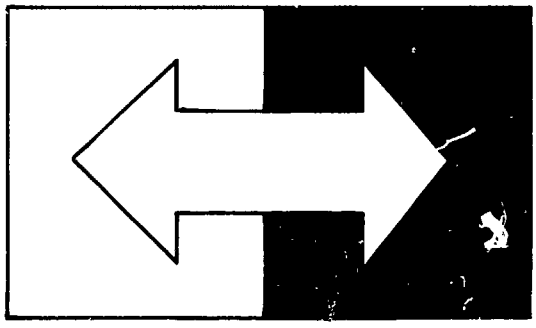
COOPERATION / CONFLICT RESEARCH GROUP



70-7

A Division of Computer Institute
for Social Science Research
Michigan State University

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)	2a. REPORT SECURITY CLASSIFICATION
MICHIGAN STATE UNIVERSITY Computer Institute for Social Science Research East Lansing, Michigan	UNCLASSIFIED 2b. GROUP

3. REPORT TITLE

Attribution of Strategies in the Prisoner's Dilemma Game: A Symbolic Interaction Approach

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Scientific Interim

5. AUTHOR(S) (First name, middle initial, last name)

Paul Joseph O'Grady

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
30 December 1970	198	106

8a. CONTRACT OR GRANT NO. F44620-69-C-0114 (THEMIS)	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO. 7921	70-7
c. 102F	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d. 681313	AFOSR-70-2885TR

10. DISTRIBUTION STATEMENT

Approved for public release; distribution unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Office of Scientific Research 1400 Wilson Boulevard (NL) Arlington, Virginia 22209

13. ABSTRACT

This report investigated the relation between cognitive factors and subjects' choices in a standard two choice Prisoner's Dilemma Game (150 trials). Mead's concept of the significant symbol was proposed as an alternative to the imitation hypothesis of Rapoport and Chammah. Mead's theory of social interaction was translated into a decision theoretic model to test this cognitive position.

Three levels of impressions of the other were assumed sufficient to describe the characteristics of the simulated other, as a result of his strategy choices. A noncontingent strategy reflected an other who would be considered a cooperative martyr. Such an impression was expected to elicit an exploitive response on the part of the other. A contingent strategy reflected an other who would be considered cooperative but not a martyr. Such an impression was expected to produce more cooperative responses by the subject. A third state, neither cooperative nor a martyr, was postulated as an error state that would elicit a noncooperative choice.

To test these predictions 120 subjects were assigned randomly to one of eight experimental conditions. An analysis of variance of the final 120 trials indicated that the subjects responded more cooperatively to a contingent than to a noncontingent strategy.

In addition subjects were asked to fill out a rating scale of the other after the thirtieth trial. A multiple discriminant function analysis of these data revealed that subjects formed impressions of the other consistent with the strategy he adopted. While this analysis tended to support Mead's theory the predictions generated by the model failed to do so. A modification of the response portion of the model was suggested to obtain a better fit to the data.

DD FORM 1 NOV 1473

UNCLASSIFIED

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Cognitive Factors						
Experimental Gaming						
Prisoner's Dilemma Game						
Mathematical Model						
Multiple Discrimination Function Analysis						
Significant Symbol						
Strategy						
Symbolic Interaction						

ATTRIBUTION OF STRATEGIES IN THE PRISONER'S DILEMMA GAME: A SYMBOLIC INTERACTION APPROACH

Paul Joseph O'Grady

Cooperation/Conflict Research Group
Michigan State University
East Lansing, Michigan

70-7

(F44620-69-C-0114)

ABSTRACT

ATTRIBUTION OF STRATEGIES IN THE PRISONER'S DILEMMA GAME: A SYMBOLIC INTERACTION APPROACH

BY

Paul Joseph O'Grady

This dissertation investigated the relation between cognitive factors and subjects' choices in a standard two choice Prisoner's Dilemma Game (150 trials). Mead's concept of the significant symbol was proposed as an alternative to an imitation hypothesis. An extensive review of the literature around the Prisoner's Dilemma revealed that the major explanation that has been proposed to account for behavior in this game is the Rapoport and Chammah imitation thesis. It was reasoned that if this were so then behavior observed in Prisoner's Dilemma Games where the other was simulated was inexplicable. For these classes of experiments it was proposed that an explanation based on social cognitions was more appropriate. This was supported by the fact that a number of experimenters working with this game had offered post hoc interpretations of the subject's behavior that included statements about the impression of the other that the subjects must have formed. Mead's theory of social interaction was translated into a decision theoretic model to test this cognitive position.

Three levels of impressions of the other were assumed sufficient to describe the characteristics of the simulated other, as a result of his strategy choices. A noncontingent strategy reflected an other who

would be considered a cooperative martyr. Such an impression was expected to elicit an exploitive response on the part of the other. A contingent strategy reflected an other who would be considered cooperative but not a martyr. Such an impression was expected to produce more cooperative responses by the subject. A third state, neither cooperative nor a martyr, was postulated as an error state that would elicit a noncooperative choice. Furthermore the effect of these basic strategies was expected to vary directly as the clarity or frequency with which the strategy was followed by the simulated other, increased. It was also postulated that a note, reflecting the underlying strategy would increase for the subject the clarity of the other's strategy.

To test these predictions 120 subjects were assigned randomly to one of eight experimental conditions. Subjects faced either a contingent or noncontingent strategy at high or low levels of clarity and with or without an exchange of notes. An analysis of variance of the final 120 trials indicated that the subjects responded more cooperatively to a contingent than to a noncontingent strategy. Furthermore the strategy had more effect on the subjects' responses as it became clearer. Passage of a note which was expected to clarify the strategy of the other increased cooperative choices across all treatment conditions resulting in an unexpected finding for the noncontingent conditions. In addition subjects were asked to fill out a rating scale of the other after the thirtieth trial. A multiple discriminant function analysis of these data revealed that subjects formed impressions of the other consistent with the strategy he adopted. While this analysis tended to support Mead's theory the predictions generated by the model failed

to do so. A modification of the response portion of the model was suggested to obtain a better fit to the data.

Two ancillary experiments were run using the same PDG game. The first study found that the sex of the player was important in determining his or her reaction to the other person's strategy. Females cooperated more with a noncontingent other whereas males cooperated more with a contingent other. Furthermore males cooperated more with an other whom they believed to be a human than they did with an other that they thought was a machine.

ATTRIBUTION OF STRATEGIES IN THE PRISONER'S DILEMMA GAME: A SYMBOLIC INTERACTION APPROACH

By

Paul Joseph O'Grady

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Psychology

To my wife, Frances, and to

my family.

ACKNOWLEDGEMENTS

I would like to express my appreciation to the members of my committee, Drs. James L. Phillips, Terrence Allen, Bertram P. Karon, and Lawrence Messé, for the help and assistance they gave in the preparation of the thesis. I would especially like to thank Dr. Phillips who, in directing the thesis, provided me with the support, encouragement and freedom to work on what I regarded as an interesting problem. I would also like to express my appreciation to Dr. C. Kenoyer, Mr. G. Mendelsohn, Mr. J. Maas and Mr. A. Hartman for their aid and assistance. The research was made possible from funds provided by the National Science Foundation (GS 2358) and by the Air Force Office of Scientific Research (F 44620-69-C-0114).

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

Introduction

Theories of Social Perception

The major premise of this dissertation is that the course of interpersonal interaction between humans can best be understood with reference to the inferences that the interactants make about their exchanges. Implicit in this statement is the idea that differing cognitions are possible for the same interaction. However, given the cognitions of any interactant, his subsequent social behavior is assumed to become understandable. Given the cognitions of both subjects the interpersonal interaction becomes understandable. The cognitions are thus assumed to determine the behavior observed in the interaction. However, there is no unique relationship between the cognition and behavior. To illustrate, it is possible to list a set of cognitions A, B and C and a set of behaviors X and Y such that when A occurs X follows, when C occurs Y follows but when B occurs either X or Y may follow depending upon circumstances. From this example it can be seen that differing cognitions (A and B or B and C) will give rise to the same behavior (either X or Y) or that differing cognitions (A and C) will give rise to differing behaviors (X and Y). Thus it can be expected that differing cognitions will give rise to the same behaviors and also that differing cognitions may give rise to differing behaviors. It is then possible to conceive of a social situation which gives rise to differing cognitions among the participants, which lead to the same behavior. It is also possible to conceive of differing social behaviors which give rise to the same cognitions and the same behavior then ensues on the part of the cognizers.

There exists evidence from several sources that people make inferences about the behavior of others and that one person's inferences may differ from another's inferences. It is also possible that one person's inferences about the behavior of the other differs from an objective description of the strategy behind the behavior. Both of these cases are described as error in the discussion which follows.

Shure, Meeker and Hansford (1965) investigated the effectiveness of a pacifist strategy on exploitation in an experiment where each of two subjects was expected to communicate a five unit message through a six unit channel. In order to succeed the entire five units had to be transmitted. Thus on any given trial only one of the subjects could succeed on the task. Once a subject had succeeded in transmitting he was able to control the outcome of the remainder of the game. In the experiment, one of the players was simulated and assumed a pacifist strategy by always letting the subject go first and never retaliating against the subject's exploitation. When the simulated player communicated his intention a number of subjects ceased to dominate the pacifist. Those who continued to dominate in the communication condition saw the pacifist as trying to embarrass and deceive them. The authors concluded that for a limited number of subjects the behavior of the simulated other led to conversion to pacifist behavior, but for others their resolve to dominate was strengthened by attributing trickery to the motives of the pacifist.

Kelley, Thibault, Radloff and Mundy (1962) found that subjects in an experimental game situation, simpler than a mixed motive game, exhibited more cooperation than subjects who had no knowledge of the other person when (a) they knew they were playing with another person

(b) were instructed to maximize their own gain. In postexperimental questionnaires 21 of the 26 dyads who reached a high level of cooperation as opposed to only two of the eight remaining dyads, reported making the assumption that their partner's behavior would be stable if he were receiving positive scores and variable if they were receiving negative ones. The authors concluded that taking account of the partner promoted the achievement of a mutually rewarding relationship. It would seem that when very simple game situations are present very little error in attributions can intrude to spoil the process of solution.

For a more complicated exchange Rosenberg and Cohen (1966) considered the interpretation of the speaker's utterance by a listener at any given time to be determined by a probabilistic process. This process, called the referential process of the listener, is modified by the listener's immediate environment, his linguistic development, previous interactions with the speaker, perception of the speaker, and so on. There is then a good chance for error to intrude in the interpersonal process according to the model. Nevertheless tests of the listener model gave a good fit to the data collected. One hundred and ten male undergraduates were all given the 256 sets, each set having three words in it. Of these three words two were a synonym pair and one was the speaker's response to one or both members of that synonym pair. The probability that the response elicited one member of the referent pair rather than another was predicted to be a linear log function of the ratio, of the response's associative strengths to each of the referent pair. This associative strength had been determined from an independent study in which a large number of subjects were asked to give the first associate that came to mind when one of the

referent pair was the stimulus. There was no systematic curvilinearity between the predicted choices and the observed choices. Furthermore the constants estimated from the data were found to be independent of the particular associative strengths used to estimate the actual choices. The model can be considered cognitive in that a stimulus is compared to hypothetical referents and that referent is selected which has a higher associative scale value. Thus communication at the verbal level is considered by Rosenberg and Cohen to involve cognitive inferential processes.

In a more pragmatic setting, post hoc analysis by Toch (1969) of reported violent incidents involving members of a police department revealed a cognitive process at work. Unlike the situations investigated above, the cognitions and inferences arising out of the situation led to deteriorating outcomes for both participants. Toch investigated the arrest reports of some 344 violent incidents that occurred over a three year period. The investigation included an interview of both participants by one of their peer group. Two thirds of these reported assaults followed one of two sequences. In the first sequence the officer initiated it by issuing an order, making a demand, or extending a request which he and most other members of the community define as a legitimate function of a police officer. From interviews it was found that the other person did not perceive the officer's behavior as legitimate but considered him to be acting in a highly abusive and threatening manner. Thus the same behavior was perceived in one manner if the person were emitting it and another manner if another person was on the receiving end of the behavior. The cognitions were such that both participants considered themselves as blameless.

Anecdotal evidence exists as well to support this viewpoint. On April 20, 1969 a group of black students emerged from the administration building they had occupied at Cornell. As they emerged a picture was taken of the blacks and distributed to the wire services. The picture showed them armed with bandoliers of ammunition and rifles poised. Some two months later H. D. Quigg and Leon Pitt (1969) of the United Press International held an inquest into the photograph. The president of Cornell reported an onslaught of mail and telegrams in reaction to the photo. All of these communications expressed horror, terror and disbelief. However Perkins noted that two negotiators who had talked with the blacks the day before, had found them extremely frightened of coming out into an ambush. That their fears were not groundless is supported by the fact that the police had never previously offered them protection, and had allowed the white fraternities into the building to fight the Negroes. Both the black students and white administrators had heard of threats emanating from the community that armed white men were reported ready to descend and terminate the black presence at Cornell. The white backlash was thus at best incomplete and at worst erroneous in the attributions made about the armed Negroes.

Not only are inferences possible in human communication and interaction but people make use of this fact when they encode their messages for communication. Thus Rosenberg and Cohen (1966) assumed that the referential process of the listener in decoding a speaker's response is similar to the comparison process the speaker undergoes while encoding the referent. (It must be said that the authors limit their theory to verbal stimuli only for matters of experimental convenience.) This similarity was exploited by Krauss, Vivekananthan

and Weinheimer (1968). In an experiment using females as subjects they instructed the subjects to find verbal labels for 24 Munsell color chips. Half of the subjects were told that the names would later be used by the subjects themselves to identify the colors (nonsocial encoding condition). The remainder were told that the names would be decoded by some other person (social encoding condition). After two weeks all subjects were asked to match each of 72 names with the appropriate color. Twenty four of the names were the ones the subject had produced under the nonsocial encoding conditions; twenty four names were produced by another subject under the nonsocial encoding condition; twenty four names were produced by another subject under the social encoding conditions. The communication effectiveness of socially and nonsocially encoded messages was assessed by measuring the frequency with which names given in the encoding session enabled subjects in the decoding session to identify colors which had elicited them. Subjects were found to be most accurate in identifying colors from their own encodings. They were next most accurate in identifying colors named by another person in the social encoding condition. The nonsocially encoded words were least accurately identified. For present purposes it can be concluded that subjects can select stimuli which are increasingly communicable when they are aware that another person is involved in the communication act.

