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INCREMENTAL EXCHANGE THEORY: A FORMAL MODEL FOR PROGRESSION IN DYADIC SOCIAL INTERACTION[1]

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I. Introduction

In attempting to understand interpersonal relationships, social psychologists ave relied primarily on research on static structures and stable states. Yet an nportant characteristic of social relationships is their gradual development over ime. Social psychological theory has not emphasized longitudinal changes in iterpersonal behavior, but has focused on the ahistorical aspects of interersonal relations. Laboratory studies have, of course, investigated changes in elationships that occur over a short time span. But such research is suited for nderstanding problems in the near term rather than for illuminating longer nteraction sequences. Longitudinal research on the development of relationships as seldom been carried out; it is expensive, it yields correlational rather than xperimental data, and it poses many practical problems.

Given the difficulties of studying longitudinal changes in dyadic relationhips, it is important to build abstract models so that the effects of hypothetical eterminants can be examined before beginning one's field research. Such odels should possess reasonable generality and a priori plausibility. One medin for model building is computer simulation, which enables us to test the fects of varying combinations of factors on sequential changes in artificial lationships.

In this paper we present a general model of dyadic social interaction stated the language of computation science. We call our computer program "REATE" and the theory underlying it "incremental exchange theory." Actually, ELATE is a general framework within which many theories can be formulated bout particular instances of pair involvement. The RELATE program brings vo hypothetical actors together for an interaction. It simulates the developent of the actors' relationship in accord with the basic tenets of our theory *and* e user's own subtheory. Since RELATE does not understand English, it can ly accept specific theories stated in the language of computation science. ence, RELATE discourages "hand waving" by its users or comments such as you know," "sort of," and "generally." Indeed, RELATE's value to social sychology may stem as much from the theorizing behaviors it forces upon its sers as from its own substantive theory.

Several frameworks have been used in the past for modeling pair behavior. We have drawn upon them in constructing the RELATE model. Let us briefly review the most relevant of these approaches before proceeding with a description of incremental exchange theory and RELATE.

II. Formal Approaches to Dyadic Interaction

A. TWO-ACTOR MATRIX MODELS

1. Thibaut and Kelley's Exchange Matrices

One paradigm that has drawn the attention of social psychologists during the last decade is the two-person outcome matrix, first generalized to diverse forms of social interaction by Thibaut and Kelley (1959). Using a schema derived from economic game theory, they put forth a conceptual framework that draws on the traditions of both reinforcement and cognitive theories, and utilizes familiar psychological concepts such as reward and cost in a payoff matrix. The interaction between two persons is considered by casting one person in the role of Row actor and the other as the Column actor. Each actor has available a repertoire of responses, varying in number and kind across situations. The intersection of the actors' responses yields an outcome to each, as specified by the payoffs in the cell at the intersection of the row and column selected. "Bimatrices" of this sort have been used for conceiving of interaction in laboratory games such as Prisoner's Dilemma, and also for conceiving of many other sorts of encounters (see Wolf & Zahn, 1972).

Despite its potential usefulness, Thibaut and Kelley's conception of the exchange matrix has so far been primarily illustrative; it has produced few unique insights or novel data. For one thing, the paradigm itself contains no rationale for coordinating actors' hypothetical payoffs with empirical data about outcome values. There exists no specified means for converting the raw payoffs used in existing experimental research on dyadic games into the theoretically defined subjective utilities upon which Thibaut and Kelley's hypothetical actors presumably base their behavior.

A second limitation derives from a predominantly static use of the game matrix. Characteristically, writings on exchange theory treat outcome matrices as though they remain stationary during interaction. Yet, in the living world, a pair's outcomes and response options usually change over time either gradually or dramatically, depending upon factors associated with the situation and the stage of a relationship.

A third limitation of the approach has been its individualistic orientation to problems that are often supra-individual in nature. To quote a recent critic of exchange theory:

> Thibaut and Kelley assume that each individual has at his disposal a sort of internal "clock" or scale which determines the comparison level (C.L.) and which indicates the profit that he might obtain if he engaged in a relationship alternative to the one in which he is engaged at present. If this profit is greater, he abandons the current relationship; if not, he stays with it. . . . What appears to me significant is the attempt to construct a theory of collective processes on the basis of an individualistic theory [Moscovici, 1972, p. 26].

Conceptions of social exchange based on Thibaut and Kelley's suggestions have neglected to account for the transformation of personal outcome preferences through social interaction or group membership. This same limitation attends other theories of social exchange, such as those of Homans (1961) or Blau (1964), which ignore one partner's gratification from the other partner's own good outcomes.

2. *Mathematical Game Models*

Another body of social psychological work has been tied to game-theoretic models of dyadic interaction. Beginning with the interest aroused by the Prisoner's Dilemma in the 1950's (Deutsch, 1958; Luce & Raiffa, 1957), social psychologists started to use game matrices for work on problems of conflict and cooperation. Such game situations seemed to present an avenue for attaining systematic knowledge about how partners might achieve accommodation in other mixed-motive situations.

Mathematical analyses of the Prisoner's Dilemma (Harris, 1969; Amnon Rapoport, 1967; Anatol Rapoport, 1966) and of other games (Wyer, 1969) led to some interesting insights into the psychology of cooperation *in games.* Rapoport (1967) introduced the ideas of interstate transitions and the discounting of future payoffs into models of game behavior, while Wyer (1969) proposed that actors weight their co-actor's payoffs differentially over the course of an interaction sequence. None of these game-theoretic models, however, linked incremental changes in payoffs with the depth of dyadic involvement. Moreover, it has been difficult to use the social psychology of laboratory games for informing the social psychology of everyday life. That realization has led to disenchantment with purely game-theoretic approaches toward social behavior (see Nemeth, 1972).

B. COMPUTER SIMULATION MODELS

Another avenue leading toward modeling of social interaction has been the use of computer simulation. Two simulation models were particularly influential for our own work: HOMUNCULUS (Gullahorn & Gullahorn, 1963) and ALDOUS (Loehlin, 1965).

1. *HOMUNCULUS*

One imaginative attempt to model dyadic interaction was stimulated by Homans' (1950, 1961) enumeration of axioms for social behavior. On the basis of some of Homans' propositions, Simon (1957) constructed mathematical models to provide predictions of social behavior. Simon's (Newell, Shaw, & Simon, 1958) introduction of computer simulation into psychology influenced Gullahorn and Gullahorn's (1963) use of Homans' principles in a computer program designed to model social behavior.

The Gullahorns' program, called HOMUNCULUS, simulated the interaction between an actor and his social environment. Most often that environment consisted of just one other actor. HOMUNCULUS was essentially a determinate model of behavior, which applied Homans' propositions in order to select an actor's behavior in the context of a well-defined social situation. Each action then became part of the actor's characteristics and could play a part in determining new actions. The actor was defined by a hierarchical structure of lists of personality characteristics and situation-action pairings of moderate complexity. To classify the actor's actions, the Gullahorns used Bales' (1950) twelve-category scheme for classifying interpersonal behavior. Despite its inventiveness, the HOMUNCULUS model has not yet contributed substantially to the social psychology of interpersonal behavior. Its complexity has made it hard to conceive of action or interaction in its terms.

2. *ALDOUS*

Another computer model of dyadic social interaction, which arises more directly out of reinforcement theory, was Loehlin's (1965) ALDOUS model. An ALDOUS actor could engage in three general types of interaction with his environment: approach, withdrawal, or attack. It appears that Loehlin was primarily interested in showing how actors can modify their behavior purely on the basis of positive and negative reinforcements. While his experiments show interesting sequences of individual and inter-individual accommodation as a result of such reinforcement, ALDOUS has produced little new knowledge concerning dyadic interaction in general.

Despite their limitations, each of these formal approaches to social interaction contributed to the development of our own model. We now turn to a discussion of the theory underlying the RELATE model: incremental exchange theory.

III. Central Features of Incremental Exchange Theory

Incremental exchange theory assumes that an essential characteristic of any social relationship is its change over time. To represent dyadic interaction, the theory employs dyadic exchange matrices like those of Thibaut and Kelley (1959). But while earlier theorists used a single static matrix to represent a relationship, we use a set of systematically linked payoff matrices to represent a relationship. The fundamental assumption of incremental exchange theory is that the expected value of a dyad's rewards increases as the depth of the relationship increases. By "depth" we mean the level of a pair's mutual involvement (Levinger & Snoek, 1972).

Consider the elementary situation that constitutes the absence of any relation between two isolated individuals--a point of "zero contact" (Levinger & Snoek, 1972). At that point, the outcome associated with a continued "stay apart" response is assumed to have a payoff of zero, while the expected payoff for mutual approach (i.e., a two-person encounter) may be greater or less than zero, depending on the anticipated pleasure of the meeting.

As a relationship proceeds, we propose that expected payoffs, in general, change from relatively small to quite large, and that the variability of payoffs increases in range. Interpersonal rewards characteristically increase if involvement deepens; conversely, if involvement recedes, they decline (Levinger & Snoek, 1972). Associated with the increase of rewards at deeper levels, however, is an increase in the potential losses entailed by noncoordination. Thus one loses little if stood up by a blind date, but it would be quite hurtful to be ignored by someone dear. Familiarity may breed reward, but it also breeds the capacity to hurt (Aronson, 1970).

In each "state" of a relationship, the actors' behaviors lead to an immediate outcome having a separate payoff value for each actor (Thibaut & Kelley, 1959). Furthermore, the outcome results in a *transition* to either the same or a different interpersonal "state"--where either the same set or a different set of behaviors and payoff values is applicable.

If both members' outcomes at the early stages of a relationship are satisfying compared to those outcomes they can obtain in alternative relationships, the pair moves into states of deeper involvement (Altman & Taylor, 1973; Levinger & Snoek, 1972; Thibaut & Kelley, 1959). If the actors experience reward from each other, they are likely to invest more in the relationship and to become more interdependent (Huston, 1973). Conversely, if interaction is unrewarding, investment in the relation diminishes; all else being equal, they will minimize contact (Thibaut & Kelley, 1959).

As people get to know one another--as they transit from superficial to deeper states of involvement--their options in interaction seem to widen. In initial contacts, behavior tends toward stereotype or etiquette. Later in a relationship, a larger number of behaviors become appropriate (Altman & Taylor, 1973).

People also consider the *costs* of interaction. Regardless of the expected rewards, particular behaviors in particular situations are costly to some people.

