44828

PERMISSION TO MICROFILM — AUTORISATION DE MICROFILMER

• Please print or type — Écrire en lettres moulées ou dactylographier

Full Name of Author — Nom complet de l'auteur
Fumio David Sunahara

Date of Birth — Date de naissance
29/12/44

Country of Birth — Lieu de naissance
Canada

Permanent Address — Résidence fixe
201 10645 80 Ave
Edmonton

Title of Thesis — Titre de la thèse
Social Exchange Theory and the Matching Law

University — Université
University of Alberta

Degree for which thesis was presented — Grade pour lequel cette thèse fut présentée
Ph. D

Year this degree conferred — Année d'obtention de ce grade
1980

Name of Supervisor — Nom du directeur de thèse
W. D Pierce

Permission is hereby granted to the NATIONAL LIBRARY OF CANADA to microfilm this thesis and to lend or sell copies of the film.

The author reserves other publication rights, and neither the thesis nor extensive extracts from it may be printed or otherwise reproduced without the author's written permission.

L'autorisation est, par la présente, accordée à la BIBLIOTHÈQUE NATIONALE DU CANADA de microfilmer cette thèse et de prêter ou de vendre des exemplaires du film.

L'auteur se réserve les autres droits de publication; ni la thèse ni de longs extraits de celle-ci ne doivent être imprimés ou autrement reproduits sans l'autorisation écrite de l'auteur.

Date
23 April 80

Signature
D F Sunahara

NL-91 (4/77)

THE UNIVERSITY OF ALBERTA

SOCIAL EXCHANGE THEORY AND THE MATCHING LAW

by

(C) FUMIO DAVID SUNAHARA

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

IN

DEPARTMENT OF SOCIOLOGY

EDMONTON, ALBERTA

SPRING, 1980

THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled Social Exchange Theory and the Matching Law submitted by Fumio David Sunahara in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

H. David Pierce
Chairman

Michael W. Gillespie

Lyle E. Larson

....

John Fox
External Examiner

....

Date: April 23/80

ABSTRACT

This thesis presents and tests an operant psychological approach to social exchange theory which examines how actors distribute their time and behavior when confronted with alternative exchange partners. In presenting this approach, the matching law is advanced as an alternative to the single operant principles currently favoured by behaviorally oriented social exchange theorists.

Two aspects of the matching law are examined. The first is concerned with whether the matching law can predict how actors distribute their time and behavior between alternative exchange partners. The second is concerned with whether the intercept of the matching equation can capture the effects of discriminative stimuli, such as signs of inequity, on the behavior of actors. The emphasis here is not on the effects of inequity on behavior per se but rather on the general issue of the stimulus control of behavior.

The results of this research indicate that the matching law does predict how actors distribute their time and behavior in response to alternative exchange partners. The research also indicates that the intercept of the matching equation can measure the effects of discriminative stimuli such as inequity on the behavior of actors.

ACKNOWLEDGMENTS

In conducting this research, numerous individuals directly and indirectly contributed to its completion. I would like, at this time, to express special thanks to my committee members, Profs. David Pierce (Chair), John Gartrell, Michael Gillespie, Lyle Larson and Frank Epling for their advice in this research and for their support during the earlier stages of my graduate training.

I would also like to thank at this time, the various individuals who acted as research subjects and for whom this research must have been very long and tedious. Finally, I would like to thank Sheila Greer and Bruce Youngren who acted as experimental confederates and who did much to facilitate data collection.

Table of Contents

Chapter Page

I. Social Exchange Theory and Choice....................1

A. Introduction......................................1

B. The Problem.......................................2

C. The Social Situation and Simplifying Restrictions4

D. Choice in Current Theories of Social Exchange....6

E. The Matching Law..................................8

F. Matching as an Elementary and General Principle.11

G. Deviations from Perfect Matching................16

H. Undermatching....................................17

I. Bias...19

J. Bias, Equity Theory and Response Asymmetry......22

K. Past Research on the Matching Law and Social Exchange...24

L. Hypotheses.......................................28

II. Methodology.......................................31

A. General Methodology..............................31

B. Subjects...32

C. Experimental Design..............................33

D. Setting and Apparatus............................34

E. Independent and Dependent Variables.............36

F. Debriefing of Subjects...........................38

III. Data Analysis....................................39

A. Suspicion and Aggregation........................39

B. Hypothesis I: The Matching Hypothesis...........41

C. Hypothesis II: The Stimulus Control Hypothesis..42
IV. Discussion..50
Appendix A..57
Appendix B..59
REFERENCES..61

LIST OF TABLES

Table .... Page

1. Level of Aggregation in Minutes 41

2. r^2 between Log Response, Log Time and Log Reinforcement Ratios 42

3. Intercepts Based on Response and Time Ratios, Order of Presentation: Group 1: Equity Inequity Equity; Group 2: Inequity Equity Inequity 44

4. Group 1 Repeated Measure Analysis of Variance Summary Table, Intercepts Based on Response Ratios 45

5. Group 1 Repeated Measures Analysis of Variance Summary Table, Intercepts Based on Time Ratios 45

6. Group 2 Repeated Measures Analysis of Variance Summary Table, Intercepts based on Response Ratio 46

7. Group 2 Measures Analysis of Variance Summary Table, Intercepts based on Time Ratios 46

8. Scheffe's Test for Multiple Comparisons 48

9. Mean Intercepts Across the Three Phases of the Experiment 49

LIST OF FIGURES

Figure .... Page

1. The Hypothetical Social Situation 4

2. Undermatching 18

3. Bias 20

4. Subject Interaction Panel 36

I. Social Exchange Theory and Choice

A. Introduction

All the major social exchange theorists (Thibaut and Kelley, 1959; Blau, 1964; Emerson, 1972a; Coleman, 1972; Homans, 1974) view social exchange as entailing choice. Actors are seen as choosing between alternative courses of action or alternative exchange partners. Blau (1964: 31-2), for example, states that, "the mutual attraction of two persons and the exchanges between them .... are effected by the alternative opportunities for each." Homans' (1974: 43) "rationality proposition" is based on the assumption that choice characterizes social exchange. The rationality proposition explicitly assumes that actors in exchange must select from several alternative courses of action. Similarly, Coleman (1972: 147-8) addresses social situations in which actors are required to choose among alternative valued "events." In his theory, Coleman attempts to predict how actors will distribute their resources to gain control over a number of valued goods. Like the previous exchange theorists, Emerson (1972: 50) includes in his theory a discussion of choice. He discusses situations in which one exchange relationship can function as an alternative to a second relationship. Finally Thibaut and Kelley (1959: 13) describe interaction in terms of interaction matrices. These matrices present the alternatives facing the actor and the possible consequences associated with each of the alternatives. All these theorists assume choice is characteristic of social behavior. The operant psychologist Goldiamond (1975: 50) goes beyond exchange theorists by assuming that choice is characteristic of all behavior. He holds this to be true regardless of whether the behavior in question is the lever pressing behavior of a laboratory animal or human social interaction. Choice, from the perspective of Goldiamond and social exchange theorists, is characterized by alternative responses having differential consequences for the organism.

B. The Problem

Homans (1974), Emerson (1972a), and Thibaut and Kelley (1959) address the issue of choice in their theories of social exchange. They argue that an actor when confronted with alternative courses of action will weigh the benefits which are associated with each of the alternatives and respond exclusively to that alternative exchange partner who promises the highest level of rewards. Evidence from animal research suggests that this may not be the most appropriate description of choice. This research suggests that an organism, when confronted with alternatives, will distribute its time and responses across the alternatives to match the number of reinforcements received from these alternatives. The relationship between how an organism distributes its responses and the relative number of reinforcements it receives is labelled the matching law (Herrnstein, 1961).

The first problem addressed here examines whether an actor, when confronted with alternative exchange partners will distribute his behavior to match the reinforcements received or respond only to the more generous of the exchange partners.

The second problem addressed in this thesis stems more directly from animal research into the matching law than from the social exchange literature. This research, however, has important and direct implications for the future conduct and conceptualization of social exchange research. Periodically, operant psychologists observed that an organism would respond to one alternative more than was warranted by the relative number of reinforcements it obtained. This proclivity was labelled bias (Baum, 1974). Bias is treated by operant psychologists as error stemming from a lack of experimental control (de Villiers, 1977) and it is hypothesized that such errors result from some unknown but systematic difference between the alternatives. To the extent that these differences between alternatives can be represented by socially important variables, the analysis of bias has important theoretical relevance to social exchange theory. Bias can capture the effects of variables (e.g. status, attitudinal similarity, equity, etc.), other than relative reinforcement which affect choice. In the present research, interpersonal equity is manipulated as one example of a socially important stimulus, and the experiment examines its biasing effect on the matching law.

C. The Social Situation and Simplifying Restrictions

A single example is employed throughout this discussion. In this example, there is one central actor, actor A, who has two alternative exchange partners, actors B and C. Actor A exchanges valued reinforcers with actors B and C. Fig. 1 presents a schematic diagram of this hypothetical social situation.

Fig. 1 The hypothetical social situation

Actor B----------------Actor A----------------Actor C

Fig. 1 approximates numerous naturally occuring social situations. For example, actor A may be a parent with actors B and C being two offspring. Similarly, actor A may be an employee with actor B being an employer and actor C being a spouse. In both situations, to understand actor A's behavior, consideration must be given to the effects of <u>both</u> of his exchange partners on him.

To facilitate discussion, two simplifying restrictions have been imposed. The number of exchange partners with whom actor A can interact is limited to two. Although the example is restricted to one central actor with two alternatives, the explanation of this central actor's behavior provided by the matching law is far more general. The matching law, as an explanation of choice, is applicable to situations in which an organism is confronted with more that two alternatives (Herrnstein, 1974: 159; Pliskoff and Brown, 1976: 72). Also, actors B and C in Fig. 1 may in fact be the same person. For example, actor A may play two different roles in relation to a single actor B. He may be both an employee of actor B with his behavior as an employee being reinforced on one schedule and a friend to actor B with his behavior as a friend being reinforced on a different schedule. (This situation is analogous to the changeover key concurrent operant paradigm which will be introduced later.) Therefore, although in this discussion of the matching law and social exchange, the hypothetical situation is restricted to a three person chain, the matching law explanation of social exchange is not necessiarily limited to this one situation. The explanation of interaction presented here, is applicable to numerous other social situations.