In a wide range of situations, evidence has been accumulated that the inferential processes of man play an important role in how he behaves and communicates and thus what will be the outcome of his social interactions. Several theories have addressed themselves to unravelling the seam of cognitive inference from the fabric of social interaction. Such a theory must indeed be complex since it involves

cognitions about self and the other's behavior. These cognitions between the two people may or may not be the same because behavior is not uniquely related to cognition. Thus the inferences for two people, A and B, may or may not agree about person B's behavior. However the historical trend of theories dealing with this sort of situation has been toward greater simplification. The following explication of four theoretical positions will illustrate this historical trend.

The first theory to be considered is that of George Herbert Mead. Mead was a sociologist who was heavily influenced by Dewey's philosophy and George Cooley's theorizing. His theoretical position could be characterized as that of a social behaviorist. This does not mean that he was interested only in that behavior which we regard as social. It means instead that all human actions have a social reference. To state it another way, distinctively human behavior is accountable only on a social basis. In particular that phenomenon known as "the mind" can be understood only in terms of social behavior. Mead's theory (1934) regards the social behavior of man as distinctly human and as qualitatively distinct from infrahuman social behavior. Mead feels that the very diverse patterns of human cooperation argue against instinctual determination of social behavior.

He postulates that the individual uses a process that (a) allows him to ascertain the intention of the acts of others (b) enables him to make his own response to that perceived intention. To understand this we must define some of Mead's terms. The act for Mead is the basic unit of analysis. It starts with an experience of disequilibrium and ends when equilibrium is restored. Included in it are the experiences and behaviors of the individual and the experiences and behaviors of other individuals

who move that act to completion. An act may be of short or long duration. Moreover acts may be subsets of other acts.

The gesture is that portion of the act which represents the entire act, it is the initial, overt phase of the act which epitomizes it. The imaginative or behavioral completion of an act is called meaning. Mead says when a gesture is presented to an animal he responds to that gesture as such. A human, however, can postpone his response in favor of finding out the meaning of the gesture by completing it imaginatively. The individual can then be expected to respond to the perceived meaning of the gesture. A gesture is a significant symbol if it has a shared common meaning among two or more persons involved in the act.

Mead's theory remains general in two respects. First of all while he defines the gesture he does not limit it to any particular form. It could as well be any one of the following or a combination of them: a posture, a facial expression, a verbal intonation, a word or an action. Second, in Mead's theory of self the individual is able to select that gesture, by means of role-taking, that best epitomizes his own intention or meaning. The more adept the person is at role-taking the more likely the gesture will be a significant symbol. This ability to share, or not to share, the attitudes and intentions of another by means of the gesture in a social situation constitutes, for Mead, "mind." For him the mind is not just what goes on in the cortex but what can develop and appear in human social interaction through shared meanings.

Heider (1958) has postulated that interpersonal relations proceed in a manner similar to Mead's theory of symbolic interaction. He is especially concerned with interpersonal perception, the naive analysis

of action and the attribution by one person to another of such states as "can, trying, desire, pleasure" and intentions and other motivational states. In analyzing the general phenomena of social perception he notes that humans look for invariances in their environment. When dealing with inanimate objects, for example, psychologists have found that a distal stimulus such as a table can give rise to a variety of proximal stimuli in the sense receptors and yet the human being is capable of having an image, or focal stimulus, that is highly correlated with the original stimulus. This phenomenon is known in the psychology of perception as perceptual constancy.

In an analagous fashion Heider finds that social perception remains veridical despite a range of mediating social situations. The distal stimulus exists in the intention, motivation or ability of the other. In general Heider refers the distal stimulus to be a disposition of the perceived other For example, the adjective 'friendly" can be ascribed to an other over a wide range of social behaviors and/or mediating conditions. Heider assumes that the human engages in such cognitive activity in order to maintain consistency in a variegated world of stimulus patterns.

An important part of Heider's social perception theory is the notion that the proximal social stimulus is embedded in a pattern of stimulation. A stimulus may be ignored or made more salient according to its fit to the meaning that the total stimulus pattern presents. Heider uses the example of a child who presents a problem at school but not at home. The teacher and the parent in discussing the problem may ignore the differential effect that the two situations have on the child. The problem may be attributted to the child by one or the other

adult and not to the child-situation interaction as may be more befitting. A second point that Heider makes about the concept of embeddedness is that in social situations it may refer to the events that transpire over a period of time. The idea is that an individual may not be able to attribute a disposition to another until he has seen him in a variety of situations. An action that has no social meaning when viewed out of its social context may become understandable when what has preceded or followed it is made salient.

Besides the ideas of social constancy and embeddedness Heider discusses the naive analysis of action, the attribution of "can" and "trying" and the attribution of "pleasure." Since two recent theoretical developments have placed special emphasis on these processes they will be briefly discussed here.

For Heider the common man's problem is to attribute dispositions to another person as a consequence of observing the other in action. The problem presents itself in several forms. Was the other just lucky or was his success due to his ability? Was the reason for the person's failure due to environmental forces or was it because he wasn't trying? Perhaps, even, his failure was due to the fact that he cannot. Perhaps he can but wasn't trying. We see here that the attribution of "can" and "try" constitute a formidable problem for the common man. Once these certain dispositions can be assigned to a social other the common man feels he understands why a certain action came about. Once he understands he can take necessary action to facilitate or impede the action by the other in the future.

In analyzing the epistemological style of the common man Heider postulates that an action can come about (or not) as a combined function

of the environmental forces present, and the power or ability of the person with respect to the action, combined with how much he tries to carry it out. The values of "can" and "trying" are related in a multiplicative way while the value of the first variable can take on positive or negative values. Very often the naive attribution is in error. The child who fails in school may be considered to be not trying by the teacher. The parent may regard the failure to advance as due to environmental forces since the teacher is considered hostile to the child. In actuality the failure may be attributed to the ability factor since the child had not learned a crucial concept in an earlier grade. It can be understood that if a person carries out a task either he "can" do it or he was "lucky." Then the possibility is there that he has the latent ability. If an action is not taken we are able to say nothing about a person's ability since he may not have been trying to perform that action. While this represents a rational approach to the analysis of attribution the naive approach does not limit itself to such rationality and thus leaves itself open to error.

A second area of concern for Heider's attribution theory revolves around the assignment of desire or pleasure to the environment or to the person interacting with the environment. Thus a person A upon reading a book may say that a book is not enjoyable. A person B upon observing person A may say that the latter does not enjoy reading books since he knows for a fact that several others have found this same book enjoyable. Person A attributes the enjoyable experience to the environment whereas person B believes the experience is due to the person reading the book. If on the other hand, person A enjoys every book he reads, B would accuse him of lacking taste or of being undiscriminating.

In other words B will perceive A to be the source of the enjoyment rather than the books.

To account for such attributions Heider states that as long as the enjoyment is closely connected with the presence and absence of the object then enjoyment will be attributed to that object. This is the principle underlying Mill's methods of experimental enquiry. According to Heider this method is the basis of attributing action to the subject and/or to the environment. Heider points out that perception is attributed to a person when he makes a differential response to the presence and absence of the object or event in the environment. This is true for both naive and scientific psychology.

The person, rather than the object, is regarded as the source of enjoyment by any neutral observer under one of two conditions. First if the person is observed to not always enjoy the object at different periods of time then it is impossible to assign enjoyment to the object. In psychometric terms one can say that this condition exists if a person has low internal consistency. Then the enjoyment will be attributed to him or his transient personality states. Likewise if a neutral person has knowledge of a group of others' reactions to the object or event he can test a particular person's reactions against this norm. If it differs markedly, then the neutral can infer that the person is the source of the enjoyment or nonenjoyment. In psychometric terms there is little interpersonal agreement.

The difference for Heider between the scientist and the naive observer in the attribution of enjoyment is that very often the latter type of person relies upon a minimum data pattern to assign enjoyment. This pattern is defined as one instance of joint absence of the object

and the effect, and one instance of their joint presence. Generally the common person does not postpone attribution until a series of joint condition-effect changes occur. Consequently one finds that people expect they will enjoy again what they have enjoyed on one occasion or else expect others to enjoy what they themselves enjoy. Heider refers to the latter error as egocentric attribution.

It was stated earlier that theoretical developments in this cognitive social approach have tended towards greater simplification. Two of these recent developments have used Heider's psychology of interpersonal relations as the starting points for their own formulations. Despite this common heritage the two latest theories outline widely differing approaches to the problem of attribution by human beings. While this illustrates the heuristic value of Heider's theory it also points out that he did not spell out a univocal and final model. The most plausible explanation for this is that Heider placed great value on the comprehensiveness of his theory and consequently analyzed a wide variety of every day human situations where he felt the attribution process was in effect. The interrelationship of these situations is left unspecified except by virtue of the similar processes at work. Jones and Davis (1965) investigated how a person or observer infers a variety of dispositions of another from his actions. Their emphasis is upon delineating the necessary and sufficient conditions for assigning the correct disposition. They assume that a perceiver seeks to find sufficient reason why another person acted as he did and why that action took on a particular form. This necessitates that the perceiver establish links between stable individual dispositions and the observed action of the perceived person. It also entails finding out which of

the actions that finally do occur were foreseen by the person emitting the action. Kelley (1967) in his theoretical analysis pursues a more formal investigation than Heider's original investigation into the area. At the same time Kelley is interested in applying several of the concrete examples that Heider used, such as "enjoyment and trying" to the analytic scheme he proposed. The problem again deals with an observed effect such as an accomplishment or an enjoyment which occurs when an individual is present and interacts with a social object such as a book, a task or another individual. A second person, or even the individual himself, is assumed to try and understand the reason for any particular effect. In the simplest case this involves partitioning responsibility for the effect between the environmental social object and the individual. In particular Kelley has tried to determine how the naive person assigns an effect such as enjoyment to an object in the environment or to the person manifesting the enjoyment.

Jones and Davis define several terms in their presentation of attribution processes. An act is a molar response which reflects some degree of personal choice on the part of the actor and which has one or more effects on the environment or the actor himself. Effects are distinctive consequences of actions. An act may have any number of effects some of which may be in common to other acts that could have taken its place. Inferences are made on the basis of noncommon effects. Correspondence refers to the extent that the act and the underlying characteristic or attribute are similarily described by the inference.

The process of attribution is assumed by Jones and Davis to start with a person, A, seeking to find why another, B, acted as he did. This means that A has to establish a link between the individual B's

disposition and the observed action. Prior to this he must make sure what effects, of the ones following from an action, were intended by the actor B. In order to attribute this intention to another the perceiver must assume that the actor was aware of the observed effect his action would have. In addition Jones and Davis assume that the actor has the ability to bring about the effect or that it was not accidental. Once the intention of the act has been determined inferences can be made about underlying dispositions. The meaning of an action or its intentional significance can be understood by listing the effects it produces against the effects all other possible acts could have produced. That is, meaning becomes clearer as the number of unique effects associated with an act decreases. Correspondence is then postulated to be related inversely to the number of noncommon effects and inversely to the assumed social desirability of these effects. The latter social desirability factor relates the action to role behavior. Therefore little information is gained about a person's dispositions when the actions he performs are dictated by his role. To recapitulate, the fewer the number of noncommon effects associated with an action the more likely the correct intention will be inferred from the action. If the action is socially desirable, i.e. if everyone wishes to perform it, then no information is gained about an actor's unique characteristics.

Hedonic relevance means that the choices of the actor have some positive or negative consequences for the perceiver. Jones and Davis (1965) propose that as relevance increases there will be an increase in the likelihood that inferences will correspond because it reduces the number of unrelated or noncommon effects. Furthermore they assume that if the consequences of an act are predominantly positive the

perceiver will be more favorably disposed toward the actor. If consequences are negative the converse holds.

The inclusion of the term "hedonic relevance" introduces attribution processes into the framework of social interaction. From time to time Heider (1958) refers to social actions that can be taken as a result of attributions about an actor formed by the perceiver. However there is no psychological process outlined whereby the attributions and the action are connected. Kelley's (1967) reformulation of Heider's theory is also not tied to social action as much as it deals with social perception. (Jones and Davis (1965) omit the criterion of temporal consistency alluded to by Heider and explained by Kelley.) Kelley focuses on the problem of assigning causality to the self or to the object in the environment. This is closest to Heider's environmental and personal forces. Jones and Davis on the other hand analyze the problem from the point of view of discriminating a person's characteristics from the intentions of his act which in turn are inferred from the consequences of his actions. This is closest to Heider's description of the assignment of ability or motivation to another. To complete this theoretical review Kelley's theory of attribution will now be explained.

For Kelley, attribution refers to the process of inferring or perceiving the dispositional properties of entities in the environment. These properties can constitute any stable feature of any object. Kelley's theory will be discussed using social situations as the objects. Some of the features one might prefer to look for in another person in social interaction is his intention, what he desires and feels or what his basic ability is. The Kelley analysis, following Heider, assumes that people tend to achieve an active mastery of the events in their

environment and, to do so, use a naive version of Mill's method of difference as their basic analytic tool. This method says that an effect is attributed to that social object which is present when the effect is present and which is absent when the effect is absent. Kelley then uses a data cube to expiain the detailed workings of this law. Along one dimension of the cube entities or social objects are placed. Along a second orthogonal dimension a time-modality factor is placed. Along yet a third factor observers or persons including one observer called the self are placed. As defined by Kelley the problem for the self is to resolve whether a particular effect resides in the social object or in the self. The self solves the problem by noting whether the effect occurs when a particular object is present but the effect does not occur when some other objects are present. The effect is deemed by the self to be caused by the entity if other observers respond to it in the same way. Finally the effect is attributed to the distal object if the effect continues to be present when the object reappears over time or in different modalities. To sum up, the attributions to the social object require that the self respond differentially to the social object but that this response be consistent over time and modality. Furthermore this response must be consistent with the other person's responses to it. As an example, Kelley examines the enjoyability of a movie. The problem for an observer is to ascertain if a movie is inherently enjoyable. The sine qua non for such an attribution to be made is that the observer finds not all movies enjoyable. Also the observer must find the particular movie enjoyable if he sees it on television or if he sees it a second time.

Finally other people must be seen to appreciate the movie in the same way. If these conditions are not met the attribution is not made to the distal object but to the self or chance.

Jones and Davis' theory is recast by Kelley into his data cube. An inference of intention to another actor is made when a particular observed effect produced by another observer, called actor, follows certain conditions. First of all the demand characteristics of the situation (i.e. that time or that modality) cannot account for the effect. That is, other observers (including self) would produce differing effects given the same situation. This is Kelley's interpretation of Jones and Davis' social desirability criterion. A second condition for attributing an intention to the actor is the observation made by the self that the actor could have produced other effects in this situation. That is, under different situations, the actor has been observed producing several effects. The inference can be made that the actor has the ability (as Jones and Davis conclude) to produce several effects. Finally in order to infer an intention on the part of the actor, the effect must be constant across differing entities for any given social situation.