Thus a shy person finds it expensive to say "hello," particularly to a stranger, even if it is likely that the stranger will respond warmly to his greeting (Jung, 1923). A proud man finds it costly to offer an apology, even if he knows it is justified and it would relieve the tension. A submissive subject fears to seize control over a task, even if he is assigned the leader role (Ghiselli & Lodahl, 1958; Smelser, 1961). Regardless of the potential outcome, then, varying basic costs are associated with differences among actors, among actions, and among situations.

Irrespective of how deeply he is involved, an individual often anticipates rewards in a dyadic interaction long before they occur. Yet even when future rewards appear clearly higher than present rewards, a person may prefer present rewards because of a *discount* (Klineberg, 1968; Mischel, 1966). One values deferred rewards less than present rewards to the extent that one is unsure about the future: "A bird in the hand is worth two in the bush." In some situations, however, deferred outcomes may be valued more than present ones.

Given that human actors consider the future, how do they evaluate it? In social interaction, an actor is sensitive to the other's probable responses in choosing his own actions. Persons differ in how far into the future they look, but they do try to anticipate their partner's most likely actions and responses. Either implicitly or explicitly one estimates the probability of the occurrence of each of the co-actor's alternative actions (Ajzen & Fishbein, 1970; Rapoport & Chammah, 1965). Of course, one person's estimates of the other's probable behavior are likely to change over the course of interaction (Wyer, 1969). Each person *learns* about the other's probable future actions from the nature of his past actions (Lott & Lott, 1972). In real life, another's past behavior exercises an obvious effect on one's current estimates of what he is likely to do next.

IV. The Premises of Incremental Exchange Theory

Incremental exchange theory is an attempt to move beyond earlier theories of exchange by incorporating assumptions about sequential process. To state the above premises of incremental exchange theory more formally, one needs a framework within which to cast the theory. We have chosen the methodology of computer simulation and call our framework the RELATE model.

A. INTRODUCTION TO THE RELATE MODEL

RELATE is a program for simulating social interaction between two persons. It is a finite-state process model, based on the conception that the current interpersonal state is determined solely by the previous state and by the behaviors selected by the two actors while in that previous state. Aside from determining the next state of the relationship, these two behaviors result in an interactive outcome with separate payoffs for each actor.

An interpersonal state refers to a given level of interpersonal involvement in a relationship between two persons. The deeper a relationship, the greater is the partners' mutual investment and the greater are their expected outcomes (Levinger, Senn, & Jorgensen, 1970; Levinger & Snoek, 1972). A state is defined in terms of five major variables:

1. The *behaviors* available in the state. Each actor has a set of mutually exclusive behavior options. The actions available to one actor may be quite different from those available to his co-actor. During any time unit, both actors choose their behavior simultaneously.[3]

2. The *cost* of each behavior, independent of its payoff.

3. A separate *payoff matrix* for each actor. If Actor 1 selects behavior i and Actor 2 selects behavior j, the payoff for Actor 1 is in row i and column j of his payoff matrix. The payoff for Actor 2 is in row j and column i of his matrix.

4. Each actor's initial *estimate of the probability* that his co-actor will choose any given behavior. A probability estimate of zero, for any of the co-actor's behaviors, would indicate that the actor is unaware that his co-actor has that option or believes there is no chance that he will use it. Estimates in any state are permitted to change during the course of interaction.

5. A *state transition matrix* which specifies which state follows each possible behavior outcome. Transitions are not probabilistic; if Actor 1 selects behavior i and Actor 2 behavior j, the next state will definitely be the state specified in row i and column j of the matrix. This next state may be either the same state, a state of deeper social interaction, or a state of lesser social interaction.

B. FORMAL BASIS OF INCREMENTAL EXCHANGE THEORY

The premises of incremental exchange theory can be stated as rules within the RELATE framework. These rules specify some processes or structures precisely and constrain others. They pertain to (1) an actor's decision-making procedures, (2) the array of potential payoffs and costs associated with his behaviors, (3) transitions across states, (4) the actor's consideration of the future, (5) his learning from past outcomes, (6) his estimation of the other's probable behavior, and (7) the termination of a relationship. These rules are formalizations of principles of incremental exchange theory.

[3] One of the problems with exchange matrices is that the behaviors available to an actor cannot depend on the co-actor's behavior choice. Yet in life they often do. If one member of a pair decides to walk away, the other cannot very well continue to talk to him. RELATE resolves this difficulty by using sequential state transitions to represent such dependencies. An actor may decide to talk to his co-actor at the same time his co-actor decides to depart. This leads the pair to a new state where conversation is impossible.

1. *Decisions*

The decision-making model is described in detail later; however, it is based upon three premises.

1.1. An actor chooses that behavior (from any given set of options) which maximizes a weighted sum of his own and his co-actor's expected payoffs for a fixed period of time into the future (his depth of search).

1.2. The weight accorded to the co-actor's payoffs increases with the depth of the relationship. At early stages, the other's payoffs receive insignificant weight; at later stages, increasing weight is accorded to the payoffs received by the co-actor.[4]

1.3. In making any particular decision, an actor considers payoffs from both current and potential future states. The relative weighting of the present and the future is determined by the discount he employs in his search strategy.

2. *Payoffs and Costs*

It is assumed that, as interaction deepens, payoffs increase in value and also in variability. So-called deeper states represent greater investment by the actors and greater potential payoffs than do earlier states. Furthermore, it becomes more costly to terminate the relationship at a later state than at an earlier state.

2.1. In deeper states the average immediate potential payoff for an actor is greater (more positive) than in shallower states.

2.2. In deeper states, the entries in an actor's payoff matrices have higher variability.

2.3. A fixed cost for initiating a behavior is associated with each behavior and the state in which it is exercised.

2.4. The cost of terminating a relationship increases with the increasing depth of the relationship.

3. *Transition Across States*

Interaction is not confined merely to one static matrix of behavior options and outcomes. The typical interpersonal relationship offers opportunities not only to repeat interaction within the same payoff matrix, but also to move forward in the relationship, to move backward, or to terminate the relationship entirely. Transitions from any given behavioral state depend upon the outcomes experienced in that state.

3.1. A transition is determined solely by the previous interpersonal state and the outcome arrived at through the actors' behavior in that state.

[4] Concern for a co-actor's outcomes may indeed by *chronologically* curvilinear. In other words, later in a relationship, when the partner is taken more for granted, the actor may easily become less concerned with his or her outcomes. In the present version of the theory, though, we assume that concern for a co-actor increases directly with depth of involvement.

3.2. Consider any two outcome cells, X and Y in $State_t$, where both actors' payoffs are higher in Cell X than in Cell Y. Any transition to a new state from the more positive Cell X must then be to at least as deep a state as the transition from the less positive Cell Y.

4. Consideration of the Future

At any given moment, an actor assesses the payoffs associated with the options then available to him. In this assessment, the other's probable behavior in the present and in future states is taken into account. Payoffs expected from future interaction with the other are weighted by a discount factor which is specified for the particular relationship.

4.1. An actor always searches out those outcomes to be expected within the present interaction state. In other words, he always examines all potential outcomes at the Depth of 1. Actors also may look into the future beyond the present state, searching to a Depth of 2, 3, 4, etc., according to their predisposition to seek out the future.

4.2. Present payoffs are worth 100% of their par value. Future payoffs are discounted to be worth from 0 up to 100% of par value.

If future states are discounted to 0%, the actor's depth of search is effectively equal to 1.

5. Estimating the Other's Probable Behavior

In any given state, the actor will possess expectations about his co-actor's likely behaviors.

5.1. An actor's subjective probabilities for his co-actor's behaviors depend initially on the actor's experience with comparable co-actors, and subsequently also on his learning from his experience with this particular co-actor.

6. Learning from Past Outcomes

In interpersonal relationships, actors frequently encounter each other in states that have been previously experienced.

6.1. If an actor selects behavior X in some state, then—if that state should recur—his co-actor will have increased his estimate of the relative probability of the actor's behavior X. The amount by which one actor increases his subjective probability of another's behavior after a single trial is his "speed of learning." Of course, in some relationships learning does not occur.

7. Termination of the Relationship

Thibaut and Kelley's exchange theory assumes that if a person's outcomes in a dyadic relationship fall below some critical point of comparison, he will leave the relationship (1959, p. 81). The following premise is consonant with that assumption.

7.1. An actor terminates a relationship if the expected payoff from a competing relationship minus the cost of terminating the current one exceeds the *expected payoff from the current relationship* by an amount sufficient to overcome the effect of past credits and debits.

In any situation being modeled, the RELATE program allows the theoretician freedom to specify exactly how past credits and debits shall affect termination. He can specify whatever function of credits and debits he wishes.

V. The RELATE Model

Having specified the premises of incremental exchange theory within the framework of the RELATE model, we can now elaborate the details of this model.

A. DECIDING ON A BEHAVIOR

The actors' decision processes are modeled with a tree searching optimization procedure developed by artificial intelligence researchers for intelligent game playing (Slagle & Lee, 1971). In any state an actor may consider (i.e., "look ahead") a specifiable number of decisions into the future. For each possible decision he might make, he must also consider all decisions his co-actor might make. These potential decision sequences can be represented as a tree that contains an enormous number of nodes if the actor looks ahead more than a few decision steps. For example, if four behaviors are available in every state, a look-ahead of five decision steps results in a tree with 4^{10} (over 1,000,000) sequences that would be considered.[5]

Our model assumes that, prior to selecting a behavior, each actor engages in a decision process that is *equivalent* to generating the tree of potential sequences representing a look-ahead of n decision steps. He then "backs up" the payoffs attainable to the top of the tree.

This backing up of payoffs is best viewed as assigning an outcome value to each node in the tree. An actor selects the behavior leading to the immediate node with the highest backed-up value.

The backing up of values from a set of nodes to their parent node is accomplished with recursive equations. Suppose Actor 1 is at a decision level in

[5] While the current RELATE model operates as though all people are maximizers, the RELATE framework is general enough that "satisficing" actors can be simulated too. Essentially, a RELATE actor wants a payoff at least as large as a parameter SAT. If he cannot find a payoff as large as SAT, he will settle for the best available. In the current version of RELATE the value of SAT is infinity; therefore, people behave as maximizers.

