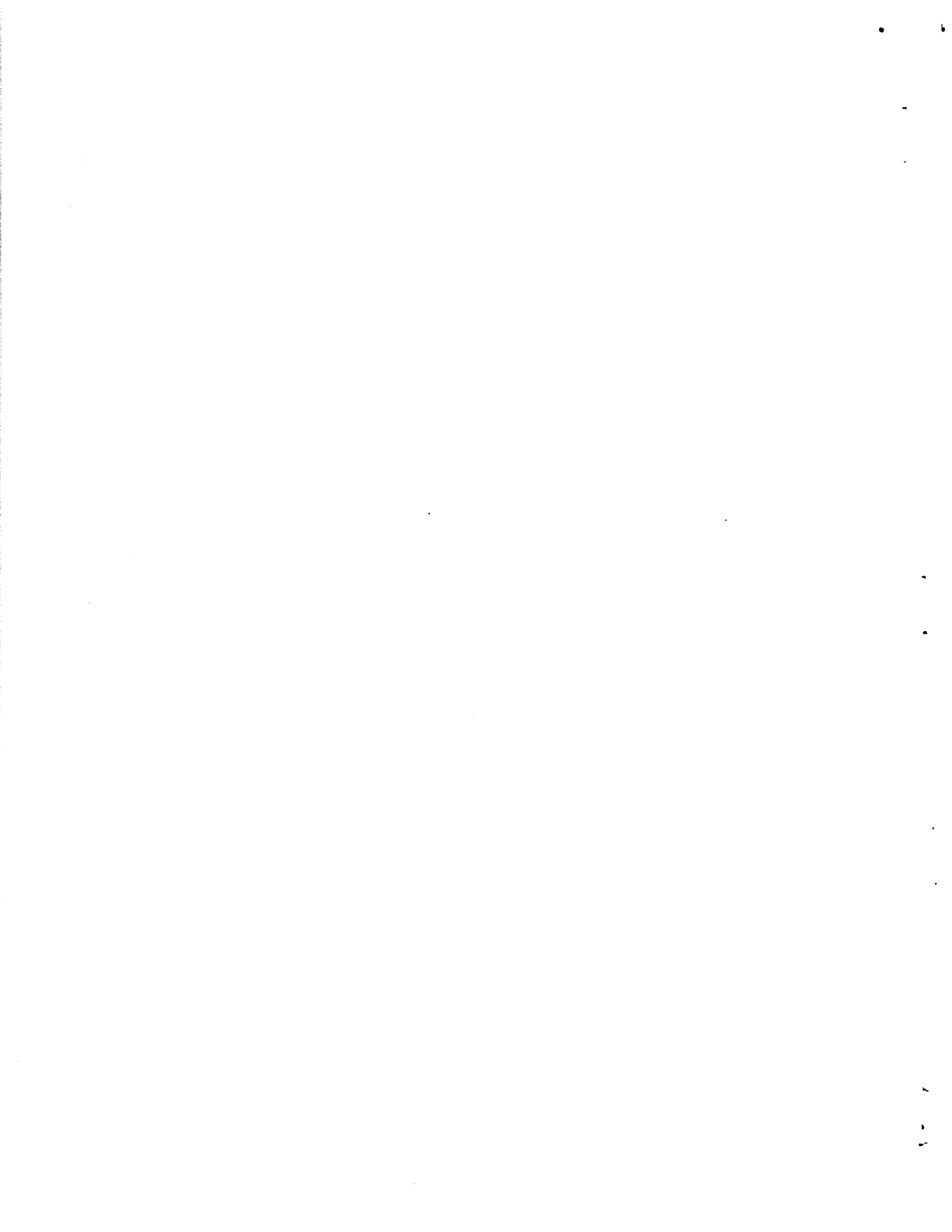
Center for International Studies

M.I.T. **

Published in
International
Interactions, 1980

* This revision of our original research proposal has been supported by grant #7806707 of the National Science Foundation to the Center for International Studies at M.I.T. The views and priorities expressed here are not necessarily those of our research sponsor.

** James Bennett is also affiliated with the Peace Science Unit at the University of Pennsylvania.



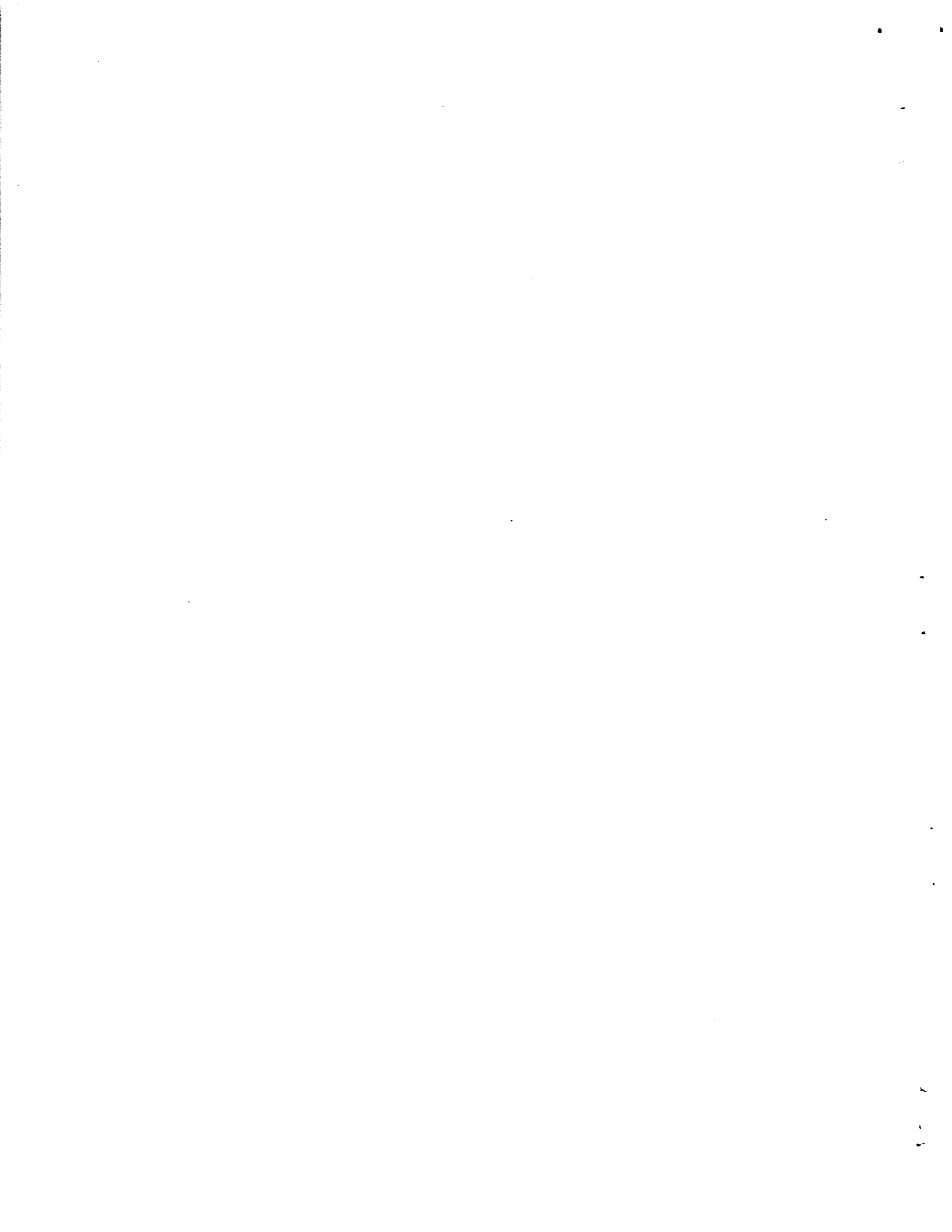
Abstract

Generalized Precedent Logics for Resolving Insecurity Dilemmas

This paper proposes the development and application of a series of gradually more powerful "reflective" logical procedures to increasingly complex and realistic sets of data on collective insecurity dilemmas. Such procedures place behavioral time series data within narratively structured practical contexts. Such accounts seek grounding in the interaction between situational determinants and the reflective, historical, linguistically mediated intentionality of social agents.

Interrelated areas of empirical analysis will include experimentally generated behaviors and narratives from Sequential Prisoners' Dilemmas and recently collected data on international conflict since 1945, in particular Butterworth's reports on conflict management by security-oriented international organizations.

A principal objective for developing precedental logics is to better understand, and so affect, the generation, reproduction and resolution of insecurity dilemmas.



THE FOCUS OF THIS RESEARCH

We wish to study difficult choices of a special kind, insecurity dilemmas. These are pervasive, threatening features of human existence that have already been the subject of much research. Using formalized models of precedental reasoning, we wish to explore directions and possibilities for further knowledge cumulation that might serve as a basis for practical, explanatory understanding.

What Are Collective Security Dilemmas?

By collective insecurity dilemmas, we mean multiparty situations characterizeable in terms of conflicting security-seeking rationales; typically these rationales evidence social contradictions between the (shortrun) security concerns or interests of individual actors and the (shorter or longer run)/^{security} concerns or interests of larger collectivities of which these actors are a part. (Elster, 1978) Moreover, since security-seeking by one actor affects the actions or outcomes of another's efforts, collective, concerted action may be necessary for effective insecurity reduction, even if it is hard to achieve. Security dilemmas may be said either to reside in the reflective consciousness of a particular actor, or to challenge existing or potentially emergent collective social unities (in particular, the identities, loyalties, organizing principles or collective capacities of groups, communities, nations or cross-national systems).

Sequential Prisoner's Dilemmas and related experimental games have been one source of slow, uneven knowledge cumulation concerning collective insecurity dilemmas. See in particular (Emshoff and Ackoff, 1970; Shubik, 1970; Burns and Meeker, 1976; Rapoport, Guyer and Gordon, 1976; Nurmi, 1977). While Rapoport's many writings on the subject since Prisoner's Dilemma (Rapoport

2.

and Chammah, 1965) urged caution concerning the generalizability of research findings (see eg., Rapoport, ed., 1974), Morton Deutsch has continually compared experimental and nonexperimental analyses of conflict resolution (Deutsch, 1973). Two judicious discussions and extensions of these arguments are (Pruitt and Kimmel, 1977) and (Snyder and Diesing, 1977).

Our own empirical work to date on the evolution of collectively organized practices for resolving successive international collective security crises conceptually parallels this largely experimental literature: many such real world conflicts have all the definitional features of collective insecurity dilemmas noted above (Alker, 1970-71, 1971, 1974, 1977; Alker and Greenberg, 1971, revised and reprinted, 1977; Alker and Christensen, 1972; Alker and Choucri, 1974; Bennett and Alker, 1977; Bennett, 1978). Moreover, this work has been part of a larger group of at least partly cumulative studies of conflict management by regional and global collective security organizations (see most recently Butterworth with Scranton, 1976; and its parent publications: Haas, Butterworth and Nye, 1972; and Haas, 1968). A related series of studies have been undertaken by Lincoln Bloomfield and his associates (Bloomfield and Leiss, 1969; Bloomfield and Beattie, 1971).

Why Artificially Model Collective Insecurity Dilemmas?

Our work starts from the assumption that naturally occurring social systems, laboratory experiments, and mathematical models thereof are all "artificial constructions." All are subject to socially interpreted rules, susceptible to human alteration. More specifically, the term "artificial"

3.

signifies a convergence of our work with the paradigm of artificial intelligence research (Newell, 1973; Boden, 1977). The directive systems, "quasi-regimes" or concerted supranational agencies structuring global and regional behavior are artificial products of purposive action and reflective human understanding. As such, they must either be convergently created and mutually renewed through time, or become subject to ossifying, divergent and often degenerate respecifications.

As amply illustrated in case studies of Cold War peacekeeping (Alker, 1971; Alker and Greenberg, 1977) and of Pacific South American conflicts (Bennett, 1978), routines for concerted peace-seeking action by national or supranational actors are hard to create, except perhaps among victorious allies. But such action possibilities can, and often do, become rigidified, niche-specific, conflict-management procedures not adequately adapted to their changing environmental agendas of actual and possible concern. The behavior partly dictated by such sets of rules often appears to operate "naturalistically" outside the actors' individual or collective control.

Yet, experience shows that this same set of actors is capable of collectively circumventing, to some degree, such dangerously constraining patterns. Through design or accident, they may embark on a redefinition of important features of the international situation including the practical rule structures, role expectations, and operational codes it embodies. Soviet-American détente, earlier degenerations of collective security into interbloc competition, and more recent recentralizations (such as the shift to superpower bilateral crisis management

4.

during the Six Days War), all constitute transformations originating within the global system.

The existence of artificial process models, empirically grounded in such historical crises sequences, allow us to model both inertial tendencies and adaptive changes in organized behavior, as well as to explore more fully than before the empirical conditions for more fundamental transformations or transitions in system rules (Hernes, 1977). And they allow us to tentatively criticize past and present practice in terms of feasible but counterfactual opportunities for more satisfactory and comprehensive systemic redefinition (Bennett and Alker, 1977; Alker and Greenberg, 1977). Current practices can also be put into sharper perspective by contrasting them with even more unsatisfactory, hypothetical, yet possible histories.

It is the actual and possible dynamics of such self-transformations (their instigation, sequence and inhibition) that we want to conceptualize and understand. Using artificial forms to simulate such dynamics allows a kind of reproductive or regenerative understanding. We believe that a modelling program capable of articulating and simulating essential features of such processes would be instrumental in the development of a theory of precedent-based historical learning that treats major breakpoints as acted-out thematic shifts in international relations (such as the repercussions of United Nations involvement in the Congo crisis, a breakpoint detected by Alker and Christensen (1972) and more fully discussed in Alker (1971) and Alker (1975)). Reinterpreting historical breakpoints as thematic shifts in patterns of intentional action coincides with our interest in dramaturgical or narrative modelling. Such a research pro-

5.

gram, incorporating precedential lessons, directed to the present, pointing toward the future, would comprise both scientific and practically suggestive peace research.

What is Significant and Special about Studying Reflective Logics?

Our concern with the resolution of collective insecurity dilemmas brings us to inquire further into a subject we have called "reflective logics" or "generalized precedent logics" for several reasons. First, in Fights, Games and Debates (1960), Rapoport advocated going beyond reactive fighting and strategic game playing to achieve conflict resolution through empathetic debates. Each representative of a particular side in a conflict should first demonstrate an ability to reproduce, to the satisfaction of the other participants in a debate, a satisfactory interpretive statement of the opposing perspectives, its principles as well as its practical views of the recent past. Once these empathetic reproductions were internalized in this fashion, each participant would know not only the others' point of view and be able to argue with it, but would share the collectively self-referential, highly reflective knowledge that both players satisfactorily understood each others' points of view including the "lessons" of history it contains. Conflict resolutions within and among individuals could thus be wedded together. Some years later, Rapoport (1967) argued that reasoned escape from the Prisoner's Dilemma was possible if both players were to adopt "meta-strategies" similarly embedding each other's contingent response possibilities in game-like strategic dilemmas. Schelling's The Strategy of Conflict (1960) somewhat similarly critiqued ordinary game theory for its non-reflectiveness concerning mutually

6.

shared "prominent" solution possibilities in mixed interest games.