From this analysis Kelley makes the point that the self may not actually need to examine variations in behavior over a number of other observers. From his prior knowledge of social pressures, shared values, and situational demands he may be able to make consensus estimates. These estimates may be correct or incorrect.

Kelley's distillation of Heider's attribution theory has been discussed, first around the conditions necessary for any attribution to be made and second, as to how the Jones and Davis' version fit into

Kelley's data cube. Kelley also introduces systematic errors that can be made in attributions. According to Heider, errors can be traced to instances in which first, the relevant situation is ignored; second, egocentric assumptions are made; third, the relevant effects have affective significance for the observer; and fourth the surrounding situation is misleading.

Jones and Harris (1966) found that subjects ignored the relevant situation (Heider's first error category) by attaching too much significance to the behavior and its effect and too little to its situational context. Subjects observed a person express an unpopular and unexpected opinion. The opinion emitted by the person affected subjects' judgments of his true opinion even though the emitted opinion was elicited by strong, legitimate external pressure. Kelley also included in Heider's first error category another type of situation where the causal complexity of the situation may be such that the relevant causal factors are not ignored but are simply not perceptible. Kelley presents the example of a person who invests in stock during an inflationary economic period. The true causality is obscure enough that he perceives himself to have the characteristics of a wise investor.

Errors due to egocentric assumptions constitute the second bias process. These are important when the evidence for the attribution is not complete. The simple presence-absence assumption of Mill is simply not enough to ascertain causality. The example of violent interactions used earlier, illustrates well the egocentric bias. In such situations according to Toch violent people held premises about others that promoted the violent interchange. Very often this premise is invoked under minimal information conditions as the next example will show.

The inquest into the Cornell racial incident reveals the second type of error process at work. It would appear that because of ignorance and/or egocentricity, the white backlash to this picture was caused by an erroneous attribution to the black students. As pointed out in the earlier discussion of this incident whites who reacted to the photograph were unaware of rumors that circulated on campus that the Negroes' lives were in danger. The reaction also ignored fact that the police had allowed fraternity members into the building to beat up the Negroes. Only those administrators who talked with the Negroes were aware of the impact these two facts had on the Negro demonstrators. The reaction to the picture also involves the third type of error in attribution processes.

Fear was involved on both sides. This fear dominated the whites' perception of the picture and at the same time the blacks fear of a minority of whites dismissed any perception of protection that the white power structure was prepared to give them. According to Heider's third source of error the magnitude of affective consequences involved in an attribution may bias the inference process. For instance, criticism directed towards an actor by a group of observers may be attributed by another observer as the fault of the actor. The actor, as observer, may attribute the common treatment to a conspiracy against him. Ego protection of this latter sort was found by Johnson, Feigenbaum and Weiby (1964). Their subjects attempted to teach a nonexistent student some arithmetic. Before the teaching began, the student was represented by a set of very poor work sheets. The student was then given a unit of instruction by the subject-instructors and observed to improve by some instructors, but for others he continued to do badly. The former

instructors tended to take credit for themselves whereas the latter tended to attribute the poor performance to the student.

Subjects have been deliberately misled by the experimenter in order to achieve a fifth kind of attributional error. Kelley discusses this type of error as separate from Heider's four categories. To use this situation the subject's attention is diverted away by the experimenter from an important causal factor. Thus Schacter and Singer (1962) created a state of physiological arousal in subjects through the administration of a drug but misrepresented the causal link between the drug and the physiological effect. The subject then attributed his physiological arousal to the situation and took his cue as to the nature of the situation from another person who was responding to the same setting. But the social model has this effect upon the subject's behavior only when the subject can find no reasonable explanation for his arousal state. Another instance of this type of error is presented in a study by Valins (1966). The stimuli were a set of slides of semi-nude females. The subjects at the same time as they were viewing the slides could ostensibly hear their own hearts beating as they viewed the semi-nude women. In actuality, variations in heart rate were coordinated by the experimenter. Ostensible heart rate was increased (or decreased) for half the slides while for the other half of the pictures the heart rate remained the same. Subjects rated as more attractive the pictures with which changes in heart rate had been associated and more frequently chose them as remuneration for their experimental participation.

While the foursome of Kelley, Heider, Jones and Davis have detailed a theoretical realm that promises to shed light on a number

of experiments and social situations, there is some reason to believe that their theory is not all that well formulated. Kelley has used experiments to illustrate one error process but these same experiments could just as well have illustrated other error processes. Thus the Valins findings could just as well be a result of Heider's third error process as well as Kelley's fifth error category. That is, Valin's experiment contained a highly arousing or affective component in that males were viewing pictures of females who were seminude. Perhaps if this condition were not present there would be no chance for subjects to make errors due to the deceptions of the experimenter. Also errors made by ignoring the relevant situation (Heider's first category) are most likely to occur if the magnitude of affective consequences is increased. Yet Kelley does not discuss this. Also Kelley does not relate the error process to the attribution process. For example, for some subjects group consensus is effective in inducing misattribution as the Asch studies have shown. Thus the group consensus can be a source of bias. At the same time Israel (1963) has found that some subjects evoke a reference group against the group consensus in order to maintain veridical attributions in the Asch conformity situation. Now this would suggest a fourth dimension in Kelley's data cube. Yet Kelley allows "shared values, social pressures and institutional pressures" to take the place of the group consensus, when no group consensus is actually present. In conclusion Kelley's formulation of attribution processes while being valuable is incomplete. The practical and theoretical importance of such processes for human beings justifies the introduction of other theories which will hopefully clarify the process by theoretical dialogue informed by experimental evidence.

It can be seen that Mead's account of minded behavior has much in common with the attribution theorists. It deals with attribution processes and with sources of error in those processes. It recognizes a time dimension (as does Kelley's) in the form of the social act which must occur over time. It recognizes as does Jones and Davis, the import of attributing intentions to the other person on the basis of observed actions. It places more emphasis on the social nature of the act in that cooperation among humans is seen as the central feature of human existence both in their thought processes (through shared meanings) and by achieving their mutual goals. This cooperation facilitates the human being. Jones and Davis introduce the social nature of the social act by way of the term "hedonic relevance." To them the fact that the actor can facilitate or impede the actions of another (the self) is as likely to cause error as it is to help the social act.

Social facilitation is introduced in yet another way by Kelley. He remarks about the human being brings to a situation values or expectations shared by others in his reference group. He uses this norm to define the situation. For Mead when the situation is the behavior of another and that behavior is used in a self-conscious manner, the actor can count on the other person sharing the intent or meaning of the gesture and of reacting to that intent rather than to the gesture itself.

Mead's formulation implicitly details sources of error in the social interaction. First of all one of the parties can be holding a "conversation of gestures" as Mead terms it. In this situation one person can respond simply to the gesture of another without regard to the other's intent. This source of error is not mentioned by Kelley

since Heider's theory and its derivatives do not consider such types of interaction. Furthermore it doesn't seem to be of major importance in Mead's theory.

A second source of error would seem to be in the way the participants define the act both in terms of its start and finish and also of who is participating. For example the psychological experimenter recently has discovered that he has been making this error rather consistently. Experiments by Orne (1962) and Rosenthal (1966) showed that the experimenter was included into the act in a reliable way by the subject whereas the experimenter had traditionally seen himself as a neutral object. This source of error parallels Heider's first error as set forth by Kelley. That is, some participants ignore the relevant situation. It may be recalled that the experiment, used to illustrate this error, involved a third person who commanded an unpopular opinion on the part of the speaker. The speaker's true opinion was seen by the subject to be related to his emitted opinion. The elicitation by the third person was ignored by the audience.

The third and major source of error covered by the Meadian framework is the lack of a significant symbol. This can occur in two ways. First, the meaning of the gesture may not be the same for the two (or more) parties. That is, because of different upbringings or subcultures, the participants of the social act interpret the gesture in different ways. The second source of error can be inherent in the gesture itself. Because of the complexity of the act or the limitations of communications relative to the act the gesture cannot convey the meaning fully. That is two or more meanings are possible for a given gesture. The single occurrences of the gesture leave the observer open to infer one or the other meaning and perhaps both.

Within this third error class, the first type of error is equivalent to Heider's errors due to egocentric assumptions. The second type of error in this class is related to Heider's first type of error. Kelley states that "in complex causal environments, the relevant causal factors in the situation are not ignored but are simply not perceptible to the person." (Kelley, 1967, p. 219).

While Mead's theory seems more cohesive than does Heider's at the same time it remains unspecified in some areas. It does not partial out of all behavior the portions of behavior it wishes to consider as leading to an inference process. Jones and Davis study behavior in terms of its effects on the environment. Mead, on the other hand, includes within the class of gestures such behaviors as grimaces, postures, gazes etc. The central importance of such stimuli for social interaction has been rather well documented (Duncan, 1969). However their relationship to inferential processes has not been as well defined as it has in the case of the effects one human being has upon his environment and/or upon another human being. Given these postulated weaknesses Mead's approach is not easily reduced to a standard laboratory situation. However, combined with Heider's formulation and Jones and Davis' adaptation a list of the characteristics of the ideal experimental test situation can be drawn up.

In search of a laboratory situation. To test Mead's formulation of significant symbols a situation is required in which the following criteria are present:

(1) The social aspects of the situation must require the mutual interaction of at least two people.

(2) The situation must be well defined in terms of the number of people who are participating and in terms of the onset and completion of the

interaction. This is so in order to eliminate the second class of errors (that is, the number of people participating in the act) that Mead's theory postulates.

(3) The situation must be of such a nature that the subjects are likely to engage in reflective thought processes. Essentially this means eliminating Mead's first class of errors, what he calls "a conversation of gestures."

(4) The situation must be of such a type that the gestures are ambiguous. That is the gestures are not totally significant symbols using Mead's terms.

(5) For methodological reasons the situation must be such that the possible significance of the symbols is well defined. This means that the number of possible gestures must be limited and the significances attached to these gestures must be well articulated and very few in number.

(6) The gesture, again for measurement reasons, must be made in one mode or dimension. That is, if facial expressions are to be used, then verbal behavior, postural gazing and mutual reinforcement cues must be controlled.

The Prisoner's Dilemma Game (PDG) (Rapoport and Chammah, 1965a) fits all of the qualities mentioned above. To verify this, the game will be explained and then the compatibility of the game with the above criteria will be demonstrated.

The PDG can best be described as a game played by two people over an extended sequence of discrete trials which may or may not have meaningful consequences to the players. Each person has two choices (usually called C for cooperation and D for defection). On

any given trial four outcomes are possible: CC, CD, DC, DD (where the first letter signifies player 1's choice and the second signifies player 2's choice). Each of the outcomes is associated with a different reward to both players as determined by the matrix in Figure 1. The payoff to player 1 is in the lower left hand of each cell and that to player 2 is in the upper right hand of each cell. Thus a joint DC choice would result in a payoff of T units to player 1 and a payoff of S units to player 2. The values of the cell entries can be varied in amount but the following inequalities must hold to maintain the structure of the PDG.

$$S<P<R<T \qquad (1)$$

$$2R>S+T \qquad (2)$$

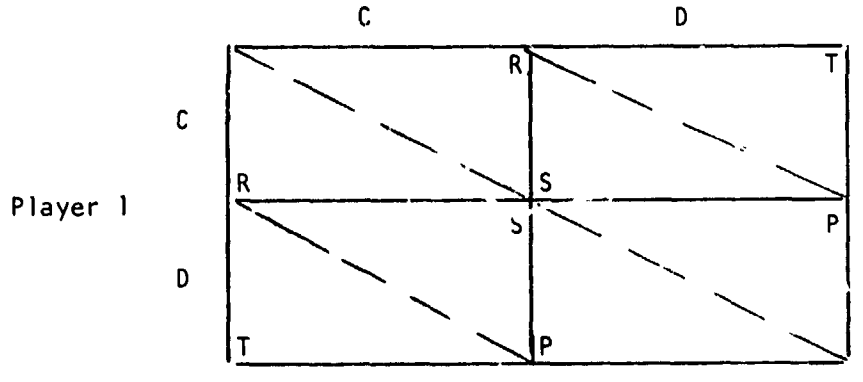


Figure 1 PDG Payoff Matrix

R is called the reward for cooperating; P is the punishment for defecting while T is the temptation to defect; S is the "suckers" payoff for cooperating while the other player defects (usually S and P are negative). Assuming that each player wants to win as many points (or cents) as possible and given the two inequalities above, the mixed motive nature of the game becomes clear. If both players

want to get the highest possible payoff, T they will both play D and both receive P, a mildly punitive outcome. If one persists in choosing C he leaves himself open to exploitation by the second player who will go after outcome T by choosing C. If the first person retaliates by choosing D after he has been exploited the dyad runs the risk of staying in the DD cell. Such a result can only lead to both players receiving nothing for their efforts (either in money or points).

Under the restrictions of these two inequalities and the assumption of symmetry, R, S, T, and P are free to take on a wide range of values. Rapoport and Chammah (1965a) looked for an index to describe the relationship between the incentive value of the payoff matrix and the course of game behavior. Their first conjecture resulted in the following hypothesis. If other payoffs are kept constant, C increases as R and S increase and decreases as T and P increase. If the entries of the payoff matrix are thought of as utilities then C (the frequency of cooperation) depends not on the individual values but on the ratio of their differences. For three variables one ratio suffices but for four variables two ratios are needed to describe the relationship. The authors found the one ratio that best describes the incentive value of the matrix in terms of frequency of cooperation in the various games to be given by Equation 3.

$$CI=\frac{R-P}{T-S} \qquad (3)$$

The particular PDG payoff matrix to be used in the present study is shown in Figure 2.

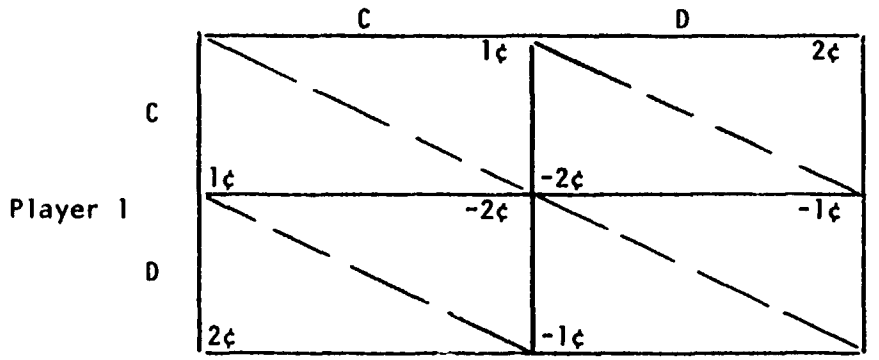


Figure 2. PDG matrix with payoffs to Player 2 in upper right of each cell.

This matrix has a CI=.5 which is a little larger than the CI used by Terhune (1968) and much larger than the CI used by Pruitt (1967).