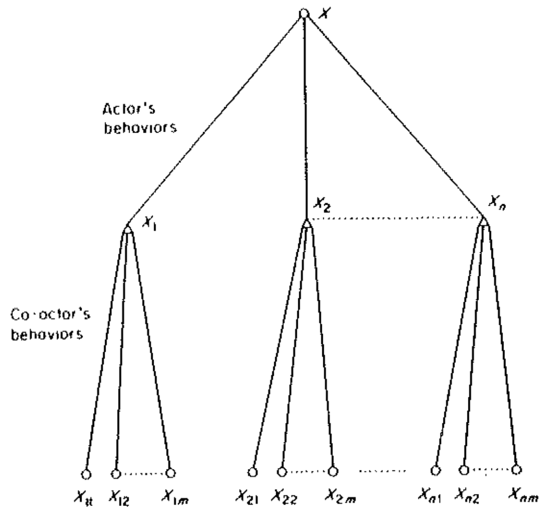

Fig. 1. Two levels of an actor's decision tree as modeled by RELATE. Node X represents one actor's decision point; nodes $X_1 \ldots X_n$ represent his co-actor's decision points for the same time; and nodes $X_{11} \ldots X_{nm}$ represent the actor's perceived decision points one step further ahead in time.

the tree attempting to determine the value of a particular node X. This situation is diagrammed in Fig. 1.

Let X be a node where Actor 1 makes a decision.

Let $X_1 \ldots X_n$ be X's daughter nodes (Actor 2 makes a decision at these nodes).

Let $X_{i1} \ldots X_{im}$ be X_i's daughter nodes (Actor 1 makes a decision at these nodes).

Let $V1\,(X)$ be the backed-up value of node X to Actor 1.

Let PAY 1 (X_{ij}) be the immediate payoff to Actor 1 associated with node X_{ij}.

Let d be the discount parameter for Actor 1.

Let L be the decision level in the tree. Accordingly, the values are backed up by equations:

$$V1\,(X) = \max V1\,(X_i) \qquad \text{for} \quad i = 1 \text{ to } n \tag{1}$$

$$V1\,(X_i) = \sum_{j=1}^{m} \left\{ [\text{PAY } 1\,(X_{ij}) + V1\,(X_{ij})] \cdot \text{Prob (Actor 2 choosing behavior leading from } X_i \text{ to } X_{ij}) \right\} \cdot d^{L} \tag{2}$$

The node X_{ij} is the same type of node as node X (i.e., Actor 1 to move) and its value would have been previously derived with the same recursive equations. It can be seen in Eq. (2) that an actor's payoff at node X_{ij} is the sum of his

immediate payoff at that node plus the backed-up value of future payoffs attainable from that node. At the deepest decision level, $L = N$,

$$V1\,(X_i) = \sum_{j=1}^{m} \left\{ \text{PAY } 1\,(X_{ij}) \cdot \text{Prob (Actor 2 choosing behavior leading from } X_i \text{ to } X_{ij}) \right\} \cdot d^{N} \tag{3}$$

This decision procedure is deterministic, not probabilistic. Probability plays a role in the model only insofar as each actor estimates the "probability" of his co-actor's actions at each time point (or node in the tree); transitions from state to state are fully determined by the outcomes. Thus, repeated executions of the program with any given set of data lead to precisely the same repeated result. This does not mean that one can easily predict how the model will behave. The simplest way to know the outcome of any given relationship is to execute the decision algorithm.

B. DISCOUNT

Future payoffs are discounted in this model by being multiplied by d^L, where d is a discount parameter and L is the number of decision steps forward from the current state. For the current state, $L = 0$; thus payoffs in the current state are always worth 100% of their point value. The discount parameter d indicates the degree to which future payoffs are considered to be either less or more attractive than their par value. If $d = 0$, then future payoffs are entirely ignored; if $0 < d < 1$, then future payoffs are worth less than current payoffs; if $d = 1$, future and current payoffs are weighted equally; if $d > 1$, then future payoffs are considered more valuable than current payoffs. For example, if the discount were .50, a payoff of "4" would be worth $.5^1(4) = 2$ at one step ahead, and $.5^2(4) = 1$ at two steps ahead, and so on.

C. DEPTH OF SEARCH

The depth of an actor's look-ahead is absolutely limited by a specific parameter provided to the decision algorithm; however, when the discount parameter is below 1, the practical limit on the depth of search will frequently be determined by the discount. For example, if d were equal to .20, very little would be anticipated from potential payoffs more than 2 steps in the future—i.e., $d^3 = .2^3$ is only .008—and possible payoffs any farther forward would be weighted even less.

D. LEARNING ABOUT THE CO-ACTOR

Our model is designed to allow each actor to alter his conception of his co-actor over the course of the interactions in two ways. First, every transition to a new joint state modifies the conceptions the actors have of each other. Moving to a new state not only may locate the actors' immediate behavior options in a new matrix with new payoffs, etc., but it permits them to look ahead to another set of nodes one step farther down the tree.

The second learning mechanism is more subtle. In selecting a behavior, each actor uses probability estimates for his co-actor's behaviors. The *initial* estimates for each state are put in as parameters of the model. However, on the basis of his actual experience in any state, the simulated actor will change his subsequent probability estimates of the other's behavior if he ever returns to that state. In other words, the behavior previously selected by the co-actor is considered more likely to be *repeated if the same state recurs in the future;* accordingly, the estimated probability for that behavior is increased and the estimates for the remaining behaviors are decreased proportionately. Hence, if $\text{Prob}_t\,(b_i, S)$ is the probability estimate of behavior b_i in State S at time t, and if b_i is selected then

$$\text{Prob}_{t+1}\,(b_i, S) = (1-\theta)\,\text{Prob}_t\,(b_i, S) + \theta \tag{4}$$

$$\text{Prob}_{t+1}\,(b_j, S) = (1-\theta)\,\text{Prob}_t\,(b_j, S) \qquad [\text{for } j \neq i] \tag{5}$$

where θ is the learning parameter, and where $0 \leqslant \theta \leqslant 1$.

F. WHAT THE MODEL DOES NOT SAY

Having specified the RELATE model in detail, it seems appropriate to make some disclaimers. First, the RELATE model is intended to be a general framework within which a variety of specific theories of dyadic interaction can be stated. Many aspects of the model remain to be elaborated and must be specified before any particular dyadic relationship can be simulated. However, these aspects are clearly revealed as a finite set of parameters, e.g., payoff matrices, transition matrices, learning rates. Furthermore, any subtheory stated within the RELATE framework must be consonant with the basic premises underlying RELATE.

Second, the RELATE model specifies some processes at a more detailed level than others. Eventually, one might describe each process in terms of simple information processing operations. At present that goal is beyond the realm of possibility. Thus, RELATE's description of social learning with a linear-incremental learning equation is a macroscopic approximation of more microscopic phenomena. One useful property of the RELATE model is that specific micro-structures can be substituted at any time without necessitating other changes in the model.

Third, while some of the rules of incremental exchange theory are certainly testable, others are neither verifiable nor falsifiable. For example, Rule 2.3, that fixed costs are associated with behaviors, is not testable because fixed costs

cannot be empirically distinguished from payoffs. Similarly, Rule 3.1, that a transition is determined solely by the previous state and the behaviors chosen, and Rule 4.1, that an actor always searches out all those outcomes to be expected in the present state, are hardly falsifiable. Such rules receive support on the basis of RELATE's overall predictive power. In contrast, rules such as 1.2, that the weight accorded to the co-actor's payoffs increases with the depth of the relationship, and 2.1, that in deeper states the average immediate expected payoff for an actor is greater than in shallower states, should be testable if depth can be operationally defined.

Finally, the RELATE model uses processes which are intended to be analogous but not necessarily identical to human decision-making processes. We do not assert that people have payoff matrices stored in memory for every state of a relationship or that they search through the tree of possible decisions as in chess; rather, we suggest that one can predict how people behave by modeling their decisions in this way.

People's memory structures and cognitive operations need not be identical to the model's, but they should be computationally analogous. Newell and Simon (1972), for example, have illustrated how people can quickly solve massive tree searching problems with heuristic techniques.

VI. Applications of the RELATE Model

In the remainder of the paper we will show how the RELATE model yields insights into four specific topics of dyadic interaction: altruism, interpersonal similarity, self-disclosure, and romantic involvement. In each of these areas, the model can make some testable predictions and serve as a heuristic for productive research. A heuristic is a "rule of thumb" that helps to guide one toward a solution to a problem or toward the truth about a phenomenon.

RELATE is a heuristic framework in that it enables us to generate hypotheses that might otherwise not be identified. It helps us locate the conditions under which a given phenomenon will occur, and to pinpoint the assumptions and parameter values required for its occurrence. For applications to sequential interaction, where empirical research is costly and difficult, a heuristic model is especially valuable for moving research into a productive direction.

VII. Altruistic Behavior

"Altruism" generally refers to one person's concern with an other (alter), as indicated by one's active assistance to the other at significant cost to the self. In this paper, altruistic behavior will refer to any action that has both of the following characteristics: (a) it yields the actor himself an immediate payoff lower than the maximum available to him, and (b) it gives his co-actor a payoff greater than the co-actor would receive if the actor selected his own maximal payoff. As Krebs (1970, p. 298) has pointed out, "the fact that man acts altruistically does not mean that he is altruistic"; altruistic actions do not necessarily confirm one's altruistic intent. Yet the occurrence of an altruistic act is of interest regardless of why it happens. For this reason we define an altruistic act solely in terms of assessed rewards and costs, even though others (e.g., Berkowitz, 1972a) have suggested that definitions of altruism should not ignore the subject's inner motivation.

The explanation of altruistic actions in two-person interactions presents a problem for any theory of social behavior that assumes humans try to maximize their personal gain. Concern for a co-actor's outcomes certainly does occur in deep interpersonal relationships (a man races into a burning house to rescue a member of his family, when he would not try to rescue someone he knows only superficially). Even in surface contacts, an actor is frequently guided by moral principles or social pressures to sacrifice personal gain (a driver will run off the road to avoid a strange child). However, in the absence of either a deep relationship or moral principle, it seems difficult to explain the occurrence of altruistic actions.

This difficulty may be seen another way. In early interaction states, two actors often have low payoff correspondence. Few of their behaviors yield equally satisfactory outcomes for both; there is a low correlation between their respective payoffs. Yet, for a relationship to deepen beyond surface contact, the actors must choose actions giving both of them desirable payoffs. If each individual tries to maximize solely his *own* current gain, outcomes with desirable payoffs for both actors seem unlikely. Yet actors do select altruistic acts, and outcomes do occur that have desirable payoffs for both actors.

A. EMPIRICAL RESEARCH ON ALTRUISM

Most research on altruism has unfortunately dealt with altruistic acts by strangers (Krebs, 1970). From these studies, it is difficult to draw conclusions about altruism in longitudinal interpersonal relations. Nevertheless, several findings are of interest. Daniels and Berkowitz (1963) found that subjects performed more altruistic acts for "supervisors" whom they were told they would like than for those they were told they would dislike. Apparently, the anticipation of liking someone increases one's altruism toward that person. Also, a co-actor who is perceived to be attractive is also perceived to be altruistic (Friedrichs, 1960). With a strange co-actor, though, two crucial variables in determining the occurrence of altruism have been the actor's belief that the co-actor will reciprocate and the actor's perception of the social norm (Goranson & Berkowitz, 1966; Frisch & Greenberg, 1968; Pruitt, 1968; Berkowitz & Friedman, 1967). Finally, a theme running throughout the research is that the anticipation of future interaction with the co-actor enhances the likelihood of altruistic behavior. All these findings are consonant with RELATE's predictions.