One further restriction has been imposed on the hypothetical situation presented above. As can be seen from Fig. 1, actors B and C do not interact. This restriction, like the previous one, does not restrict the applicability of the matching law to social interaction. It is expected that the same abstract process would account for the behavior of actors B and C as accounts for the behavior of actor A. The only effect of having actors B and C interact would be to alter the specific values of the reinforcement schedules to which actor A is exposed. The abstract process which explains actor A's behavior would remain unchanged. Again, this restriction has been imposed to facilitate the discussion. It in no way alters the substance of the discussion.

D. Choice in Current Theories of Social Exchange

Homans explains choice in terms of his rationality proposition which states:

> In choosing between alternatives, a person will choose that one for which, as perceived by him at the time, the value, V, of the result, multiplied by the probability, p, of getting the result is the greater (1974: 43)

According to the rationality proposition, Actor A's choice between alternative exchange partners is determined by the difference between the values of pb x Vb and pc x Vc. The terms pb and pc refer to the probability of obtaining rewards from actors B and C respectively and Vb and Vc refer to the value of the rewards to be obtained from the two alternative exchange partners. The rationality proposition predicts that if pb x Vb is greater than pc x Vc that actor A will interact exclusively with actor B to the exclusion of actor C.

Thibaut and Kelley (1959) provide an analogous explanation of choice. They employ the concept of comparison level for alternatives (or CLalt) to explain the effects of alternative exchange partners. Thibaut and Kelley (1959: 21) define their concept of CLalt as:

> ... the lowest level of outcomes a member will accept in light of available opportunities. It follows from this definition that as soon as

outcomes drop below CLalt the member will leave the relationship.

The key issue with respect to an actor's CLalt is the relative returns to be obtained in the alternative relationships. If actor B provides actor A with a given level of outcomes and actor C provides him with a higher level of outcomes, actor A will leave the relationship with actor B and interact exclusively with actor C.

The contention that comparison levels for alternatives determines choice is also contained within Emerson's (1972a; 1972b) theory of social exchange and dependence. Emerson argues that an actor's dependence on a given partner varies directly with the comparison level for that relationship and inversely with the comparison levels of alternative relationships.

While the various authors just discussed disagree upon the exact process which accounts for choice, they agree upon the outcome of choice in social situations. They conceptualize the choice process as one in which an actor when confronted with alternative exchange partners will weigh the merits of the various alternatives and interact <u>solely</u> with the alternative which is seen as providing the highest level of returns to the actor. In doing so, the actor ceases to interact with the alternative exchange partners who provide lesser returns.

E. The Matching Law

The conceptualization of choice advanced by operant psychology differs markedly from that advanced by current exchange theorists. Operant psychology explains choice in terms of the matching law.

De Villiers (1977: 234) describes the two basic concurrent operant paradigms.

> In one of these ... the animal switches back and forth between two spatially separated keys or levers, each associated with a different reinforcement schedule. In the second, ... the animal switches between two schedules programmed on the same key by responding on a changeover (CO) key; each schedule is correlated with a different stimulus. The first method will be referred to as a two-key or two-lever concurrent, the second as a CO-key concurrent schedule.

The matching law describes the relationship between the number of reinforcements the organism receives from the alternatives and the number of discrete responses it directs to the two alternatives. An early version of the matching law is presented in Eq. 1.

$$Bb/Bc = Rb/Rc \quad (1)$$

In Eq. (1), Bb and Bc represent the number of responses directed toward the two alternatives and Rb and Rc represent the number of reinforcements obtained from these alternatives. Eq. (1) states that an organism responds so that the ratio of the two concurrent operants is equal to the ratio of obtained reinforcements.[1]

As can be seen in Eq. (1) the prediction of choice based on the matching law differs markedly from the predictions made by Homans, Thibaut and Kelley and Emerson. These authors predict that if there is a disparity between the returns available in the alternative relationships that an actor will interact exclusively with the alternative which provides the greater returns. In contrast to this, the matching law predicts that the actor will distribute his reponses between his alternatives to match the number of reinforcements he receives from these alternatives.

The matching law addresses an issue which is of central concern to social psychologists, sociometric choice. Sociometric choice pertains to the ranking of group members in terms of how attractive they are to their fellows. Individuals high in the hierarchy are responded to at a higher rate than members lower in the group's hierarchy. The matching law accounts for the <u>relative</u> rate at which actors respond to their fellow group members. It predicts the rate at which an actor will respond to one exchange partner, relative to the rate at which he will respond to a second partner.

The matching law's concern with relative rates of response is in marked contrast to exchange theorists such as

----

[1] The relationship in Eq. (1) obtains even when reinforcements are virtually independent of responses as in an interval schedule. Therefore it cannot be argued that the relationship in Eq. (1) obtains because an organism's responses determine the number of reinforcements received as in a ratio schedule (Catania, 1966: 225).

Homans. Homans bases his exchange theory on the law of effect which predicts the absolute rate at which one actor will respond to a second actor. Absolute rates of response are not informative with respect to sociometric choice. The absolute rate at which an actor responds to another actor is not important. What is of concern is whether the actor responds more to one of his partners than to another. Relative rates determine the ranking of individuals within the group. Consequently, a matching law based theory of social exchange is more central to the concerns of social psychologists than exchange theories based on the law of effect and absolute rates of response. (See Appendix A for a discussion of absolute rates of response in concurrent operant settings.)

The two concurrent operant paradigms described previously by de Villiers have their analogues in day to day social interaction. The relationship between the two-key paradigm and social interaction is readily apparent. Actors are often confronted with two or more exchange partners and are required to distribute their responses among these alternatives. Responding to a particular partner is analogous to responding on a particular key. How the actor distributes his responses among the alternatives depends upon the relative number of reinforcements obtained from his alternative partners.

The relationship between the CO-key paradigm and social interaction is less apparent. When an actor is confronted with a single exchange partner, the question arises as to what constitutes choice in such a situation. Choice may pertain to the roles the actor plays in relation to this single exchange partner. For example, actor A may play two different roles in relation to a single partner, actor B. He may be an employee of actor B with his behavior as an employee being maintained by one schedule and at the same time he may be a friend to actor B with his behavior as a friend being maintained on a second schedule. Actor A is still confronted with a choice. He must distribute his behavior across the roles he plays. How he distributes his behavior is determined by the relative number of reinforcements he has obtained when playing each of these roles. The matching law in such situations describes not with whom the actor interacts but rather how much of his time and effort he puts into each of his roles.

F. Matching as an Elementary and General Principle

The issue of whether the matching law constitutes an elementary behavioral principle must be approached on two distinct levels. To the behavioral psychologist, the issue of whether the matching law is an elementary principle pertains to whether the behavior of concurrent operants can be understood in terms of other behavioral principles such as the law of effect, satiation, discrimination and generalization. This is the level at which Homans (1974: 21-2) approached the issue of whether matching is an elementary form of behavior. Homans notes some of the early literature on matching but does not include the matching law as a proposition in his theory of exchange on the grounds that the matching law can be derived from the law of effect. This is an erroneous assertion (Catania,1966: 214). To derive the matching law from the law of effect would first require the identification of the functional relationship between operants and reinforcements in a single operant setting. This, operant psychologists have not done. They have not identified the functional relationship which exists between the rate of response and schedules of reinforcement. Unless the functional relationship between operants and reinforcements in a single operant setting is identified, it cannot be argued that the matching law can be derived from the law of effect. Consequently, Homans is unjustified in disregarding the matching law on the grounds that he has demonstrated that it can be derived from the law of effect.

The second level on which the elementary nature of the matching law must be addressed pertains to whether the matching law captures the "true" functional relationship which underlies the behavior of concurrent operants. It is obvious that the degree to which the matching law captures reality is, and must remain, an unknown. Past evidence, however, suggests that any other model postulated to describe the behavior of concurrent operants will find it difficult to supplant the matching law. The errors in predicting choice generated by the matching law are small.

In certain instances, less than 0.01% of the variance was unexplained (Miller, 1976; Pliskoff and Brown, 1976). While the predictive power of the matching law does not demonstrate that it captures the true relationship between concurrent operants and the concurrent schedules of reinforcement, it does indicate that the matching law is a useful tool for predicting choice, and a tool which warrants consideration by social psychologists concerned with the prediction of choice in social interaction.

To be a useful addition to the social exchange literature, the matching law must be a general principle. That is, it must account for choice in diverse situations. The vast majority of research on the matching law has employed concurrent interval schedules. If it were the case, as suggested by Herrnstein and Loveland (1975), that matching obtains when interval schedules are employed but not when ratio schedules are employed, the generality of the matching law would be threatened. Further, if it were the case that ratio schedules characterize social interaction (Molm, 1979: 159), then the utility of the matching law as a general principle of exchange would be completely discredited.

Evidence suggests that the questions posed by the research of Herrnstein and Loveland, and Molm do not threaten the utility of the matching law as a general principle of exchange. If Molm were correct that naturalistic settings involve ratio schedule, and if

Herrnstein and Loveland were correct that ratio schedules produce responding on a single alternative, then the matching law should not describe behavior in free interaction settings. Individuals in naturalistic settings, from the combined arguments of Molm and Herrnstein and Loveland should respond only to one exchange partner rather than distributing their behavior in accordance with the matching law. The available evidence suggest that this is not the case. Gray and von Broembsen (1976) observed that the matching law described the behavior of actors in naturalistic settings. They employed the matching law to account for the behavior of actors in an uncontrolled, free interaction setting (Bales et al., 1951). Gray and von Broembsen's observation implies that free interaction does not involve ratio schedules as suggested by Molm, or that ratio schedules do not produce responding on a single alternative as suggested by Herrnstein and Loveland, or both. Regardless of which interpretation is correct, the research of Gray and von Broembsen is important in that it greatly broadens the generality, and therefore the utility, of the matching law as a principle of social exchange theory.