Quite intriguing parallels exist between this obviously normative literature and the few empirical studies of Sequential Prisoner's Dilemma (such as Emshoff and Ackoff, 1970; Kelley and Stahelski, 1970) where perceptions of intentions of competing players were repeatedly obtained and compared with game play. Going beyond the reasonably accurate move-matching and policy-matching models of Sequential Prisoner's Dilemma (henceforth called SPD), Emshoff and Ackoff find empirically that their typical player does not "[a]ct in such a way that if others also acted in the same way [he/she] would benefit thereby" (Rapoport, expositing Howard, 1967, p. 5, after Kant's categorical imperative); but rather that he/she learns from the past according to a Modified Golden Rule: "Do unto others as you believe they would do unto you!" Reflective situational understanding in this case works like a perverted "role-reversal" mechanism that projects onto others what one wants to do oneself.

Despite the fact that either kind of reflective rationality, Rapoport's Kantian "ought" or Emshoff's Realist "is," can account for the behavioral lock-ins which frequently occur in SPD games (where "lock-in" refers to mutually self-renewing cooperative moves or the rigidly repetitious joint defections), one is nevertheless struck by the presence of still another reasoning mechanism at play: the act of self-consciously choosing, and in certain instances redesigning or remolding, the heuristics which direct choice behavior. This act by which the strategic heuristic directing choice are themselves made objects of choice is of course assumed in both Emshoff, Ackoff, Schelling and Howard-Rapoport, but deserves to be made explicit, and can be made so by utilizing a conception of interaction dilemmas different from that conventionally

7.

employed in the SPD literature.

The act of standing above and making problematic the basis upon which choice is made is a prime constituent of the phenomena of rule-governed behavior investigated by the Piaget-Kohlberg-Loevinger-Selman research program in moral, ego and cognitive development (relevant sources are cited below; recent summary volume of the direction of this research are Loevinger, 1976 and Kohlberg and Turiel, 1971). We believe that the question of how heuristic, rule-governed and principled behavior undergoes change (or "development," if we follow Kohlberg et al.) suggests a basis upon which to conceive an internally-generated, psychosocially realistic resolution to SPD. Moreover, we would argue that the two ideal type behavioral models we have identified with Emshoff-Ackoff and Howard-Rapoport can be convincingly integrated and subsumed under a larger conception of precedential thinking in the SPD interaction -- a conception we spell out more completely at a later point; we note here, however, that Howard (1978) has ^{recently} developed a somewhat similar Piagetian perspective.

A second, and independent, research departure links our previous international relations treatments of insecurity dilemmas to SPD-related work and the issues of reflective, precedential reasoning. In both Howard's formalistic and Emshoff's psychological-empirical approaches, reasoning about the present is done in terms of behavioral rules constructed from an actual or hypothetical past. By "precedent logics" we mean procedures for finding and applying to the current situation exemplars or lessons from the past. Such logics are explicit in empirically-oriented studies where memory is a prime factor, but are implicitly used as well in Howard's proofs since his metastrategies can be interpreted as simultaneous or hypothetical precedent logics based on the

8.

fiction that one's strategy choice is made as if one knows already what strategy the other is committed to (c.f. Rapoport's interpretation of Howard in his rebuttal to Harris, Rapoport 1969a, 1969b). As they become more complex, precedent logic models reflectively incorporate not only particularistic associations from the experienced past, but narratively constructed lessons of history. Such interpretations become part of the public or private reflections through which complex agencies transform their current input into hard-to-predict outputs, thus increasing self-determination and limiting the causal efficacy of external forces or agencies.

Although there is a natural overlap between the problem-solving/memory-search-like operations we have dealt with to date under the rubric of "precedent logics" and the reflective cognitive operations we see at work in the collective action dilemmas encapsulated in Sequential Prisoner's Dilemma, we find it imperative to investigate a still wider range of such operations. We term this expanded set of procedure-like phenomena "reflective logics," or "generalized precedent logics," and we propose to identify and to extract such procedures from empirical instances (hence the interest in empirical game play), while at the same time seeking to design/instrumentalize artificial versions of such logics. A chief result, and one of our ultimate purposes, is to construct the means, in simulation form, for rigorously inspecting the operation of these "logics" as they contribute to the generation, exacerbation, and periodic resolution of insecurity dilemmas in the international arena.

When we compare the formalisms we have in mind with the great majority of published papers in mathematical sociology, political economy and politics, it is clear that something fundamentally different from ordinary statistics

9.

and deductive modelling is is involved. Consider Figure 1 which shows an early Alker-Christensen precedent tree, generated by successful references to Charter norms in disputes involving hostilities on non-Cold War issues. Using serially ordered data and either standard time series routines (ESP, TSP) or general statistical packages (SPAA, BMD), it was impossible to calculate the sequential linking and evolution of such historical "precedents." A pattern-matching program was necessary to represent to the historical searching involved. Statistically significant improvements in predicting UN involvement resulted from the use of such precedents. Known breakpoints in behavioral prediction equations were also avoided.

As an instructive example, intermediate in its representation of historically reflective intentionality, note the self-redefining, strategy-sharing and precedential redefinition features of the recent Bennett and Alker routines in Figure 2. Here logically recursive list processing operations are used formally to represent such reflections. Precedent trees more complex than Figure 1 are generated by such routines. Yet, they still do not come close in historical generality to the interpretive powers of Schank-Abelson script appliers (Schank and Abelson, 1977; Alker, 1975) and the recent frame-based artificial intelligence literature (two M.I.T. examples are Roberts and Goldstein, 1977 and Stansfield, 1977).

We believe that cognitive processing models that realize significant parts of the Rapoport-Howard-Kohlberg "reflective" point of view can ultimately be programmed. Conscious political knowledge will be representationally approximated and then manipulated using artificial intelligence formalisms and the associated literatures. System creation, renewal and decay will be

CHARTER PRECEDENT^{1,2}
FOR GENERAL ASSEMBLY AND SECURITY COUNCIL

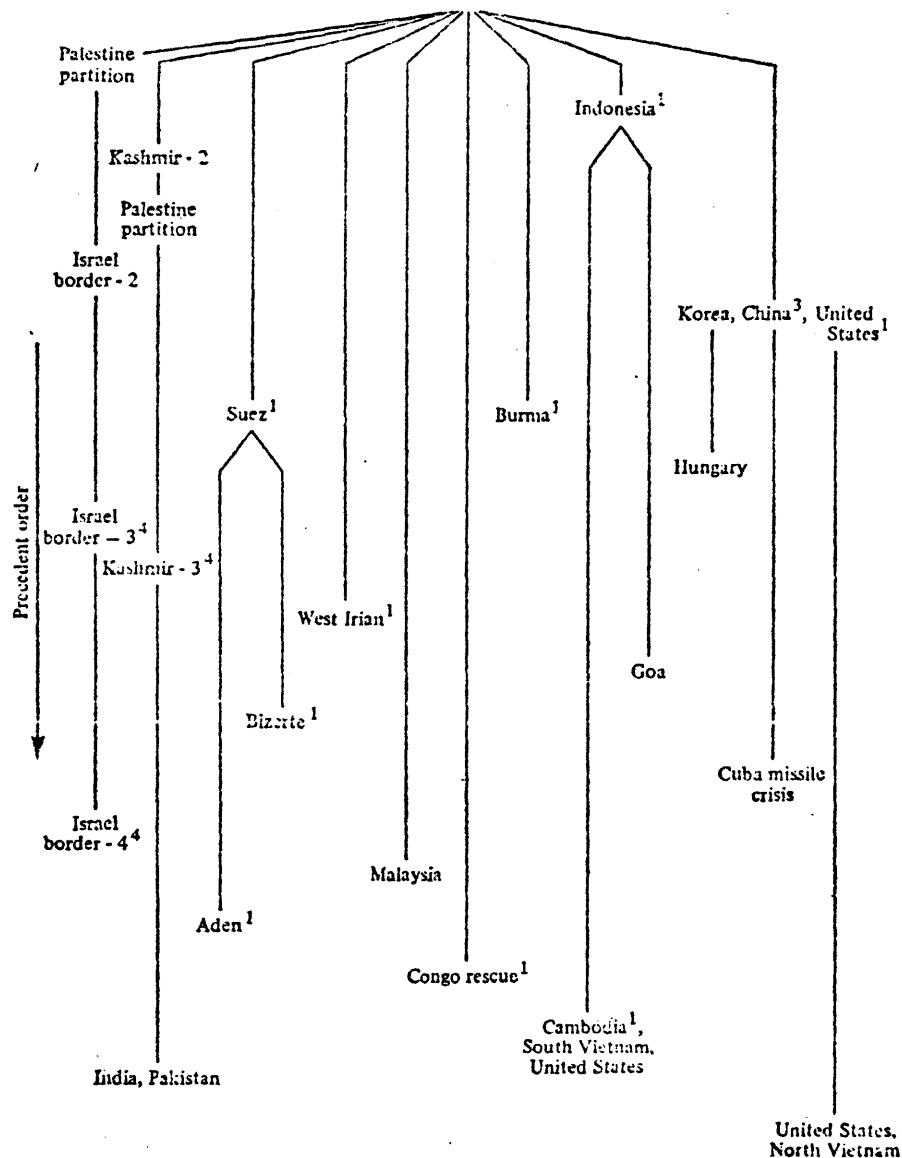
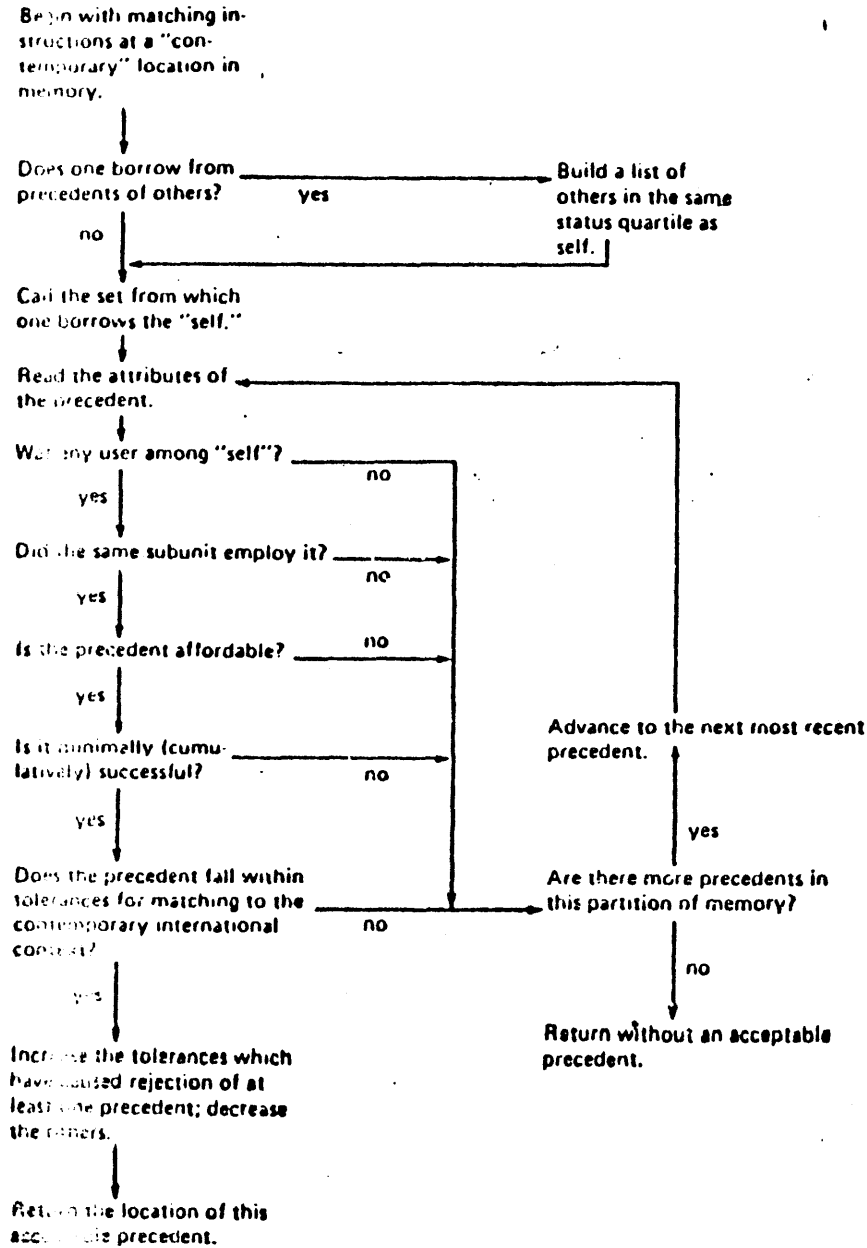


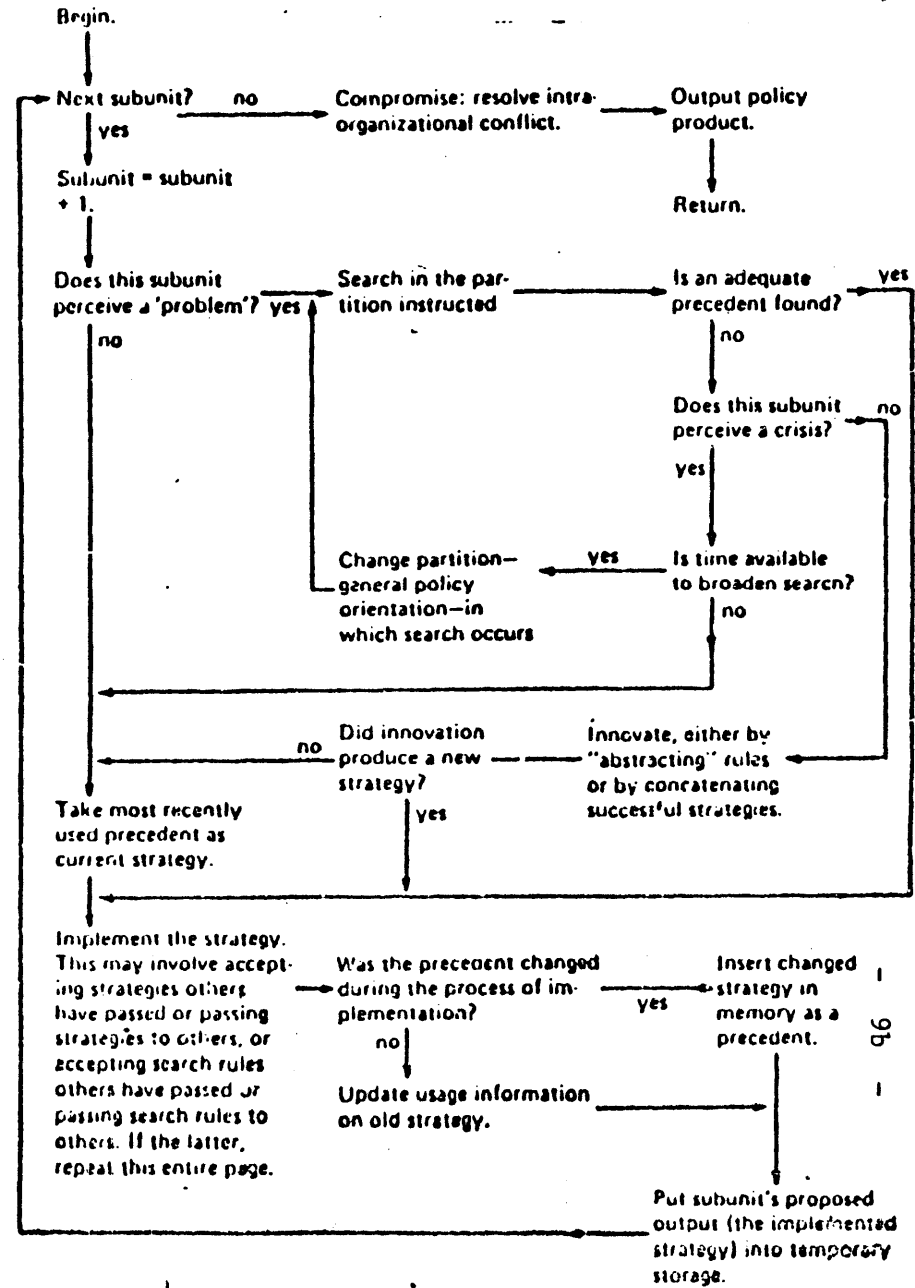
Figure 1: Charter application and charter evolution: cases involving international hostilities on colonial and other issues by parties that are neither great powers nor on opposite sides of the Cold War . 1: cases judged to have been at least in part settled by the United Nations. 2: Charter precedent is high coercive and non-coercive involvement by the Security Council (with success in stopping hostilities and settling issues) and high non-coercive but not successful General Assembly involvement. 3: this case is a violation of Charter expectations. 4: this case would no longer be governed by a weakened successful involvement precedent if the appeal of such a precedent is extinguished by two intervening, similar but non-successful cases. Note how the anomaly of U.N. Korean involvement (due in part to a Soviet boycott of the Security Council) allows/encourages the consideration of other Cold War disputes involving the United States, despite original Charter-based expectations of U.N. noninvolvement in such cases.