From this explanation and considering some other findings about the PDG we can move to an examination of the six criteria outlined above for a suitable experimental situation in which to test Mead's theory.

The first criterion demanded that the situation require the interaction of two or more people. This is true of the PDG since, before any reward can be received by either, both persons playing the PDG have to respond. Furthermore in order to attain a profitable outcome both have to learn to cooperate by choosing C.

The second criterion related to the definition of the situation both insofar as the number of people involved is well known and insofar as the beginning and ending is defined for people. The PDG is presented as a game for two people and the onset and finish of each trial is well established just by the features of the game itself.

The third criterion was concerned with selecting a situation in which the thought processes of subjects were likely to be operative. For the PDG, the experimenter can increase the likelihood of such thought processes occurring by making increased financial reward contingent upon apprehending the strategy of the other player. That players pay attention to the other person's strategy and behavior in bargaining games has been documented by Murdoch (1968). He found that the variance accounted for by social factors in a bargaining type game explained some 50% of the total variance. Personality factors explained only 30% of the total variance. Murdoch's analysis came from a study by Druckman (1967). Murdoch concluded that situational as opposed to personality variables should be studied in bargaining situations. It can be expected that variations in the other person's behavior in a PDG will have a large influence on subject's performance over and above personality differences in the subject. In addition Kelley et al (1962) in a similar game type situation to the PDG found from post experiment questionnaires that subjects often engaged in strategy assignment to the other player during the game.

The fourth criterion concerns the ambiguity of the gesture either on the part of the stimuli used or on the part of the encoding-decoding process. McClintock and McNeel (1966) have analyzed PDG choices in terms of the ambiguity they pose for the experimenter in inferring the motivations of his subjects. A C choice by any player can mean that he wants to maximize joint game. A D choice can mean that he wants to get the greatest possible gain for himself or that he wants to minimize his maximum possible loss. There is no reason to assume that subjects do not face the same dilemma when they

confront the other person's choices. Since both the experimenter and the subject achieve competence over their environment by the method of differences, one can expect that dilemmas confronting the experimenter also face the subject. This line of reasoning leads to a view of the PDG as a mixed information game.

Regarding the fifth criterion the PDG is reasonably well defined as far as choices and outcomes are concerned. The significance of PDG choices will be delimited in a model at the end of this chapter.

In addition to meeting the criteria discussed above, an additional reason for using the PDG is that the interpersonal effects can be controlled as the sixth criterion calls for. The PDG is an excellent way of establishing communication in one mode only. The experimenter can control the situation so that the alter cannot be seen or heard. In fact the only source of information about the alter is through his choices in the game. This methodological fact satisfies the sixth criterion for a suitable experimental situation in which to test Mead's ideas about social thought. If the PDG can be accepted as such an experimental situation then it behooves us to look at the results from the magnitude of experiments performed around this game situation.

Prisoner's Dilemma Game Research Findings

This summary of findings will be divided into five sections. The first section will deal with the personalities of both players. The second section will outline experiments in which the strategy of the other player was controlled. The third section will present experiments where the communication pattern was varied. The fourth

section will deal with experiments in which the reward structure was manipulated. The fifth section will serve to review those experiments relating theoretical positions to the PDG. Preceding each section will be an abstract of the findings in that area. PDG findings have been reviewed in other articles (Terhune, 1968, Vinacke, 1969, Gallo and McClintock, 1965). The major conclusions of these reviews will be mentioned insofar as these apply to the PDG but articles mentioned by them which do not appear to be of great importance will not be reviewed here again. Within each section reviews of articles will be grouped so that there is at least an intuitive similarity among the manipulated variables.

Personality. The results from personality studies in the PDG give a very confusing picture. In examining studies in which sex of the subject was varied Gallo and McClintock (1965) conclude that sex is not related to PDG choices. Rapoport and Chammah (1965b) on the other hand, found that both the sex of the player and his opponents have large effects on the level of cooperation in a 300 trial PDG but that this difference does not emerge on the first two trials. Tedeschi, Lesnick and Gahagan (1968) found sex differences emerged by trials 3, 5 and 10 in 100 iterations of the PDG but these differences disappeared after the full play of the game.

Measured personality variables have also been found to not reliably affect the level of cooperation from experiment to experiment. This has been pointed out in a review by Terhune (1968) and is illustrated again in recent studies by Sermat (1967b) and Lutzker (1960). On the other hand real life personality differences such as the degree of mental health, the race of the opponent, the degree

of friendship of the two players and an economic orientation on the part of the players seem to affect the level of cooperation consistently. The economic factor promises to be especially important since Dolbear and Love (1966) found that it overrode the effects of friendship. Crowne (1966) found that subjects with an entrepreneurial background were more competitive than bureaucratic background subjects. Subjects taking business courses are more competitive than students in non-business courses. Finally, frequency of economic crimes among juveniles is correlated with defective choices.

Gallo and McClintock (1965) have summarized findings from the personality research on the Prisoner's Dilemma prior to 1965. They claim that a large number of studies show no relation between sex and the amount of cooperation. This last conclusion was based on a relatively large number of studies. From a fewer number of experiments they found that scores on the F scale tended to correlate negatively with cooperation while subjects who were scored as high internationalists made more cooperative choices.

The best study on sex differences has been done by Rapoport and Chammah (1965b). Using several game matrices they ran 70 pairs of males, 70 mixed sex pairs and 70 female pairs for 300 trials. They concluded women pairs tended to cooperate much less than men when both sexes played in like sex pairs. In mixed sex pairs women became more cooperative than when they played with other women. Men became more competitive when they played with women than when they played with men. An index, M, was developed which takes into account the success of a "martyr" run by a player. A successful run was defined as the conversion of an exploiter to cooperation. An unsuccessful

run meant that the martyr changed to defection. These two frequencies were combined into M. When a man was the defector in the martyr run, the run failed to be successful about 2.5 times more than it was successful regardless of whether the martyr was a man or a woman. When a woman was the defector, nonsuccesses outnumbered successes 3.7 to 1 if the martyr was a man, and 4.8 to one if the martyr is a woman. Tentatively, women have more of a tendency to exploit. However as Rapoport and Chammah point out, if the martyr run had continued longer women might have succumbed to the inducement and switched to cooperation.

In this same article, Rapoport and Chammah present an explanation of why male groups come to cooperate more than do female groups. First of all they define p_1 as the correlation of a subject's response on trial n with the other subject's response on trial n-1. For the male pairs p_1 was .51. For the female pairs it was .34 while for the mixed sex groups it was .35 and .39. They consider this measure as evidence that men tend to be more imitative. This leads to a consideration of two automata with a tendency to perfectly imitate the other i.e. p_1=1.00. Under conditions that the automata choose randomly on the first trial, have a bias to maximize their payoff and minimal "noise" is introduced into the system, the tendency will be for the system to lock in on the mutually cooperative cell. Rapoport and Chammah reason that men's higher cooperative response frequencies stem from their greater tendency to give tit-for-tat (as measured by p_1) in situations of this sort.

Tedeschi, Lesnick and Gahagan (1968) found no differences in cooperative choices over 100 iterations of a PDG between males and females when faced with an alter who cooperated as much as he defected

in a highly competitive game. Females did cooperate more than males for the first ten trials of the game. Under low levels of competitiveness the authors feel that the sex differences in cooperativeness may persist throughout the game.

Vinacke (1969) in his review of PDG findings found four studies where males were clearly more cooperative than females and three studies where there was no difference in playing that could be reliably assigned to sex differences. Vinacke concludes that the laboratory game situation makes males less exploitive than they would otherwise be while females become more exploitive. By the words "laboratory game situation" Vinacke means that females infer from the PDG matrix that the experimenter wants them to compete. Thus females become more competitive in order to cooperate with the experimenter. Presumably males are inherently more competitive and once they perceive the experimenter's intent react against it.

Komorita (1965) found that females tend to be more cooperative than males when facing an unconditionally cooperative other while the reverse was true for a conditionally cooperative other. Horai and Tedeschi (1969) in a study to be reviewed later found no effect on subjects' PDG plays that could reliably be attributed to sex. Kanouse and Wiest (1967) could not find any difference in cooperation that could be attributed to the player's sex or the sex of the other person. Bixenstine and O'Reilly (1966) found males to be more cooperative than females.

Terhune (1968) used three one trial games and two 30 trial games to assess the effect of the subject's motivational structure on the amount of cooperation he displayed. The one trial games varied

along Rapoport's cooperative index. In all three one trial games subjects who were high need achievers were more cooperative; subjects who measured high in need affiliation were more defensive where defensive means they chose D and expected the other to choose D. Subjects who had a high need for power were most exploitive. In a 30 trial game where communication was not allowed the difference due to motivation disappeared over trials. This was true also of a thirty trial game in which communication was allowed. Subjects in the noncommunication games perceived the other person as a competitor and opponent. This was used as a reason by the subjects for their own competitiveness. In addition for all motive types it was found that the less favorable the first trial outcome, the more conflict there was in subsequent trials.

Terhune also reviewed the findings of the research on personality and cooperation-conflict in games. Most personality scales do not relate to cooperation. Those which are related to cooperation are not replicated by other studies.

Deutsch (1960b) found that the F scale did predict PDG behavior but this was not found by Wrightsman in a non-zero-sum game. The Internationalism-Isolationism scale was found to relate to behavior in several non-zero-sum games but Pilisuk et al (1965) found it did not explain behavior in an expanded PDG. Christie's Machiavellianism scale was found to predict behavior in some games but not in a non-zero-sum game. Some of the needs (autonomy, abasement, aggression, deference) as measured by the Gough adjective check list were related to PDG behavior but other needs (nurturance, dominance) were not. The

following scales did not predict behavior in a non-zero-sum game or an expanded PDG: Guilford Zimmerman test, eight basic values questionnaire, self acceptance, monetary risk preference, risk taking scale, verbal hostility, rigidity, social responsibility, personal optimism, anti-police attitudes, political cynicism, Crowne Marlowe's social desirability and Edward's social desirability (Terhune, 1968).

Lutzker (1960) administered his Internationalism-Isolationism scale to a group of 600 students. From the population of returnees he took the highest 11% of scores and the lowest 19%. (Isolationists were unwilling to participate in the experiment.) In addition a control group of untested subjects was included. He found that internationalists cooperated more than the isolationists as did the control group. Also competition increased over the 30 trials for the isolationist and control groups but not for the internationalists.

Sermat (1967b) found that neither the MMPI dominance scale nor the Lutzker Internationalism-Isolationism scale correlated significantly with cooperative choice frequencies under a 100% competitive treatment condition in the PDG.

In two, two trial PDG games involving various combinations of real and imaginary payments, Wrightsman (1966) defined as a trusting person one who chose C, expected the other to choose C and gave as his reason for this a concept of trust, fairness or cooperation. Trustworthy behavior was defined as present when the subject chose C after the other had chosen C. On the Philoscphies of Human Nature scale trusting subjects had generally more positive attitudes towards others, saw people as more trustworthy, more altruistic and more independent than did distrusting subjects and other subjects. Several

other scales including the F scale were not related to trusting behavior. None of the scales predicted trustworthiness. In the second experiment trusting subjects had more favorable views of human nature but the mean values of the three groups were arranged differently from that of experiment one.

Bobbitt (1967) in his doctoral study found that subjects who were classified as internally controlled, that is those who try to alter present social conditions for the sake of personal gain, as measured by the I-E scale were significantly more cooperative than those who were classified as externally controlled. This latter phrase means those persons willing to accept the social condition. This difference occurred when the other was simulated and was predominantly uncooperative for an initial block of trials. The two groups were not differentiated when the simulated other switched his strategy in the second block of trials. In a second experiment when the simulated other was predominantly cooperative in the initial block of trials, internals cooperated more than externals. In this second experiment when the other was uncooperative in the first block of trials internals again cooperated more than externals.

Knapp and Podell (1968) decried the lack of relationships found between personality measures and PDG game behavior. They postulated that this occurred because only paper and pencil measures were used. As a basis for individual differences they used samples of prison inmates, mental patients and students. For 24 trials all three groups faced a simulated other who responded at the 50% cooperative level. All three groups were then split into two halves. One half of the subjects faced an 80% cooperative other while the other half met a 20% cooperative other. All three groups under the latter condition responded

at approximately the same level of cooperation although inmates tended to be more cooperative. Under the 80% C condition students were more cooperative tnan patients who were, in turn, more cooperative than inmates. In addition this is one of the few studies to find a differential response on the part of subjects to any unconditional strategy on the part of the other player. Rapoport (1968), in commenting on this article, mentions that subjects may have been responding to the perceived change in the other person's strategy and not to the unconditional strategy itself. In the same comment he mentions an unpublished manuscript by Chammah in which about one half the subjects cooperate and one half exploit a simulated other who responds cooperatively 100% of the time.

Harford and Solomon (1969) used a better defined patient population in their comparison of normals and schizophrenics. The schizophrenics were split into paranoids and nonparanoids and then matched on a number of pregame psychological tests. Twenty four patients were in each group. However normals were college students and did not match the patient group. All subjects then played a PDG for 30 trials against either a reformed saint or lapsed sinner strategy. In the latter condition the confederate chose cooperatively for the first three trials and then switched to conditional cooperation for the remainder of the game. In the reformed sinner condition the confederate chose noncooperatively for the first three trials, then switched to unconditional cooperation for the next three trials, and finally changed to conditional cooperation. In describing the reaction to these strategies the authors conclude that, when the sinner is punitive and tough the paranoid is docile and cooperative; with the

sinner's abrupt shift to a soft benevolence the paranoids become exploitive. With the saint strategy the reverse is true. Initially they are exploitive, but then switch to cooperation when the confederate becomes conditionally cooperative. The authors conclude that the paranoids' interpersonal stance is not indiscriminant and can be modified by variations in the strategy of the other party. The normals were more sensitive to strategy changes than either of the patients. Also the reformed sinner strategy was more effective in establishing a trust relationship with the students than with the patients. Finally the students chose competitively more than the patients.

Heller (1967) in his doctoral thesis found that Caucasian and Mexican-American subjects played more competitively when the other subject was a Negro than when the other was a member of their own race. This study was limited to juveniles who had been incarcerated. At the same time measures of racial prejudice in whites and Mexican-Americans did not predict their level of cooperativeness. Frequency of economic crimes was correlated with the level of cooperativeness as was a measure of socialization and the Marlowe Crowne Social Desirability Scale. Both of the last two correlations disappeared however for some of the experimental conditions.

Crowne (1966) set out to investigate the correlates of two person non-zero-sum game behavior in the economic motivation of the subject. Subjects were classified as entrepreneurs or bureaucrats according to the jobs their fathers held. Entrepreneurial parents are those engaged in risk taking occupations (farmers, small businessmen, doctors etc.). The sole criterion of bureaucracy is employment in a relatively large organization. He also measured level of aspiration.