Both Homans and Thibaut and Kelley in their discussions of choice assume that actors have knowledge of the returns available in the alternative relationships. In Homans' rationality proposition, actors know both the value of rewards to be obtained from the alternative exchange partner's and the probability that these rewards will be forthcoming. Similarly, Thibaut and Kelley assume that actors know what rewards are available in the alternative relationships. Further, Homans and Thibaut and Kelley predict that actors will respond exclusively to the alternative they know to be the more profitable alternative.

If knowledge of the returns available from the alternatives produces responding on a single alternative, then the generality of the matching law as a principle of exchange would be greatly reduced. If knowledge had this effect, the matching law would apply only to those few situations in which actors had no knowledge of the rewards available to them in their alternative relationships. Research evidence suggests that knowledge does not determine whether an actor will match or respond simply on the more lucrative alternative. In research by Burgess and Neilsen (1974) subjects had knowledge of the available rewards and responded exclusively on one alternative as predicted by Homans and Thibaut and Kelley. However in a gambling study by Hamblin et al. (1975) where subjects knew the probability of reward associated with the various alternatives, the subjects distributed their behavior across alternatives in a manner consistent with the matching law. If information were the crucial factor which produced responding on a single alternative then Hamblin et al.'s subjects should have responded only on one of the available alternatives. This did not take place, suggesting that information concerning alternatives is not sufficient to produce responding on a single alternative. The importance of this observation is that it suggests the availability of information does not restrict the applicability of the matching law as a principle of exchange. Matching can still obtain in situations in which subjects have knowledge concerning the returns available in the alternative relationships.

Before proceeding, one further comment must be made concerning the generality of the matching law. To this point the dependent variable in the matching equation has been the ratio of responses directed toward the alternative exchange partners. In addition to predicting the ratio of responses, the matching law can also predict the relative amount of time the actor spends interacting with his alternative partners. That is the ratio, Tb/Tc, can be substituted for Bb/Bc (Baum, 1972: 263). Further the matching law is generalizable to situations involving more than two alternative relationships. A modified version of the matching law describes the behavior of an organism when confronted with more than two alternatives (Herrnstein, 1974: 159; Pliskoff and Brown, 1976: 72).

G. Deviations from Perfect Matching

In the preceeding discussion, the matching law has been presented as a simple equality of ratios. This simple equality is descriptive of behavior in only a very limited number of situations. In the following discussion, those factors which may affect this simplified model are presented.

A current form of the matching law is presented below (Miller, 1976: 336).

$$(Bb/Bc) = k\ (Rb/Rc)^a \quad \text{.....................(2)}$$

Where the coefficient, k, and the exponent, a, are equal to one, Eq. (2) is exactly the same as the version of the matching law presented earlier. Eq. (2), however, is not amenable to statistical estimation. To estimate the values of k and a, Eq. (2) must be logarithmically transformed into the following (Graft *et al*., 1977: 184).

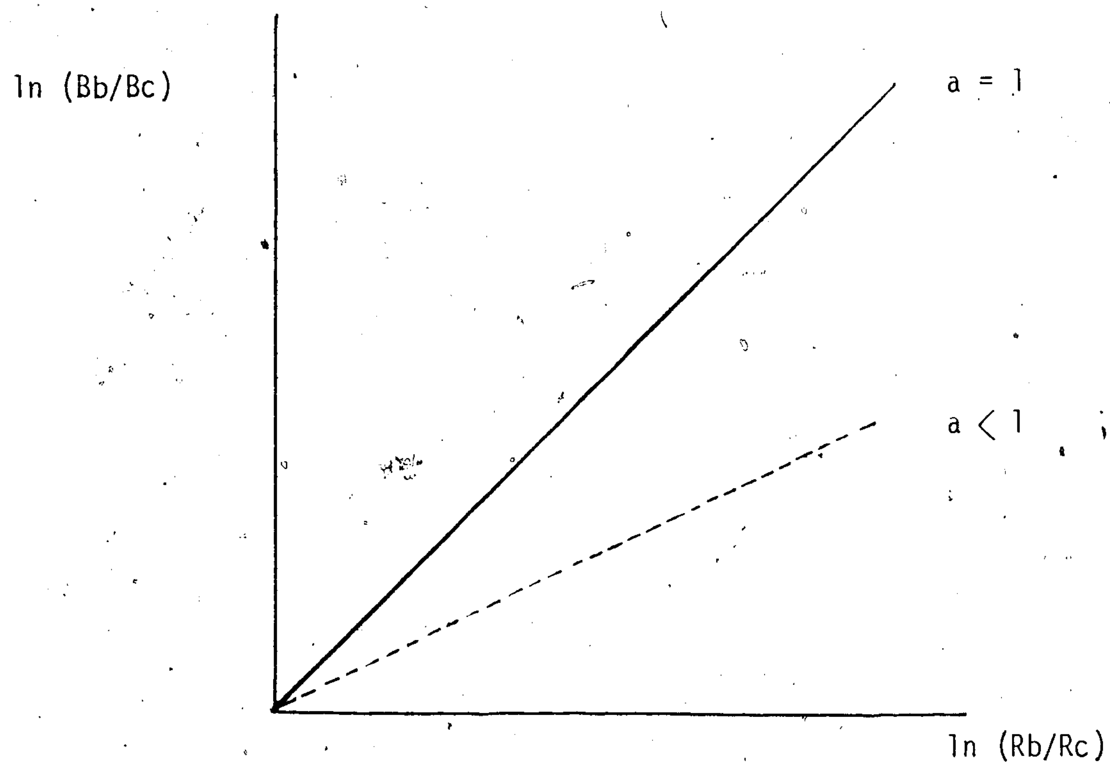
$$\ln (Bb/Bc) = \ln k + a \ln (Rb/Rc) \quad \text{.....................(3)}$$

In Eq. (3), the degree to which the estimated values of a and ln k differ from one and zero respectively, reflects certain properties of the exchange relationship.

H. Undermatching

Baum (1974: 232) refers to situations in which the regression coefficient a differs from one toward indifference as "undermatching." Fig (2) presents a hypothetical example of undermatching. In Fig. 2, the horizontal axis represents the log of the ratio of obtained reinforcements, and the vertical axis represents the log of the ratio of responses. The solid diagonal line represents a hypothetical regression line where the matching of responses to reinforcments is perfect (a = 1). The broken line represents a situation of undermatching. In terms of the log

Fig. 2 Undermatching



ratios presented in Eq. (3), a unit increase in the log reinforcement ratio produces less than a unit increase in the log ratio of responses.

The factors which produce undermatching are obscure. Baum (1974: 232-3) suggests that undermatching may result from poor discrimination; that is, the concurrent schedules of reinforcement are presented in such a fashion that response differentiation does not occur. In animal research, to facilitate response differentiation, a change over delay, COD, is instituted.

> For example, if a 1-sec. COD is programmed for key pecking in the pigeon, a peck on a given key cannot be reinforced unless at least 1 sec. has passed since the pigeon moved from one key to the other (Catania, 1966: 216).

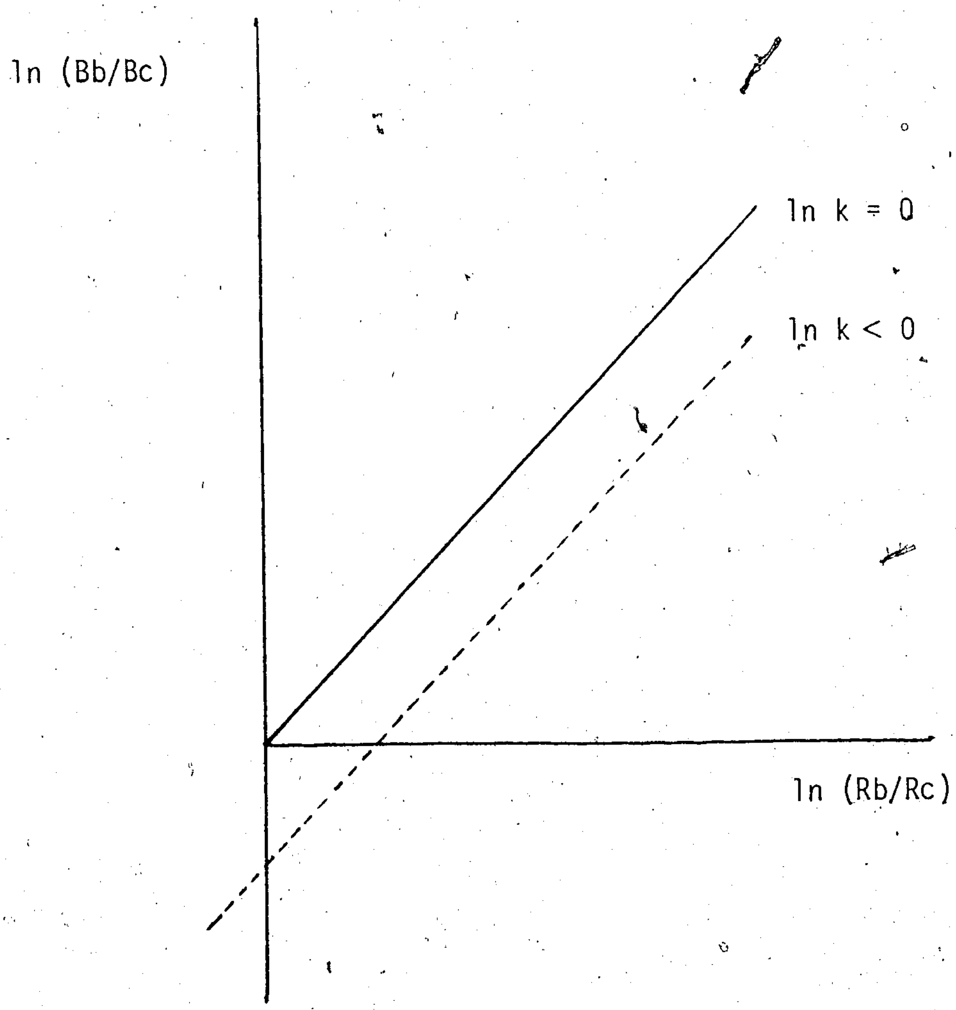
Discrimination is enhanced by separating one of the concurrent operants and its associated reinforcement from the other with a brief pause during which time responses are not reinforced.