(Source: Alker and Christensen, 1972, p. 219)

Figure 2: Some Reflective Precedent Logics



Process of local search.



Overview of the strategy search-implementation process.

10.

represented in such artificial languages as are there employed. The peace-generating potential of such research will, of course, depend importantly on the kind of critical, scientific and humanistic contexts in which such work is engendered and applied.

The Analytical Strategy of the Present Proposal

The basic intent of the present proposal is to develop and apply a series of gradually more complex and powerful "reflective" logical procedures to an increasingly complex and realistic set of data on collective insecurity dilemmas.

The axis of logical complexity we have in mind corresponds roughly to the computational procedures sequentially discussed above; greater empirical realism means adding intentionalist data, more and more disaggregated, to behavioral data, first experimentally generated and then "field" collected. Because of their structural similarities to more complex insecurity dilemmas, and due to the greater availability data in SPD-type experiments, literature review, data collection, and (re)analysis activities will begin at this level. Models designed to replicate the Emshoff and Ackoff theories, reinterpreted to allow Howard-type reflections as well, will be applied selectively to data collected in an undergraduate course and in a previous Michigan study (Nelson, unpublished). We shall try to suggest script or frame type interpretations that reproduce key features of the post-game narrative summaries generated by M.I.T.-Wellesley students, and post-SPD interviews obtained by S. Nelson (unpublished) at the University of Michigan. Comparisons of these formalized narrative accounts, going beyond available PLI or FORTRAN simulations, should generate important insights into the mechanisms of dilemma renewal and

11.

resolution; special narrative-oriented methodological developments will also be required.

Parallel to this effort, and drawing upon it, will be two PL/I modelling efforts. The first will be an effort to replicate a revised version of the Alker-Christensen-Greenberg model on Butterworth's previously cited 1945-1975 data set on security disputes before international organizations (IO's). Included in the revised, but still highly aggregated model will be procedures designed to imitate the decisions and non-decisions of these conflict management organizations i.e., their agenda processes .

A more efficient, available and useful disaggregated collective insecurities model is also needed. A revised Bennett-Alker model will be programmed and selectively used to analyze post 1945 conflicts inside and outside of security oriented IOs. More detailed case studies of particular conflicts may be undertaken as well. But first more capacities for reflectively learning and generating policy actions need to be included in the Bennett-Alker model. Relevant specific mechanisms can be micro-analytically explored in SPD narrative data sets. These reflective mechanisms hold out the promise of simulating the inventive aspect of historical conflict resolution processes, as well as the pathology of such processes. There are four primary lines of inquiry in this effort, which will now be discussed in greater detail.

MODELLING SEQUENTIAL PRISONERS DILEMMAS

Given our interest, the role of generalized precedent logics in resolving collective insecurity dilemmas, the first order of business will be to write

"precedent logic" PL/I simulation models of move and policy-making game play, inspired by Emshoff and Ackoff (1970). Sequential data will include past and present predictions of the opponent's moves and policies (and the players own "responses"). Although such models have been shown to predict perhaps seventy percent of game play, our primary interest will be in the breakpoints and residuals they generate and the behavioral evidence they provide for strategies of different levels of cognitive complexity. Thus, we will examine the breakpoints and larger residuals for behavioral evidence that reflective redefinitions of the game situation and one's own strategies in it have occurred.

Relevant course-generated data is being, and has been, collected, including student narratives about game play. Moral development inventories are also available to provide an independent account of the levels of cognitive complexity and the modes of moral reasoning of which the player is normally capable. A second data set, gathered in one-hundred-move SPD experiments by S. Nelson at Michigan, will also be analyzed by similar models. His systematic taped interviews with both SPD players and the experimenter right after SPD completion will be useful for narrative purposes. Especially suggestive cases will be selectively summarized and transcribed.

Important possibilities exist for comparing and contrasting deterministic explanations derived from behavioral models with the participants' own intentional, context-conditioned, normative accounts. It is hoped that a second generation of SPD models using narrative reflections as data (not just their predictions) can then be generated. Thereby, the possibility of a "perverted Golden Rule" mode of play, similar to Emshoff's (1970) model in Figure 3 below, can be directly

Figure 3

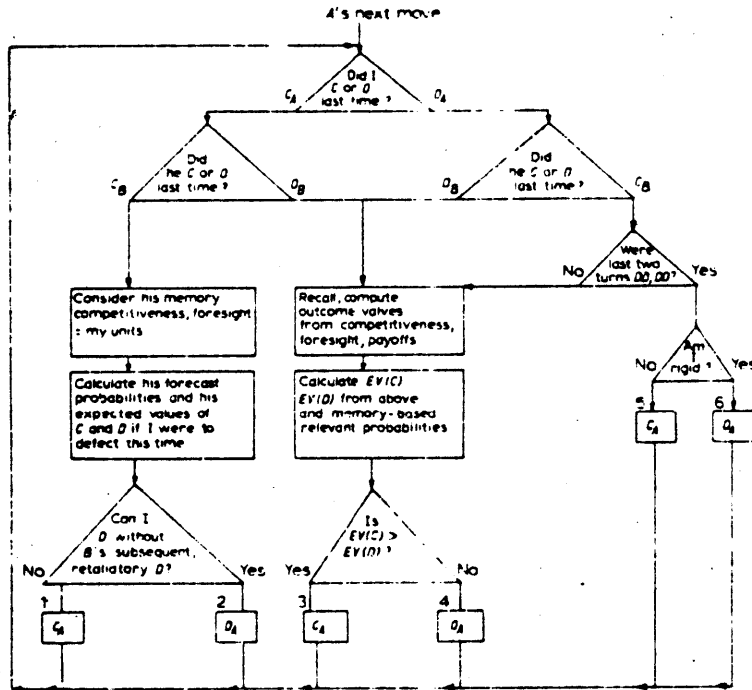


Figure 3. Emshoff's precedent logic for playing iterated Prisoner's Dilemma. Source: J.R. Emshoff, pp. 308-313. I have departed from his flow chart format in the interests of compactness. For the first two moves, when an inadequate history of precedents is available, values of various payoffs are computed, random behavioral probability estimations are assumed, actual data is used, and the memory value of these responses is established.

(Source: Alker, "Are There Structural Models of Voluntaristic Social Action?", 1974, p.224.)

tested for. At the same time the possibility of other equally complex, but less socially pathological coordinated role sets can also be explored, and "residuals" data generated on the attainment, renewal and the revision of such action perspectives.

This present subproject attempts to find easily programmable regularities in such action sequences; the subproject on narrative modelling below will address more directly the "residuals" data on strategic restructuring or reflective cognitive reorganizations. For the larger purpose we intend to benefit from restructured Bennett-Alker "reflective precedent logic" routines derived from earlier collective insecurity studies and, vice-versa, improve upon their empirical adequacy. After all, the principle substantive justification for looking carefully at participant SPD narratives is to learn more useful information about how, why or why not such collective insecurity dilemmas have been experimentally resolved.

UPDATING THE ALKER-CHRISTENSEN-GREENBERG UN PEACE-MAKING SIMULATION

Some of the limitations of the previous Alker, Christensen and Greenberg simulation studies were due to the poor quality of its highly judgmental, aggregated data base. Fortunately, Robert Butterworth (Butterworth, with Scranton, 1976) provides a machine-readable data set with an inventory of variables similar to, but more extensive than those used by Alker, Christensen and Greenberg. Both the Alker-Christensen-Greenberg and the Butterworth studies reflect the intellectual parentage of Ernst B. Haas (1968). The new data set also goes approximately ten years beyond the data set used in the Alker-Christensen-Greenberg papers, and thus also allows the predictive testing of the projections published in 1971 for a significant period after 1965. But, like the earlier

14.

data set, it must be recoded into a more disaggregated (phase specific) structure.

In doing this work, we expect to find similar types of "residuals," breakpoints, convergent and divergent national views and agenda "nondecisions." Thus, analogously to the multi-stage modelling effort of the previous project, the objective is / to develop in parallel a more accessible, powerful, disaggregated set of reflective precedent logics (roughly like those in Figures 1 and 2 above). These/are to be used in analyzing the Butterworth data, and for going beyond it to work on the conflict management agenda process, and to study particular historical turning points like the Cuban Missile Crisis, the Congo and détente in somewhat greater detail.

PLANS FOR REWRITING THE BENNETT-ALKER COLLECTIVE INSECURITIES SIMULATION

The Bennett-Alker simulation (Bennett and Alker 1977; Bennett 1978) reproduces important aspects of international insecurity management processes characterized by the "perpetuation of failure." Security, defined unilaterally, and realized through collective quasi-regimes, leads repeatedly to failure. Individually reasonable security-seeking strategies undermine collective security: they are social contradictions (Elster 1978, Chapter 5).

The Bennett-Alker model is specialized and its internal functioning segmented for convenient application to one particular extended historical case, viz. security management by the states and non-national entities of the Southern Pacific region in the nineteenth century. Many of its specifications thus per-

mit neither study of contemporary security problems nor application to the more general purposes of this research project for developing reflective concepts pertinent to the resolution of insecurity dilemmas or contradictions. In the revisions indicated below, we require that the model address both contemporary international security issues and sequential prisoners' dilemma protocols. In short, it will embody more general reflective characteristics enumerated in Section 1.2.

Without going into detail, we first describe the basic principles of design of this simulation model in order to isolate those features of it which will be revised or extended. / ^{We will review} three features that are strengths relative to other simulations such as contemporary "global" models (Alker 1977, Ward and Guetzkow 1978) and Bremer's outstanding extension of the Inter-Nation Simulation (1977). In addition, three relative weaknesses are targeted for comprehensive redesign.

Basic Principles in the Current Model.

In the description which follows, those cognitive and strategic capabilities which are to be extended receive greatest attention. We begin by observing the major qualities of the international environment, then recount the processes of goal formulation, problem identification, and strategy adaptation which lie at the heart of the actor's adaptive capacities. The reader is referred to Bennett (1978) for detail.

An international environment formed of networks of exchange in the modes of wealth, prestige and military power shapes the range of possible action of each actor. Additionally, the exchange networks are limited by patterns of product complementarity and material necessity, which is initially exogenous but subsequently altered by the transactions and events generated within the simulation. The geographical possibilities of the era are introduced by proximity relationships, which remain exogenous information during the course of the simulation. In this fashion, one can examine the interactions among a "local" system of regional states and non-national actors within a surrogate global context.

The actors can measure dyadic (and more complex) patterns of exchange both directly, in terms of summary flows, and indirectly, by using an index of their relative positions in a vertically, partially ordered stratification system. The index of stratification position reflects basically the opportunity costs to each actor of disrupting its existing relations of exchange with all the others in its immediate environment. The stratification indices, and not the exchange patterns directly, are employed to define goals and in complex fashions to monitor actors' progress. In this as in many other measures of the model, the actors produce particularistic measures of performance responsive to their own problems and prospects for mobility within the stratification system. An experimenter can compute parallel measures appropriate to an external or "global" perspective. An interesting capability

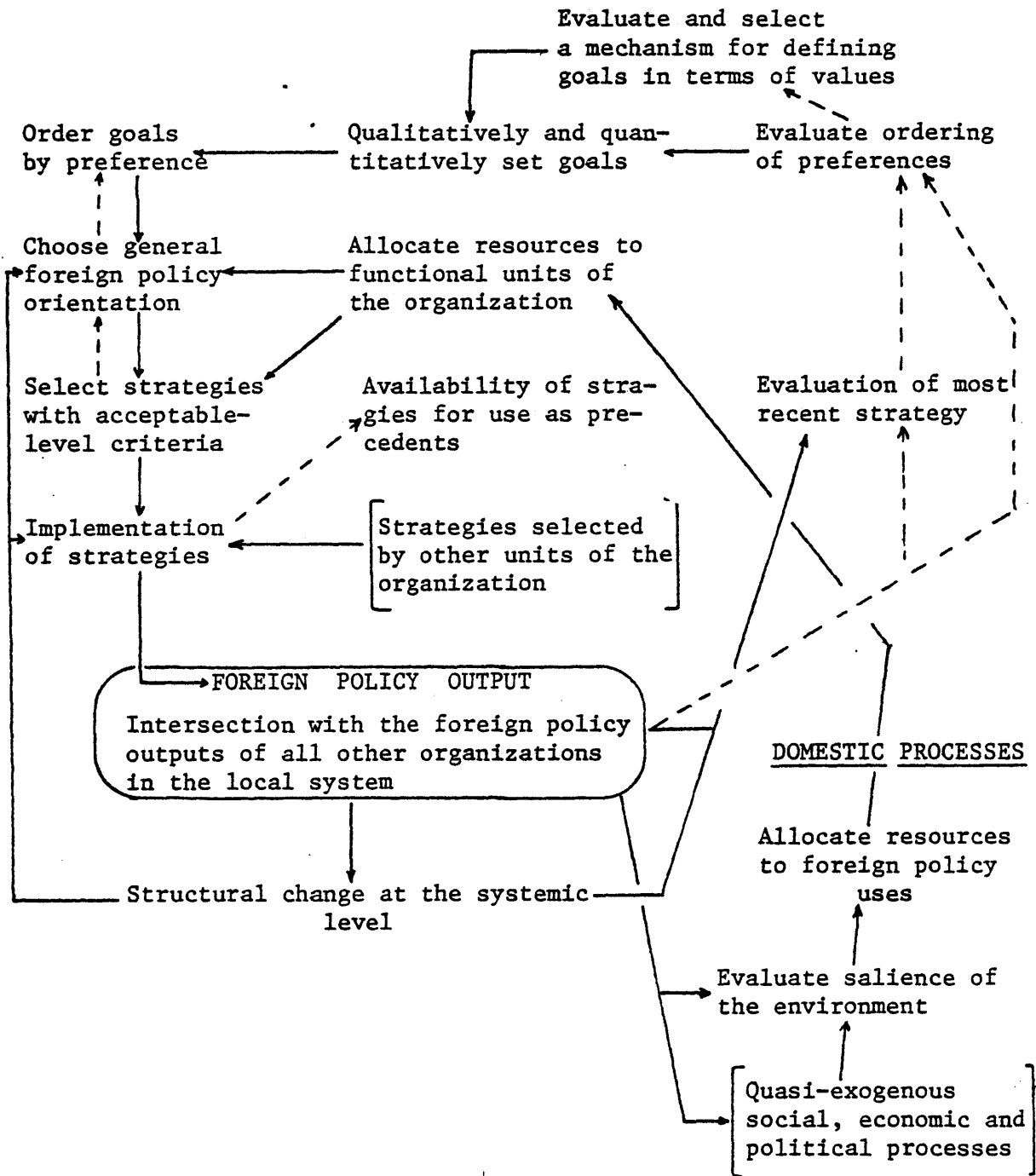
of the simulation involves actors' attempts to moderate poor performance within the stratification system by revising their measurements of position until "progress" emerges. More generally, "learning" extends beyond capacity to maintain equilibrial states; actors "learn" to redefine, in effect, their problems, prospects and experiences to avoid negative results.