Although he had markedly unequal cell frequencies Crowne used an unweighted means of analysis of variance. Entrepreneurial backgrounds produced more exploitive bargaining over the 20 trial PDG although this was marginally significant. Interaction between family orientation and level of aspiration was significant also. Bureaucrats and entrepreneurs with tendencies to escape from competition were more cooperative than the remaining entrepreneurs.

Dolbear and Love (1966) felt that the risk orientation that subjects take toward games would predict how the subjects would respond in the PDG. Risk was measured in a lottery type game where the subjects' propensity to take risks could be assessed from their choices. In the PDG itself risk was measured by the number of times a subject chose C when faced with a stooge who chose D 13 straight times. Their data indicate that risk orientation is not a good predictor of the subjects' risks in the PDG. The subjects were from business school and this may reflect in the negative findings. When the stooge switched to a 100% cooperative strategy the subjects became suspicious of the experiment. This is one of the few studies to report on this suspicion.

The effect on cooperation of the prior degree of friendship between the players has also been studied (Oskamp and Perlman, 1966). The subjects from the two colleges were divided into four groups in which the pairs of males had differing degrees of mutual friendship. This was a standard PDG game played for thirty trials. Points won were converted to money after the game was over. They found that cooperation was lower at the college where business was the prime subject matter. Friendship at this college had no effect on the way the game was played. At the smaller nonbusiness school cooperation

was higher and here the level of attained cooperation depended on the degree of mutual liking. This finding seems to be similar to Crowne's (1966) and to Swingle and Gillis' (1968).

Swingle and Gillis (1968) found that high school subjects whose opponent was a friend were initially more cooperative but gradually moved to a competitive strategy. They were markedly affected by their friends' strategy changes. Subjects who played against a disliked other, settled early in the game into a highly competitive strategy and remained unaffected by abrupt strategy changes on the part of the other.

As Sheff (1967) noted, social psychological experimenters shy away from measuring subjects' perceptions in mixed motive games. Lumsden (1966) ran an experiment in which this was done. No statistical tests were used to assess results. One of Lumsden's aims was to judge the degree of similarity between the traditional laboratory experimental games and real life international conflicts. Consequently he used a PDG matrix and a "chicken" matrix for two of the games and two international problems to simulate the traditional games. The latter two games evoked a very high percentage of C responses from the participants. This was explained by way of a peace norm, in the Norwegian subjects, evoked by the internation context. Of the two traditional games the subjects were consistently less cooperative in the PDG game. In addition, after the 100 trial game was completed the subjects were administered a semantic differential. There were marked differences between the profiles of self and other in the two traditional experimental games. In particular subjects evaluated themselves more favorably than they evaluated the other. Although no test of significance

is reported the percentage of cooperation was found to be negatively correlated with the level of self evaluation.

Deutsch (1960b) had subjects play a two trial two position game. On the first trial they played from the first position. That is each S made his choice before the other had to make his. (In fact the other person was fictional). Here the S had to decide whether to trust the other or not. In the second position the S chose second after he knew the choice of the fictional other. Here the subject could be trustworthy or not since the fictional player always chose cooperatively. Subjects who were trusting tended to be trustworthy. Those who were suspicious tended to be untrustworthy. A point biserial correlation was obtained on the subjects' game behavior and F scale score. The obtained value was significant. That is, trusting and trustworthy subjects had low scores on the F scale while suspicious and untrustworthy subjects scored high.

Marlowe, Gergen and Doob (1966) manipulated the personality of the other player. The subjects played a PDG for 30 trials where the simulated other player was programmed to play an 80% cooperative strategy. Prior to playing the game, the personality of the simulated other player was manipulated on an egotism-humility dimension. A six item pregame questionnaire indicated this manipulation was effective. Crossed with this dimension was a dimension wherein half the subjects were led to believe they would meet their partner after the game. As predicted the interaction was significant, indicating that the subjects exploited the humble other when no post game interaction was anticipated but exploited the egotistical other person when post game interaction was expected by the subjects. Furthermore the same six

item questionnaire was administered after the game to the subjects. Perception of the humble partner was found to be virtually unaltered by the game experience. The subjects' perception of the egotistical other was changed. They came to see him as significantly less egotistical, less independent and more likeable. No assessment of the experimental deception was mentioned by the authors. In a second experiment, subjects exploited a simulated partner significantly more when they anticipated no future interaction than when they anticipated they would meet him after the game. No prior information was given about the personality of the other person.

Sampson and Kardush (1965) used a sample of preadolescents who were involved in a summer camping trip in a 50 trial PDG. Points won during the game could be convered to candy. They found that the overall level of cooperation was low and that it decreased over the game. Using a marginal significance level ($p<.10$) these authors conclude that Negroes initially were more cooperative than whites but that their cooperation declined faster than for the white children. In addition for male white pairs, the older children cooperate more than the younger ones. The relation is reversed for the females. For Negroes, the younger children were more competitive. Sex did not interact with age for Negroes.

Simulated strategy findings. This section deals with studies wherein the game behavior of the other is controlled in some way. Success or friendship prior to the game itself was manipulated and the effect on a standard strategy studied. The simulated subject made promises with varying credibility or utilized a power advantage in differing ways. Experimenters frequently varied the simulated person's

strategy by making it contingent or noncontingent on the subject's choices. Sometimes the strategy was changed in frequency or contingency in the middle of the game to see if the primary strategy exerted more of an effect than did the later strategy or vice versa. Finally experimenters are beginning to investigate the effect of the simulated person's strategy on the subject's ratings, impressions and preferences for the supposed other.

A wide variety of experiments showed that extra game experience affects the way the PDG is played. Thus strategy change was found to affect cooperation only if the subject considers he is playing against a friend as opposed to a person whom he doesn't know. Subjects who witnessed a competitive other cooperated more than a control group against a cooperative other. Pregame dyadic interaction was found to increase cooperation even if the game occurred one week following the original interaction. Subjects were more cooperative in a short game when another promised to cooperate. In a longer game the promise to cooperate affected only the trial after it was sent. In the latter experiments the message promised cooperation only on that trial and did not refer to an overall strategy. When a simulated other held power over the subject, benevolent use of that power increased cooperation over and above when both players held the power. Mere possession of the power did not affect cooperation when two subjects possessed it or when only one subject did.

Komorita (1965) found that females tended to be more cooperative when facing an unconditionally cooperative other while males were more cooperative when faced with a conditionally cooperative other. What the simulated other did early in the game affected how the subject

responded to him later in the game. Thus Sermat (1967a) found that an unconditional strategy, either cooperative or competitive, produced more cooperative choices in a later contingent condition than subjects who early in the game faced a contingently cooperative other. Sermat (1967b) in another experiment found early choice strategy by a simulated other affected subjects' later responses in a PDG in a cooperative direction only when the other was known to be free to change his strategy anytime. Swingle (1968) in an experiment similar to Sermat's found only a significant increase in variability of response after the strategy change occurred.

Several experiments find that subjects do not respond differentially to the differing levels of noncontingent cooperation. It is only in indirect fashion that subjects can be inferred to respond differentially to different unconditional strategies. Thus Gahagan and Tedeschi (1968) found that subjects under some conditions were more cooperative when the simulated other chose C 75% of the time than when the other chose C 50% of the time. Faucheux and Moscovici (1968) found a similar effect when the name "nature" was associated with the opponents 62% cooperative strategy and the name "chance" was associated with the 50% cooperative strategy. While the game was not a PDG the authors found that subjects chose cooperatively more often when they played against "nature" than when they played against "chance." Komorita (1965) found that females respond cooperatively more to an unconditionally cooperative other than do males. Furthermore as the simulated other became more cooperative females increased their level of cooperation. Neither Solomon (1960) nor Bixenstine, Potash and Wilson (1963) found any difference in the

level of competitive choices when groups of subjects faced an unconditionally competitive other or an unconditionally cooperative other.

Impressions of the simulated other have also been studied as a function of the strategy he adopts. If he changes this strategy in the middle of the game Swingle and Coady (1967) found that impressions so formed were determined by a primary effect at least in a game run for a relatively large number of trials. Wilson and Insko (1968) in a shorter game found that impressions of the other were formed by a recency effect. Tedeschi, Aranoff, Gahagan and Heisler (1968) in an experiment using several simulated strategies felt that any explanation of the subject's PDG behavior must involve knowledge about the other person's cognitions of the opponent's intentions. Harford and Solomon (1960) also interpret PDG behavior in terms of cognitive inferences although no data is presented for this. Solomon found that subject's inferences about the other person's strategy are contingent upon the type of strategy the simulated other uses. Komorita and Mechling (1967) also explained their findings in terms of impressions the subjects formed about the other person.

Evans (1964) created three groups in his study. For group one a promise to cooperate was made to the subject and E backed this up with a threat to take away points if the stooge didn't keep his promise. In group two the confederate made the same promise but no threat was mentioned. In group three no promise was mentioned. The subjects were run on a six trial game where the other player always gave the same response on any trial as the subject. Group one was significantly more cooperative than group three. Both groups one and two rated the

confederate as more trustworthy than did group three. For trial one, 12 out of the 15 subjects in group one chose C whereas only seven out of 30 in the other two groups did so.

Komorita, Sheposh and Braver (1968) introduced a third alternative choice to the normally two choice PDG. The difference between the third choice and the regular two choices of the PDG was that use of this choice assured negative outcomes for both players. If used unilaterally the outcome was always worse for the other player no matter what choice the other player made. This third choice was used by a stooge in one experiment as a unilateral threat. The stooge used the power in a passive manner under one condition, in a benevolent way for a second condition and in a malevolent way in a third condition. Under a second experiment where both the subject and the stooge had the power (bilateral threat), the stooge was programmed to utilize his in a benevolent or a passive way. A matching strategy was added as a fourth condition in experiment two. Under unilateral power, the benevolent use of power increased cooperation. Under bilateral power the benevolent strategy increased cooperation but significantly less than the benevolent condition in the unilateral threat experiment. In experiment one malevolent use of power resulted in increased mutual defection. With regard to the passive power condition for both experiments the authors conclude that such power must be exercised if the power is to be effective. The theoretical discussion centered around the perception and communication of power without any empirical evidence that such perceptions occurred.

Gahagan and Tedeschi (1968) point out that there are two general ways of studying the strategy of the other. The first is to use a post hoc method, as did Rapoport and Chammah (1965b), to look at the

choices of one player and how they affect the choices of the other on various measures. The other is to simulate the choices of the other player and see what result this produces in the subject's simulated choices. These authors chose the latter course and as an experimental manipulation had one half of their subjects play against a 50% cooperative strategy, while the other half played against a strategy wherein the opponent played cooperatively 75% of the time. Each of these strategies was crossed with three levels of a factor called credibility of promise. Throughout the game subjects received one of five possible promises. It was always the same promise though and informed the subject that the confederate was going to choose cooperatively on the next trial. The stooge kept his promise 30% or 60% or 90% of the time. Thirty five females and 37 males were assigned at random to the six cells. Subjects played the PDG for 110 trials under instructions to maximize gain. They participated as part of course credit and received no pay. The authors analyzed the proportion of cooperation over the entire 110 trials (CP1); the proportion of cooperation following messages (CP2); the frequency with which promises were reciprocated on the ten message trials (FR1); the behavioral credibility of their messages (CR1); Rapoport and Chammah's trustworthiness (TW), repentence (R), forgiveness (F) and trust (T). Strategy by itself, had no effect on any of the dependent variables. The discussion centered around the fact that while subjects can discriminate between the two strategies they can still not make predictions of the other's choice and, hence cannot act upon their discriminations. The credibility factor produced differences on the CP2, FR1 and T variables. The subjects sent more messages of intention to cooperate when the promises were 90% credible than at either the 60%

or 30% levels, which, in turn were not different from each other. Subjects not only reciprocated highly credible messages but they also tended to cooperate on the next trial. The messages had no effect on the overall level of cooperation. This is interpreted as meaning the subjects discriminated between the postmessage trial and the remaining trials. Also trust (T) diminished as credibility diminished. The strategy by credibility interaction was significant on CP1, CP2 and F (forgiveness). The 75% cooperative strategy produced more overall cooperation at the 60% and 30% credibility levels than did the 50% cooperative other. No difference existed among the strategies at the 90% credibility level.

Swingle and Gillis (1968) in a PDG, investigated whether liking had any effect on cooperative plays. If the opponent changed his strategy from cooperative to competitive or vice versa this affected the subjects' responses in the expected direction only if the programmed other was considered a likeable person. The reaction to strategy change on the part of the opponent was interpreted as a tendency on the part of friends to match the behavior of the friend.

Swingle (1968) found that male subjects who witnessed a non-cooperative other before playing the game themselves were more likely to respond cooperatively to a benevolent strategy than were a control group. The data indicates that such cooperation was increased the longer the subjects witnessed the noncooperative other in practice sessions. Witnessing an unconditionally cooperative other seemed to have little effect when the other became uncooperative in the game itself. As in another study the author felt that subjects responded differently to similar strategic postures of their opponents. From

correlation data the author concluded that highly cooperative subjects retaliate against the opponents defection immediately and severely. Highly competitive subjects tend to switch to a more cooperative response when the opposing player defects.

Harrison and McClintock (1965) manipulated pregame dyad success. If subjects were run immediately following the experimental manipulation, dyads who had experienced success were significantly more cooperative than subjects who experienced failure or a control group who had no previous contact besides the PDG. If subjects participated in the game one week after the manipulated success failure condition, cooperation for both the successful and unsuccessful dyads was higher than for the control group but not different from each other.

Sermat recently published two studies on initial cooperation-competition. In the first study (Sermat, 1967a) the subject was faced with a 100% cooperative other or a 100% competitive other for 30 trials. Following this the subject's opponent was switched to conditional cooperation for 200 trials. A control group faced a conditionally cooperative other throughout the game. The first two groups were found to become increasingly cooperative over the last 200 trials unlike the control group. Sermat relates two other unpublished studies that found a decrease in the cooperation over trials. Regardless of the type of pretreatment, subjects who received a cooperative choice from the simulated other player on the first trial in the PDG, were consistently more cooperative than subjects who received a competitive first choice. The subjects played the game for course credit. Little nformation is given as to whether the subjects were aware they were playing against a confederate. The pretreatment

phase was presented as one experiment. The conditional strategy was presented as a separate experiment.