Undermatching, as a property of human social interaction, may be of little interest to social psychologists. In experimental investigations of the matching law with human subjects, a one second COD was observed to be sufficient to produce good matching (Schroeder and Holland, 1969: 101). In naturally occuring social interaction, it is probably the case that there is at least a one second delay between the time an actor switches from one exchange partner to an alternative and the time that the alternative presents a reinforcer.

I. Bias

The intercept, ln k, in Eq. (3), is probably of greater interest when the matching law is applied to explain social interaction. Situations in which the intercept is not equal to zero are called biased (Baum, 1974: 233). Fig 3 illustrates such a situation. In Fig. 3, the solid diagonal

Fig. 3 Bias



line represents a hypothetical regression line where the log ratio of responses exactly matches the log ratio of obtained reinforcements. The broken line indicates the presence of bias.

The presence of bias in animal research is considered to be indicative of a systemmatic error on the part of the experimenter stemming from a lack of experimental control. For research examining human interaction, however, deviations of the intercept, ln k, from zero may prove to be a useful dependent variable.

With respect to variation in ln k, Baum (1974: 233) states:

> When k equals one (and log k equals zero) there is no bias. If k is less than or greater that one, preference is biased by some unknown, but invariant, asymmetry between the alternatives.
> Bias means unaccounted for preference.

If in Fig. 3, Bb and Bc represent actor A's responses to actors B and C respectively and if Rb and Rc represent the reinforcements actor A receives from actors B and C, then the inference can be drawn that there is some factor which is causing actor A to prefer his relationship with actor C over his relationship with actor B. This is not meant to imply, however, that actor A directs more responses to actor C than to actor B. Rather, what is implied is that actor A is responding more to actor C than would be predicted solely on the basis of the number of reinforcements received. Had the broken line in Fig. 3 fallen above the perfect matching line (ln k > 0), the inference would be drawn that the value of ln (Bb/Bc) is greater than what would be predicted if the ratio of obtained reinforcements were the only variable operative.

In casual modelling terms, bias results from the incomplete specification of the appropriate causal model. If it were possible to specify the biasing variable, then it should be possible to systematically vary the value for the intercept by introducing and removing the biasing variable from the experimental setting. This potential for manipulating the location of the intercept, renders possible the integration of a matching law based theory of social exchange with other theories of social interaction.

J. Bias, Equity Theory and Response Asymmetry

In this thesis, inequity is manipulated as one example of a biasing variable of interest to social psychologists. To understand why inequity should bias the matching equation, consideration must be given to what Baum (1974: 234) refers to as response asymmetry, and to the properties of an inequitable relationship. One form of response asymmetry pertains to the stimulus control of behavior. For example, if the responses of an organism are punished when a red light is on, the presence of a red light in the future will lower the probability of response. If the organism is then placed in a concurrent operant setting in which one alternative is paired with a red light, and the other not, the organism will respond less on the alternative paired with the red light than would be predicted simply on the basis of the food reinforcements received. The discriminative stimulus, the red light, exerts control over the behavior of the organism.

The effects of inequity are analogous to the effects of the red light. Equity theory states that actors who undercompensate others will be punished (Walster et al., 1972: 2). Additional evidence suggest that actors who allow themselves to be undercompensated will also be punished (Thibaut, 1950; Lerner and Simons, 1966). In such situations, inequity, like the red light, becomes a discriminative stimulus. If an actor with this history is then placed in a concurrent exchange setting, it would be predicted that based on the discriminative function of inequity the subject would respond less to an inequitable partner than would be expected on the basis of the reinforcements received. This implies that the intercept of the matching equation would deviate from the theoretical value of zero toward the equitable partner.

Viewed from the perspective of the matching law, inequity is simply one source of bias in exchange relationships. Stimulus control variables and value variables (e.g. variable versus fixed schedules of reinforcement, Emerson, 1972a: 53) become integrated into a matching law based exchange theory through their biasing effect on the intercept of the matching equation. The objective of this research, therefore, is to test the hypothesis that the intercept of the matching equation, ln k, captures the biasing effect of an important social stimulus, interpersonal inequity.

K. Past Research on the Matching Law and Social Exchange

The matching law has received very little attention from social psychologists concerned with the problem of social exchange. These investigations, while supporting the utility of the matching law to account for social interaction, involved either the examination of data which were not truly amenable to testing the predictions of the matching law or entailed research designs which precluded the investigation of the matching law's full implications.

Gray and von Broembsen (1976) and Hamblin (1977, 1979) re-analysed existing data rather than generating new data to examine the applicability of the matching law to social interaction. These data, while adequately described by the matching law, were not amenable to determining the direction of causation. For example, Gray and von Broembsen observed that the matching law adequately accounted for the distribution of responses in a free interaction setting (Bales et al., 1951). In such free interaction settings there can be three different interpretations for the observed correlation between the relative number of reinforcements received and the distribution of responses. It may be the case, as stipulated by the matching law, that the reinforcement ratio determined the response ratio. However, it may also be the case that the response ratio determines the reinforcement ratio. Finally it may be the case that there is reciprocal causation between the response and reinforcement ratios. The direction of causation cannot be determined in uncontrolled free interaction settings.

To test the direction of causation, the approach of operant psychologists must be adopted. The reinforcements an actor receives must be presented on an interval schedule so that the number of reinforcements received is independent of the subject's rate of response. Such schedules permit the unambiguous interpretation of the relationship between the reinforcement and response ratios.

Conger and Killeen (1974) collected data expressly to test the applicability of the matching law to social exchange. In their research, one subject and three confederates, E1, E2, and E3 were brought into the laboratory for a thirty minute experimental session. During the first fifteen minutes of the session, E1 and E2 reinforced the subject on a random time schedule with E1 giving seven reinforcers to the subject for every three given by E2. During the last fifteen minutes, E1 and E2 reversed roles so that E1 gave three reinforcers for every seven given by E2. The role of E3 was to prompt the subject if the subject's behavior stalled. The responses made by subjects to E1 and E2 and the reinforcements subjects received from E1 and E2 for the last five minutes of each fifteen minute half session were then employed to estimate a single equation. (For one subject three data points were collected while for another subject only a single data point was collected.) The correlation between the distribution of responses and reinforcements was 0.90.

An analogous estimation procedure was adopted by Hamblin et al. (1975). The authors conducted a gambling experiment in which subjects were confronted with alternative cages, with each cage containing a different ratio of light and dark balls. Subjects were allowed to examine the cages to estimate the approximate ratio of light and dark balls contained in each cage. They were able to estimate the actual ratios relatively precisely. Subjects averaged only two per cent error in estimating the ratio of light and dark balls in each cage. Subjects were then required to bet on which of two alternative cages would produce a randomly selected ball of a particular hue. The relative amount of money bet on alternative cages was then regressed on the relative amount of money to be won from the alternative cages and the objective relative probability of winning on the alternative cages. This multivariate version of the matching equation was estimated across individuals. That is, the data from all the subjects were employed to estimate a <u>single</u> equation. The value of R^2 for different populations of subjects ranged from 0.88 to 0.96.

There is a critical problem associated with Conger and Killeen's and Hamblin et al.,'s estimation procedure. Hayes (1953: 269) observes with respect to functions which are estimated across individuals that this type of curve

> ... indicates the average performance of a group of S's... These curves are quite irrelevant to basic problems of learning theory since their forms are determined not only by the forms of their component individual curves, but also by the distribution of

the individual curves.

It is the form of the matching equation as determined by the value of a and the location of the curve as determined by ln k which are of vital importance. Unless the function for each individual is estimated separately, it is not possible to interpret the values of a and ln k unambiguously. The estimation procedures of Conger and Killeen and Hamblin et al. preclude the examination of the full implications of the matching law. To interpret the variation in a and ln k, experimental data must be collected in a manner which permits the estimation of individual level functions. Data on each individual must be collected across a sufficient number of values of the nominal reinforcement schedules so that individual level functions can be estimated. Data must be collected within a single subject across time.

An additional benefit is to be gained by initially collecting data from each individual across time. By estimating the individual level functions, it can be determined whether in fact estimating the aggregate function distorts the form of the resulting function. If no such distortions are introduced, it would be possible in subsequent investigations to employ the aggregate rather than the individual level functions. This would greatly simplify future data collection.

This thesis will attempt to rectify the methodological shortcomings of past research and to explore more fully the implications of the matching law for social exchange. In doing so, it is hoped that the matching law will be adopted as a basic premise of a general theory of social exchange.

L. Hypotheses

Two aspects of the matching law have been emphasized. It has been argued that how an actor distributes his time and responses between alternative partners is determined by the ratio of reinforcements he receives from these partners. The first hypothesis is therefore:

Hypothesis I   The log of an actor's response ratio is a linear and positive function of the log of his ratio of obtained reinforcements. This relationship assumes the following form.

$$\ln (Bb/Bc) = \ln k + a \ln (Rb/Rc)$$

$$\ln (Tb/Tc) = \ln k + a \ln (Rb/Rc)$$

where Bb and Bc are the number of responses actor A directs toward his two alternative exchange partners, B and C,

Tb and Tc are the amount of time actor A spends interacting with his two alternative exchange partners, B and C,

Rb and Rc are the number of reinforcements actor A receives from actors B and C, and

a and ln k are empirically derived constants.

The two equations presented above are alternative versions of the same hypothesis. They simply employ different operations for the same dependent variable, social interaction.

The testing of Hypothesis I also constitutes an indirect test of the position of current exchange theorists.

Current exchange theorists predict that after having experienced unequal returns from two alternatives, an actor will respond exclusively to the alternative who provided the higher level of outcome. If this is the case, then the number of responses the actor directs to the partner who provides the lower level of outcomes should be zero, and as a consequence the number of reinforcements received from this partner should be zero. If support is found for the matching law conceptualization of interaction, Hypothesis I, then by implication the data do not conform to the prediction of choice advanced by Homans, Thibaut and Kelley, and Emerson. If support is found for Hypothesis I, this means that subjects responded to both alternative partners and received reinforcements from both alternatives even when the level of outcomes from the alternatives were unequal. This conclusion is contrary to the prediction made by Homans, Thibaut and Kelley, and Emerson.