A dimension of friendliness-hostility complements the three dimensions of exchange. A friendliness-hostility indicator monitors the significance of events generated within the simulation. It also defines special events, such as "war", which is maximal hostility. Other events, such as "integration", require prolonged and complex patterns of exchange as well as friendliness to emerge.

All international relations in the model can ultimately be reduced to the three modes of exchange, plus friendliness-hostility. However, as touched upon below, actors can more efficaciously attain goals the better they are able to generalize higher-order patterns, demarcate behavioral roles (of themselves as well as others), and develop summary memories of their experiences. It is, furthermore, not difficult to extend the number and kind of dimensions of exchange, and one can freely substitute among sociometric measures.

The internal processes of each actor, as well as its interface with the environment, are schematized in Figure 4. The internal mechanisms follow closely the Simon-Cyert-March theory of organizational behavior. We note here three important postulates of that theory. First, the organization is conceived as a loose coalition of interests, such that internal resolution of conflict among organizational units is minimal, and each unit pursues its specialized dimension of value -- corresponding to one of the dimensions of the stratification system -- more or less autonomously, limited only by the resources available. Second, new policies are formulated only when a problem is recognized: such happens when adequate progress

Figure 4. A Purposive Interpretation of a State's Foreign Policy Process*



* Solid lines represent major causal structure-altering relations. Dotted lines represent cybernetic parameter-altering relations.

toward goals is blocked by inadequate resources or by the actions of other organizations and other units of the same organization. Even when a new policy is attempted -- that is, when the process of "search-adaptation-implementation" must be initiated-- solutions/as similar as possible to those previously used. Thus the organization is fundamentally conservative and inertial. Third, rather than attempt to predict the activities of others, the organizational units guide policies appropriate to the "present" by codified "lessons" of the past. They record, in summary fashion, rules for reproducing historical patterns of acts, together with evaluations of the immediate outcomes of the policies, and information to assess the environmental appropriateness of the policies to address subsequent problems. Each complex of contextual information, evaluation, and rules is called a "strategy"; its internal configuration is summarized in Figure 5. Lists of rules (i.e., predicates) and qualifiers (i.e., targets) comprise the operational information stored in a collective memory. The memory is compartmentized by general policy orientation, and its contents are differentially accessible to the several actors of the system, according to relations such as their international roles, power bases, frequency of usage, evaluation, and so on.

Under certain conditions, actors may exchange strategies. Thus their repertoires of potential foreign policies are sharable as well as dynamic. Nevertheless, the adaptive capacities of actors rest largely in their processes for seeking out contextually appropriate strategies and shaping these to the current context. The process involved is summarized in Figure 6. Here one sees that only problems motivate search. A number of modules for "innovation" are available as different experimental conditions under which model performance can be assessed.

One particularly powerful capacity concerns the actors' ability to replace lists of qualifiers, which identify targets of action directly by

Figure 5. Characterization of Collective Memory as Lists of Strategies

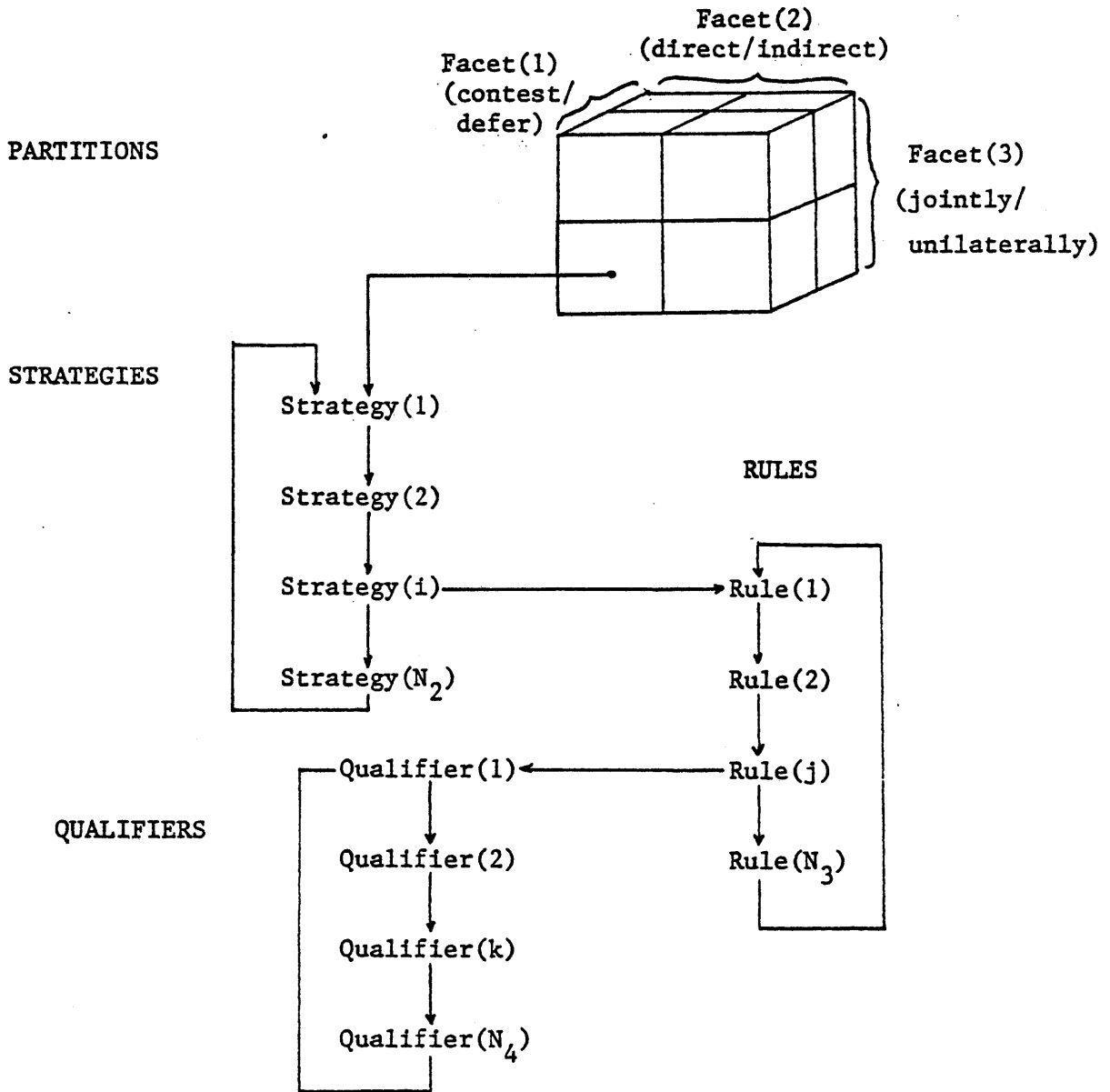
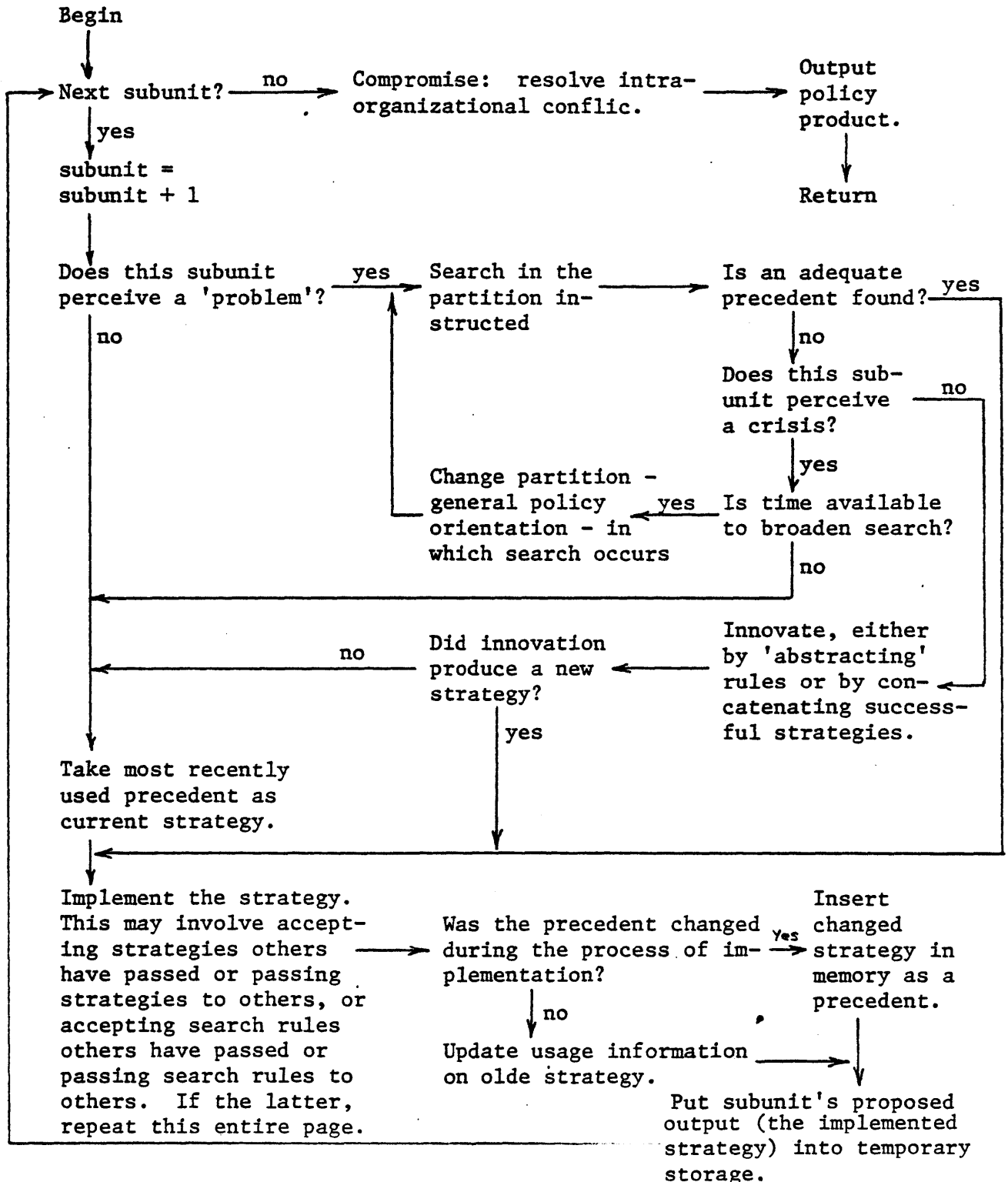


Figure 6. Overview of the Strategy Search-implementation Process



reference to the networks of exchange, with the "role" occupied by the targets. This feature simplifies description of policy at the same time that it tends to extend the applicability of the policy to novel situations. A large number of roles may be defined by actors; one typical experimental trial yielded the partial list of roles in Table 1. The underlying structure of policy remains, however, to be expressed as the union of a number of operational rules, each applied to the intersection of actors given by the qualifiers or roles. Contingency is implicit in the matching of strategy to environment, but strategy-sequences can be built up only by usage and must remain transient features of a relatively stable international milieu.

An important window on understanding model performance is provided by tracing the cross-sectional and temporal usage of strategies by actors in the system. An initial repertoire of strategies has been, in experiments to date, granted to all actors; this is summarized in Table 2. Correspondingly numbered strategies, and variations shaped from them by the adaptive mechanisms referred to earlier, are recorded for one organizational unit in Figure 7. A remarkable feature of this record is the successful usage of variations of strategies "isolate opponents" and "separate" opponents on three occasions, 1835-37, 1864-65, and 1881-82. On the first and third occasion, the simulation yielded wars closely resembling the two major wars of the region at approximately the same dates. When viewed against the backdrop of available repertoires of strategy, the patterns of evolution of policies, as graphically displayed in figures such as Fig. 7 give insights into the **actors' internal** processes of goal-seeking that would escape statistical analyses at the systemic level of phenomena.

In its current form, the model sharply reflects the limitations of foreign policy in organizations pursuing precedent-based "lessons" as foundations for insecurity management. Without abandoning the organizational representation of national and transnational participants pursuing self-defined goals in an environment of unequal opportunity and vulnerability, we intend

Table I. An Actor's View of Its Local System -- Roles Recognized
By Chile in the Third Segment, Iteration 4 (1887) of a
Simulated History of the Southern Pacific System, 1832-1904.

Local system members: Peru, Ecuador, Bolivia, Gibbs, Britain, United States, North, Argentina, Colombia, Brazil

Enemies: Bolivia, Peru, Argentina

Friends: Britain, Gibbs

Rivals: Peru

Major powers: United States, Britain, Argentina

Neutrals: United States, Britain (sic), Gibbs, Ecuador, Colombia

Higher status in all modes: Britain

Mixed statuses: Argentina, United States, Brazil

Lower status in all modes: Bolivia, Ecuador, Brazil (sic), Gibbs (sic)

More rapidly increasing power: Britain, United States

Less rapidly increasing power: Bolivia, Ecuador, Colombia

More rapidly increasing wealth: Argentina

...

Adjacent to self: Peru, Bolivia, Argentina, Britain, United States, Gibbs, North

Proximate to self: Peru, Ecuador, Bolivia, Argentina, United States, Britain, Gibbs, North

Others dependent upon self in economic exchange: Bolivia, Peru, Tarapaca, Tacna-Arica

Others vulnerable to self in economic exchange: Bolivia, Tarapaca, Tacna-Arica

Others upon which self is dependent in economic exchange: Britain, Gibbs

Others to which self is vulnerable in economic exchange: Britain, Gibbs

...

Colonies (i.e., disputed territories) of self: Tacna-Arica, Tarapaca, (sic: not Antofagasta)

Others which share similar prestige relations as self: Argentina, Peru

Others which share similar prestige relations as rival: Bolivia, Ecuador, Chile (sic)

Others which share similar alliance relations as self: None

Others which share similar alliance relations as rival: None

...

Others from which "residual" proposals will be accepted in economic exchange: Gibbs

Others from which "residual" proposals will be accepted in prestige exchange: Britain

...

Others not having higher status than self in all modes: Argentina, United States, Brazil, North (sic)*

* A variety of lists of complements to the roles above also exist.