B. MODELING ALTRUISM VIA RELATE

The RELATE model can treat altruism in either of two ways. First, in accord with Rule 1.2, the RELATE actor weights the alter's payoffs to an increasing degree as the relationship between them deepens. Correspondingly, the actor's payoffs transcend his initial individualistic interests; they are affected by developments in the relationship and his behavior is thereby also affected. Thus the man who risks his life for a family member does so because he is deeply affected by the other's own payoffs. We refer to such actions as "true altruism."

Second, RELATE can account for altruistic behavior in shallow relations, where one's concern for alter's own payoffs is nil. Even when actors maximize purely their own gains, altruistic actions will occur if interaction is viewed in the longitudinal context of a continuing relationship rather than a static event. This second form of altruism may be labeled "self-seeking altruism."

a. Simulating self-seeking altruism. To demonstrate the occurrence of self-seeking altruism, we designed a two-actor relationship with five potential interaction states and two behaviors per state: an altruistic behavior and a nonaltruistic behavior. If both actors selected the altruistic behavior in any of these states, they would progress to the next deeper state of involvement. If either or both chose the nonaltruistic behavior, however, their relation would transit back to a lower state of involvement. In accord with a basic premise of incremental exchange theory (Rule 2.1), the deeper the mutual involvement represented by a state, the greater was its mean payoff. In every state, though, the nonaltruistic behavior had the greater immediate expected payoff. In game theory terms, we were considering a relationship consisting of an interconnected sequence of five Prisoner Dilemma states. Since our goal was to demonstrate that "altruistic" behavior could occur even when the actor does not consider his co-actor's payoffs, the actor's parameters were set so that he completely ignored his partner's payoffs in all five stages of involvement.

Following these principles, we constructed and simulated the relationship called Relationship I in Table I. The simulation began with the two actors in the second lowest state of involvement, State 2. Table I shows that if either actor selects the nonaltruistic behavior (NA) in State 2, the interaction moves into State 1, which contains less desirable payoffs for both actors. In contrast, repeated joint selections of behavior A, the altruistic choice, will successively

TABLE I

TRANSITION AND PAYOFF MATRICES FOR TWO RELATIONSHIPS USED TO SIMULATE THE OCCURRENCE OF ALTRUISM

	Actor's behavior	State 1[a] A	State 1[a] NA		State 2 A	State 2 NA		State 3 A	State 3 NA		State 4 A	State 4 NA		State 5 A	State 5 NA	
Prescribed transition from present state into next state (Co-actor's behavior)																
	A	2	1		3	1		4	2		5	3		5	4	
	NA	1	1		1	1		2	2		3	3		4	4	
Payoffs received by actor[b]																
Relationship I: Δ States[c] = 6.0; Δ Rows[d] = 10.0 (Co-actor's behavior)																
	A	4	26	11[e]	10	20	5	16	14	1	22	8	7	28	2	13
	NA	14	16	1	20	10	5	26	4	11	32	2	17	38	8	23
Relationship II: Δ States[c] = 5.0; Δ Rows[d] = 10.0 (Co-actor's behavior)																
	A	5	25	10	10	20	5	15	15	0	20	10	5	25	5	10
	NA	15	15	0	20	10	5	25	5	10	30	0	15	35	5	20

[a] In State 1, an *A–A* outcome leads forward to the matrix of State 2, while any other outcome leads to State 1 (see Fig. 2). This set of transition matrices applies to both Relationships I and II.

[b] The co-actor's payoffs are given by the symmetric matrix.

[c] "Δ States" is the difference in expected payoffs between each row of each state and the same row in the next deeper state of mutual involvement.

[d] "Δ Rows" is the difference in expected payoffs between the two rows of each payoff matrix.

[e] The marginal numbers refer to the actor's expected values from Responses A and NA, respectively, when he has no information about the co-actor's probable response.

lead to states of deeper interaction: to States 3, 4, and 5. In this series, State 5 is conceived to be the deepest state of pair involvement. Figure 2 shows the state transitions possible in this relationship.

b. Results. The output from the simulation of Relationship I is shown in Table II and diagrammed in Fig. 3. The parameter settings for this simulation are shown in Table II. The actors began interacting in State 2 and both chose the "altruistic" behavior. Hence, they moved into the next deeper state of involvement, State 3. Here they also selected altruistic behaviors. They progressed to State 4, selected the altruistic behaviors again, and progressed to the fifth and deepest state. Here, though, both chose the nonaltruistic alternative and re-

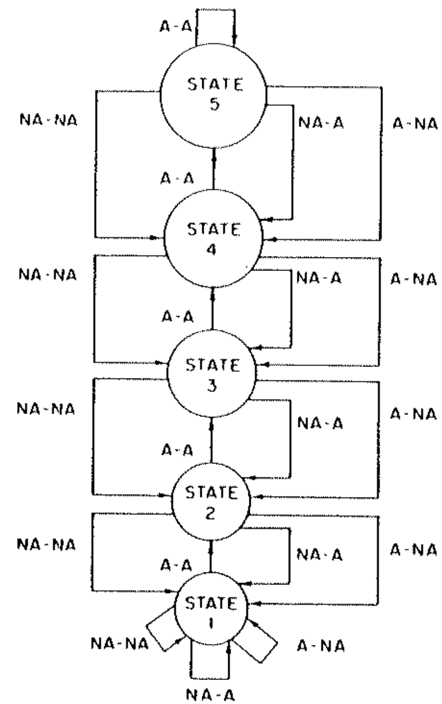

Fig. 2. State transition diagram for all relationships used to simulate self-seeking altruism. (See Table I.)

turned to State 4. From then on, the interaction alternated between States 4 and 5, altruistic behavior always being selected in the fourth state and nonaltruistic in the fifth state.

Why did this happen? In States 2, 3, and 4, the greater potential payoffs in the deeper states were sufficient to induce a self-seeking actor to behave altruistically so that he could reach deeper involvement and the possibility of higher payoffs. But in State 5 no further progress to a deeper state was possible; the actors found it more profitable therefore to select the immediately gratifying nonaltruistic alternative.

Does this simulation imply that two people in a dyadic interaction will behave altruistically until they reach a point where deeper involvement cannot be achieved? Perhaps this will happen in some situations. But it is more likely that by the time no deeper involvement can be achieved, each actor will have begun to weight his co-actor's payoffs and true altruism will occur. (In this simulation, no such weightings have been employed.) The RELATE model does

TABLE II
SUMMARY OF THE SIMULATIONS OF RELATIONSHIPS DIAGRAMMED IN FIGURE 2 SHOWING WHEN THE ACTORS ARE ALTRUISTIC

State	EV(A)[a]	EV(NA)[a]	ΔEV[a]	Actor's[b] behavior	Actor's immediate payoff	Actor's cumulative payoff
Relationship I (Δ States = 6.0, Δ Rows = 10.0)						
2	3.00	1.00	2.00	A	10	10
3	22.50	13.00	9.50	A	16	26
4	46.00	37.00	9.00	A	22	48
5	62.50	64.00	−1.50	NA	8	56
4	46.00	37.00	9.00	A	22	78
5	62.50	64.00	−1.50	NA	8	86
4[c]	46.00	37.00	9.00	A	22	108
Relationship II (ΔStates = 5.0, Δ Rows = 10.0)						
2	3.75	5.00	−1.25	NA	−10	−10
1	−7.50	0.00	−7.50	NA	−15	−25
1	−7.50	0.00	−7.50	NA	−15	−40
1[c]	−7.50	0.00	−7.50	NA	−15	−55

[a]The second and third columns show the backed-up expected values (EV) for altruistic and nonaltruistic behavior, respectively. The fourth column contains the difference between columns 1 and 2 which governs the choice of behavior in that state; positive differences lead to A choices, and negative differences lead to NA choices.

[b]Since all parameters were set at identical values for both actors in these simulations (Discount = 1.0, Depth of Search = 5, Initial Probability Estimates = 50/50, and Learning Rate = 0.0), the co-actor always chose the same behavior as the actor.

[c]In both of these simulations RELATE's termination routine was inhibited, and the simulations were stopped by the experimenter.

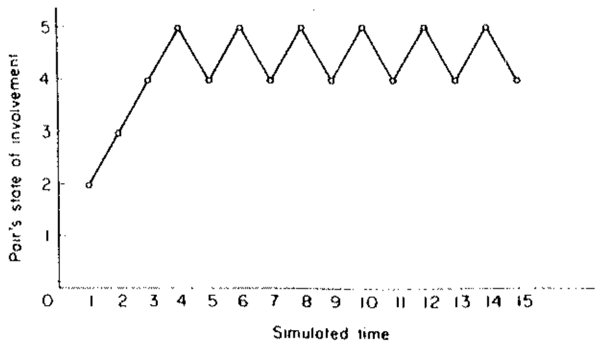

Fig. 3. The pattern of state transitions observed in simulating Relationship I of Table I. (See Table II.)

assert that altruistic acts can occur in shallow interactions without either actor caring about the other's rewards, simply because such acts further the self-seeker's efforts to reap the benefits of deeper involvement.[6]

As one would expect from a heuristic theory, these results suggest more questions than they answer. What types of actors would be most likely to display self-seeking altruism? In what situations would self-seeking altruism be most likely to occur? Rewards in future states must obviously be higher, but how much higher? What influence does the actor's estimate of his co-actor's probable behavior have upon his own decision? How will the actor's propensity to be altruistic change as he gains experience with his co-actor? While empirical data are lacking, the RELATE program can be used to derive some predictions.

c. *Payoff matrices.* In order for an actor to choose an altruistic behavior, the increments in his payoffs between the current state and the next state reached as a result of the act must be large enough to overcome the advantage in immediate payoffs for the nonaltruistic act. But how great must the increment be? In Relationship I this increment, called Δ States, was 6.0; self-seeking altruism occurred when Relationship I was simulated. In contrast, Relationship II in Table I had a Δ States of only 5.0; here self-seeking altruism did not occur. In Relationship II, the increment between states was not sufficient to overcome the immediate advantage of one's nonaltruistic action, but on all other parameters Relationship II was identical to Relationship I.