In a second experiment Sermat (1967b) had a simulated player choose D for 50 trials and choose C for 20 trials. Three conditions were grafted on to this basic strategy. Group one was informed that the other player was free to change his strategy at any time and that he knew the outcome of every trial. Group two was informed that the other player had committed himself to playing a strategy and was informed of the outcome of every trial. Group three was told the other player had committed himself to playing a strategy and was uninformed about the outcomes. The three groups did not differ in the rate of competitiveness over the first 30 trials although the rate declined over the blocks. In the last 20 trials, group one became significantly more cooperative than either of the committed groups. Neither the MMPI dominance scale nor the International-Isolationism scale correlated significantly with cooperative behavior under the initial treatment condition. Again no mention is made of testing the experimental deception.

Pylyshyn, Agnew and Illingworth (1966) found that pairs of subjects played more cooperatively than did individuals against a confederate who played a high percentage of tit-for-tat. Furthermore the pairs increased at a faster rate than did the individuals. By trial 150 individuals were picking C 16 out of 25 times. Subjects played for money.

Minas, Scodel, Marlowe and Rawson (1960) ran three PDG games. In the first game subjects played in natural pairs for 30 trials. In the second game subjects faced another player who made the same

choice as they did. In yet a third game subjects played a confederate who chose D 100% of the time. In all three games the subject chose competitively about 60% to 65% of the time.

Harford and Solomon report using a "lapsed saint" strategy as well as a "reformed sinner" strategy on both the mentally ill (1969) and normals (1967, 1969). In the 1967 study the "lapsed saint" is defined as a strategy where for the first three trials the simulated other cooperates and then responds in a tit-for-tat fashion until 30 trials have been completed. The "reformed sinner" strategy is identical to the "lapsed saint" strategy except that three D choices precede the "lapsed saint" strategy. Harford and Solomon report that a "reformed sinner" strategy is more effective in eliciting cooperation than is a "lapsed saint" strategy. The interpretation is made in terms of impressions that subjects must glean from the two strategies although no empirical evidence is presented for this.

Komorita (1965) placed males and females against a conditionally cooperative and an unconditionally cooperative other player for 80 trials. Females tended to be more cooperative (but always .3 or less) to an unconditionally cooperative other. For the conditionally cooperative other males were more cooperative. Females increased their cooperativeness as the simulated other player increased hers. Males cooperated at the same low level throughout the range of values that the unconditionally cooperative other performed. The interpretation that Komorita places on his findings is that females are more concerned with interpersonal relations than males whereas males are more concerned with maximizing gain.

Tedeschi, Aranoff, Gahagan and Heisler (1968) conducted an experiment to test the interpretation of PDG results according to partial reinforcement theory. Seventy undergraduates (30 females and 40 males) were randomly assigned to one of seven conditions. The C strategy choices of group one subjects were "reinforced" 100% of the time and subjects' D choices were reinforced 0% of the time. The other groups had different schedules. In group two the subjects were reinforced 75% of the time for C's and 0% for D's; group three had 100% for C's and 25% for D's; group four had 75% for both C's and D's; group five received 50% for C's and 0% for D's; group six was reinforced on 100% for C's and 50% for D's. The data for cooperative strategy selections over 100 iterations of the PDG generally supported a partial reinforcement interpretation. However the fact that no differences existed between conditions on trials to extinction was interpreted as indicating that recourse to inferences about the other's intentions may be necessary to handle PDG data.

Sermat (1967a, 1967b) in studies previously reviewed here, found that subjects responded more cooperatively to a contingently cooperative other when they have faced an unconditionally cooperative other or an unconditionally competitive other early in the game than subjects who faced a conditionally cooperative other early in the game. In addition subjects were more likely to exploit an other whom they knew to be committed to a cooperative strategy than an other who may change his cooperation at any moment. This occurs when the other has consistently chosen competitively over an initial block of trials and then consistently chooses cooperatively for a block of trials.

In a study to be reviewed later in this section, Swingle and Coady (1967) did not obtain the latter finding of Sermat despite a similar procedure. No information was given by the experimenter about the degree of commitment of the other in the experiment. However Swingle and Coady observed that the variability of response increased when the strategy changed.

Bixenstine, Potash and Wilson (1963) placed 24 males and 24 females in a PDG which ran for 90 trials. Unbeknownst to them they were playing against a confederate who, for one half the subjects played an 83% cooperative strategy, and for the other half of the subjects played an 83% competitive strategy. This condition was in effect for 30 trials after which the confederate adopted a strategy that matched the other player's responses 83% of the time. The purpose was to determine the effects of initial level of cooperation on the subjects own level of cooperation. The only significant effect they found in predicting percent cooperation was an arbitrary measure of ethicality both for the initial 30 trials and the final 60. The authors concluded that the initial strategy difference did not make any difference in the way the subjects chose. However for the analysis of the last 60 trials the reported F value for the initial strategy by sex interaction was 2.439. For one and 40 df the tabled F is 2.84 ($p<.10$). The authors seem to have accepted the null hypothesis on only marginal evidence. They report that none of their subjects evidenced any suspicion that they were not playing the person they were paired off with. Furthermore they found in pilot work that unvariable benevolence led subjects to believe they were not playing a real person.

Bixenstine and Wilson (1963) using the same game format but with a different strategy sequence ran 40 male and 40 female subjects. Forty eight of the subjects faced a simulated strategy of 95% C for 40 trials, followed by 50% C for 20 trials, then 80 trials of 5% C, then 20 trials of 50% C and, finally 40 trials of 95% C. The second group of 32 subjects received the following sequence of strategies for the same trial lengths as did the first group: 5% C, then 50% C, 95% C, 50% C and 5% C. The design then calls for differing initial cooperation levels for 40 trials followed by a reduction to a 50% cooperation by both groups for 20 trials. For subjects who had faced a 95% cooperative other during the first 40 trials the probability of responding with a C response to a C response by the other on the previous trial was generally lower than the probability of responding with a D response to a C response by the other on a previous trial. For subjects who faced a 5% C strategy in the first 40 trials just the reverse was true. Moreover the probability of a cooperative response was higher for the 5% group than for the 95% group. The authors conclude here, unlike their previous experiment that tacit communication is possible in the PDG. They further indicate that subjects were not suspicious that they had not been playing another person.

Faucheux and Moscovici (1968) executed an experiment which is relevant to the common finding that subjects respond with a competitive strategy to the unconditional choices of a simulated player regardless of the level of cooperation at which the opponent plays. According to the authors, nature can be conceived, on the one hand, as a condition representing some sort of order governed by fixed rules

which enable one to understand it and then to make predictions about it. Chance is thought by them to mean that the opponent is in an erratic state which evades comprehension and prediction. The opponent is perceived to be working actively against the subject perhaps raising hopes in order to deceive. On the other hand, nature because of its regularity is perceived by the subject to be on his side. Half of the subjects (French medical students) were informed that they were to play a game against chance. The other half were told they were playing a game against nature. The latter condition resulted in an opponent strategy of 62% cooperation. The former experimental condition gave the opponent a 50% cooperative strategy. The game was played for 50 trials. As expected, subjects played more exploitively against nature than chance apparently because of a preconception that nature is systematic and can be solved, while chance is capricious and even malevolent. The Ss did not so clearly perceive the winning exploitive strategy when playing against chance. The experimenters also experimentally manipulated feelings of self esteem. Those subjects with high self esteem played more exploitively than did those with low self esteem. When the experimenters assessed feelings of natural self esteem no relation was found between subjects with high self and low self esteem and exploitive play.

Solomon (1960) had subjects play a six trial game for imaginary money. Conditions of power were varied by presenting four matrices. One of the groups was in an equal power matrix condition which in reality satisfied the conditions for a PDG matrix. Each subject received one of three types of games strategies from the simulated other. The other was unconditionally cooperative

for group one; for group two, the other made a conditionally cooperative choice; for group three, the other made an unconditionally uncooperative choice. Groups one and two were significantly more cooperative for all four games. For the PDG subjects a conditionally cooperative other was evaluated more favorably than an unconditionally cooperative other. Furthermore the conditional cooperation in the PDG was more effective in inducing subjects to play cooperatively. There was no statistical difference between the unconditional strategies. Also data indicated that the subjects competitive choices were based upon an exploitive intention more for the conditionally cooperative other than for the other two strategies. Finally subjects made attributions about the motives of the player they were facing. The responses were classified as (a) cooperative (other seeks mutual gain), (b) individualistic (other seeks maximum gain), (c) out of field (other does not want to win or else he doesn't understand). In the PDG, the conditionally cooperative other never received motive (c). Seventy five percent of the time he was seen as being cooperative. The remainder saw him as individualistic. For the unconditionally cooperative other, 50% saw him as cooperative, 7% saw him as individualistic and 36% put him out of field.

Komorita and Mechling (1967) studied the effect of betrayal on a group of 64 subjects, 32 women and 32 men. Each subject played with a member of the same sex and was instructed to maximize joint gain. The authors were interested in studying distrust after a betrayal and how long before a reconciliation occurs. They consequently had a pre-programmed strategy to play against the subject. For one experimental condition the preprogrammed player defected on two consecutive trials after four cooperative responses or after ten such responses. In addition, matrix values were manipulated so that there was high and

low temptation to defect and high and low losses for a double cross. The major unexpected finding was that reconciliation was slowest under the high temptation, high loss and four trials to defection condition. In addition the programmed player in the high temptation condition was evaluated more negatively. One of the interpretations of the three way interaction centered around an ambiguous impression the subjects must have held of the other player after just four trials. Fear of a doublecross would then be high for this group. For subjects who faced an opponent who doublecrossed after ten trials, it was postulated that such subjects held a firmer impression of the other's basic cooperativeness despite his doublecross.

Swingle and Coady (1967) found that subjects were insensitive to abrupt strategy changes when the programmed player began in a 100% competitive or 100% cooperative state for 50 trials and then switched to one of the following four levels of cooperation - 0%, 25%, 50%, 100%. Both of the initial strategies elicited high competitiveness and this remained at the same level for groups who changed as for the group which served as a control. Variability of response was found to increase after the strategy change. Subjects in postexperiment ratings indicated they would rather play again with the initially cooperative player. No preference effect was reliably related to the last half strategy change. Evaluation of the other was most strongly determined by the partner's initial strategy. Partner's final strategy was reported to affect evaluation but the authors appear to be in error here. That is Factor A, partner's initial strategy, is treated as if it had 3 df when it had only 1 df in the experimental design. Factor B, partner's final strategy, is treated as though it was associated with 1 df when

in fact it had 3. This has the effect of reducing the mean square due to the initial programmed strategy and inflating the mean square due to the final programmed strategy. If the df were changed it would result in a change in the conclusion. Specifically the partner's final strategy would not be seen as affecting the subject's evaluation of him. Only the initial strategy would affect evaluation.

Wilson and Insko (1968) found that subjects' impressions of another person were formed by his recent behavior rather than by behavior he had performed previously. The PDG was played by 40 females and 40 males for 20 trials. Under one condition in the first block of ten trials a stooge played cooperatively 80% of the time. For the final ten trials the stooge played competitively 80% of the time. Under other experimental conditions the stooge adopted the same strategies in reverse order. Subjects impressions of the stooge were explained by a recency and not a primacy effect. Only two subjects suspected the experimental deception.

Communications in the Prisoner's Dilemma Game. The studies in this section refer to studies where various types of notes or verbalizations are exchanged. Notes can assume several forms. They can refer to the sender's strategy (with varying degrees of reliability or credibility) either on the trial following, or a series of trials, following the transmission of the note. The note can also convey an expectation of what the other should do and convey (or not) what will happen if he doesn't do this.

The communication can also clarify outcomes where the joint outcome is not available to one or both subjects. It can affirm a cooperative norm or it can establish a cooperative intent over a

period of time. The note can be issued by the experimenter as a form of establishing an orientation in the game.

Several studies have found that transmission of a note increased cooperativeness in the form of cooperative choices or else in the form of the other's perceived trust or intent. One study however found that threatening notes of varying credibility influenced cooperation in an extended game but only on that trial to which the notes referred, namely the one following their transmission. In another study the credibility of the note had an effect on the subject's cooperation in the entire game but the type of effect it had depended on the level of cooperation of the other subject.

Pregame free social interaction facilitated cooperation especially when it involved a statement of a cooperative norm or an exchange of a series of standard notes. Experimenter instructions have been found to facilitate or impede cooperation at least in shorter length games. Kanouse and Wiest (1967) reported that subjects expected the other to carry out the same strategy to which they were oriented by experimental instructions. Thus experimental instructions may in some sense be considered a form of indirect communication.

In general, communication seems to markedly influence the subject's choices in a PDG. The reason for this given by most authors is that it establishes the intent or state of the opponent. The effect of the note seems to increase the more it is nonthreatening or nonaggressive in tone at least as far as can be told from the Horai and Tedeschi, and Gahagan and Tedeschi studies.

Loomis (1959) used the PDG to study the effects of communications on the frequency of cooperative strategy selection by subjects. The notes expressed varying degrees of intention, expectation,

retaliation and absolution. The subject did not have to honor his note but for two levels of note sending the note informed the subject that the confederate would retaliate if the subject did not do as the note bade him. Ten groups of subjects were run for five trials, of which the first trial outcome was analyzed. Half of these groups were receivers and half were senders of notes. Perceived mutual trust was considered present if the subject expected a cooperative choice by the other person on the first trial and also perceived the other person as expecting him to choose cooperatively. They found that regardless of the type of note sent it was effective in increasing perceived mutual trust. As the level of the note increased (i.e. from expectation only, to intention only, to expectation plus intention, to expectation plus intention plus retaliation, to expectation plus intention plus retaliation plus forgiveness) the level of perceived mutual trust increased. Finally Loomis found that as perceived mutual trust increased, subjects increased their level of cooperation.

Swenson (1967) allowed subjects to send notes to one another prior to playing any trial in a 30 trial PDG. The game differed from the usual PDG in that the outcome information to both subjects was varied. For one group only one subject had complete information about the joint outcomes, the other person had knowledge only of his own outcomes. For a second group both had knowledge of joint outcomes for any particular play of the PDG. Crossed with this condition was a condition where the subjects were allowed to send or receive notes of the form, "I have chosen _____. You have chosen _____." In one group the sender of the note had complete outcome information. For another group the sender was the person who had incomplete outcome

knowledge. For yet a third group both parties could send notes, but they alternated communications. As is common he found that cooperation decreased over the first 30 trials. However there was evidence of less of a decline in cooperation in the alternating communication group.

Radlow and Weidner (1966) investigated the effects of unenforced commitments in a game that ran for 98 trials. The experiment allowed a pregame phase in which five standard notes could be exchanged until a standard strategy had been agreed upon or until 15 exchanges had taken place. Even though the strategies were unenforceable the results indicate that negotiations with unenforceable commitments results in a very high percentage of C being chosen, (about 90%). When no communication was permitted, subjects started choosing C at about 55%, went down to between 40% and 50% by the thirtieth trial and returned to between 60% and 65% by the end of the game. Radlow and Wiedner hypothesize that the familiar U curve of the noncommunication groups is a part of the dynamic process by which players explore one another's intent. Preplay communication could be expected to eliminate this phase of exploration.