Table 2: Strategies Initially Available

Partition I: Direct/Unilateral/Contest

1. Isolate opponents
2. Separate opponents
3. Attempt regional hegemony
4. All with great power against opponents

Partition II: Indirect/Unilateral/Contest

5. Develop capabilities more rapidly than can opponents
6. Placate great powers
7. Penetrate disputed regions

Partition III: Direct/Joint/Contest

8. Build alliance against opponents
9. Build alliance against extra-regional threat
10. Encourage regional solidarity
11. Institutionalize a collective security system

Partition IV: Indirect/Joint/Contest

19. Build up regional capabilities

Partition V: Direct/Unilateral/Defer

12. Accede to great power's security system
13. Undertake resolution of disputes with opponents

Partition VI: Direct/Joint/Defer

14. Act as agent of great powers
15. Acquiesce to great power penetration

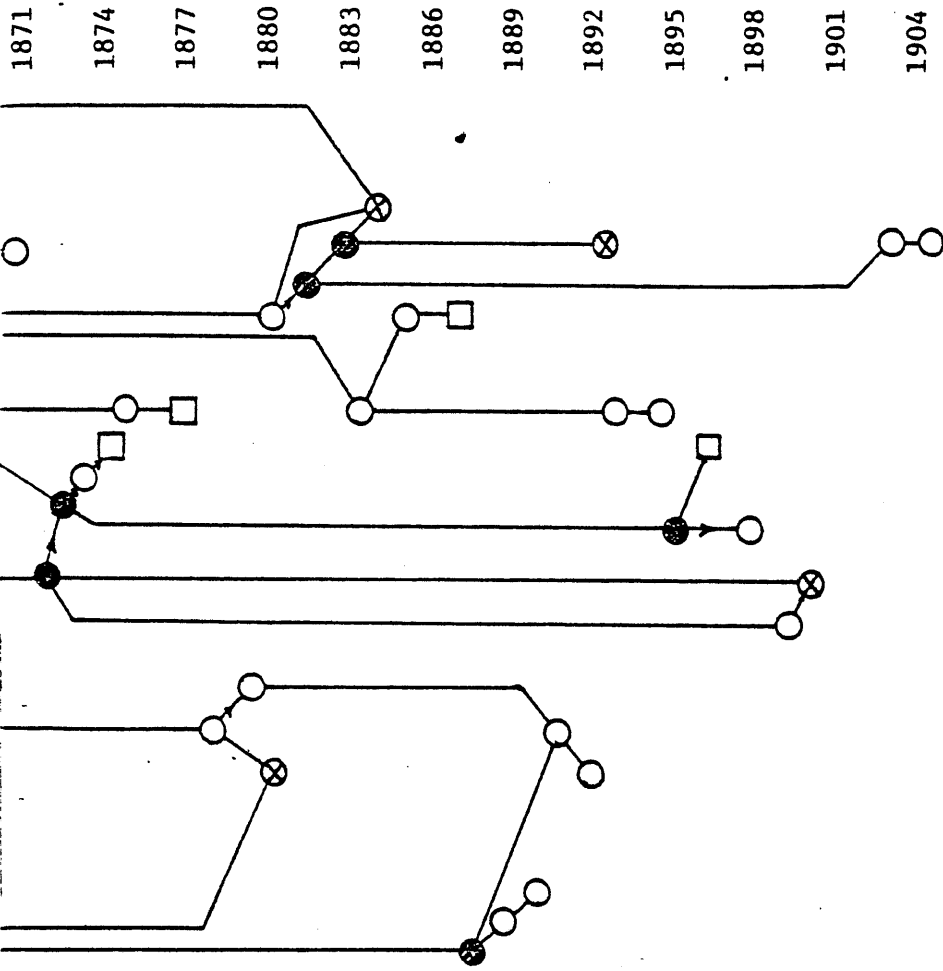
Partition VII: Indirect/Joint/Defer

16. Mediate between regional and external actors
17. Enter joint management of regional security system

Partition VIII: Indirect/Unilateral/Defer

18. Avoid transactional competition with opponents

Unit's Strategies: 1832-1905



- Code:
- implementation of a strategy
 - no change during implementation
 - change during implementation
 - failure
 - success
 - generalization
 - innovation

to exploit more fully contemporary advances in fields of artificial intelligence, which elaborate the mechanisms by which policy is converted to memory, and historical precedents drawn from memory reconverted into guidance for subsequent policy.

Extending list processing in the simulation.

For us the promise of list processing is its capacity to represent not only the practical intentionality of means-ends calculation, but also the processes which define and redefine political goals themselves. In this simulation, lists record logical relations, such as set memberships and types of logical exchange; they also store instructions as separate elements (or nodes) that can be recombined to render novel policies of the organizations. Here we mention one kind of relation, the actors' "roles," within an international system and one kind of instruction, "rules" of foreign action.

There are a variety of modules, or procedures, in the model by which actors generalize the foreign targets of their policies. A generalized class of targets is replaced by a summary description, which is called a role. As in the sociological concept of role, these summaries signify regular behavioral expectations about the targets. Roles are relations inserted into operational strategies of action, replacing the original, typically more complex, set of instructions by which the targets were identified. The modules for generalization are fixed but variably selected. Some of the possible roles are consequences of the choice of mechanism by which goals are defined. For example, with the status discrepancy mechanism is associated a set of role-identifiers for determining such summary relations as "others will all statuses higher than the self's" or "others with mixed statuses." It reduces uncertainty to identify another in such a role. Other role-identifying modules correspond to aspiration-achievement and capability-balancing mechanisms. Still other modules operate under all mechanisms of goal definition.

Lists can contain instructions as well as relations. One kind of instruction, a rule, is an atomistic predicate. Examples are "increase economic transactions slightly," "sever diplomatic relations," and "make war." The objects of these predicates, which function as potential targets of the activity specified, are found not in the lists of predicates but in subordinate lists of qualifiers. Such subordinate lists consist of abstractly coded relations which, when evaluated in a particular international context, yield a (possibly empty) set of targets.

For both roles and rules, the list structures permit great flexibility for operational meanings to be derived from a preexisting set of foreign policies. These are expressed as collections of rules (aggregated into strategies -- a concept extended below) complemented by qualifiers, which may be roles. The range of meanings arises from rearranging -- by deleting, concatenating, interchanging, etc. -- elements in the lists. Capabilities for the modeled actors to learn and adapt are, in the most reduced sense, the modules for altering list structures.

List processing is both conceptualization and technology. It is central to contemporary work in artificial intelligence. List processing is only partially exploited in the Bennett-Alker model, however, for several organizational levels consist of more orthodox, fixed form specifications. In particular, the means for determination of goals, discussed below, are established unalterably at the outset of each simulation trial. Actors cannot responsively alter their definition of objectives except by swapping one predetermined mechanism for another. That is, they can only choose among a fixed set of goals

(and adaptively adjust the level of aspiration for each) but not create new goals or new values. Familiar organizational phenomena, such as the interchange of means and ends cannot, therefore, find expression in the existing simulation. Nor can there be "discussion" or negotiation among simulated actors over which goals are appropriate (as "feasible") or legitimately shareable (as "non-contradictory" in collective application). There are major attributes of reflective processes that must be implemented in an enhanced simulation.

Expansion of the capacity for organizational learning.

In its present form, the simulation does not permit organizational actors or their parts to perform diagnostics on past performance. They cannot reflect upon, nor record that they have reflected upon, themselves or their perceived relations to the international environment (Bennett 1975). This seriously constrains the effectiveness of organizational learning (March and Olsen with others, 1976).

In the existing model, however, organizations and their behavioral components can adapt in a variety of ways. Instruments of such adaptations include: permanent channels (of variable capacity) for negative feedback; directed alteration of repertoires of strategies (such as by generalization, as mentioned above); variable attention to problems (which are interpreted as search-motivating conditions); and incomplete and simplified records of evaluated experiences used as a basis for historical precedents. To extend the capacity for diagnosis requires the addition of means by which actors can

gain tentative causal interpretations of their world. This, in turn, involves the use of higher-level relations for describing foreign policies. Two important higher-level relations are "believing" and "realizing." We must first introduce the syntax projected for recording events in the rewritten model in order to illustrate extensions to higher-level relations.

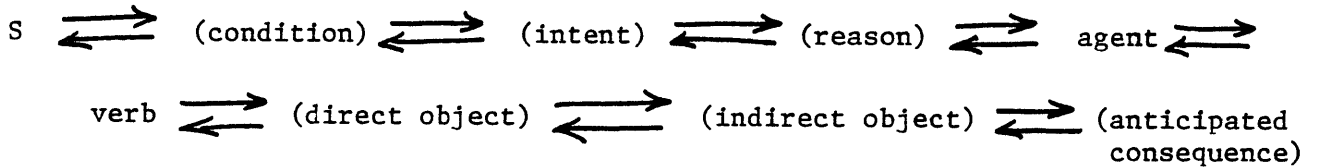
The syntax of a strategy-as-sentence of the Bennett-Alker model may be schematized as

condition \longrightarrow agent \longrightarrow verb \longrightarrow direct object,

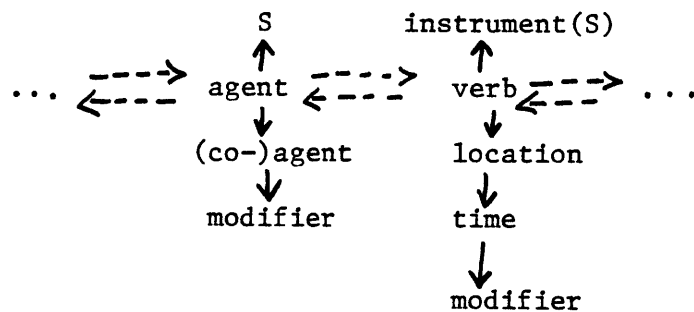
where "agent" is always the self, "verb" is a collection of rules, and "direct object" consists of a set of targets produced by evaluating the qualifiers. In addition, "condition" is an invariant vector of values with which the contemporary international system is compared. If the vector "matches" the system, the strategy sentence is applied as a basis for foreign policy. Individual sentences cannot now be linked together in more complex units of meaning.

Many other things cannot be expressed with such a limited surface structure. Especially constraining is the inability to relate consequences, reasons, and intentions to an act. A fully adequate structure would need to express all the components of a valid speech act (Searle 1969; McCarthy 1973). A pragmatic extension of the simple structure above enables most of the propositional content of a speech act to be included. Linkages among sentences accommodate information about the relationship between speaker (here, the policy maker) and the proposition. Such linkages involve functions of "belief" and "realization."

A tentative surface structure for the expression of political events and strategies is



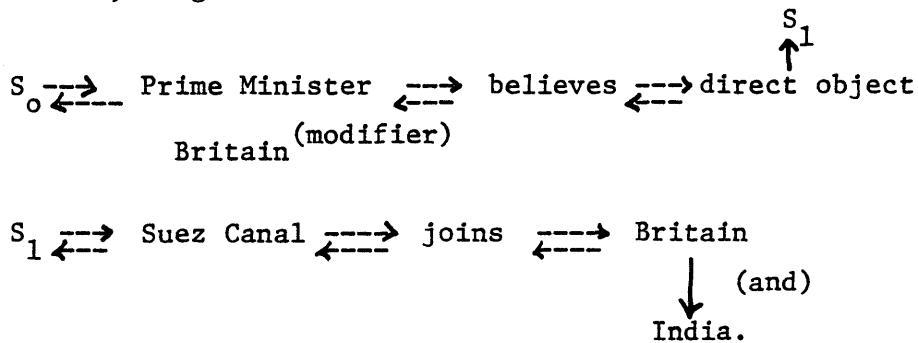
(Here "S" indicates that the list is a sentence. The parentheses indicate those "parts of a speech act's syntax" which may not be specifically recorded.) The syntax above differs from the first one in two important respects. First, there are more differentiated parts, enabling one to express more information about the event in its context, including justifications and expectations of consequences. Second, each of the parts may refer to (i.e. be substituted by) an entire sentence, and it may be modified in appropriate fashion. For example, enlargement upon the agent-verb phrase yields a schematization of



Because other parts of the sentence can also invoke other sentences, complex structures can be constructed to record the conditions under which events occur, reasons for their emergence, internal sequences of incidents that constitute them, and so on. Indeed, "event" is transformed to mean "short story" or, more specifically in the present research, "case study" in the historians' sense of a

unique combination of parties, incidents, motives, results, and individualistic interpretations of all these.

It is straightforward to expand the schematization to illustrate higher-order predicates such as "believe" and "reflect upon." By reference to the Suez crisis, we get



A crucial simplification in the schematization hides the uniqueness of higher-order relations. All parts of the "main syntactic line" are connected in both directions, but references to parts "above" and "below" that line may be connected in only one direction, as in this illustration. Thus the British Prime Minister can believe a thing which need not appreciate the existence of his belief. Put differently, along the "main line" all parts of the sentence are accessible from any part, but access may be limited among different "main lines." This merely acknowledges the fact that not all social or cognitive relations have inverses.

Straightforward expansion of the example would yield a diagram for the self-referential statement that "The British Prime Minister realizes that he (the Prime Minister) believes that the Suez Canal links Britain and India," or the other-referential claim that "The President of Egypt realizes that the Prime Minister of Britain believes that the Suez Canal links Britain and India."

Asymmetries of knowledge and awareness are incorporated at a surface syntactical level into the expression of events. Such sentences get their significance from filling in other parts, such as reasons (for a belief) and the anticipated consequences (of an act or belief). Still further extensions enable us to represent search-motivating problems, such as social contradictions involving the fallacy of composition, as discussed by Elster (1978). Parallels with the interpersonal phenomenological concerns of Alperson (1975, 1977) and Lefebvre (1977a, b) are not accidental.

These syntactic devices facilitate much more extensive capabilities for modelling organizational understanding and learning in the rewritten simulation. The actor can diagnose its experience, comment upon that diagnosis, and retain a record -- commentary upon its own beliefs -- to assist subsequent problem-solving.

Values as idealizations.

A third strong feature of the simulation is its use of multiple values to guide the behavior of actors. Values are operationalized as indices of status, in a generic sense of relative position, computed over transactions in the actor's local system. Three values are wealth, prestige and (military) power. Depending upon the organization's choice of mechanism, goals can be expressed differently in terms of variable levels of the three values. For instance, a goal of lessening status incongruence invokes all three values; that of attaining some aspired future state may utilize only one.

The notion of there existing only three fixed kinds of values is admittedly primitive. Yet once complex systems of belief and understanding are expressible

in the model, it is a short step to implementing goals as desired or idealized situations, whose componential values take on the character of separate propositions. Because the list engineering permits propositions to be easily altered, the rewritten simulation will allow dynamic revision of values in a qualitative as well as quantitative manner. One rather crude, but possibly interesting, way to redefine values is for the actor to successively negate problematic conditions of its existence. Values would inhere in the processes required to attain the conditions implied by these successive negations. (One such possible value is consistency, which is, of course, not guaranteed to be possible from such processes.) This invokes Popper's concept of the "piecemeal social engineer," who "will adapt the method of searching for and fighting against the greatest and most urgent evils of society rather than searching for and fighting for its greatest ultimate good" (Popper, 1945). Alternatively, one could hypothesize "positive" definitions of value, such as satisfaction of dynamically defined "basic human needs."

Reflection upon one's security dilemmas is most potent when it can engender processes of value-transformation. In rewriting the simulation we hope to at least demonstrate this as a possibility.

Problem solving as the realization of valued propositions.