The second aspect of the matching law which is examined in this thesis pertains to the sensitivity of the intercept of the matching equation to socially important variables. The second hypothesis concerns the relationship between signs of interpersonal inequity and bias.

Hypothesis II If actor A is inequitably treated (undercompensated) by actor B and equitably treated by actor C, then the intercept of the matching equation will be less than zero ($\ln k < 0$)

An alternative and somewhat less stringent version of Hypothesis II can also be advanced. It may be the case that there are present in the experimental setting or brought into the setting by subjects, sources of uncontrolled and systematic bias. That is, in the absence of inequity there may be some factor which causes subjects to prefer one alternative over the other. This uncontrolled source of bias would be indicated by the intercept of the matching equation deviating from zero when both relationships were equitable. If this situation obtains, then the appropriate test for the effects of inequity would be to see if the intercept of the matching equation in the presence of inequity is less than the intercept in the absence of inequity.

II. Methodology

A. General Methodology

Two principles guided data collection in this research. The first of these was the concept of abstractness (Zelditch, 1968) in the sense intended by Burgess and Neilsen (1974: 430) when they stated that, "the setting should be as abstract as the theory being tested."

In naturalistic settings, numerous stimuli are present. Most of these are irrelevant to the theory being tested but unfortunately, many of these stimuli may not be irrelevant with respect to the behavior of subjects. To eliminate the problem of these uncontrolled stimuli competing with the experimental manipulation, the social situation is stripped down to its abstract essentials. By doing this, the experimental control which is a prerequisite for good prediction is achieved (Henschel, 1971).

The second principle guiding this research was replication. While sociologists typically use statistical tests to evaluate hypotheses, this research relied more upon intersubject and intrasubject replication (Sidman, 1960). Intersubject replication means that the phenomenon under investigation can be observed reliably across subjects. If only one subject is employed, any change in the behavior of that subject can be explained in terms of some idiosyncratic characteristic of that subject. Such a threat to the internal validity of the research is avoided when the change in behavior is observed to occur across subjects. Intrasubject replication means that whenever a single subject is exposed to a particular stimulus, that the subject will respond in a similar fashion each time. By demonstrating intrasubject replication, threats to internal validity from such factors as history and maturation are eliminated (Campbell and Stanley, 1963). The design of this research permits findings to be replicated both within and across subjects.

B. Subjects

Six male and six female undergraduate students from the University of Alberta were employed as subjects. They were selected on the basis of their expressed need for money to ensure that the points given during the research would function as positive reinforcers. According to the employment contract signed by these subjects, their remuneration was prorated on the points they received and gave away during the research. The contract also stipulated that a bonus of $40.00 would be paid to the subjects, conditional on their completing all twelve hours of research. Seven pre-test subjects were also employed for two hours each. These subjects were employed to evaluate whether the schedules presented to subjects would adequately simulate the behavior of real human exchange partners. These pre-test subjects were also employed to determine whether the schedules produced sufficient variability in responding and to set the value of the inequity manipulation.[2]

C. Experimental Design

The experimental design was a counter balanced ABA design (Glass et al., 1975). Each subject participated for twelve, one hour sessions. The twelve hours were divided into three, four hour phases. The phases of the experiment corresponded to whether Partner A acted equitably or inequitably. For three randomly selected females and three randomly selected males (Group 1), Partner A acted equitably during the first and third phases of the experiment and inequitably during the second phase. For the remaining three females and three males (Group 2), Partner A acted inequitably during the first and third phases and equitably during the second phase.

Within each of the three phases of the experiment, subjects were exposed for thirty minutes to each of the eight values of the concurrent reinforcement schedules. The order in which the schedules were presented was randomized within and across phases of the experiment and across subjects.

The experimental design permitted the collection of eight data points for each subject, within each phase of the

----

[2]During pre-testing, it was observed that when gross inequities were created, two points given away for each point received, that responding on the inequitable alternative was suppressed entirely. This is consistent with Bradshaw et al. (1979) who observed that large response costs suppressed responding. This implies that the matching law may describe exchange only within a certain range of inequity values.

experiment. Each data point corresponded to one-half hour of exposure to each value of the concurrent reinforcement schedules. In this way, functions could be estimated for each subject, for each phase of the experiment and consequently intrasubject and intersubject replication could be evaluated.

D. Setting and Apparatus

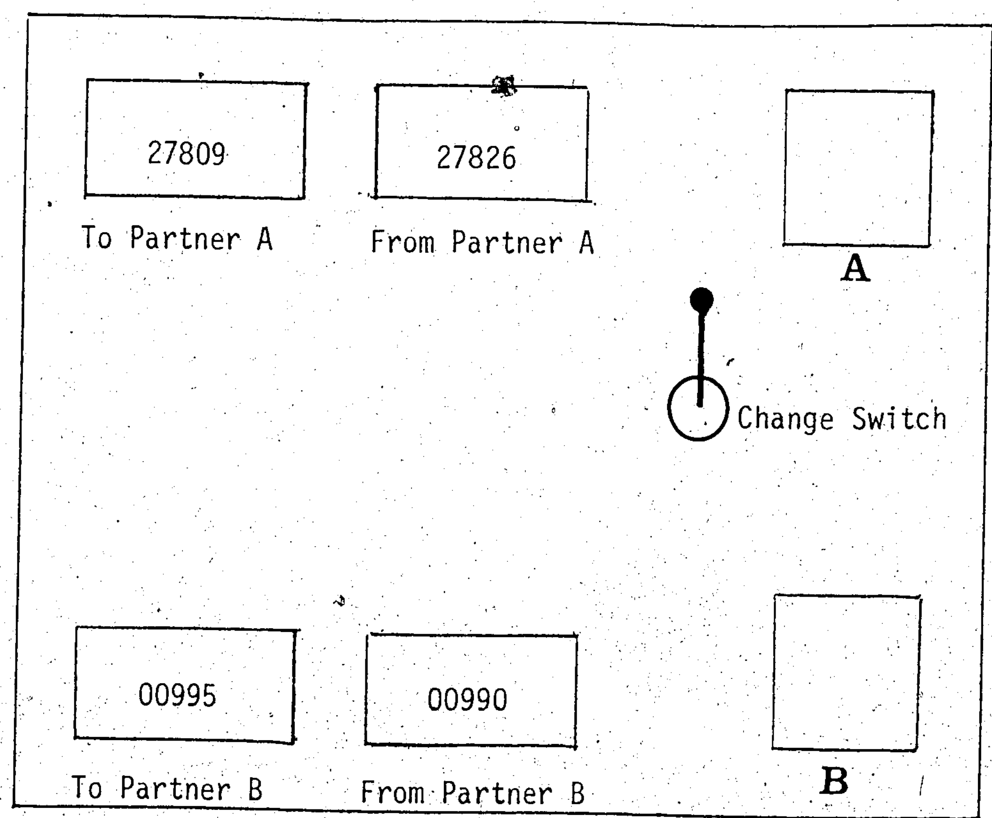
For each of the twelve, one hour sessions, two subjects and one confederate, all of the same sex, were brought into the laboratory. The confederate gave the subjects the impression that they were interacting with two alternative exchange partners when in fact they were being run simultaneously and interacting with operant programming equipment (Coburn Instruments).

At the beginning of the first experimental session, subjects read standardized instructions (Appendix B) which informed them they were the centre person in a three person chain and that they could exchange points with the subjects at the ends of the chain. Subjects also were informed that they and their partners must work equally hard to give away a point. This information was given to preclude subjects attributing signs of inequity to differences in the apparatus rather than to differences in the amount of work they and their partners were putting into the exchange relationships. Finally subjects were informed that each point they received from their partners was worth 1¢ to them and each point they gave away would cost them 0.1¢.

Subjects were provided with an interaction panel, Fig. 4, which apparently allowed them to exchange with their partners. The response buttons, A and B, permitted subjects to respond to their exchange partners ostensively located at the ends of the chain. The "Change Switch" allowed the subjects to choose either of their partners at any time and also prevented simultaneous responding to both partners. To ensure that the subjects operate only "live" buttons, lights were located in the response buttons which illuminated only if the "Change Switch" was pointing in the direction of the manipulated button. The counters labelled "To Partner A" and "To Partner B" indicated the number of points the subjects ostensively gave to their partners. The counters labelled "From Partner A" and "From Partner B" indicated the number of points the subjects received from their partners. The operant programming equipment controlled the points which appeared on the four counters.

Sixteen channel Compatible Printers (Med Associates) recorded the responses made by the subjects to their partners, the reinforcements they obtained from their partners, and the number of times the subjects switched from one partner to the other every minute. Mechanical counters recorded the number of seconds the subjects spent responding to each of their partners, and the number of points subjects gave away to each of their alternatives. These data were recorded at five minute intervals.

Fig. 4 Subject Interaction Panel



E. Independent and Dependent Variables

The independent variable for Hypothesis I, the matching hypothesis, was the log of the ratio of obtained reinforcements the subjects received from their exchange partners. The reinforcements received from Partner A, formed the numerator of this ratio, and the reinforcements from Partner B the denominator. Operant programming equipment controlled the rate at which the subjects could receive reinforcement. This equipment was programmed for the following eight concurrent interval schedules (VI 2.2 sec/VI 4 sec, VI 2.6 sec VI/4 sec, VI 3 sec/VI 4 sec, VI 3.4 sec/VI 4 sec, VI 4 sec/VI 2.2 sec, VI 4 sec/VI 2.6 sec, VI 4 sec/VI 3 sec, VI 4 sec/VI 3.4 sec). The dependent variable for Hypothesis I was operationalized in terms of the subject's log ratio of response to Partners A and B, and the log ratio of time the subject spent responding to Partners A and B.