Mathematical analysis of RELATE's decision algorithm suggests that the occurrence of self-seeking altruism does not depend on any other characteristics of the payoff matrices than the increment in mean payoffs across states (Δ States) and the difference in mean payoffs between the altruistic and nonaltruistic rows of the matrices (Δ Rows). Additional simulations have verified that the relative values of Δ States and Δ Rows completely determine whether or not self-seeking altruism occurs, as long as the actors are not "learning" about each other (θ = 0). If Δ Rows and Δ States remain constant, the entries in the matrices can be altered in any manner without affecting the outcome of the simulation. Figure 4 shows which values of Δ States and Δ Rows will produce self-seeking altruism under the parameter settings used in Table I—that is, when the actors (a) are not learning anything from the other's behavior ($\theta = 0$); (b) are searching five steps into the future; and (c) are not discounting the future (d =

[6] Analogies to the international arena are readily imaginable. It is not uncommon for self-seeking international actors to engage in overtly altruistic actions in order to build deeper nation-to-nation involvements (e.g., trade relationships) that return ample benefits. Even Berkowitz's (1972a, p. 65) notion of an individual's "selfless action on behalf of others" based on "internalized standards of conduct" reverts *ultimately* to the actor's own benefit. For one learns early in life that one's generous actions create a healthy interpersonal climate, contributing to a wholesome society which in turn rebounds to the benefit of the actor himself.

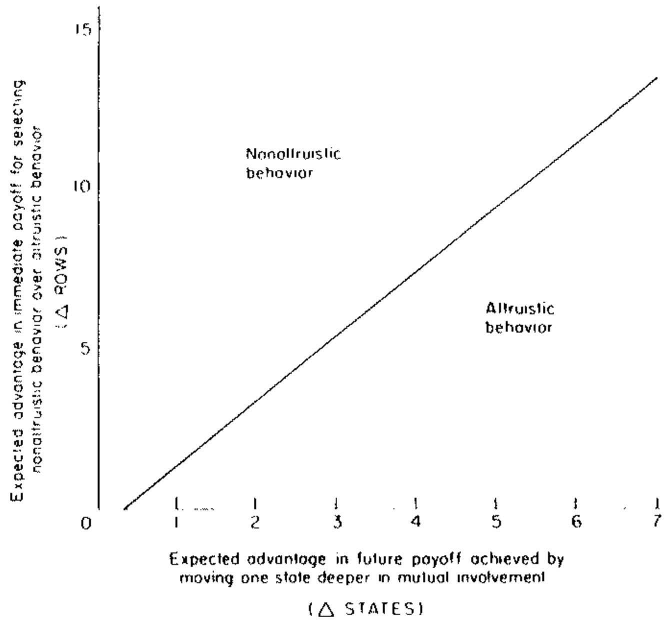

Fig. 4. The occurrence of self-seeking altruism as a function of differences between current and future payoff matrices.

). The slope of the indifference line separating the altruistic from the non-altruistic region was ascertained through computer simulation.

From the RELATE model one can conclude that, no matter how much the immediate cost of being altruistic is increased, a person will behave altruistically if his payoffs in deeper states of involvement are incremented in proportion to the slope of the indifference line. Furthermore, the actor should not care about the exact distribution of his payoffs as long as his expected payoffs in deeper states are incremented sufficiently. Finally, neither the distribution nor the expected values of his co-actor's payoffs should affect his choice of behavior.

d. Depth of search and discounting. Mathematical analysis of RELATE's decision algorithm also revealed that either decreasing an actor's depth of search into the future or increasing his discount for future payoffs will decrease the slope of his indifference line. For example, if the depth of search were reduced from 5 to 2, the slope of the indifference line in Fig. 4 would be reduced from 2 to .5. In other words, the less the actor looks ahead, and the more he discounts the future of the relationship, the less altruistic will be his present behavior. However, no matter how little he discounts the future or how deeply he

examines it, he will not behave altruistically if outcomes of future states are less rewarding than those found in current states.

e. Estimates of the co-actor's probable behavior. Figure 5 shows the results of another set of simulations. They indicate that the more likely an actor thinks it is that his co-actor will behave altruistically, the more likely he is to behave similarly. Such a finding is the opposite of what a self-maximization model predicts for a *static* mixed-motive payoff matrix of this type (a Prisoner's Dilemma matrix; see Gallo and McClintock, 1965). RELATE predicts that, in a series of situations of this sort, a person will tend to be altruistic.

f. Effects of learning about the co-actor. So far, our discussion of altruism has been limited to situations in which actors learn nothing about each other ($\theta = 0$). What happens in the more realistic situation where each actor learns to change his view of the co-actor's probable behavior?

To answer this question, some of the previous relationships were simulated at two different rates of learning ($\theta = .20$, and $\theta = .50$). The actors' ***initial***

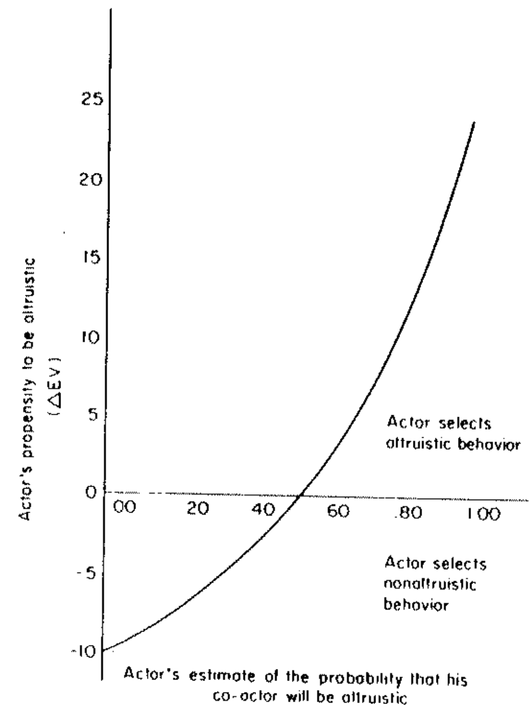

Fig. 5. An actor's propensity to behave altruistically as a function of his estimate that his co-actor will behave altruistically.

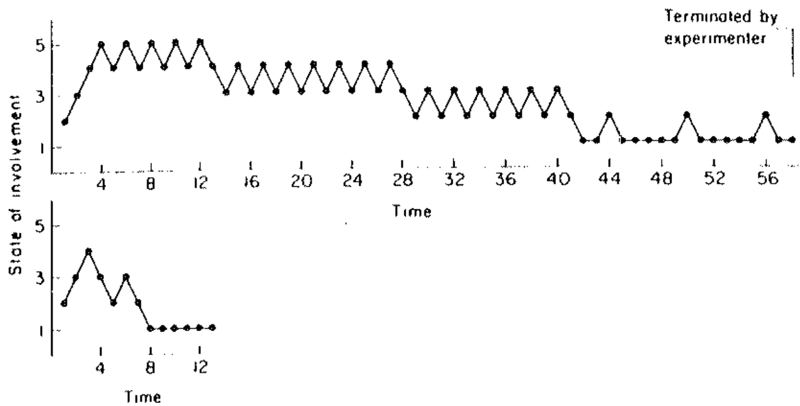

Fig. 6. The pattern of state transitions observed in simulating two variations of Relationship I. The upper graph is the output from simulating a pair of slow learners (θ=.20); the lower graph is the result from a simulation of fast learners (θ=.50).

behaviors remained exactly the same as when no learning (θ = 0) had been permitted. Their initial actions were still determined completely by the association between current and future payoffs shown in Fig. 4. However, the learning rate greatly affected what eventually happened in these relationships. Results of nine simulations at different rates of learning are summarized in Table III, and two of the runs are shown in detail in Fig. 6. Each simulation was terminated when it reached a "steady state," that is, when the relationship cycled in one or two states and the probability estimates had converged to 1.0 or 0.0.

As Table III indicates, a pair whose members rapidly (θ = .50) change their estimates of each other's probable behaviors is less likely to reach a steady state of mutual involvement than a pair that learns more slowly. Apparently, learning quickly that one's co-actor will be altruistic at a shallow level of involvement removes some of an actor's incentive to be altruistic in order to advance to a deeper level. This result can explain the empirical finding that altruistic acts considered inappropriate to a pair's level of involvement are less likely to be reciprocated than ones that are (Kiesler, 1966; Schopler & Thompson, 1968).

C. THE UTILITY OF ALTRUISM

In a world where self-seeking is advocated by many "successful" persons in public life, there is an inclination to deride various forms of helpfulness. Practical men view altruism as soft-headed. "Irrational" is a label applied to Biblical injunctions such as "Love thy neighbor as thyself." As our practical world careens from one crisis to another, however, the limits of self-seeking interpersonal relations become increasingly visible.

TABLE III
LEVELS OF INVOLVEMENT WHEN RELATIONSHIPS REACH "STEADY-STATE"[a] AS A FUNCTION OF THE ACTORS' LEARNING RATE AND PAYOFF MATRICES

Payoff matrices[b]		Learning rate			
		θ = .20		θ = .50	
Difference in column sums	Difference in diagonal sums	Final steady-state[a]	Time to steady-state	Final steady-state	Time to steady-state
−8	12	State 4–State 5	21	State 4–State 5	14
0	12	State 4–State 5	21	State 4–State 5	14
+8	12	State 4–State 5	21	State 4–State 5	14
−8	30	State 4–State 5	21	State 1	19
0	30[c]	State 4–State 5	26	State 3–State 4	19
+8	30	State 4–State 5	25	State 3–State 4	13
−8	48	State 1	57	State 1	13
0	48	State 4–State 5	28	State 2–State 3	12
+8	48	State 4–State 5	21	State 2–State 3	12

[a]Steady-state was reached when the relationship settled in a single state or a cyclical pattern of transitions was established and the actor's probability estimates approached unity so no further learning was possible.

[b]In all these relationships the difference in expected values between rows (Δ Rows) was 10 and the difference between states (Δ States) was 6, the same as Relationship I of Table I.

[c]This is Relationship I.

The RELATE model is one attempt to provide a rational solution to this issue. Its focus is purely on dyads, but the pair may serve as the prototype for analyzing more complex relationships. By showing how others' payoffs can be weighted into own payoffs, and by demonstrating a technique for assessing the consequences of own behavior, RELATE suggests ways in which humans can optimize interpersonal functioning. The demonstration is, of course, entirely artificial, but the model suggests how social theory may help bridge the gap between "practical self-interest" and "true altruism."