In most contemporary simulations of social action, the motivational aspects are weaker than the cognitive calculi. Problems are typically viewed as disparities between desired and achieved states; efforts at problem solving are more or less direct attempts at reducing salient disparities. As indicated above, value redefinition is rarely an option. These limitations apply to the Bennett-Alker model as it presently stands.

In rewriting the simulation, we continue the emphasis of Simon-March-Cyert organizational theory on search activity being problem motivated. But we refocus the object of the search to be not immediate means for reducing these salient disparities but highly contingent, contextually sensitive strategies for realizing valued propositions (however they were acquired). In other words, not only are the extensions enumerated in previous sections presupposed to enable a propositional structure of goals, but also means-ends relations become instrumentally problematic. Intervening conditions between the set of propositions accepted as true and those valued propositions desired to be made true emerge as the focus of the actor's cognitive and analytic efforts.

The recursive attention to instrumental changes is wholly lacking in the present model. On the other hand, it is central to an understanding of meaning in the resolution of security dilemmas. Unless the actor can acquire capabilities for (strong) causal understanding or (weaker) practical inferencing about action-consequent and action-reaction, it cannot be said to be "artificially intelligent." To fill unspecified parts of the syntactic "main line" actors must be able to perform inferential activities. For instance, imputing reasons to another's act (such as by asking why and how the Egyptian President came to the awareness of the British Prime Minister's conception of geography) creates a chain of reasoning suggestive of ways to alter or avert the act in the future. Furthermore, instantiating specific consequences on the basis of subsequent experience leads to an if-then understanding and to the dynamic acquisition of theories of the counterfactual on the basis of which the actor can exercise choice.

The intermediate steps in processes of authentication of valued propositions are to be researchable with the rewritten model. This should be true whether the domain of interest is the verbal protocol of a sequential prisoners' dilemma or the process of decolonization.

Reflexion as commentary upon reasons,

In the present model, the actor "remembers" what it did, and it records partial information about what others did, but it has no capability to record reasons for anything that anyone did. Its "lessons" are limited to zero-order correlations. By introducing reasons into the surface structure of political accounts, we intend that the rewritten model feature "learning" that proceeds faster than experience.

In many respects, the organizations in the Bennett-Alker simulation behaviorally resemble simple automata, despite their internally complex structures and cognitive power. Their evaluation of each international event as an isolated condition allows them to evaluate just that one internal state corresponding to the event. They cannot generalize to evaluate the class of similar internal states, nor can they evaluate internal states on the basis of hypothetical international events. Thus, their appreciation of the demands and opportunities afforded by the environment never "catches up" with that repeatedly transformed environment, and they "perpetuate failure." Yet, real policymakers do purport to improve their understanding of the world on the basis of counterfactual reasoning and generalization from "similar" antecedents to "similar" consequents. Such learning is not strictly logically supported, but it affords a powerful improvement over the limitations of experience.

In the rewritten simulation, we implement reflection as, in part, commentary upon reasons. It is possible to conceive of reasons as being of three broad types, each corresponding to a particular kind of potential lesson. First, there are reasons that affirm the essentially deterministic aspects of such an occurrence. These may be invoked when the actor is more or less automatically pursuing a general policy from which it can be diverted only by drastic failure. For instance, the nearly automatic expression of policy as operational rules, as Kaplan developed them, or as standard operating procedures, in a more microscopic sense, are both examples of actions whose "why" admits of no effective response. Similar reasons may be given if no viable policy options were apparent, even after extensive organizational search. Thus, "it was the only thing to do" is another response which tends to stop inquiry.

A second type of reason is essentially expression of intention, although an explicit goal may be absent. Thus, a reason for a particular international initiative may be the avoidance of some consequence anticipated from the non-performance of the act. De facto, intention can occur in three parts of the "main line" syntax: as "intent", as "anticipated consequence," and as "reason." However, different answers may be given to questions about these three slots. For example, contradictions between, say, positively valued intent and negatively valued anticipated consequence are inherent in situations such as security dilemmas and prisoners' dilemmas.

The third type of reason justification. Here one encounters a normative dimension of action that also may conflict with anticipated consequent. Justification may involve a statement of permission, such as invocation of one's

global roles or self-referential claims to deference. It may instead involve a statement of obligation, made by reference to other (normative) reasons or to expectations of others (e.g. anticipatable reactions).

In undertaking choice among policies, the organization weighs arguments supporting alternatives. That is, it pursues the chain of reasons supporting each alternative and comments -- by way of evaluation -- upon each chain. As a result, even those alternatives dismissed from further consideration receive a string of commentary. Each receives evaluation even when it is not implemented, in distinction to the current structure of simulation. The evaluation must clearly be based upon the organization's claims at counterfactual understanding. And this understanding -- which may, of course, lead to error as well as insight -- compounds itself with commentary upon commentary. In such fashion, new information may be wrongly reconciled with and used to support mistaken notions about if-then relations (Jervis, 1970). But the overwhelming advantage is that the organization can acquire lessons from its own analytic activity as well as from the events of its environment.

Extended applicability.

The final weakness to be addressed is that mentioned at the outset: the simulation is currently tailored to a single historical setting. The rewritten form will consist of modules which can be juxtaposed to address a variety of reflexive modelling problems. The two addressed in this project are post-World War II security problems and SPD sequences and protocols. A more general orientation is to address historical data analysis.

Three sorts of model components will be rigorously separated in function so that the simulation is exportable. First, several procedures for simple

manipulations of lists comprise a LISP-like core to the modeled entities' cognitive and analytic capabilities. This encompasses mechanisms for constructing, managing and traversing complex networks of propositions, higher-level relations, and commentary. In the jargon of artificial intelligence, these are called "augmented transition networks." The projected collection of procedures will lack the flexibility of LISP but compensate by offering to the user a more direct representation of events and decision processes.

A second sort of component will perform the input and output operations. These will be made entirely separate from the list processors, even though closer integration might entail slightly greater efficiency. However, the researcher who wishes to interface the list processing modules with his own structures of data, or who works in a computational environment that makes specialized demands upon input and output, will require a complete separation.

The final sort will be modules of "mini-theory" to administer organizational problem-solving processes, search sequencing, priorities for selecting loci for changes in propositions, and -- most importantly -- rules for instantiating unfilled slots in the syntax of propositions. In short, the inferential and (organizationally bounded) deductive powers of the behavioral units of the model will be separately packaged, so that a user might conveniently alter these without revising the list processing components.

Moving toward an empirical test of a revised collective insecurities model.

Anyone familiar with complex simulation modeling knows that core theories, when modularly programmed, are not easily falsified. Parameter adjustment, variable

redefinition, missing data and "bad" data all get in the way of disconfirmation. At the same time, readjustments to "save the theory" are remarkably easy to make. Different modules work better in one context than in another. But the practical impact of model-based resolution of security dilemmas depends to an important extent upon the approximate empirical validity of assumptions embodied in a particular combination of modular programs.

Thus, an important part of the work in simulating international security dilemmas will be critical, hypothetical model analysis (such as was partially undertaken and reported in the Alker, Christensen and Greenberg papers).

An important source of comparison will be the simple simulation derived from a respecification and estimation of the Alker-Greenberg model in terms of Butterworth's (1976) data. But we are also exploring other typologies for recording events data, including that developed by Leng and Singer (1978), Bloomfield's CASCON system (1974), Azar's COPDAB collection (1975), and other data sets. One purpose in this wide search is to see how much background information can be profitably filled in the lacunae in the Butterworth data.

NARRATIVE MODELING

Like the three lines of investigation and model building we have outlined to this point, the fourth is concerned with how precedents or lessons from the past are initially acquired and then subsequently applied in the practical activity of strategic problem-solving. Again, the purpose is to design models which instantiate the interpretive and intentional processes which structure and restructure political action. But the fourth subproject departs from the others in the way it articulates these issues while rendering them in the dynamic format of a simulation. The principle

questions which are posed and which we seek to embody in the operation of this simulation of the evolving logic of strategic interaction (and the binds, / and contradictions and circularities to which it is prone) can be presented in the form of three assertions:

- 1) that an individual actor's elected course of action is principally determined not by the analysis performed on options, but by the prior construction of the set of possible initiatives and consequences attributable to the parties involved -- a cognitive process which involves defining new situations on the basis of comparison across multiple dimensions with previously experienced situations which exist as richly described incidents in individual and collective memory;
- 2) that the formal and tacit control of conflict exercised by the significant actors as they successively interact in varying strategic circumstances is feasible only insofar as they acquire competence in defining the strategic issues in accordance with heuristics which are mutually intelligible -- a working consensus emerges which widens and makes more complex the strategic planning of each as it is predicated on the perception and planning of the others;
- 3) that the reproduction and expansion of this capacity to solve problems in parallel in the face of new contingencies leads to the transformation of the actual conduct of international affairs and is the fundamental determinant of the robustness of a working relationship between and among actors which channels and forecloses lethal conflict.

We label this subproject "narrative modeling" to underscore the primacy of what we feel to be the generic unit of political reasoning and calculation: practically interpreted and re-interpreted sequences of actions. Read from the past, or read into the past, and repositied in institutional memory, these (re-)interpreted action sequences constitute "histories;" fabricated within the contingent world of the present and used to anticipate conceivable futures, they comprise strategies, plans and utopias. The idea of narrative

conveniently captures several of the characteristics of those systems we most want to exhibit in simulation.

"Narrative" draws attention to a process of structuring information or imposing an intelligibility, while the act of "narrating" points to the scenario-building and justificatory activities which drive and focus the process of policy making. In a situation of actual or potential conflict, information is sought out and used to the extent that it can be assembled into hypothetical courses of action in which roles, capacities, propensities, and constraints are joined into plausible wholes. A policy-generating body, for example Truman's Blair House meetings in June, 1950, or Kennedy's Excom, is involved in a collective exercise in generating and exploring multiple narratives, each of which extends the knowable present into the unknowable future. The action taken, insofar as it is understandable to the actor involved, will be predicated on one or more of these fabrications.

Where precedents, conceived as structures of information, were pictured as fixed configurations of factors, we now add an emphasis on the sequencing and logical entailment which binds congeries of factors and events into such intelligible wholes. The process of constructing precedents involves transforming naked events into chains of antecedents and consequences. The factors comprising events, and the events themselves, are selected and linked together by causal and intentional connectives to yield a plausible ordering or configuring such that each contributes to the possibility or necessity of the next. Plot-like in structure, these interpretations assign roles and rationales that, along with situational factors, are assembled into unfolding sequences of choice, accident, and error -- all conditioned by circumstance.¹

The most salient of these interpretations, like the "Lesson of Munich," can play an immediate role in strategic problem-solving by uncritically imposing attributes and intentions on significant actors in new situations, blinding the actors to fundamental differences of context. Precedents are suffused with attributed intentions which explain, justify, and condemn. The coherence of a precedent derives from the causal linkages identified and on the purposes and postures assigned by the actor to himself and to others.

Conceived as a process of building and augmenting narratives, there are clearly two orders of constraint which shape and select policy. The first comprises factors which set a bound on the scope and diversity of the narratives (or scenarios) the policy-making apparatus is capable of generating. The second involves the mechanisms of choice which select and amalgamate the narratives under consideration. Precedents, as narrated structures encapsulizing the relevant past, enter into the search and evaluative procedures at both levels. Precedents invoke and constrain the understanding which is brought to bear on new contingencies; moreover, precedents orient the process of choice as it suppresses certain options and infuses others with the character of necessity.

¹ For the purposes of designing a system which imitates strategic perception and planning, we emphasize those properties of narrative structures which facilitate attribution of intention, inference-making, and disambiguation as those understanding processes have been researched in areas within Artificial Intelligence (Charniak, 1972, 1974, 1975, 1976, 1977; Hewitt, 1971a, 1971b; McDermott and Sussman, 1974; Sussman, Winograd and Charniak, 1971; Winograd, 1972, 1973). An alternative and broader conception of narrative modeling would utilize the frameworks of analysis developed by Formalist and Structuralist literary criticism (Barthes, 1966; Bremond, 1964; Chatman, 1978; Culler, 1975).

The dynamics of conflict and its resolution pictured in terms of the interactions of narrative systems.

Conflict and crisis, as well as the steady state in which violence remains latent, can be partially explicated in terms of dynamics which are approximated by the interactions of artificial systems equipped with the story-building and story-appraising characteristics we have described. The capacities of the individual systems are such that, once fitted into a context and forced to interact, they are capable of jointly creating that quickening momentum which fans suspicions into full fledged crises. The mechanisms which generate and sustain tension are the same mechanisms, namely those which interpret and anticipate eventualities, which make possible the deliberate control and resolution of tensions.

In the series of incidents which lead to crisis, each party is engaged in constructing and updating plausible explanations (scenarios) which, to some tolerable degree, answer the questions of "why" and "wherefore." In these narrative-like explanations, roles and rationales are assigned. Each actor devises schemas which interrelate its intentions and conception of itself and its role with the intentions and characteristics attributed to significant others. Those other parties are similarly engaged. The question then arises as to the degree of fit or parallelism among or between these autonomously constructed definitions of the strategic situation. These are the issues of syncratization that Schelling raises in his illustrations of the coordination problems which the parties to a conflict must tacitly resolve if that reciprocity of expectation is to be achieved which is vital to the control or resolution of the dispute (Schelling, 1960, 1966).

Where Schelling explores the perceptual syncratization, i.e. the recognition

of "prominent" solutions, which parties to a conflict must achieve if a stable basis for resolution is to come about, we want to stress the more inclusive activity of which coordinated perception is a part: the competence acquired in solving the shared problem on the basis of a narrative logic which is mutually intelligible. Schelling deals with the question of the acquisition of such a shared competence as a fundamental by-product of repeated interactions which serve to establish a "tradition" for the management of conflict.

There are immediate and practical reasons for exploring how a consensual basis for the resolution of conflict is acquired and why, in some instances of the most recalcitrant disputes, competence fails to emerge. It can be the case that a conflict resists resolution because the actors are devoid of the capacity to generate a shared interpretation of the causes and issues which is sufficient for the purpose of identifying a path out of their vicious stalemate. Herbert Kelman's work on the Israeli-Palestinian conflict (Kelman, 1978) is a prime example of this failure, and illustrates a situation in which the narrative competence of each of the parties is practically unintelligible (or incredible) to the other. Kelman's analysis traces the irreconcilability of the conflict to the inability on the part of both the Israelis and the Palestinians to fathom the explanative logic in which the other's most fundamental demands are imbedded. Neither seems capable of fully recreating the reasoning which motivates the other; each argues from within a narrative framework which bestows the legitimacy of national identity onto one party while denying such identity to the other. Stated in the terminology which we have used to describe the design of our simulation, the two parties lack the

means to reconstruct the narrative-like rationale which the other assumes in defining his most fundamental grievance. Kelman's emphasis on the practical steps which may in time enable each to access the self-understanding of the other exemplifies not only the type of explanative structure we want to portray, but also the transformation in such structures which must be realized if the essential impasse is to be circumvented, and Arab-Israeli insecurity dilemmas are to be resolved.

Kelman's case illustrates a general principle in the resolution of conflict via instilling the joint capacity to redefine the situation (or alter the set of narratives which prevail). Piecemeal accommodation on matters of secondary importance cultivates a basis of mutual expectation, which in turn adds to the possibility for accommodation on the more central issues of the dispute. The step-by-step procedure Kelman hopes to stimulate, like the succession of gestures and responses which Schelling refers to as the establishing of a "tradition" of interaction, involves each party in a graduated exercise of displaying his "character" and reasoning to the other. The basis emerges for further accommodation and with it the possibility for constructing commensurate if not shared accounts (narrated understandings) of the origins and future of the conflict. If this is achieved, then a modus vivendi rooted in his party's understanding can be jointly practiced. This, then, is effective resolution, not imposed by a third party but autonomously generated by those immediately involved. The possibility of a mutually arrived at solution to a dispute that runs as deep as that of the Middle East, a solution which is robust with a respect to future complications, must ultimately involve, as Kelman argues, the capacity on the part of each to recreate the understanding which directs the perception and fears of the other.