The independent variable for Hypothesis II, the stimulus control hypothesis, was the disparity between what the subjects gave to and received from their alternative exchange partners. When both partners acted equitably, subjects gave away points according to the same schedules which determined the points they received, the eight concurrent interval schedules presented previously. Under a condition of one equitable and one inequitable relationship, subjects gave away seven points to Partner A for every five points they received from Partner A. At the same time, there was only a small random disparity between the points subjects gave and received from Partner B. The rate at which points were given away was also controlled by the operant programming equipment. The intercept of the matching equation was the dependent variable for the stimulus control hypothesis.

F. Debriefing of Subjects

At the end of the twelfth experimental session, subjects were given their $40.00 bonus for completing the experiment and then questioned to determine whether they were suspicious of the conditions of the experiment. Subsequent to this, subjects were informed of the true conditions of the experiment, and questions they had concerning the experiment were answered. Subjects were then asked not to discuss the experiment with anyone until the completion of the research.

III. Data Analysis

A. Suspicion and Aggregation

Only Subject 12 guessed that he was interacting with a machine rather than with other subjects. He reported that he became aware of this approximately three quarters of the way through the experiment. The data are consistent with his verbal report of when he became suspicious. Subject 12 matched during the first and second phases of the experiment. For Phase I the correlation between his response and reinforcement ratios was $r^2 = 0.87$ and the correlation between his time and reinforcement ratios was $r^2 = 0.84$. The corresponding correlations for Phase II are $r^2 = 0.79$ and $r^2 = 0.75$. All correlations are significant at the 0.05 level of significance. Finally, during Phase III when Subject 12 was aware that there had been a deception, the correlations were not significant. The correlation between his response and reinforcement ratios was $r^2 = 0.41$ and the correlation between the time and reinforcement ratios was $r^2 = 0.43$. The realization that he was interacting with a machine negatively affected Subject 12's behavior. Consequently his data are not reported in the following analysis.

In animal research, rather than exposing an organism to each value of the reinforcement ratio for a fixed period of time, the organism is exposed to the reinforcement ratio until its behavior stabilizes. Following this, data from several more weeks of responding are then aggregated to form a single data point. In this research, the data were also aggregated beginning with the last five minutes of exposure to each value of the reinforcement ratio. The last five minutes were examined first to avoid including in the data the unstable behavior which follows a change in the reinforcment ratio. If during the last five minutes of exposure, the subject did not respond at least one hundred times to each partner and receive at least one reinforcement from each partner, the last ten minutes of exposure were examined. This procedure was followed until the subject met the criterion of one hundred responses to and one reinforcement from each of his partners.

If the degree of aggregation required to meet criterion varied across the three phases of the experiment, the analysis was based on the lowest level of aggregation which was common to all three phases. Table 1 presents the level of aggregation for the eleven subjects. By maintaining a constant level of aggregation across the three phases of the experiment, differences between phases cannot be attributed to differences in aggregation.

One further comment must be made concerning the aggregation of data. The mean level of aggregation for males was significantly greater than the mean level of aggregation for females ($t = 2.87$ $df = 9$ $p < .05$).

Table 1 Level of aggregation in minutes

Subject	Minutes of aggregation	
1	15	FEMALES
2	5	
3	25	
4	15	
5	5	
6	5	
7	30	MALES
8	20	
9	20	
10	20	
11	30	

B. Hypothesis I: The Matching Hypothesis

The first hypothesis stated that there would be a positive correlation between the log response ratio and the log reinforcement ratio. Hypothesis I also stated that there would be a positive correlation between the log time ratio and the log reinforcement ratio. Table 2 presents these correlations. Of the sixty-six r^2 values, sixty are significantly greater then zero ($p < 0.025$ 1 tail). This strongly supports the descriptive power of the matching law in human social interaction.

Table 2. r^2 between log response ratios, log time ratios and log reinforcement ratios

	Baseline		Intervention		Return to Baseline	
Subject	Response Ratio	Time Ratio	Response Ratio	Time Ratio	Response Ratio	Time Ratio
1	0.34	0.36	0.50*	0.83*	0.00	0.39
2	0.93*	0.78*	0.80*	0.84*	0.90*	0.90*
3	0.82*	0.87*	0.98*	0.98*	0.72*	0.66*
4	0.76*	0.79*	0.90*	0.94*	0.98*	0.98*
5	0.78*	0.75*	0.87*	0.85*	0.82*	0.92*
6	0.69*	0.61*	0.61*	0.64*	0.67*	0.63*
7	0.63*	0.54*	0.84*	0.84*	0.99*	0.97*
8	0.18	0.17	0.91*	0.92*	0.87*	0.74*
9	0.72*	0.70*	0.76*	0.82*	0.93*	0.89*
10	0.98*	0.98*	0.97*	0.95*	0.73*	0.54*
11	0.92*	0.91*	0.99*	0.99*	0.98*	0.98*

* $p < 0.025$ 1 tail

C. Hypothesis II: The Stimulus Control Hypothesis

The behavior of Subject 1 poses a problem with respect to Hypothesis II. As can be seen in Table 2, during the first and third phases of the experiment, Subject 1 was not under the control of the money given to her by her alternative exchange partners. Consequently good estimates are not possible of the intercepts during these two phases of the experiment. Without an estimate of the intercept for at least one of the two phases, there is no standard against which the intercept for the second phase of the experiment can be contrasted. Consequently it is necessary to eliminate Subject 1's data for the analysis of Hypothesis II.

Table [illegible] presents the intercepts and the order in which equity was manipulated for the two groups of subjects. Except for three instances, exposure to one inequitable and one equitable relationship resulted in an intercept lower than the intercept observed when both relationships were equitable. Subject 7 failed to exhibit recovery when the third phase intercepts were based on both time and response ratios. Subject 9 did not show recovery when the third phase intercept was based on the response ratio. However, the data generally indicated a systematic relationship between the presence of the discriminative stimulus, inequity, and variation in the intercept of the matching equation.

Rarely under conditions of two equitable relationships were the intercepts exactly equal to the theoretical value of zero. This renders testing the intercepts against zero problematic. To eliminate this problem and to supplement the previous analysis, a repeated measures analysis of variance was performed to see if the intercepts systematically varied with the manipulation of inequity. In the initial analysis, sex of subject did not have a significant effect on the intercepts. Consequently, in the subsequent analysis sex of subject was ignored. Tables 4 and 5 present the summary tables for the repeated measures analysis of variance for Group 1 subjects. In Table 4, the intercepts are based on the matching equations employing the log response ratio as the dependent measure. In Table 5, the intercepts are based on matching equations employing the log time ratios as the

Table 3 Intercepts Based on Response and Time Ratios, Order of Presentation: Group 1 Equity Inequity Equity; Group 2: Inequity Equity Inequity

Group 1:

	Response Ratio Intercepts			Time Ratio Intercepts		
Subject	Equity	Inequity	Equity	Equity	Inequity	Equity
4	-0.02	-0.70**	0.08	0.02	-0.39	0.00
5	0.02	-0.23	-0.17	-0.01	-0.21	0.06
8	0.00	-0.15	-0.02	-0.03	-0.08	-0.02
10	0.04	-0.09	-0.03	0.01	-0.26*	-0.03
Mean	0.01	-0.29	-0.04	0.00	-0.24	0.00

Group 2:

	Response Ratio Intercepts			Time Ratio Intercepts		
Subject	Inequity	Equity	Inequity	Inequity	Equity	Inequity
2	-0.28*	0.06	-0.08	-0.23	0.05	-0.13
3	-0.39*	0.18	-0.24	-0.47**	0.17	-0.31
6	-0.12	0.01	-0.04	-0.08	0.09	-0.10
7	-0.29**	-0.08	-0.07	-0.16	-0.10	-0.08
9	-0.42	-0.24	-0.19	-0.29	0.08	-0.05
11	-0.35*	-0.10	-0.28**	-0.35*	-0.04	-0.23*
Mean	-0.31	-0.03	-0.15	-0.26	0.04	-0.15

** $p < .025$ 1 tail
 * $p < .05$ 1 tail

dependent variable. Tables 6 and 7 present the corresponding summary tables for Group 2. For Group 1 subjects, when response ratios were employed to estimate the matching equation, the intercepts of the equations did not vary systematically with the manipulation of inequity. However, for these subjects, when time ratios were employed to estimate the equations, the intercepts of the resulting equations were significantly different from one another. For

Table 4 Group 1 repeated measures analysis of variance summary table, intercepts based on response ratios

SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARES	F RATIO	PROBABILITY
Subjects	0.062	3	0.021		
Repeated Measure	0.213	2	0.107	2.150	0.116
Within Repeated Measures	0.203	6	0.034		

Table 5 Group 1 repeated measures analysis of variance summary table, intercepts based on time ratios

SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARES	F RATIO	PROBABILITY
Subjects	0.015	3	0.005		
Repeated Measure	0.213	2	0.079	11.934	0.008
Within Repeated Measures	0.040	6	0.007		

Table 6 Group 2 repeated measures analysis of variance summary table, intercepts based on response ratios

SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARES	F RATIO	PROBABILITY
Subjects	0.114	5	0.023		
Repeated Measure	0.237	2	0.118	12.013	0.002
Within Repeated Measures	0.098	10	0.010		

Table 7 Group 2 repeated measures analysis of variance summary table, intercepts based on time ratios

SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARES	F RATIO	PROBABILITY
Subjects	0.072	5	0.014		
Repeated Measure	0.285	2	0.143	11.735	0.002
Within Repeated Measures	0.122	10	0.012		

Group 2 subjects, Tables 6 and 7, regardless of whether the intercepts were bases on the log response ratios or the log time ratios the intercepts differed significantly from one another across the three phases of the experiment.

To examine the differences amongst the intercepts in greater detail, Scheffe's tests for multiple comparisons were performed. In performing these tests, three different comparisons were made. The phase one intercepts were tested against the phase two intercepts, the phase three intercepts were tested against the phase two intercepts, and the phase one and three intercepts, in combination, were tested against the second phase intercepts. Since there was no effect of the inequity manipulation for Group 1 subjects when response ratios were employed to estimate the matching equations, the intercepts based on these data were not subjected to Scheffe's test. Table 8 presents the results of the Scheffe's test for the remaining data. As can be seen in Table 8, all the comparisons were significant. The direction of the differences can be seen in Table 9 which presents the mean intercepts for the two groups. In all cases, in Table 9, the mean intercept values, when subjects were exposed to one equitable and one inequitable relationship, were less than the mean intercepts when subjects were exposed to two equitable relationships.