Consider, for instance, the simulation shown in Fig. 3. Under the payoff conditions of Relationship I (see Table I), altruistic behavior was the actor's rational choice whenever the pair was located in States 1 through 4, but not in

State 5 (the highest possible state in this simulation). Pure self-interest dictated that an actor choose cooperation, an immediate self-sacrifice, in order to reach the potential higher payoffs in future states. Having reached the maximum, though, self-interest required a noncooperative choice; Fig. 3 therefore shows that later interaction between these two self-seekers cycles indefinitely between States 4 and 5. In living relationships, though, partners do continue to act altruistically in later states, for they increase the weight of the other's payoffs in considering their own payoffs. Thus RELATE demonstrates the insufficiency of mere self-seeking and the importance of concern for one's co-actor for maintaining a deeper relationship.

VIII. Similarity and Attraction

It is beyond the scope of this paper to review research on similarity and dyadic interaction. The weight of evidence indicates that there is a positive association between attraction to a stranger and his perceived similarity in attitudes, values, or other characteristics (Byrne, 1971). For long-term interpersonal relationships, there is also evidence of a positive association between attraction and *perceived* similarity (Curry and Emerson, 1970; Levinger and Breedlove, 1966; Newcomb, 1961). The evidence is weaker concerning the association between attraction and *actual* pre-acquaintance similarity (Curry & Kenny, 1974; Levinger, 1972).

Levinger and Breedlove (1966) suggested that actual similarity (or agreement) would correlate with attraction only to the extent that such similarity promotes the achievement of a pair's interpersonal goals: "The more that agreement is *instrumental* for furthering the goals of the . . . relationship, the higher should be the correlation with . . . satisfaction" (p. 368). Neither their study nor subsequent research has yet succeeded in explaining what sorts of actual similarity are generally instrumental. The RELATE model, however, can help delimit our search for the sort of actual similarity most likely to further the development of dyadic relations.

To model the effect of similarity, we will first define "similarity" unambiguously in the language of RELATE. In what different ways can RELATE actors be similar? Two actors can display varying degrees of similarity on any of the variables defining them: on behavior options, behavior costs, estimates of the co-actor's probable behavior, discounting of the future, learning rates, or payoff matrices. The difficulty is to decide what similarity shall mean in terms of these parameters.

Similarity has generally been measured by agreement on a set of attitude questions and/or sameness on socio-cultural, physical, or intellectual traits.

Within the RELATE model, it is necessary to distinguish between similarity on *permanent traits* not under behavioral control and similarity manifested in *behavior preferences*, e.g., political attitudes, moral principles, or recreational preferences. While a co-actor's permanent traits may be important for affecting an actor's payoffs, those characteristics are not under the co-actor's control. The subtheory used to construct the initial payoff matrices would take account of each actor's traits in determining payoffs. For some people and for some traits, the more desirable characteristic in a co-actor will be identical to the actor's own characteristic. For other people and other traits this will not be true. In either case, trait similarity only determines the initial values placed in the payoff matrices representing a relationship.

Similarity of *behavior preferences*, on the other hand, directly affects the outcome of a RELATE interaction. Here, the RELATE framework forces us to recognize two different types of similarity in behavior preferences: *symmetry* and *payoff correspondence*. These two types of similarity can be illustrated with an example. (a) Suppose the payoff John receives from giving a present to Susan is the same as the payoff Susan receives from giving a present to John. Obviously, John and Susan are similar in their feelings about giving presents to each other. This type of similarity represents *symmetry* between John's and Susan's payoff matrices. (b) In contrast, suppose that John gains the same payoff from *receiving* Susan's present as Susan gets from *giving* the present. Here the two actors are similar in their feelings about Susan giving John a present. This type of similarity is represented by similar payoffs for the two actors within one cell of the payoff matrix. In other words, the payoffs in the cell for Susan giving and John receiving are the same for both actors. This type of similarity will be called *payoff correspondence*.

What does the RELATE model predict about these two types of similarity? The model predicts that payoff correspondence is directly relevant to whether or not a relationship deepens, but that symmetry is not. In particular, the greater the payoff correspondence among cells in a state, the greater are the chances that the pair will progress to the next deeper state of involvement.

To see why payoff correspondence affects the development of a relationship and symmetry does not, let us look at the example in Table IV. Three 3×3 payoff matrices are shown. For both actors, and in all three cases, the average immediate payoff for each behavior is 5.0. However, Matrix A has perfect payoff correspondence; Matrix B has perfect symmetry; Matrix C has neither, although some degree of symmetry and payoff correspondence occurs in any matrix. As a function of the actors' behaviors, let us allow transitions from the present state of the relationship to states up to two levels of involvement deeper and one level shallower. The transition matrices must be constructed to obey Rule 3.2. The following directions will accomplish this:

TABLE IV: MATRICES FOR SIMULATING THE EFFECTS OF SIMILARITY ON DYADIC INVOLVEMENT

Inputs — Payoff matrices[a] (Co-actor's behaviors; each cell: number above diagonal \ number below diagonal)

Actor's behavior	A Perfect corresp.				B Perfect symm.				C Neither			
	4 \ 4	3 \ 3	8 \ 8	5.0	4 \ 4	3 \ 9	8 \ 2	5.0	4 \ 2	3 \ 9	8 \ 4	5.0
	9 \ 9	5 \ 5	1 \ 1	5.0	9 \ 3	5 \ 5	1 \ 1	5.0	9 \ 7	5 \ 5	1 \ 3	5.0
	2 \ 2	7 \ 7	6 \ 6	5.0	2 \ 8	7 \ 1	6 \ 6	5.0	2 \ 6	7 \ 1	6 \ 8	5.0
	5.0	5.0	5.0		5.0	5.0	5.0		5.0	5.0	5.0	

Outputs — Backed-up expected payoffs (immediate + future)[c] (Co-actor's behaviors)

Actor's behavior	A Perfect corresp.				B Perfect symm.				C Neither			
	5 \ 5	4 \ 4	10 \ 10	6.3	5 \ 5	4 \ 10	8 \ 2	5.7	4 \ 2	4 \ 10	9 \ 5	5.7
	11 \ 11	6 \ 6	0 \ 0	5.7	10 \ 4	6 \ 6	0 \ 6	5.3	11 \ 9	6 \ 6	0 \ 2	5.7
	2 \ 2	9 \ 9	8 \ 8	6.3	2 \ 8	6 \ 0	8 \ 8	5.3	2 \ 6	6 \ 0	8 \ 10	5.3
	6.0	6.3	6.0		5.7	5.3	5.3		5.7	5.3	5.7	

Inputs — State transition matrices[b] (Co-actor's behaviors)

Actor's behavior	Perfect corresp.			Perfect symm.			Neither		
	+1	+1	+2	+1	+1	0	0	+1	+1
	+2	+1	-1	+1	+1	-1	+2	+1	-1
	0	+2	+2	0	-1	+2	0	-1	+2

Outputs — Frequency of occurrence of outcomes (Co-actor's behaviors)

Actor's behavior	Perfect corresp.			Perfect symm.			Neither		
	+1	+1 50%	+2	+1 100%	+1	0	0 25%	+1	+1 25%
	+2	+1	−1	+1	+1	-1	+2 25%	+1	-1 25%
	0	+2 50%	+2	0	-1	+2	0	-1	+2

[a]The number above the diagonal in each square is the co-actor's immediate payoff and the number below the diagonal is actor's immediate payoff. The marginals are an actor's expected immediate payoff for each behavior under the assumption that each of the co-actor's behaviors are equally probable.

[b]The numbers in the transition matrices represent transitions to states of deeper mutual involvement (+1 and +2), to states of less involvement (−1), and to the same state (0). The text describes how these transitions were selected in accordance with the rules of incremental exchange theory (e.g., Rule 3.2).

[c]The discounted, expected future payoffs in the states to which the pair could transit were given by the numbers on the transition matrices (this satisfied Rule 2.1 of incremental exchange theory). Therefore, the backed-up expected payoffs are the sum of the immediate payoffs and the transition numbers.

> If both actors' payoffs > 5, then move to $State_{t+2}$;
> if both actors' payoffs > 2, then move to $State_{t+1}$;
> if both actors' payoffs > 1, then stay in $State_t$;
> otherwise, move to $State_{t-1}$;

Transition matrices constructed according to those directions are shown below the payoff matrices in Table IV. Note that there are many more opportunities to advance deeper from the state of perfect payoff correspondence (Matrix A). Furthermore, in all three matrices, the cells which lead to deeper states are cells with high payoff correspondence.

What are the chances that the actors will select behaviors which lead to a +2 transition? Since both actors look ahead, and higher payoffs occur in those future states reached by +2 transitions, the expected gain associated with a cell is increased when it has a +2 transition. In the illustrative matrices of Table IV, we have used the transition numbers −1, 0, +1, and +2 as the discounted expected future payoffs associated with transitions. Adding these expected future payoffs to the expected immediate payoffs gives the values in the third set of matrices in Table IV for the backed-up expected payoffs.

If we examine these total expected payoffs, we can see which behaviors the actors would choose. The percentages in the cells of the final set of matrices in Table IV indicate the expected frequency of each dyadic choice. Thus the perfectly correspondent state has a 50% chance of being followed by the +1 state and a 50% chance of being followed by the +2 state. The perfectly symmetric state offers no chance of any +2 transition, but certainty of +1 transition. Matrix C offers an equal 25% chance of being followed by either the same state or states −1, +1, or +2 levels different from the current one.

This example has shown analytically why high payoff correspondence is the type of similarity that is most likely to advance an interpersonal relationship. Comparable analyses will assist future empirical studies on the effects of similarity on attraction. A practical problem will be to specify real world payoff correspondence on the basis of predictive rather than post hoc criteria.