As the example should illustrate, like Schelling we find deductive game theory, though immensely suggestive, ultimately incomplete for our purposes since it fails to explore the logic and maneuver which goes on within the tacit dimensions of conflict. The idea of narrating systems which interact, and through interacting potentially achieve that parallel interpretive capacity requisite to that subtle coordination required by any and all bargaining, focuses attention on precisely those areas conventional game theory neglects.

Thus our conception of conflict resolution is one of dual or parallel problem-solving where resolution entails an achieved competence on the part of each party to generate the narrative-logic which orients the other. This shared competence establishes the reciprocal basis for adjustment and mutual accommodation.

In this broad area of concern, we follow our basic intent of moving from single intentionalist analyses of laboratory data to complex formal analyses of historical data. Kelman's work is a contextually rich example of an historical conflict; an example of contrived conflict which shares many of the same dynamics is the stylized behavior evidenced in Sequential Prisoner's Dilemma. An illustration of the interaction of incommensurate narrative-understandings in the SPD context, based on previous analyses of player's accounts, would be the history of exchanges enacted by two players with radically different interpretations of themselves and the situation. One student, attending management school, might be personified as "Competitor;" the other, bent on a teaching career, as "Educator." Competitor starts play with the apparent objective of "beating" the other player; educator wants to "educate" his opponent concerning the long run virtues of a joint cooperative pattern of play. Various story lines, theme sequences, narrative accounts

or scripts might be generated by each in the course of what subsequently transpires.

One such narrative account has both Competitor and Educator cooperating on the first round for entirely different reasons -- Machiavellian deception concerning true intentions and altruistic signalling; initial joint cooperation is also very differently interpreted. Another account begins with random starting moves and heavy propensities to be imitative. Subsequent play may involve significant redefinitions of overall goals, instrumental strategies for realizing them, and/or the moral sophistication and reflective complexity of situational self-characterizations. Ironic, dramatic turning points might occur when Educator realizes he is "educating" his opponent to defect by rewarding such defections, or when both players realize the experimenter has set them an unfair task, or when Competitor feels securely ahead. Differently interpreted joint cooperations might indeed finally result, or be "irrevocably" lost. Such narrative account may contain as pieces the move -- or policy-matching -- themes previously described; at the same time these newer accounts involve more fundamental restructuring of intentional action.

The data structures and operative functions which implement narrative systems.

To capture in simulation the structure and interactions we have sketched requires a programming medium which is extremely flexible not only in the data structures it will accommodate, but in the ease with which these structures can be manipulated. A second fundamental requirement is that it be possible to create an environment which is partitioned not only in the sense that selected information is available to one or several but not all subsystems, but in the sense that the logic of the operations performed differs from subsystem to subsystem. The object

is to build into the design of the simulation a wide range of capabilities for replicating those factors of risk, uncertainty, partial knowledge, and distortion, which derive from the fact that in real conflict situations the information and intentions of individual actors are opaque or semi-opaque to others. An adequate system must be capable of both replicating diverse narrative structures (and narrative-based procedures), and of housing these in distinct subsystems which are dynamically linked so as to perform complex interactions.

In our view, a working medium which fulfills these requirements can be engineered on the basis of programming strategies utilized in learning and real world problem-solving systems which employ flexible and procedure-oriented data structures variously termed "frames," "scripts," "schemas," and "depictions" (Minsky, 1975a, 1975b; Abelson, 1973, 1976, 1978; Schank and Abelson, 1975, 1977; Rumelhart and Ortony, 1976; Hayes, 1977; Winston, 1977a; for fuller discussions see Mefford, 1979). To render the localized or scoped character of information and reasoning which is vital in our study of evolving parallel processes, we augment the system along the lines of Hendrix's work with "partitioned networks" or "spaces" (Hendrix, 1975, 1978; Bruce and Newman, 1978; Stansfield, 1977). The language of preference for this work is LISP which is extended to facilitate the building and alteration of these large, flexible data structures (Roberts and Goldstein, 1977; Bobrow and Winograd, 1976, 1977).

According to Minsky, the phenomenological power of frames resides in their representational capacity for embodying a configuration of diverse information regarding a situation; the frame serves to, in a sense, designate in

advance what is "natural" or expected, and conversely what is unlikely or absurd. The general conception is that

[a] frame is a data-structure for representing a stereotyped situation like being in a certain kind of living room or going to a child's birthday party. Attached to each frame are several kinds of information. Some is about what one can expect to happen next. Some is about what to do if these expectations are not confirmed.

(Minsky, 1975b: 104)

Collections of related frames can be linked together into frame-systems in which the effects of important actions and the impact of learning is mirrored by transformations between frames (Winston, 1970, 1977b).

Problem-solving on the basis of frames can be construed as a process of fitting incoming information into the configuration of types of facts and related actions which have been preassembled to constitute the frames in the system's repertoire. Identifying the course of action which, for example, a crisis or negotiating ploy holds out for an actor is a process of selecting and imposing a frame or analogue onto the situation. In so doing, the actor becomes aware of a specified array of plausible dangers and opportunities -- the assembled information which will enter into subsequent calculations as to options and their consequences. In a fundamental sense, the choice of action is structured by the initial, possibly inadvertent selection of the frame or script which is to orient the definition of the situation. Choice is circumscribed by the criteria and limits which the orienting frame imposes on the field of conceivable options. To stress, with the concept of frame, this pre-structuring of choice is to emphasize that strategic problem-solving involves substantially more than the conventional notion of the analysis and evaluation of all possible courses of action or interpretations. As Abelson

argues (Abelson, 1978), the deeper dimension of decision making is almost binary in character, a matter of invoking or not invoking a particular definition. Once the definition or frame is in place, for instance, that riots in a foreign capital is the work of Communist agents, the universe of response is essentially fixed. The crucial initial step is finding the applicable reference, a step which can be thought of as "matching" new information against what one or more frames require if they are to be invoked. This matching involves fulfilling the frame's "entry conditionals," the crucial initial step in the application of a frame or a script. This entails satisfying the "front end to the script, mediating between presentation of the defining context for the script and participation in it. This is a little decision program . . . learned along with the script, containing "action rules" or criteria for participation." (Abelson, 1978)

If we lack in our repertoire of experiences or within the scope of our imagination anything which closely resembles some new situation we confront, we are forced to adapt existent frames or, in the rare case, innovate new ones (Winston, 1977b). In such circumstances, the resources at our disposal are the attributes of the frames we can call up and modify, extend and qualify, and otherwise reshape. These processes of restructuring -- learning in all of its forms -- are inherently self-monitoring, self-reflective activities. It is a principle objective of this project to capture such activities as they contribute to the genesis, reproduction, and possible resolution of political conflict.

CONCLUDING OVERVIEW

The search for better understanding of the blockages limiting conflict

resolution has taken us down several intersecting but not yet charted paths. Four of these proposed, partly studied lines of inquiry have been sketched in this early report on a project dealing with increasingly disaggregated and historically complex forms of insecurity dilemmas. For the transcendence of such dilemmas or social contradictions to be real, old modes of action must be broken, counter-factual reanalyses of historical success and failure must be creatively attempted, and new "lessons" must be forged and shared as bases for practical action.

Our perspective has meant greater scientific attention to qualitative, narratively structured historical information -- be it sequential Prisoner's Dilemma protocols, post-PD debates with experimenters and opponents, precedentally organized time-series data on UN disputes, Butterworth's short narrative case descriptions of such disputes, intentionally described but structurally embedded historical security conflicts, or the more elaborate outline of reflective failures in Kelman's Middle East analysis.

Joined to our emphasis on the need for shared understandings of typically qualitative lessons of the past has been sustained concern with the formal logics of precedential analysis. Alternatively, ^{these} / have been called "reflective logics," or "generalized precedent logics." We are committed to exploring further the usefulness of formalisms not usually used in studies of insecurity problems, the importance of reflective operations -- self-referring and other-referring calculations with several levels of possible embeddedness -- follows from a variety of suggestive literatures both on the roots of and remedies for unreflected upon controversies. The merit, as well as the justification of the proposed

investigations lies most fundamentally in combining and utilizing practical narrative understandings and formalized precedential reasoning.

REFERENCES

1. Abelson, Robert P. "The Structure of Belief Systems." In Computer Models of Thought and Language. Edited by R.C. Schank and K. M. Colby. San Francisco: Freeman, 1973.
2. _____ "Script Processing in Attitude Formation and Decision Making." In Cognition and Social Behavior, J.S. Carroll and J.W. Payne (eds.). Hillsdale, N.J.: Erlbaum, 1976.
3. _____ "Scripts." Address to Midwestern Psychological Association, May, 1978. Typescript.
4. _____ "Concepts for Representing Mundane Reality in Plans." In Representation and Understanding: Studies in Cognitive Science. D. Bobrow and A. Collins (eds.). New York: Academic Press, 1975a.
5. Alker, Hayward R. Jr. "Le Comportement Directeur (Directive Behavior)." In Revue Francaise de Sociologie, XI-XII, Numero special 1970-71.
6. _____ "Assessing the Impact of the U.N. Collective Security System: An Operational Multicultural Approach." Proceedings of the American Society of International Law, Vol. 65 (1971): 33-39.
7. _____ "Are There Structural Models of Voluntaristic Social Action?" In Quality and Quantity 8(1974).
8. _____ "Polimetrics: Its Descriptive Foundations." In Handbook of Political Science, Nelson Polsby and Fred Greenstein (eds.). Reading, Ma.: Addison-Wesley, 1975.
9. _____ "A Methodology for Design Research on Interdependence Alternatives." In International Organization 31(1977).
10. Alker, Hayward R. Jr. and Nazli Choucri. "Methodological Perspectives and Research Implications." Vol. III of Lincoln P. Bloomfield, Hayward R. Alker, Jr., and Nazli Choucri, Analyzing Global Interdependence. Cambridge, Ma. : Center for International Studies, M.I.T., 1974.
11. Alker, Hayward R. Jr. and Cheryl Christensen. "From Causal Modelling to Artificial Intelligence: The Evolving of a U.N. Peace-making Simulation." In Experimentation and Simulation in Political Science, LaPonce and Smoker (eds.). Toronto: University of Toronto Press, 1972.

REFERENCES

12. Alker, Hayward R. Jr., and William Greenberg. "The U.N. Charter: Alternate Pasts and Alternate Futures." In The United Nations: Problems and Prospects, Edwin H. Fedder (ed.). Center for International Studies, University of Missouri, 1971.
13. Alperson, B.L. "In Search of Buber's Ghosts: A Calculus for Interpersonal Phenomenology." In Behavioral Science 20(1975), 179-190.
14. _____ "Three Calculating Engines for Interpersonal Phenomenology." In General Systems 22(1977), 171-182.
15. Azar, Edward E. and Thomas J. Sloan. Dimensions of Interaction: A Source Book for the Study of Behavior of 31 Nations from 1948-1973. Pittsburgh: University Center for International Studies, University of Pittsburgh, 1975.
16. Ashley, R.K. "Look Out for Lakatos; Self-Correction in the Analysis of International Compound Dilemmas." A paper presented to the annual meeting of the International Studies Association, St. Louis, Missouri, March, 1977.
17. Barthes, Roland. "Introduction a analyse structurals des recits." In Communications 8(1966): 1-27. English translation "Introduction to the Structural Analysis of Narratives." In Roland Barthes, Images, Music, Text. New York: Hill and Wang, 1977, pp. 79-124.
18. Bennett, James P. "Foreign Policy as Maladaptive Behavior: Operationalizing Some Implications." In Peace Science Society Papers 25(1975), pp. 85-104.
19. _____ "Imperialism on a Swallowtail: Applications of Catastrophe Theory to International Relations." In Quality and Quantity 12(1978).
20. Bennett, James P. and Hayward R. Alker, Jr. "When National Security Policies Bred Collective Insecurity: The War of the Pacific in a World Politics Simulation." In Karl W. Deutsch et al (eds.) Problems of World Modelling, Cambridge, Ma. Ballinger, 1977.
21. Bobrow, D.G. and T. Winograd. "An Overview of KRL, a Knowledge Representation Language." In Cognitive Science, Vol. I, 1(1977): 3-46.
22. Bobrow, D.G. and T. Winograd and the KRL Research Group. "Experience with KRL-0: One Cycle of a Knowledge Representation Language." International Joint Conference on Artificial Intelligence, Cambridge, Aug. 22-25, 1977. Pittsburgh: Department of Computer Science, Carnegie-Mellon University, 1977. Vol. 1, pp. 213-222.

REFERENCES

23. Boden, Margaret. Artificial Intelligence and Natural Man. New York: Basic Books, 1977.
24. Bloomfield, Lincoln P. and R.R. Beattie. "Computers and Foreign Policy -- the CASCON Experiment." In Journal of Conflict Resolution 15(1971): 43-46.
25. Bloomfield, Lincoln P. and Amelia C. Leiss. Controlling Small Wars: A Strategy for the 1970s. New York: Knopf, 1969.
26. Bloomfield, Lincoln P. and Cornelius J. Gearin. "Political Games: Experiments in Foreign Policy Research." In Technology Review 77(1974-1975): (Oct. - Nov. 1974): 50-59.
27. Bremer, S.J. Simulated Worlds. A Computer Model of National Decision-Making. Princeton, N.J.: Princeton University Press, 1977.
28. Bremond, Claude. "Le Message Narratif." In Communications 4(1964): 4-32.
29. Bruce, Bertram and Denis Newman. "Interacting Plans." Technical Report No. 88. Cambridge: Bolt, Beranek and Newman, June, 1978.
30. Burns, T.R. and Meeker, L.D. "A Systems Theory of Multi-Level Multiple Objective Evaluation and Decision-Making." In International Journal of General Systems 3(1976): 105-125.
31. Butterworth, R.L. with Scranton, M.E. Managing Interstate Conflict, 1945-1974: Data With Synopses. Pittsburgh: University Center for International Studies, University of Pittsburgh, 1976.
32. Charniak, E. "Organizational Inference, A Frame-like System of Common Knowledge." In Theoretical Issues in Natural Language Processing. pp. 42-54. Edited by R. Schank and B.L. Nash-Webber. Cambridge, Ma.: June, 1975.
33. Charniak, E. "Towards a Model of Children's Story Comprehension." AI TR-266. Cambridge, MA.: Artificial Intelligence Laboratory. M.I.T., 1972.
34. _____ "He Will Make You Take It Back: A Study in the Pragmatics of Language." Technical Memorandum No. 3. Castagnola, Switzerland: Istituto per gli Studi Semantici e Cognitivi, 1974.
35. _____ "Inference and Knowledge, Part I." In Charniak, E. and Yorik Wilks (eds.) Computational Semantics. An Introduction to Artificial Intelligence and Natural Language Comprehension. Amsterdam: North-Holland, 1976: 1-21.