Table 8 Scheffe's test for multiple comparison

Group 1

Dependent Variable	Comparison	F Ratio/ Degrees of f	Probability
Time ratios	Baseline vs. Intervention	15.44/(2,9)	0.05
	Return to baseline vs. intervention	16.11/(2,9)	0.01
	Baseline and return to baseline vs. intervention	21.04/(2,9)	0.01

Group 2

Dependent Variable	Comparison	F Ratio/ Degrees of f	Probability
Response ratios	Baseline vs. intervention	23.52/(2,15)	0.01
	Return to baseline vs. intervention	7.52/(2,15)	0.05
	Baseline and return to baseline vs. intervention	16.13/(2,15)	0.01
Time ratios	Baseline vs. intervention	23.25/(2,15)	0.01
	Return to baseline vs. intervention	9.18/(2,15)	0.05
	Baseline and return to baseline vs. intervention	20.56/(2,15)	0.01

Table 9 Mean intercepts across the three phases of the experiment

Group 1

	Equity	Inequity	Equity
Based on time ratios	-0.002	-0.235	0.002

Group 2

	Inequity	Equity	Inequity
Based on response ratios	-0.308	-0.028	-0.150
Based on time ratios	-0.263	-0.042	-0.150

IV. Discussion

The results of this research clearly demonstrate that the matching law describes the behavior of actors when they are confronted with alternative social exchange partners. The matching law predicted very precisely how subjects would distribute their time and behavior in response to the reinforcements they received from their alternative partners. By supporting the matching law conceptualization of choice, the data with equal clarity indicate that the position of current exchange theorists is untenable. Subjects in this research did not interact solely with the alternative partner who proved to be the more generous. Their behavior was not in accord with Homans', Thibaut and Kelley's, and Emerson's account of choice in social interaction.

While it is important that this research has been able to demonstrate the applicability of the matching law to social situations, it is perhaps of even greater importance that this research has shown that the intercept of the matching equation is sensitive to the manipulation of a sociologically important social stimulus. The intercepts of the matching equations in this research deviated from the theoretical value of zero, away from the inequitable partner. Subjects responded more and spent more time interacting with their equitable partners than was warranted by the relative number of reinforcements they received from this partner.

The sensitivity of the intercept to the manipulation of socially important stimuli has important implications for both the operational and theoretical levels of exchange theory. At the operational level, the intercept provides a quantitative and directly interpreted measure of the effects of a systematic difference between alternative exchange partners. This point is illustrated by the matching equations for Subject 2 for the initial inequitable phase of the experiment and the subsequent equitable phase.

$$\text{Inequity} \quad \ln(Bb/Bc) = -0.28 + 0.92 \ln(Rb/Rc)$$

$$\text{Equity} \quad \ln(Bb/Bc) = 0.06 + 1.00 \ln(Rb/Rc)$$

When Rb and Rc are equal, the log of the reinforcement ratio is equal to zero and the predicted value of the log response ratio is equal to the intercept. When the antilog of the log response ratio and intercept are taken, the following obtains.

$$\text{Inequity} \quad Bb/Bc = 0.76$$

$$\text{Equity} \quad Bb/Bc = 1.06$$

The value 0.76 indicates that if the reinforcements obtained from both alternatives were equal, that Subject 2 would respond 76 times to her inequitable partner for every 100 times she responded to her equitable partner. Similarly, the value 1.06 indicates that in the second phase of the experiment, under a condition of equal reinforcements from both alternatives, Subject 2 would respond 106 times to the partner who had previously treated her inequitably for every 100 responses she gave to the partner who had previously acted equitably. As can be seen from this example, the intercept of the matching equation captures the effects of systematic differences between alternatives in a manner which is very easily interpreted.

Employing ln k as the operational definition of the effects of systematic differences between alternatives has marked advantages over the approach of Hamblin (1977) to this problem. Hamblin advanced a multivariate version of the matching equation in which the systematic difference between alternatives is included as a term in his equation. Hamblin's equation is presented below. His equation has been changed to make his notation consistent with the notation employed throughout this thesis.

$$\ln (Bb/Bc) = \ln k + a \ln (Rb/Rc) + n \ln (Vb/Vc)$$

Vb and Vc represent the value of the reinforcers received from the two alternatives. A problem with this approach is that it requires a level of measurement which is not often found. Rarely in social psychology is the independent variable assigned a numeric value which corresponds to some underlying metric. Most stimuli of interest to social psychologists are conditioned stimuli, and are not as easily measured as Hamblin's concept of value. Thus unless status were first quantified, the effects of having exchange partners of unequal status could not be investigated. The bivariate version of the matching equation does not require this level of measurement in order for research to proceed. Rather all that is necessary is to create a systematic difference between alternatives without regard to the degree of difference which exists between the alternatives. Consequently, employing the intercept of the bivariate matching equation to capture the effects of systematic differences between alternatives is methodologically more tractable than Hamblin's multivariate approach.

The sensitivity of the intercept ln k to systematic differences between alternatives also has important theoretical implications for the development of social exchange theory. The differences which exist between alternatives which are of concern to social psychologists pertain to such variables as equity, status, attitudinal similarity, and degree of previous exposure. Berger and his associates (1977) are concerned with how individuals respond differentially to individuals of higher or lower status. Byrne (1971) is concerned with how differences in attitudinal similarity affect interaction. Finally, Zajonc (1968) is concerned with how differences in previous exposure affect attraction. All these authors are concerned with how systematic variation in one or another variable affects how an individual responds to his social environment. In developing their discussion concerning the effects of variables such as status, attitudinal similarity, and degree of previous exposure, the authors have developed unique theories to explain the effects of each of these variables. The sensitivity of the intercept of the matching equation to systematic differences between alternatives in combination with the principle of discrimination (Homans, 1974: 22), may render possible the integration of these particular theories with a matching law based theory of social exchange. This contention is based on the position that many of the variables of interest, such as status, function as discriminative stimuli.

In this research it was argued that signs of inequity biased the matching equations because such signs function as discriminative stimuli. Other variables of interest to social psychologists may function in an analogous manner. For example, actors may find that responding to a high status actor is more likely to result in positive consequences than responding in a similar fashion to low status actors. If such differential consequences obtain, then status characteristics acquire discriminative functions. That is, an individual is more likely to emit deferential responses in the presence of a high status actor than a low status actor.

If this characterization of status as a discriminative stimulus is correct, then it would be predicted that in an exchange setting involving alternative partners of unequal status, that an individual would respond more to the high status actor than was warranted by the relative number of reinforcements obtained from this individual. The intercept of the matching equation would deviate from the theoretical value of zero toward the higher status exchange partner. The effects of status on interaction from this perspective are accounted for by the stimulus control proposition in combination with the matching law.

If analogous arguments are possible with respect to other variables which past research has shown to affect interaction, then one could account for the effects of such variables in terms of a standard set of propositions, rather than creating unique theories to account for the effects of each of them separately. For example, if the effects of status on interaction can be accounted for by the stimulus control proposition in combination with the matching law, the elaborate set of propositions developed by Berger and his associates to account for the effects of status is rendered unnecessary. To the extent that the development of a standard set of propositions is possible, the concept of bias may prove to be the theoretical point at which the various theories of interaction intersect with a matching law based theory of social exchange.

The matching law conceptualization of social exchange provides a parsimonious and precise description of the relationship between an actor's behavior toward alternative social exchange partners and the reinforcements received from these alternative partners. As a basic principle of social exchange theory, the matching law locates an actor's relationships within a broad network of social relationships. Relationships are not viewed in isolation but rather in terms of their functioning as alternatives for one another. In doing so, the matching law makes choice the major focus of attention for social exchange theory. This is in marked contrast to previous conceptualizations which have stressed the law of effect and absolute rates of response. While the law of effect must still be included in any behavioral theory of exchange, it can no longer serve as the basis of predicting choice. Rather the matching law, with its concern with relative rates of response (i.e. sociometric choice) is a more appropriate basic premise. It provides a simple and precise account of how an actor distributes his time and behavior between alternative exchange partners.

Appendix A

Absolute Rates of Response and The Matching Law

Although single operant principles cannot be employed to predict behavior in concurrent operant settings, the opposite is not the case. The absolute response rate on one key in a concurrent operant setting can be predicted on the basis of reinforcements obtained in that setting. Hunter and Davison (1978: 536) propose two alternative equations which can be employed to predict absolute response rates in concurrent operant settings. These equations are presented below.

$$Pi = ki(Ri/\Sigma R)^{a} \quad \ldots\ldots (1)$$

$$Pi = ki(Ri^{a}/\Sigma R^{a}) \quad \ldots\ldots (2)$$

where Pi is the overall response rate on key i,

Ri is the overall obtained reinforcement rate resulting from responding on key i,

ΣR is the sum of Ri across n keys, and

ki is empirically derived.

The value of a which was employed in estimating Eq. (1) and (2) was the estimated value of a based on Baum's log ratio formulation of the matching law. Hunter and Davison [illegible]ise" ratios of the data from the four keys, A to [illegible]/C, ... D/A) and fit these ratios across the [illegible] conditions where there were four operants. These data were fit according to the following equation.

$$\ln (Pi/Pj) = a \ln (Ri/Rj) + \ln k \qquad (3)$$

In Eq. (3), the values of Pi and Pj are equivalant to the values of Bb and Bc employed throughout this thesis.

In fitting Eq. (1), the percentage of variance explained ranged from 77% to 90% across the four birds employed by the authors, with a mean variance explained of 85%. When Eq. (2) was estimated for each bird, the variance explained ranged from 77% to 92% with a mean of 86%. It is apparent then that although single operant principles cannot be employed to predict relative rates of responding in concurrent operant settings, that absolute rates of responding can be predicted on the basis of modified versions of the matching law.

Appendix B

Instructions to Research Participants:

Centre Person

The purpose of this research is to study long term social interaction. As you can see from the following diagram, you are the centre person in a three person chain. You have two people you can interact with, Partner A and Partner B. Two other research participants act as these two individuals.