IX. Self-Disclosure

A common characteristic of social relationships is reciprocal disclosure of feelings and personal information. Jourard (1971) has outlined many of the factors affecting disclosure and proposed that *reciprocity* is central to disclosure in dyads. Altman (1973) has reviewed the variations on this theme, and concludes that

> For the most part, conceptualizations have been vague, point to the phenomenon as fairly universal, say little about factors which may accelerate or slow down its occurrence, and only grossly identify potential underlying mechanisms. (p. 251)

TABLE V

A SIMULATION OF SELF-DISCLOSURE IN FOUR HYPOTHETICAL RELATIONSHIPS

		Inputs						Outputs[a]				
		Actor's immediate payoff matrix		Immediate transition matrix		Actor's expected future payoffs		Actor's total expected payoffs (immediate + future)				
						New state	Payoff	Derived payoff matrix		Expected payoffs		
Strangers		Co-actor's behavior[b]						Co-actor's behavior		Actor's estimate of probability of co-actor disclosing		
		ND	D	ND	D			ND	D	0%	50%	100%
Actor's behavior[b]	ND	0	2	1.0	1.0	1.0 No further contact:	0	0	2	0	1	2
	D	1	3	1.0	1.0			1	3	1	2	3
	D-ND							1	1	+1	+1	+1
Acquaintances		Co-actor's behavior						Co-actor's behavior		Actor's estimate of probability of co-actor disclosing		
		ND	D	ND	D			ND	D	0%	50%	100%
Actor's behavior	ND	0	2	2.0	2.1	2.0 Continuing friendship:	4	4	8	4	6	8
	D	1	3	2.2	2.3	2.1 Actor gets added power:	6	5	13	5	4	13
						2.2 Co-actor gets added power:	6					
	D-ND					2.3 Greater friendship:	10	9	5	9	2	+5
Friends		Co-actor's behavior[b]						Co-actor's behavior		Actor's estimate of probability of co-actor disclosing		
		ND	D	ND	D			ND	D	0%	50%	100%
Actor's behavior	ND	0	2	3.0	3.1	3.0 Continuing friendship:	10	10	14	10	12	14
	D	1	3	3.2	3.3	3.1 Actor gets added power:	12	5	23	5	14	23
						3.2 Co-actor gets added power:	4					
	D-ND					3.3 Greater intimacy:	20	5	9	5	+2	+9
Intimates		Co-actor's behavior						Co-actor's behavior		Actor's estimate of probability of co-actor disclosing		
		ND	D	ND	D			ND	D	0%	50%	100%
Actor's behavior	ND	0	2	4.0	4.0	4.0 Continuing intimacy:	20	20	22	20	21	22
	D	1	3	4.0	4.0			21	23	21	22	23
	D-ND							1	1	+1	+1	+1

[a]The derived payoff matrix is computed by adding the immediate payoff to the expected payoff in the resulting future state. The total expected payoff is then calculated from this matrix for each of three probability estimates by the actor.

[b]ND, no self-disclosure; D, self-disclosure.

Altman (1973) goes on to propose a theory integrating two ideas: (1) that reciprocity is a social norm, and (2) that disclosure is rewarding to both discloser and recipient. At shallow stages of involvement, social norms play a primary role in disclosure while at deeper stages the positive outcomes associated with disclosure play the more important part. As Rubin (1974) has pointed out, one interesting characteristic of disclosure concerns the surprising degree of intimacy that people often display in disclosures to strangers. Altman's theory predicts that *reciprocity* of disclosure will be high among strangers, but only for non-intimate topics. Reciprocity of intimate disclosure of topics will peak at moderately deep levels of involvement and be least at both the shallowest and deepest ends according to his theory.

What assumptions must be made within the incremental exchange framework to yield parallel predictions about dyadic disclosure? The central assumption is that the act of self-disclosure in the short run is rewarding to the discloser, even if it is not reciprocated by the recipient. Given this premise, reasonable assumptions about actors' payoffs can produce a RELATE simulation that accords well with observed data.

In considering predictions about self-disclosure, one must remember that predictions pertain only to average behavior; innumerable situational and interpersonal variables will affect the actual occurrence of disclosure. Further, among the several different aspects of disclosure one must be careful to specify the dependent variable. Shall one try to predict, for example, the frequency of an actor's disclosure, the intimacy of disclosures that do occur, or the likelihood that a particularly intimate item will be disclosed? Or is one making predictions about a dyad's tendency toward reciprocation?

Using the RELATE framework, we will model predictions about one actor's preference for self-disclosure over nondisclosure, and about the payoffs he receives from disclosure. Table V presents the matrices we constructed for several hypothetical cases. Four levels of mutual involvement are represented: (1) strangers, (2) acquaintances, (3) friends, and (4) intimate companions. The *immediate* payoffs for disclosure are the same at each level of involvement; disclosure is assumed to have a slightly positive payoff, higher than for nondisclosure whether or not the co-actor reciprocates. The transition matrices and expected payoffs for future states are constructed in accordance with the rules of incremental exchange theory, and are also based on assumptions about the potential structure of payoffs and costs that would follow from either disclosure or nondisclosure. The transitions prescribed in Table V reflect our assumption that neither stranger nor intimate relationships are much changed by particular instances of disclosure, while acquaintanceships and friendships may be affected substantially.

Strangers. At this minimal level of involvement, there is no significant prospect for future interaction. Hence the immediate payoff constitutes the only payoff that an actor considers. Table V suggests that disclosure is slightly preferred over nondisclosure, although expected payoffs are low no matter what the actor believes will be done by his co-actor.

Acquaintances. If two people see each other repeatedly, the situation is different; they seriously consider payoffs in future states. A RELATE actor evaluates the state that would result if he discloses intimate information and his co-actor does not. If that happens, the co-actor obtains power, which he may use to the actor's potential harm. Such an eventuality would contain potentially high negative payoffs. Unless the probability of reaching that state is perceived to be low, its negative payoffs overcome the slightly positive immediate payoffs for disclosure; thus nondisclosure seems preferable.

Table V suggests that acquaintances prefer nondisclosure unless they believe that their disclosure will be reciprocated. On the average, there is a preference for nondisclosure. If reciprocal disclosure is believed rather likely, however, the actor will make disclosures. Reciprocation does yield much higher payoffs than it does for strangers, since it tends to move acquaintances toward friendship.

Friends. What happens when acquaintances have moved deeper toward friendship? At this point, the other's nonreciprocation is less threatening, since an actor does not fear that a friend will hurt him. Furthermore, potential future payoffs from reciprocal disclosure are now larger, since reciprocation strengthens friendship ties. Consequently, unless one believes that the friend is almost certain *not* to reciprocate, one is prone to disclose intimacies to a friend. Table V suggests that preferences for self-disclosure will be quite strong if reciprocation from a friend is believed likely, much stronger than for strangers or acquaintances; payoffs will also be much greater. Such outcomes depend, of course, on both actors' beliefs that the other is likely to reciprocate and that deeper involvement with their friend will be highly rewarding. If either actor does not wish deeper involvement, or if either believes that the other is unlikely to disclose intimacies, the pair will not progress beyond this point in their relationship.

Intimates. Finally, let us consider a deeply involved pair. In reaching their current interpersonal state, the partners have previously engaged in many intimate disclosures; each member has learned much about the other. Each member possesses much power over the other. It appears, then, that single acts of nonreciprocation now possess little significance, for both members already know very much about each other. Accordingly, current outcomes are dictated primarily by immediate payoffs for disclosure. Table V therefore suggests that intimate companions will slightly prefer disclosure over nondisclosure, but the difference is no greater than that held by strangers. However, the absolute value of either act is far greater than in less intimate relationships.

The above predictions are summarized in Fig. 7. One curve shows an actor's gains from choosing disclosure over nondisclosure; the other curve plots the expected value of disclosure. These predictions are derived from the rules of incremental exchange theory, from the premise that on the average self-disclosure itself has an immediate positive payoff for both discloser and recipient, and from other assumptions about payoff levels and transitions that follow from varying outcomes. Other assumptions could, of course, lead to quite different predictions. While there are insufficient longitudinal data to test these RELATE predictions empirically, it appears that they describe existing findings as well as any other theory.

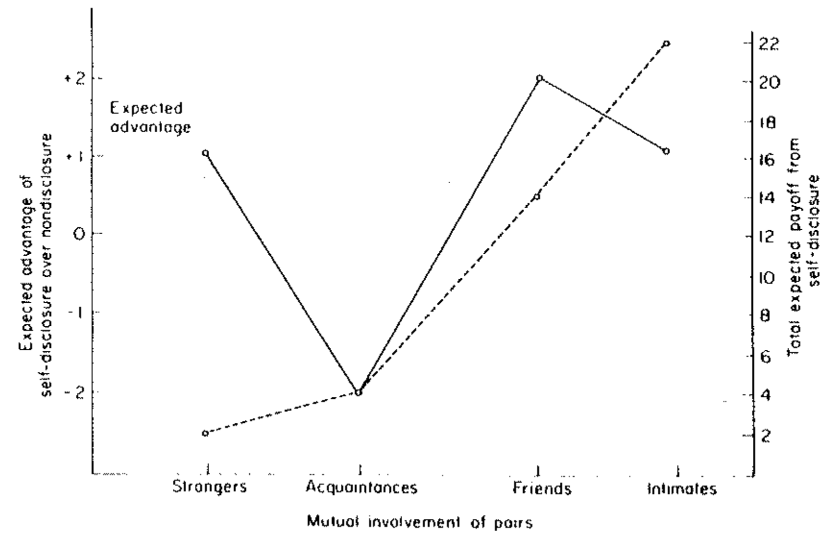

Fig. 7. The model's predictions about an actor's gain from self-disclosure to his co-actor as a function of their level of involvement.

X. Romantic Involvement

One fascinating longitudinal relationship is a romantic involvement. We have discussed some processes relevant to such an involvement, but many other processes also affect its course. It is not possible to compare a simulation of romantic involvement with parallel empirical data, because adequate longitudinal data do not exist. Data that do exist pertain mainly to initial interactions between potential romantic partners (see Berscheid & Walster, 1974), or to data from longer relationships collected at time points that are months apart (see Levinger, Senn, & Jorgensen, 1970).