REFERENCES

36. _____ "A Framed Painting: the Representation of a Common Sense Knowledge Fragment." In *Cognitive Science* 1(1977): 355-394.
37. Chatman, Seymour. Story and Discourse: Narrative Structure in Fiction and Film. Ithaca, N.Y.: Cornell University Press, 1978.
38. Chomsky, Noam. Aspects of the Theory of Syntax. Cambridge, Ma.: M.I.T. Press, 1965.
39. Chomsky, Noam. Problems of Knowledge and Freedom. Pantheon Books, New York, 1971.
40. Choucri, N. and North, R.C. Nations in Conflict. San Francisco: Freeman, 1974.
41. Culler, Jonathan. Structuralist Poetics. Structuralism, Linguistics, and the Study of Literature. Ithaca, N.Y.: Cornell University Press, 1975.
42. Deutsch, Morton. Resolution of Conflict. Constructive and Destructive Processes. New Haven: Yale University Press, 1973.
43. Elster, J. Logic and Society: Contradictions and Possible Worlds. New York: Wiley & Sons. 1978.
44. Emshoff, J.R. "A Computer Simulation Model of the Prisoner's Dilemma." In *Behavioral Science* 15(1970): 304-317.
45. Emshoff, J.R. and Ackoff, R.L. "Explanatory Models of Interactive Choice Behavior." In *Journal of Conflict Resolution* 14(1970): 77-89.
46. Feffer, M.H. "The Cognitive Implication of Role-Taking Behavior." In *Journal of Personality* 27(1959): 152-168.
47. _____ "Developmental Analysis of Interpersonal Behavior." In *Psychological Review* 77(1971): 197-214.
48. Feffer, M.H. and Gourevitch, V. "Cognitive Aspects of Role-Taking in Children." In *Journal of Personality* 28(1960): 383-396.
49. Flavell, J.H. The Developmental Psychology of Jean Piaget. New York: Van Nostrand, 1963.
50. _____ "The Development of Inferences about Others." In Understanding Other Persons. T. Mischel (ed.). Totowa, N.J.: Rowman & Littlefield, 1974.

REFERENCES

51. Ginsburg, H. and Koslowski, B. "Cognitive Development." In Annual Review of Psychology 27(1976): 29-61.
52. Haas, E.B. "Collective Security and the Future International System." Denver: University of Denver, 1968.
53. Haas, E.B., Butterworth, R.L. and Nye, J.S. Conflict Management by International Organizations. Morristown, N.J.: General Learning Press, 1972.
54. Hayes, Phillip J. "On Semantic Nets, Frames and Associations." International Joint Conference on Artificial Intelligence, Fifth, Cambridge, MA.: August 22-25, 1977. Pittsburgh: Department of Computer Science, Carnegie-Mellon University, 1977 Vol. 1 pp. 99-107.
55. Hendrix, Gary G. "Expanding the Utility of Semantic Networks Through Partitioning." International Joint Conference on Artificial Intelligence, Fourth, Thilisi, Georgian SSR, Sept. 3-8, 1975, pp. 115-121.
56. _____ "Encoding Knowledge in Partitioned Networks." Artificial Intelligence Center, SRI International MS. April, 1978.
57. Hernes, Helga. "Classical Theories of Foreign Policy Making as Cognitive Archetypes." In Matthew G. Bonham and Michael J. Shapiro (eds.) Thought and Action in Foreign Policy. Proceedings of the London Conference on Cognitive Process Models of Foreign Policy, March, 1973. Basel and Stuttgart: Birkhauser, 1977: 242-262.
58. Hewitt, C. "Description and Theoretical Analysis (Using Schemata) of PLANNER: A Language for Proving Theorems and Manipulating Models in a Robot. M.I.T. Ph.D. Thesis, June, 1971. Reprinted as AI-TR-258. M.I.T. AI Laboratory, April, 1972.
59. _____ "Procedural Embedding of Knowledge in PLANNER." International Joint Conference on Artificial Intelligence, Second, London, 1971. London: British Computer Society, 1971, pp. 167-182.
60. Howard, Nigel. "A Piagetian Approach to Decision and Game Theory." In Hooker, Leach and McClennen (eds.) Foundations and Applications of Decision Theory, Vol. I, pp. 205-225. Dordrecht, Holland: D. Reidel, 1978.
61. Herrera, A.O. et al. Catastrophe or New Society? A Latin American World Model. Ottawa: International Development Research Centre, 1976.

REFERENCES

62. Holsti, O.R. Crisis Escalation War. Montreal: McGill-Queens University Press, 1972.
63. Jervis, R. The Logic of Images in International Relations. Princeton, N.J.: Princeton University Press, 1970.
64. Kelley, H.H. and Stahelski, A.J. "Errors in Perception of Intentions in a Mixed-Motive Game." Journal of Experimental Social Psychology. 6(1970): 379-400.
65. Kelman, Herbert C. "Israelis and Palestinians: Psychological Prerequisites for Mutual Acceptance." In International Security 3(1978): 162-186.
66. Kohlberg, L. "Stage and Sequence: The Cognitive-Developmental Approach to Socialization." In Handbook of Socialization Theory and Research. D.A. Goslin (ed.) Chicago: Rand, McNally, 1969.
67. _____ Stages in the Development of Moral Thought and Action. New York: Holt, Rinehart and Winston, 1969.
68. _____ "From is to Ought: How to Commit the Naturalistic Fallacy and Get Away with it in the Study of Moral Development." In Cognitive Development and Epistemology. Edited by T. Mischel. New York: Academic Press, 1971.
69. _____ "Moral Judgement Interview Form A -- Standard Scoring Manual; Moral Judgement Interview Form B-1; Moral Judgement Interview Form B-2; Standard Form Scoring Guides." Harvard University, mimeographed, 1973.
70. Kohlberg, L. et al. "Standard Form Scoring Manual." Cambridge, MA: Harvard University, mimeographed, 1973.
71. Kohlberg, L. and DeVries, R. "Relations between Piaget and Psychometric Assessments of Intelligence." A paper presented at the Conference on the Natural Curriculum, Urbana, Illinois, 1969.
72. Kohlberg, L. and Kramer, R. "Continuities and Discontinuities in Childhood and Adult Moral Development." In Human Development 12(1969): 93-120.
73. Kohlberg, L. and Turiel, E. Recent Research in Moral Development. New York: Holt, 1971.
74. Kuhn, D., Langer, J. and Kohlberg, L. "Relations between Logical and Moral Development." In Recent Research in Moral Development. L. Kohlberg, and E. Turiel (eds.). New York: Holt, 1971.
75. Kuipers, Benjamin J. "A Frame for Frames: Representing Knowledge for Recognition." In Representation and Understanding; Studies in Cognitive Science, pp. 151-184. Bobrow, D.G. and Collins, A.

REFERENCES

75. (cont.) (eds.) New York: Academic Press, 1975.
76. Lefebvre, V.A. The Structure of Awareness. Beverly Hills: Sage Publications, 1977b.
77. _____ "Introreflective Analysis: Using Algebraic Polynomials with Boolean Coefficients to Represent a Person's Inner World." In Behavioral Science 22(1977a), 49-52.
78. Leng, Russell J. and J. David Singer. "Toward a Multi-Theoretical Typology of International Behavior." Mario Bunge, Johan Galtung, Mircea Malitza (eds.) Mathematical Approaches to International Relations Vol. I, Romanian Academy of Social and Political Sciences, 1978, pp. 71-93.
79. Loevinger, J. "The Meaning and Measurement of Ego Development." In American Psychologist 21 (1966): 195-217.
80. _____ Ego Development: Conceptions and Theories. San Francisco: Jossey-Bass, 1976.
81. March, J.G. and J.P. Olsen, with others. Ambiguity and Choice in Organizations. Oslo: Universitetsforlaget, 1976.
82. McCarthy, T. A. "A Theory of Communicative Competence." In Philosophy of Social Science 3(1973), 135-136.
83. McDermott, Drew V. and Gerald J. Sussman. "The CONNIVER Reference Manual." AI-M-259A (Revision of 259, May, 1972) Cambridge, MA Artificial Intelligence Laboratory, M.I.T., 1974.
84. Mefford, Dwain. "Recursive vs. Structural Reflection: Dialectics as an Instrument of Analysis Applied to the Genesis of Interpersonal Relations." Paper prepared for the First Annual Meeting of the International Society of Political Psychology, New York, Spetember, 1978.
85. _____ "Simulating the Practical Logic of Deterrence: An Application for Artificial Intelligence." Paper prepared for the Annual Meeting of the International Studies Association, Toronto, March 21-24, 1979.
86. Mesarovic, M.D. and Pestel, E. Mankind at the Turning Point; The Second Report to the Club of Rome. New York: Dutton, 1974.

REFERENCES

87. Minsky, Marvin. "A Framework for Representing Knowledge." in Patrick Winston (ed.) The Psychology of Computer Vision. New York: McGraw-Hill, 1975. pp. 211-277.
88. Minsky, Marvin. "Minsky's Frame System Theory." in R. Schank and B. L. Nash-Webber (eds.) Theoretical Issues in Natural Language Processing. An Interdisciplinary Workshop. Cambridge, MA M.I.T., 10-13 June, 1975, pp. 104-116.
89. Nelson, Stephen D. "The Effects of Power and Resource Inequalities on Interaction in a Mixed Setting," Unpublished Ph.D. dissertation, University of Michigan, 1970.
90. Newell, Allen. "Artificial Intelligence and the Concept of Mind." in R. Schank and K. Colby (eds.) Computer Models of Thought and Language. San Francisco: W.H. Freeman, 1973. pp. 1-60.
91. Nurmi, H. "Ways Out of the Prisoner's Dilemma." In Quality and Quantity 11 (1977): 135-165.
92. Piaget, J. "Development and Learning." In Piaget Rediscovered, pp. 1-12. R. E. Ripple and V.N. Rockcastle (eds.). Ithaca, N.Y.: Cornell University Press, 1964.
93. _____ Six Psychological Studies , New York: Random House, 1967.
94. _____ "Intellectual Evolution from Adolescence to Adulthood." In Human Development 15 (1972): 1-12.
95. Piaget, J. and Inhelder, B. Memory and Intelligence. New York: Basic Books, 1973.
96. Pruitt, D.G. and Kimmel, M.J. "Twenty Years of Experimental Gaming: Critique, Synthesis and Suggestions for the Future." In Annual Review of Psychology 28 (1977): 263-292.
97. Rapoport, A. Fights, Games and Debates. Ann Arbor: University of Michigan Press, 1960.
98. _____ "Escape from Paradox." In Scientific American 217 (July, 1967): 50-56.
99. _____ "Comments on Dr. Harris' Note on Howard's Theory of Meta-Games." In Psychological Reports 25 (1969a): 765-766.
100. _____ "Reply to Dr. Harris' Comments on My Comments." In Psychological Reports 25 (1969b): 857-858.

REFERENCES

101. Rapoport, A. "Prisoner's Dilemma -- Recollections and Observations." In Anatol Rapoport (ed.) Game Theory as a Theory of Conflict Resolution. Dordrecht, Holland: Reidel, 1974. pp. 17-34.
102. Rapoport, A. and Chammah, A. Prisoner's Dilemma. Ann Arbor: The University of Michigan Press, 1965.
103. Rapoport, A. and Guyer, J. and Gordon, G. The 2 x 2 Game. Ann Arbor: University of Michigan Press, 1976.
104. Rest, J. "Comprehension Preference and Spontaneous Usage in Moral Judgement." In Recent Research in Moral Development. L. Kohlberg and E. Turiel (eds.) New York: Holt, 1971.
105. Roberts, R.B. and Goldstein, I.P. "The FRL Primer." AI Memo 408. Cambridge, MA: Artificial Intelligence Laboratory, M.I.T., July, 1977.
106. Rumelhart, D.E. and Ortony, A. "The Representation of Knowledge in Memory." In R.C. Anderson, R.J. Spiro and W. E. Montague (eds.) Schooling and the Acquisition of Knowledge. Hillsdale, N.J.: Erlbaum, 1976.
107. Schank, Roger C. "Conceptual Dependency: A Theory of Natural Language Understanding." In Cognitive Psychology 3 (1972): 552-631.
108. _____ "The Structure of Episodes in Memory." In Representation and Understanding: Studies in Cognitive Science. Bobrow, D. and Collins, A. (eds.) New York: Academic Press, 1975a.
109. _____ Conceptual Information Processing. Amsterdam: North Holland, 1975b.
110. Schank, R.C. and Abelson, R.P. "Scripts, Plans and Knowledge." A paper for the 4th International Joint Conference on Artificial Intelligence. 1975.
111. _____ Scripts, Plans, Goals and Understanding: An Inquiry into Human Knowledge Structures. Hillsdale, N.J.: Erlbaum, 1977.
112. Schank, R.C. and Colby, K.M. (eds.) Computer Models of Thought and Language. San Francisco: Freeman, 1973.
113. Schelling, Thomas C. The Strategy of Conflict. New York: Oxford University Press. 1960.
114. _____ Arms and Influence. New Haven: Yale University Press. 1966.
115. Searle, J.R. Speech Acts: An Essay in the Philosophy of Language. New York: Cambridge University Press, 1969.

REFERENCES

116. Selman, R. "The Importance of Reciprocal Role-Taking for the Development of Conventional Moral Thought." In Recent Research in Moral Development. Kohlberg, L. and Turiel, E. (eds.) New York: Holt, 1971.
117. _____ "The Development of Conceptions of Interpersonal Relations: A Structural Analysis and Procedures for the Assessment of Levels of Interpersonal Reasoning Based on Levels of Social Perspective-Taking." Cambridge, MA: Harvard-Judge Baker Social Reasoning Project, 1974. Mimeographed.
118. Shubik, Martin. "Game Theory, Behavior and the Paradox of Prisoner's Dilemma: Three Solutions." In Journal of Conflict Resolution 14 (1970): 181-193.
119. Snyder, Glenn H. and Diesing, Paul. Conflict Among Nations. Bargaining, Decision Making and System Structure in International Crises. Princeton, N.J.: Princeton University Press, 1977.
120. Stansfield, James. "COMEX: A Support System for a Commodities Expert." M.I.T. Artificial Intelligence Laboratory Memo No. 423. M.I.T. August 3, 1977.
121. Sussman, Gerald, Terry Winograd, and Eugene Charniak. "MICRO-PLANNER Reference Manual." AI-M-203A M.I.T. Artificial Intelligence Laboratory. Cambridge, MA: 1971.
122. Ward, M.D. and H. Guetzkow. "Integrated Global Modelling: Economic Engineering or Social Science." Paper presented at the 6th Global Modelling Conference, Vienna, Austria, 1978.
123. Winograd, T. Understanding Natural Language. New York: Academic Press, 1972.
124. _____ "A Procedural Model of Language Understanding." Roger C. Schank and K.M. Colby (eds.) Computer Models of Thought and Language. San Francisco: W.H. Freeman, 1973. PP. 152-186.
125. Winston, Patrick H. "Learning Structural Descriptions from Examples." M.I.T. Artificial Intelligence Laboratory AI TR-231 Cambridge, MA: M.I.T. Reprinted in Patrick H. Winston (ed.) The Psychology of Computer Vision. New York: McGraw-Hill, 1975.

REFERENCES

126. Winston, Patrick H. Artificial Intelligence. Reading, MA:
Addison-Wesley, 1977.
127. _____ "Learning by Hypothesizing and Justifying Transfer
Frames." Artificial Intelligence Memo No. 414. Cambridge, MA:
Artificial Intelligence Laboratory, M.I.T., April, 1977.