Horai and Tedeschi (1969) allowed a simulated partner to threaten the subject in various ways during a 150 trial PDG. The procedure allowed the simulated partner to threaten the subject with a loss of five, ten or twenty points in addition to the usual trial outcome if the subject did not make a particular choice on the next trial as the partner demanded. Further the experiment called for the simulated partner to back up his demand on 10%, 50% or 90% of the trials on which the subject failed to comply with the demand. In order for this

procedure to be carried out ten noncompliance trials had to be elicited from the subject. This was done by increasing the frequency of the demands until the noncompliance criterion had been reached. The major dependent variable was taken to be the number of threats issued across the three credibility levels, the three magnitude of punishment levels and the two sexes. The major findings with respect to credibility was that all three credibility levels differed among themselves with the ten percent credible other eliciting more noncompliance and the 90% credible other eliciting more compliance, while the 50% credible other was intermediate. The punishment factor showed that although the five and ten point conditions did not significantly differ from each other they both differed from the 20 point condition. None of the interaction factors nor sex factor was found to be significant. Moreover, when the percentage of cooperation was used as the dependent variable it was found to differ as a function of credibility. The 90% credibility condition yielded significantly lower cooperation than the other two levels. This was explained in the following terms. By complying more often the 90% credibility group experienced more threats since ten noncompliances were needed. Since the simulated partner cooperated 50% of the time and since the partner defected on all the threat trials, the proportion of cooperative strategy selections on nonthreat occasions by the partner was greater for the high credibility players. These players had a greater opportunity to discover that threat trials were clearly different from nonthreat trials and that they could exploit the more cooperative play of the other on the non-threat trials. No other condition, including sex, had any statistical relation to the amount of cooperation.

Kanouse and Wiest (1967) gave a one trial, paper and pencil version of the PDG to a group of subjects. They had two levels for each of the following: partner condition, instructional set, sex of the other player and sex of self. The subject was told that his partner was a member of his class or an imaginary partner and, that the partner was a member of the same or opposite sex. Furthermore the subject was given a cooperative or competitive set. The data were analyzed by Sutcliffe's multiple classification procedure. Of the subjects given the cooperative set, 67% chose C as compared to only 37% who were given the individualistic set. The amount of cooperation was not affected by the imaginary or real status of the other player. Nor did sex of the subject or sex of the partner affect the percentage of C. The expected choice of the partner was related to the instructional set given the subject in that those given cooperative instructions felt that the partner would behave cooperatively while those given individualistic instructions felt that he wouldn't.

Deutsch (1960a) investigated the concepts of "trust" and "suspicion" using the PDG. The essential features of "trust" according to Deutsch are (a) that the individual is confronted with an ambiguous path, a path that can either lead to an event perceived to be beneficial or an event perceived to be harmful (b) he perceives that the beneficial or harmful event is contingent upon the behavior of another person (c) he perceives the strength of the harmful events to outweigh the strength of the beneficial events. The individual is more likely to choose the ambiguous path if he perceives the beneficial events as stronger as compared to the harmful events and he has greater confidence

that beneficial events will occur rather than harmful. This is said to be related to how much he trusts the other person.

Suspicion is postulated by Deutsch to occur (a) when the individual is confronted with the possibility that a potentially harmful event will occur (b) he perceives that the occurrence of the harmful event is contingent upon the behavior of another person (c) he perceives the possibility of engaging in behavior that will prevent or reduce the harmful consequences of the other person's behavior, if it occurs. Deutsch considers a choice not to take an ambiguous path a type of suspicious choice. An individual is considered as more likely to make a suspicious choice if he perceives the strength of the harmful effects to be greater and he is confident that the suspected behavior of the other will occur, and if he is more able to prevent or reduce the harmful consequences of the other's behavior.

Deutsch postulated that a cooperative motivational orientation would lead a subject to expect that the other had a reliable benevolent intention toward him and would facilitate trust. The subject with a competitive orientation would be most likely to expect a reliably malevolent intention from the other just as his own intention would be malevolent. When subjects are individually motivated only an exchange intention was postulated to occur and that under special circumstances (i.e. they both make their choice at the same time). Also the opportunity to communicate with the other would lead Deutsch to expect that individualistic individuals would encourage mutual cooperation.

In both the one trial and the ten trial PDG Deutsch found that a cooperative orientation leads the individual to make a cooperative choice. The competitive orientation leads to D choices. However with

the individualistic orientation, the choice to cooperate or not is a function of the experimental treatments. The opportunity to communicate by note prior to choosing among the individualistically oriented subjects increased their cooperation. The opportunity to communicate in the other two motivationally oriented groups did not enhance or deter cooperation.

Gahagan and Tedeschi (1968) pointed out that most of the research on PDG and communication had been done with relatively few trials. Also none of the researchers had investigated the "credibility" of the written messages. In their experiment, the subjects were 37 males and 35 females. They played the game for no money and for a total of 110 trials. A communicated message was considered by the authors to be credible for them if the "other person" does what he says he will do on the particular trial in question. They established three credibility levels. For group one, 30% of the time the other player did what he said he would. For group two, 60% of the time the message was true. For group three the message was true 90% of the time. The subjects in each of these three groups were randomly assigned to an opponent who was 50% or 75% cooperative. It was found that the subjects who received highly credible (90%) messages cooperated more often than the other two groups on the trial following the message. (The message was, "I am going to push the cooperative switch on this trial"). This group was also more likely to reciprocate promises. There was a significant strategy by credibility interaction on the overall proportion of cooperation. The 75% strategy produced more cooperative choices than the 50% strategy when messages were 60% credible. The reverse was true when the messages were 30% credible.

No difference was found when the messages were 90% credible. They conclude from this that the strategy of the other did not affect the subject's behavior if the other's promises were consistently backed up by his behavior. At the lower credibility levels the recipient of messages was more likely to take the overall strategy into consideration.

Oskamp and Perlman (1965) found that a small amount of social interaction prior to beginning the game increased the amount of cooperation in a PDG that ran for 30 trials. Also they found that the public commitment involved in stating a norm, namely that cooperation is desirable, can increase the level of cooperation. Subjects who publicly disagreed with a competitive norm were the most cooperative. This experiment was unusual though in that it found a relatively high level of cooperation among subjects. It did find that males were more cooperative than females and that very few subjects expressed that deception by the experimenter was present even though the simulated other chose C 100% of the time.

Reward matrix manipulations in the Prisoner's Dilemma Game. Gallo and McClintock (1965) in their review of game studies predicted that there would be a difference in cooperation if real money was used to pay off subjects in PDG experiments. In studies reviewed below there was no statistical difference in cooperation when money, shock or exam credits were used as the reward outcomes. Thus while the Gallo and McClintock hypothesis has not been disproved no support for it has been evidenced in the very few studies reviewed here.

More attention has been paid to finding an index to describe the incentive value of any PDG matrix. While the exact index has

not been specified the work of Rapoport and Chammah (1965b) and Steele and Tedeschi (1967) have developed powerful predictive indices. The latter authors point out that more subtle personality effects may emerge only when the cooperation index is in an intermediate range.

Recently there have been attempts to modify the outcome matrix so that it will reflect a very real fact of social interaction. There is a feeling that once an interaction occurs the outcome matrix is modified. This type of experimental manipulation while it may increase the realism of the game situation, introduces unnecessary complications that hinder proper experimental design.

Evans (1964) reports an experiment in which half of the subjects were told that the points they won in a six trial game represented money that they could take home with them. The other half were told that the points they accumulated would be converted to exam credits and added to their final exam scores. The subjects interacted with bone fide subjects and there were 18 dyads in each condition. No statistical difference was found between the two groups in the frequency with which they chose C.

In previous experiments Radlow had used a one trial payoff selected randomly from a large number of trials. Evans and Grumbaugh (1966b) tested that procedure against one whose payoff depended upon the outcome of every trial. The authors found that the payment schedule did not affect the percentage of cooperation.

Bixenstine and O'Reilly (1966), prior to the PDG, had subjects roughly scale shock in terms of amount of money they would forego to avoid the shock. Forty males and 40 females were then run in a PDG

with a member of the same sex as their partner. Half of the pairs received shock for the first part of the game and then money for the second part as the payoff for the outcome matrix. The other half of the subjects received shock and money in reverse order. No difference in cooperation was observed when shock was the outcome and when money was the outcome, if other factors were held constant. Like other studies males were observed to be more cooperative than females. This difference was most apparent in the game in which shock came first. Unlike most other studies the level of cooperation was high.

Radlow (1965) performed two experiments on a 98 trial PDG. Payoff was on the average between three and four dollars and was based on the outcomes of one unknown trial picked randomly from the 98. No statistical tests were performed on the experimental results. For both experiments Radlow found that subject's cooperative choices initially went down in frequency then went back up. The experimental difference between experiments one and two was that the latter contained more explicit (but essentially neutral) instructions about the nature of the game and the reward matrix. In experiment two he found that subjects cooperated about 25% more than in experiment one.

Using a standard PDG matrix and paid, recruited subjects, Gumpert, Deutsch and Epstein (1969) found that subjects who played the game for 20 trials for real dollars (RD) were less cooperative than subjects who played for imaginary dollars (ID). Subjects in the RD and ID conditions were paid the same amount for participating but the subjects in the RD condition were given $10 in real money and asked to attach great importance to winning or losing the money. The authors do not specify whether the RD subjects were, allowed to

keep their game winnings. Subjects in the ID condition were given only an imaginary $10 and instructed to play as though they were playing with real money. Subjects in the ID condition chose cooperatively about 50% of the time whereas subjects in the RD condition chose cooperatively about 31% of the time during the 20 trials. The authors conclude that Gallo and McClintock's contention that subjects would increase cooperation if paid real money is incorrect.

Messé, Dawson and Lane (1970) advance an equity explanation for the effects on subject's PDG choices of differential reward level. They speculate that subjects who receive high rewards for the very little work involved in short PD games would be in an aversive state since they received more than they felt they deserved. Subjects to escape from the aversive state would give themselves less money by stabilizing their choices at mutual noncooperation. To test this hypothesis Messé et al had half the subjects face a high reward condition and half face a low reward condition. In addition for each of these two subgroups half of the subjects were required to fill out an extensive pregame questionnaire while the other half were placed directly into the ten trial game. It was predicted that subjects in the high reward condition who performed a pretask should be significantly more cooperative than those who did not fill out the questionnaire. It was predicted that under low reward conditions subjects would cooperate less if they worked on the pregame questionnaire than if they did not. Both of these predictions were borne out supporting the position that a "norm of equity" mediates the effect of reward level on behavior in the PDG. That is when their

sense of equity is not violated either for them or against them subjects are motivated to do well. When so motivated mutual cooperation is more easily achieved.

McKeown, Gahagan and Tedeschi (1967) had a stooge play a game for 100 trials in which he held relatively high power over the other person's outcomes. In one condition he made sure the other got detrimental outcomes 10% of the time, in another condition 50% of the time and in a third condition 90% of the time. After the first 100 trials were completed the subject was given the strong power position. They found that varying the strategies of a strong "dummy" player against a weak player who knows he will shift to the stronger position at the midpoint of the experiment does not affect the subjects' cooperation choices when he does become more powerful. However the groups do respond differently on a "plaintiveness" strategy. This was measured as the frequency with which the subjects cooperate following a mutual defection. The 50% other produced more "plaintiveness" than the 10% powerful other. The 90% powerful other produced an intermediate amount of "plaintiveness." No mention was made of subjects suspecting the experimental deception.

Under the restrictions of the two inequalities defining a PDG and assumption of symmetry, R, S, T, P are free to take on a wide range of values. Rapoport and Chammah (1965a) looked for an index to describe the relationship between the incentive value of the payoff matrix and the course of game behavior. Their first conjecture resulted in the following hypothesis. If other payoffs are kept constant, C increases as R and S increase and decreases as T and P increase. If the entries of the payoff matrix are thought of as

utilities then C (the frequency of cooperation) depends not on the individual values but on the ratic of their differences. In an extensive discussion they point out that for three variables one ratio suffices but for four variables two ratios are needed to describe the relationship. This means that all other ratios can be derived from these basic ratios. The authors found the one ratio that best describes the incentive value of the matrix in terms of frequency of cooperation in the various games to be given by CI, where CI is equal to R-P/T-S. Axelrod (1967) from purely strategic considerations developed a second CI which was equal to $(T-R)\ (T-S)/(T-P)^2$. Rapoport (1967a) suggested that his own formula is more compatible with a psychological interpretation whereas Axelrod's has a nice geometric interpretation.

Steele and Tedeschi (1967) generated a total of 208 indexes and, in a correlational study found that the index, log (T-S)/(R-P), had the highest correlation r=.64) with the proportion of D choices across 42 game matrices. This correlation, while high, was considered incomplete since only one dyad was used with each matrix. In addition not all of the game matrices were of the PDG type.

Jones, Steele, Gahagan and Tedeschi (1968) set out to make a statistical test for linearity of their index using only PDG matrices. They designed a two factor experiment with one of the factors having three levels of CI (.1, .5, .9). The second factor increased the absolute magnitudes of the payoffs while holding the CI constant. The proportion of cooperative responses was found to increase linearly as a function of the log of CI. Furthermore the matrix with negative values produced more cooperation especially over the high levels of

CI (.5 & .9). Cooperation was observed to decrease over time. Subjects here were playing for points and not for money.

Recently there has been a determined effort to make the PDG a more authentic representation of the real life situation by adding values to the outcome matrix. Guyer (1968) argued that the utilities in the payoff matrix in social situations are not stable, that they tend to change as a function of the past history of the participants. The experimental game that he used featured game payoffs which were responsive to the strategy choices that the players made. The procedure called for eight different sequences of Prisoner's Dilemma Games each containing 25 distinct games. Each sequence was characterized by successively increasing or decreasing the R or the P parameter or both. The parameter changes were made contingent upon the subject's joint response by a series of eight rules. It was found that when reward is either moderate and fixed or large and increasing a decreasing severity of punishment produced as much cooperative behavior as did an increasing severity of punishment. He interpreted this to mean that a decreasing severity of punishment in a dynamic environment produces as much cooperation by engendering good will as does an increasing severity of punishment which promotes cooperation only by its deterrent effect.