Partner A----------You----------Partner B

You interact with your partners by means of the gray interaction panel in front of you.

The interaction panel allows you to interact with your two partners by pressing the buttons marked A and B. By rapidly pressing button A, you can give points to your Partner A. You give points to your Partner B in the same way. You are the only source of points for your partners. The numbers which appear on the counters marked To Partner A and To Partner B tell you how many points you have given each of them. To switch your attention from one partner to the other, you must throw the switch marked Change Switch in her direction. For example, if you throw the switch in the direction of Partner B, this will turn on a light on Partner B's panel telling her that you are ready to interact with her. If you notice that when you are pressing a particular button that the button does not light up, this means that

formulation of the law of effect." Pp. 203-287 in W.K. Honig and J.E.R. Staddon (eds.), Handbook of Operant Behavior. New York: Prentice-Hall.

Emerson, Richard M.
1962 "Power-dependence relations." American Sociological Review 27: 31-41.

1969 "Operant psychology and exchange theory." Pp. 379-405 in R.L. Burgess and D. Bushell (eds.) Behavioral Sociology. New York: Columbia University Press.

1972a "Exchange theory, part I: a psychological basis for exchange." Pp. 38-57 in Joseph Berger et al., (eds.) Sociological Theories in Progress, Vol. Two. New York: Houghton Mifflin.

1972b "Exchange theory, part II: exchange relations and network structures." Pp. 58-87 in Joseph Berger et al., (eds.) Sociological Theories in Progress, Vol. Two. New York; Houghton Mifflin.

Glass, G.V., V.L. Wilson and J.M. Gottman
1975 Design and Analysis of Time-Series Experiments. Boulder: Colorado University Press.

Graft, D.A., E.G. Lea and T.L. Whitworth
1977 "The matching law in and within groups of rats." Journal of the Experimental Analysis of Behavior 25: 182-194.

Gray, L.N. and M.H. von Broembsen
1976 "On the generality of the law of effect: social psychological measurement of group structures and processes." Sociometry 39: 175-183.

Hamblin, Robert L.
1977 "Behavior and reinforcement: a generalization of the matching law." Pp. 469-502 in Robert L. Hamblin and John H. Kunkel (eds.) Behavioral Theory in Sociology. New Brunswick, N.J.: Transaction Books.

1979 "Behavioral choice and social reinforcment: step function versus matching." Social Forces 57: 1141-1156.

Hamblin, R.L., D.L. Clairmont and B.A. Chadwick
1975 "Utility and gambling decisions: experiments and equations." Social Science Research 4: 1-15.

Hayes, Keith J.
1953 "The backward curve:a method for the study of learning." Psychological Review 60: 269-275.

REFERENCES

Baum, William M.
1972 "Choice in a continuous procedure." Psychonomic Science 28; 263-265.

1973 "The correlation based law of effect." Journal of the Experimental Analysis of Behavior 20: 137-153.

1974 "On two types of deviation from the matching law: bias and undermatching." Journal of the Experimental Analysis of Behavior 22: 231-242.

1975 "Time allocation in human vigilance." Journal of the Experimental Analysis of Behavior 23: 45-53.

Berger, J., Fisek M. H. and M. Zelditch Jr.
1977 Status Characteristics and Social Interaction. New York: Elsevier.

Blau, Peter M.
1964 Exchange and Power in Social Life. New York: Wiley.

Burgess, R.L. and J.M. Nielsen
1974 "An experimental analysis of some structured determinants of equitable and inequitable relations." American Sociological Review 39: 427-443.

Byrne, D.
1971 The Attraction Paradigm. New York: Academic Press.

Campbell, Donald T. and Julian C. Stanley
1963 Experimental and Quasi-Experimental Designs for Research. Chicago: Rand McNally Company.

Cantania, A. Charles.
1966 "Concurrent operants." Pp. 213-270 in Werner K. Honig (ed.) Operant Behavior. Areas of Research and Application. New York: Appleton Century-Crofts.

Coleman, James S.
1972 "Systems of Social exchange." The Journal of Mathematical Sociology 2: 145-159.

Conger, Rand and Peter Killeen
1974 "Use of concurrent operants in small group research." Pacific Sociological Review 17: 399-416.

de Villiers, P.A.
1977 "Choice in concurrent schedules and a quantitative

the Change Switch is pointing in the wrong direction. Also, because of the Change Switch, you can interact with only one partner at a time.

Only while the Change Switch is pointing in the direction of a particular partner, can that partner give you points. The numbers which appear on the counters marked <u>From Partner A</u> and <u>From Partner B</u> tell you how many points each of your partners has given you.

For each point you receive from each of your partners, you will receive one cent (1¢). However, each point you give away to one of your partners will <u>cost</u> you one tenth of a cent (0.1¢). You will be paid the difference between what you earn and give away at the end of every second experimental session. The interaction panels are designed so that you and your partners must work equally hard to give away one point.

When you hear the sound of the buzzer, you may begin interacting with your partners. After 1 hour, the buzzer will sound again telling you to stop interacting. Please remain seated until the research assistant tells you that you can leave.

If you have any questions concerning how to operate the panel or what any of the counters indicate, please ask the research assistant now, before the research begins.

REFERENCES

Baum, William M.
1972 "Choice in a continuous procedure." Psychonomic Science 28; 263-265.

1973 "The correlation based law of effect." Journal of the Experimental Analysis of Behavior 20: 137-153.

1974 "On two types of deviation from the matching law: bias and undermatching." Journal of the Experimental Analysis of Behavior 22: 231-242.

1975 "Time allocation in human vigilance." Journal of the Experimental Analysis of Behavior 23: 45-53.

Berger, J., Fisek M. H. and M. Zelditch Jr.
1977 Status Characteristics and Social Interaction. New York: Elsevier.

Blau, Peter M.
1964 Exchange and Power in Social Life. New York: Wiley.

Burgess, R.L. and J.M. Nielsen
1974 "An experimental analysis of some structured determinants of equitable and inequitable relations." American Sociological Review 39: 427-443.

Byrne, D.
1971 The Attraction Paradigm. New York: Academic Press.

Campbell, Donald T. and Julian C. Stanley
1963 Experimental and Quasi-Experimental Designs for Research. Chicago: Rand McNally Company.

Cantania, A. Charles.
1966 "Concurrent operants." Pp. 213-270 in Werner K. Honig (ed.) Operant Behavior. Areas of Research and Application. New York: Appleton Century-Crofts.

Coleman, James S.
1972 "Systems of Social exchange." The Journal of Mathematical Sociology 2: 145-159.

Conger, Rand and Peter Killeen
1974 "Use of concurrent operants in small group research." Pacific Sociological Review 17: 399-416.

de Villiers, P.A.
1977 "Choice in concurrent schedules and a quantitative

Henschel, R.L.
1971 "Sociology and prediction." American Sociologist 6: 213-220.

Herrnstein, R.J.
1961 "Relative and absolute strength of response as a function of frequency of reinforcement." Journal of the Experimental Analysis of Behavior 4: 267-272.

1970 "On the law of effect." Journal of the Experimental Analysis of Behavior 13: 243-266.

1974 "Formal properties of the matching law." Journal of the Experimental Analysis of Behavior 21: 159-164.

Herrnstein, R.J. and D.H. Loveland
1975 "Maximizing and matching on concurrent ratio schedules." Journal of the Experimental Analysis of Behavior 23: 107-116.

Homans, George C.
1961 Social Behavior: Its Elementary Forms (Original ed.) New York: Harcourt Brace Jovanovich.

1974 Social Behavior: Its Elementary Forms Revised Edition. New York: Harcourt Brace Jovanovich.

Hunter, I.W. and M.C. Davison
1978 "Response rate and change over performance on concurrent variable-interval schedule." Journal of the Experimental Analysis of Behavior 29: 535-556.

Lea, S.E.G.
1978 "The psychology and economics of demand." Psychological Bulletin 85: 441-466.

Lerner, M.J. and C.H. Simmons
1966 "Observers reaction to the 'innocent victim': compassion or rejection." Journal of Personality and Social Psychology 4: 203-210.

Miller, H.L. Jr.
1976 "Matching-based hedonic scaling in the pigeon." Journal of the Experimental Analysis of Behavior 25: 335-347.

Miller, H.L. Jr., and Donald H. Loveland
1974 "Matching when the number of response alternatives is large." Animal Learning and Behavior 2: 106-110.

Molm, L.D.
1979 "The effects of reinforcement differences and disruptions of social exchange in alternative task situation." Social Psychology Quarterly 42: 158-171.

Pliskoff, Stanley S., and Thomas G. Brown
1976 "Matching with a trio of concurrent variable-interval schedules of reinforcement." Journal of the Experimental Analysis of Behavior 25: 69-73.

Rachlin, H.
1974 "Self-control." Behaviorism 2: 94-107.

Rachlin, Howard, Green, L., Kagel, J.H. and R.C. Battalio
1976 "Economic demand theory and psychological studies of choice." Pp. 129-154 in Gordon H. Bower (ed.) The Psychology of Learning and Motivation. New York: Academic Press.

Schroeder, Stephen R. and James Holland
1969 "Reinforcement of eye movement with concurrent schedules." Journal of the Experimental Analysis of Behavior 12: 897-903.

Sidman, M.
1960 Tactics of Scientific Research. New York: Basic Books.

Thibaut, J.
1950 "An experimental study of the cohesiveness of underprivileged groups." Human Relations 3: 251-278.

Thibaut, John W. and Harold H. Kelley
1959 The Social Psychology of Groups. New York: Wiley.

Walster, Elaine, Walster, G. William and Ellen Berscheid
1978 Equity Theory and Research. Boston: Allyn and Bacon.

Zajonc, R.B.
1968 "Attitudinal effects of mere exposure." Journal of Personality and Social Psychology Monograph Supplement 9: 1-27.

Zelditch, M.
1969 "Can you really study an army in the laboratory?" Pp. 528-539 in A. Etzioni (ed.) A Sociological Reader on Complex Organizations. New York: Holt, Rinehart and Winston.