To simulate the development of a romantic involvement via the RELATE

TABLE VI
STATES AND BEHAVIORS IN THE SIMULATION OF ROMANTIC INVOLVEMENT

State	Behavior options (for either person)
1. Meeting	1. Initiates a friendly interaction with other. 2. Responds warmly. (Adopts a warm stance toward other person.) 3. Responds coolly. (Adopts a cool stance toward other.)
2. Request	1. Asks for a date. 2. Takes a warm stance toward other. Says "yes" if other asks for a date. 3. Seems cool toward other. Says "no" if other asks for a date.
3. Begin dating	1. Actively communicates liking for the other person. 2. Nonverbally (i.e., nonexplicitly) communicates liking for the other person. 3. Nonverbally communicates *dis*liking for the other person.
4. Disclosure	1. Makes very intimate disclosures. Shows great interest in hearing other's disclosures. 2. Makes only moderately intimate disclosures. 3. Does not volunteer personal self-disclosure and expresses only polite interest in other's disclosures. 4. Expresses clear disinterest in either making or hearing disclosures.
5. Romance	1. Actively tries for deepening romantic involvement. Wants to see the other more often. 2. Takes a positive stance toward other. Responds warmly. 3. Accepts present involvement but does not want any deepening of romantic involvement. 4. Dislikes present involvement. Expresses rejection of the other person.
6. Sex	1. Initiates sexual behavior more intimate than one's own usual standard. 2. Accepts sexual behavior more intimate than usual standard, if it is proposed. 3. Restricts sexual behavior to usual standard for the situation. 4. Restricts sexual behavior to *less* than usual standard.
7. Harmony	1. Yields completely to the other's wishes. 2. Emphasizes compromise rather than conflict. 3. Negotiates and bargains. Emphasizes formal agreement.
8. Future	1. Proposes plans that involve the other person in the future (e.g., 6 months from present). 2. Adopts an accepting stance toward future plans (though status of future is not made explicit). 3. Rejects future planning.
9. Commitment	1. Openly declares against romantic involvement with others by either partner. 2. Expresses *dis*interest in other romantic prospects. 3. Expresses interest in other romantic prospects. 4. Declares that self and other should maintain interest in other romantic contacts.
10. Permanence	1. Initiates "semi-public" action that implies permanency. 2. Adopts a positive stance toward actions implying permanency. 3. Rejects only actions that imply permanency without rejecting the current relationship with the other person.
11. Proposal	1. Suggests marriage. 2. Accepts suggestion of marriage, if it is made. 3. Rejects marriage at this time, without implying rejection of the other person. 4. Rejects other person and, therefore, marriage to that person.

model, one must first state a subtheory within our framework. Our subtheory specified 11 potential states of a pair's involvement. These states and the behaviors available in the states are shown in Table VI. To arrive at reasonable values for the payoff matrices, transition matrices, and other parameters, a scaling study was conducted.[7] Each subject in the study received a brief per-

[7] John Goldin carried out this study.

sonality sketch of two hypothetical actors: John and Susan. John was described as attractive, but shy and introverted; Susan was described as attractive and extroverted. Initially, each subject ranked the 11 states in order of their relative depth of involvement. After completing this ranking, subjects filled in each of the 11 payoff matrices for the actor of their own sex, and then compared the payoffs across states. Finally, the subjects constructed transition diagrams for the relationship and suggested appropriate values for the other parameters. The payoffs that subjects had supplied were then normalized so that both actors' payoffs were on the same scale in each state. The scaled values obtained for a male and a female subject (graduate students in social psychology) provided the input for the simulation of romantic involvement described below.

The simulation began with the hypothetical actors meeting as strangers. The course of the romance is summarized in Fig. 8. It can be described as follows:

> John and Susan first meet in a class. Susan initiates a friendly interaction, and asks John for a date at the same time as John is asking her. On their initial dates, they both actively (though nonverbally) communicate liking for each other. However, neither is willing to be very intimate in their disclosure to the other.
>
> After a period of time in this situation, John learns that Susan is willing to disclose intimacies in response to his disclosures, and he confides in her completely. This leads the pair into active striving for a deep romantic involvement. They both initiate sexual behaviors more intimate than their standard. They establish a pattern of interaction where Susan is willing to yield completely to John's wishes, though John is not ready to reciprocate. When John proposes

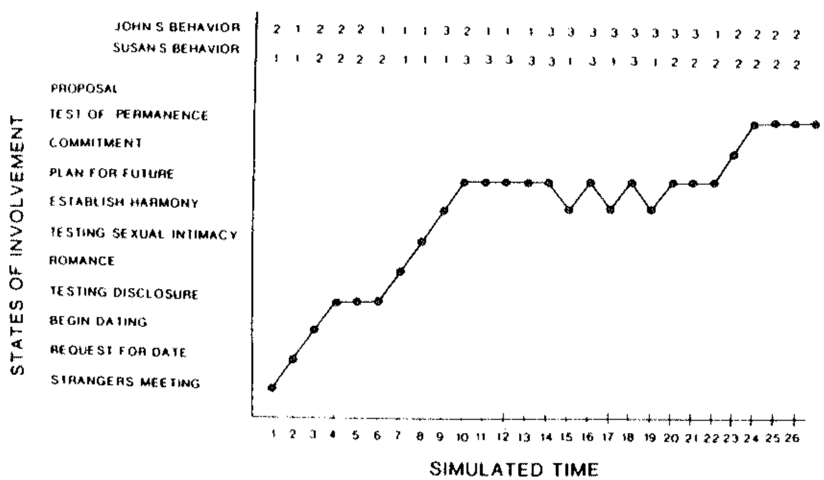

Fig. 8. The pattern of state transitions observed in a simulation of romantic involvement. The behaviors the hypothetical male (John) and the hypothetical female (Susan) selected at each point in time are noted at the top and described in Table VI.

> future plans for the pair, however, Susan is evasive and noncommittal. As a result, John stops proposing such plans and the pair remains in this situation for some time (i.e., alternating between the state called "Establish harmony" and the state "Plan for future"). Finally, Susan adopts a more positive stance toward the future; John, detecting this, proposes future plans again. This time Susan accepts the plans, and they both express disinterest in alternative romantic prospects. They move into a state of semi-permanency, where each partner adopts a positive stance toward actions implying real permanency, though neither proposes marriage.

While we know of no hard data with which to compare the course of this relationship, the behaviors within sections of this simulation agree with anecdotal evidence and intuitive knowledge. Susan, the extrovert, initiated interaction at a shallow level, but was reluctant to get deeply involved. John, the introvert, was passive at first, but later initiated movement into a deep relationship. The pair had to establish a pattern of reciprocal disclosure early in the relationship in order to advance deeper. Perhaps, however, the most interesting aspect of the simulation was the way in which the pair reached commitment. John learned that his proposal to consider future plans was not welcomed and he stopped proposing. After a time, though, Susan detected that their relationship would begin to regress if she failed to become more positive toward future plans. She became so. John then proposed future plans again, and the hurdle was overcome.

RELATE's simulation of the development of a romantic involvement is interesting, but this example depends completely on views of a hypothetical pair by a few participating subjects. More representative simulations await further research. Readers should note that different views about what states are preferred or probable will lead to results entirely different from those depicted here.

The present simulation, then, is illustrative rather than definitive. While it is unlikely that we will soon attain novel insights about real life pairs from such simulations, a reward-cost model of deeper relationships does have applicability. Current findings by the second author and his co-workers are that people can meaningfully report on their rewards and costs in current and past relationships, and that they can compare such rewards and costs. Preliminary findings indicate that as relations deepen there is a general increase in the structure of expected payoffs; it appears that while actual payoffs do not necessarily increase greatly, the probability of positive payoffs becomes considerably higher. As relationships deepen, costs deriving from increased commitments and obligations also increase. This scheme also enables us to analyze sex-role stereotypes about a deeply involved partnership: The female partner is judged to invest more highly in the relationship at a higher cost than the male partner, but is also believed to derive significantly higher rewards. Such work illustrates how the simulation model can serve as a heuristic for research entirely unconnected with computer formalization or mathematical abstraction.

XI. Conclusions

This paper has described a general theoretical framework for modeling dyadic interaction. The framework, which we call "incremental exchange theory," was built in order to move beyond current theories of social exchange. It incorporates two major assumptions: (1) that the potential goodness of interaction outcomes varies directly with depth of pair involvement, and (2) that pair development implies a sequential movement from one outcome matrix to another, the direction and amount of movement being contingent on current outcomes. The ensuing RELATE computer model incorporates two operations that advance it beyond current exchange conceptions. One feature is the differential weighting of the co-actor's payoffs in the actor's assessment of own rewards; this moves the model beyond heretofore "individualistic" conceptions, and allows us to account for the influence of alter's feelings on the actor's own choices. A second feature is the body of state-to-state transition rules, which allow us to proceed beyond the limitations of static matrix conceptions. The formal basis of the RELATE model is intended to be so general as to adapt it for application to a wide variety of dyadic problems.

In brief, the RELATE model treats any pair relationship as a finite set of interpersonal outcome matrices or states. Any actor's perspective upon those states hinges on his view of the transitions from state to state, which in turn depend on the outcomes that either do or can occur at any given point in the anticipated sequence. In choosing his behavior from his available options at any given moment, the actor bases his choice on some combination of present and future considerations—as affected by the behavior options and payoffs in each possible state, perceived transitions between states, his depth of search into the future, his discounting or accentuation of future payoffs and costs, and by his initial estimates of his partner's own actions as modifiable through learning about the partner's actual behavior during interaction.

In assessing the merits and limitations of the present model, it is important to note its flexibility and its tentativeness. One purpose of the model is to permit us to test the implications of simplifying assumptions for specifying longitudinal sequences, in order to guide the design of actual empirical research. For that purpose, the RELATE model has several limitations. The major ones are the following: (1) Incremental exchange theory, on which the model rests, is not a complete theory; it cannot completely specify the rules of social behavior, because those rules are largely unknown. (2) The model itself contains a large number of parameters, which render it complex and also make its predictions

difficult to disconfirm. (3) Most of the concepts within the model, such as payoffs, costs, or discounts, are extremely difficult to define operationally. Its impact, therefore, is mainly that of a meta-theory that *points* to avenues of theoretical development.

In viewing these limitations, readers may note that they are similar to those of earlier exchange theories. As Simpson (1972, pp. 14–18) has suggested, theories of social exchange have excluded from their domain various problems that must be dealt with before they can fruitfully be applied. Like other reinforcement approaches, social exchange theories offer no substantive theory of what constitutes rewards or costs (see Levinger, 1974). Our present effort does not escape this criticism.

The RELATE model contains many parameters. For any given application, it is left to the user to specify states, behaviors, payoffs, costs, probability estimates, discounts, depth of search. In practice, then, the model is hard to use. One reason for introducing these parameters is to call attention to the complexity rather than to evade it. For instance, it would be possible to lump a behavior's costs into the same term as its payoffs; but it seems more accurate to assume that costs can occur prior to and independent of outcomes. RELATE's user must decide how to employ the various parameters. If the user wishes, he can greatly simplify the model by appropriate choices of parameters.

The RELATE model has been applied to a variety of central issues in the social psychology of dyadic relations which have been extremely resistive to theoretical advance. Our applications have illustrated RELATE's solution to the following knotty problems: (1) how altruism can occur in shallow interactions; (2) what sorts of "similarity" are most clearly linked to interpersonal attraction; (3) how degree of self-disclosure is likely to vary across different levels of intimacy; and (4) how romantic involvements develop within a longitudinal perspective of incrementing payoffs. It would be tempting to consider other dyadic phenomena, such as aggression, divorce, persuasion, or attitudinal convergence. However, "subtheories" compatible with RELATE remain to be developed.

The model, then, is a heuristic framework for integrating current ad hoc theories of a variety of dyadic phenomena which are usually treated as distinct topics, and are poorly tied to one another. This is the major rationale for this model. To put it in the word's of Abelson's (1968, p. 326) assessment of several other computer simulation models of social behavior: RELATE can serve as "a spur to the better articulation of theories."