Rapoport and Cole (1968) created a Multiple Prisoner's Dilemma Game (MPD) for the same reasons that Guyer modified his outcome matrix. The MPD in addition to the joint outcome information presented by the PDG matrix gives the players information which sends them to one of several other PDG matrices. Which matrix they go to is a function of their joint outcome. Thus one or both players may take a temporary

loss in order to maneuver the dyad to a more favorable game. To test the game three female groups faced a player who played an unconditionally cooperative strategy. Three game matrices were employed. For groups one and three, the confederate increased his cooperation as he went from game one to game three. The players in group three were told they were playing against a preset strategy. This group attained more points than those in group one. All groups were also found to play the same percentage of C across the three games and a significant decrease in C occurred over trials. Subjects were asked to estimate how the stooge would play in the future. Mean estimates of each group corresponded fairly closely to the actual probabilities in each subgame, with high confederate probabilities underestimated and low probabilities overestimated. However the standard deviation of these estimates was large. The subjects' estimates were used to test a dynamic programming model (Rapoport, 1967b). The test involved ranking optimal policies of playing the MPD on the basis of the subjects' perceived strategy of the other player. At the end of the game the experimenter asked the subjects to rank eight possible policies to yield a chosen ranking. The correlation between the optimal policy rankings had chosen rankings for the two models was not statistically different from zero thus refuting the model. To account for this Rapoport and Cole explained there were indications that the subject made conditional probability estimates of the other person's behavior. The model calls for unconditional estimates to be made.

Theoretical formulations about the Prisoner's Dilemma. Not many studies have been oriented toward direct theoretical tests of

behavior in the PDG. The few tests of learning theory predictions have not fared too well. Rapoport and Chammah's imitation theory of PDG behavior is discussed later in this chapter.

Vinacke (1969) claims that it is crucial to determine how the players perceive the game. He also noted that the players' perception of the choices may not be the same as the experimenter's. Recently two models have been advanced to account for PDG behavior in terms of the attributions that the players make about one another's behavior or the estimates of their future choices based upon their current choices. The former model is developed by Scheff (1967) from a consideration of a number of current theories including Schelling's theory of tacit coordination, Mead's theory of meaning and gesture, and Schutz's theory of intersubjectivity. Anatol Rapoport is the author of the latter model. It represents the player's choices now as being at least partially determined by what will happen in the future. Thus any player is assumed to estimate the policy of the other player from that player's current choices. However this last model has not stood up too well to the limited empirical tests to which it has been put.

An article (Tedeschi, Aranoff, Gahagan and Heisler, 1968) has already been reviewed demonstrating that the partial reinforcement effect of learning theory does not account for behavior in the PDG. These authors found that all groups, even though they had been on differing schedules of reinforcement required the same number of trials to a specified criterion of extinction.

An attempt was made by Halpin and Pilisuk (1967) to relate the more complex behavior of the PDG to the findings of probability matching studies. The usual finding in two choice experiments

is that subjects will come to select the more frequently rewarded alternative with a frequency asymptotically equal to the frequency with which that alternative occurs. Sixty subjects were run under three conditions. In group one, subjects were presented with a series of 200 choices, 138 of wh -h were C's while 62 were D's. Subjects knew they were playing against a preset strategy, played for money and were asked to predict the lights. In the second group, a game with a "real" other, the subjects were told they were playing with another person of the same sex. Payoffs were for money and were determined by a PDG matrix. In addition subjects were awarded a 1¢ gain or loss for correctly or incorrectly predicting other's choices. The sequence of choices was the same as that specified in the first condition. Group three had the same conditions as group two but they were told they were playing a computer. For groups one and three the mean number of predictions was quite close to the observed number of C choices. For group two, subjects overestimated the number of C occurrences. (There were 72 Cs in the last 100 trials; group two estimated 81; groups one and two estimated 71.) While this difference was not significant for the final 100 trials, it was significant for the total 200 trials. Thus there was no indication that subjects match even their estimations to the opponent's choices in a human social situation. The authors do not indicate if the subjects in group two realized they were playing against a preset strategy.

Preliminary evidence would indicate that simple learning theories are not capable of handling PDG choices. Rapoport and Chammah (1965a, 1965b) have advanced an imitation model to explain game playing.

Game theory also has not as yet predicted PDG choices. For a one trial game, game theory predicts that rational players should choose D. However empirically this has not proven to be the case (Terhune, 1968).

Rapoport (1967b) developed a semi-rational theory of game behavior for iterated plays of the PDG. In this model the players are assumed to play a sequence of different component games. The players are considered not only sensitive to the outcomes of a particular choice on a particular trial but also considerate of future gains or losses. This consideration comes about because the players realize that their choices make tacit communication or collusion possible. Thus Rapoport believes that players realize that their present decision may partly determine future decisions of the partner. Furthermore Rapoport assumes that players are capable of estimating their partner's propensities. Thus $\overline{X}$ is player A's subjective probability that player B will choose cooperatively following a pair of joint C choices by both players. The propensity $\overline{Y}$ is A's subjective probability that B will choose cooperatively following a joint CD choice. These subjective probabilities plus two more, reflect what A thinks that B will do at time t after a joint choice at time t-1. Thus it is assumed that A believes that B has a policy and his estimates of this policy come from the tacit communication that is said to occur in the PDG.

Taking into account these subjective probabilities, the expected immediate reward and the future consequences of the decision, Rapoport developed expected outcomes for each of all possible distinct policies in the PDG. As yet however he has failed to show that this

imaginative model applies to what subjects actually do. (Rapoport and Cole, 1968).

T. J. Scheff (1967) has developed a theory of social consensus and coordination. He reviewed Schelling's theory of tacit coordination, Mead's theory of meaning and gesture and Schutz's theory of inter-subjectivity. His purpose was to point out that humans are capable of making attributions of value and intent. In particular he views mixed motive games as interactions in which it is necessary for a participant to coordinate his behavior with the other's when the intention of the latter are unknown. However no adequate theoretical argument has been advanced to account for the PDG. Schelling, as reported by Scheff, felt that what was present in human social situations was the mutual assessment and often successful coordination of subjective information by the players or the meeting of minds. Scheff reports that for Mead communication was only a means to an end. That is communication increased consensus between the participants. Schutz called such joint thought "intersubjectivity" when there was a shared consciousness between two persons involved in a collaborative act. Scheff reports that Schelling had a similar explanation for behavior in mixed-motive games. "Tacit coordination" was the term Schelling applied, and explained it in terms of "the meeting of the minds," "mutual perceptions" and suggestions.

To provide a more specific and operational statement to these theories Scheff defines three terms; consensus, communication and coordination. Consensus, the key term, is defined not merely as agreement about a statement X, but also awareness of the agreement and also awareness of the awareness. Thus consensus is said to exist

between two persons, with respect to the issue X, if there is an infinite series of correct, mutually reciprocating attributions of each to the other's attributions. The decisions of the game players, that is their pattern of moves Scheff calls coordination. Mutual coordination is cooperation in terms of PDG behavior. When both players defect Scheff calls it failure of coordination. If either player exploits the other Scheff terms it asymmetric coordination.

The basic postulate is that coordination is a function of consensus and communication. Scheff makes several specific predictions.

1) With no communication between players, coordination is a function of consensus:

(a) The greater the consensus, the more mutual coordination.

(b) The less the consensus, the more failure of coordination.

(c) The more asymmetric the consensus, the more asymmetric the coordination, with the person making the most accurate attribution profiting by the asymmetric coordination.

2) When communication is allowed, consensus is a function of communication:

(a) The more the communication, the greater the consensus.

(b) The more unidirectional the communication, the more asymmetric the consensus, with the person receiving the messages making more accurate attributions than the sender.

3) Coordination depends upon consensus, which, in turn may depend upon communication.

(a) If consensus is constant, then the amount of communication may be increased indefinitely without leading to more coordination.

In proposition 3) communication is seen as a causal process in coordination. However communication is causal only in that it leads to more consensus.

The author finds that the Deutsch experimental findings support his theory but only by assuming that attributions were involved. Consensus as defined here was explicitly measured by Loomis, and Scheff finds that this experimenter's findings with respect to the initial trial of the PDG are consistent with the major tenents of the predictions outlined above. In the Deutsch experiment Scheff notes that under the cooperative and competitive set of instructions explicit information about the other player's intent is given. For the cooperative instructions it is stated that the other player intends to play cooperatively, while in the competitive instructions the other player's intent to play competitively was made salient. Moreover for both types of instructions the idea of reciprocity of perspectives is explicitly stated. The "individualistic" instructions of a third group did not delineate the intent of the other player. Scheff claims that the findings of this study can be explained in terms of consensus rather than motivation. In Scheff's terms, Deutsch found that with an increase in consensus there was more mutual coordination (89% chose mutual coordination) while with less consensus there is failure of coordination (88% chose mutual defection). Finally the more asymmetric the consensus the more asymmetric the coordination.

Loomis' study defined the "state of perceived mutual trust" as a situation in which the individual understands that the other person is aware, and believes the individual is aware, that there is no reasonable alternative but cooperation. Scheff feels that this definition reflects what he has called consensus. To ascertain

the state of perceived mutual trust, Loomis asked each player two questions before the first move. "What do you think the other person will choose?" "What do you think he thinks you will choose?" Loomis in terms of Scheff's proposition found that the more the communication, the greater the consensus. Asymmetry of communication produced asymmetry of consensus. Finally Loomis found that the greater the consensus the more mutual coordination. That is, subjects in consensus cooperated 79% of the time. Subjects in the dissensus condition failed to mutually coordinate their moves. This occurred 78% of the time.

Experiment 1: Problem and Hypotheses

An imitative explanation for PDG behavior has been advanced by Rapoport and Chammah (1965a, 1965b). This explanation has been proposed by Bandura and Walters (1963) for other dyadic social situations and a general reciprocity norm has been advanced by Gouldner (1960). Rapoport and Chammah correlated the total frequency of C responses and the presence of C responses by the other person on zero, one and two trial lags. From the high correlations obtained for several hundred subjects in several types of game situations these authors state: "The interaction effect in repeated plays of Prisoner's Dilemma is strong and positive. In the single sessions a pronounced tendency is observed of each player to imitate the other. It is fairly clear, therefore that a search of individual correlates of this frequency will not be rewarding." (Rapoport and Chammah, 1965a, p. 67).

However under some game conditions, Terhune (1968) found differences in cooperative responding when players were selected for personality differences on need for power, need for achievement and

need for affiliation. In single trial games, where feedback did not occur, opportunity for communication was minimized and the cooperation index was relatively high, the need achievement and need affiliation subjects were more "cooperative" than the need for power subjects. In an extended trial game with a low cooperation index, personality differences in cooperation were obtained when explicit communication was allowed. Personality differences due to internal-external control were also obtained by Bobbit (1967). Knapp and Podell (1968) obtained differences in cooperation due to gross personality differences as did Harford and Solomon (1969). Rapoport and Chammah (1965a) show that females have a lower imitation index than do males. Furthermore males have a higher imitation index playing males than they do playing females. It is concluded then that personality differences do affect the frequency of cooperative responding.

In addition to these personality differences various authors have shown that a subject's reactions to confederate strategies cannot be explained by imitation. Loomis observed that 13% of the time subjects exploited a cooperative strategy on the first trial. Harford and Solomon (1969) showed that subjects reacted differently to "lapsed saint" and "reformed sinner" programmed strategies over a short period of trials. Swingle and Gillis (1968) showed that imitation would occur only if the programmed other was considered a likeable person. Swingle and Coady (1967) observed that subjects were insensitive to abrupt strategy changes when the programmed player began in a 100% competitive or 100% cooperative state for 50 trials then switched to several different levels of cooperation. Also

Gahagan and Tedeschi (1968) found that under conditions of low credibility subjects reacted differently to two different unconditionally cooperative strategies. (50% and 75%). However this is also in the direction of exploiting the confederate.

Furthermore, the correlations which Rapoport and Chammah computed do not necessarily constitute an "explanation" of PDG behavior. Rather, they can be said to describe the behavior of the subjects. Therefore the concept of imitation can be considered only a description and not an explanation of PDG choices.

The postulates of Mead's theory would explain the communication effect found in PDG iterated plays. (Wilson and Insko, 1968; Komorita and Mechling, 1967; Swingle and Coady, 1967; Evans, 1964) The gesture is that portion of an act which epitomizes it. The gesture has two functions. If the player is the recipient of gestural behavior the problem becomes to match the strategy of the other person with that behavior. If the participant is about to act in the social situation the problem becomes one of selecting that behavior (or sequence of behaviors) that will epitomize (or not, if deceit is the goal) the strategy. When a gesture can stand for two strategies its clarity can be said to decrease as the probability of its assignment to one of the strategies approaches .5. For example, a D choice in the PDG without further information, can only tell the observer that a subject plans to maximize his own gain (since T is the highest payoff) or that he wants to maximize relative gain (since T-S is the biggest differential payoff).

It is hypothesized that the information gained by a knowledge of the other person's choices in the PDG serves as gestures about

that person's state or strategy. Subjects are hypothesized to act on this information in order to advance their own best interests in a PDG with monetary payoffs. This hypothesis, at least in part, is in opposition to the hypothesis that Rapoport and Chammah put forward. Specifically it is maintained that subjects will imitate the other only so long as it remains in their best interests to do so.

The strategies of a hypothetical person in the PDG can be placed along two dimensions--a cooperative dimension and a martyr dimension. Thus from a player's choice one can infer that he is cooperative (C) or not ($\overline{C}$). At the same time one can infer that he is in a state of martyrdom (M) or not ($\overline{M}$). Since these strategies are independent, four combined strategies are possible: CM, $C\overline{M}$, $\overline{C}M$, $\overline{CM}$. The psychological interpretation is straightforward for three of these strategies. CM would describe a player who is unconditionally cooperative, whether the other subject is cooperating or defecting. $C\overline{M}$ refers to a subject who will cooperate only as long as the other player does. In other words such a player would be unwilling to receive an S payoff very often. $\overline{CM}$ describes a strategy for a player who is not willing to receive less than a maximum reward. The type of player who uses this strategy hopes to maximize own gain, or relative gain between subjects, without regard to social interdependence. $\overline{C}M$ does not seem psychologically feasible since such a subject would be unwilling to settle for even moderate social payoffs and, instead, looks always for the other subject to win.

A number of the following hypotheses have been substantiated for short runs of PDG plays. In view of Rapoport and Chammah's

(1965b) findings that there is an abrupt change in game behavior following trial 30 they need to be confirmed for a much larger number of trials. While Gahagan and Tedeschi ran their game for 110 trials, on an unconditionally cooperative strategy, they did not pay their subjects nor did they include conditionally cooperative strategies for comparison. It is still unresolved if the paying of subjects serves to motivate them. In view of the Gallo and McClintock review (1965) one can expect subjects to behave differently in monetary payoff conditions.

Hypothesis 1. As the clarity of the gesture increases with respect to a given strategy, that strategy of the player will have a stronger effect on the frequency of cooperative responses of the other player for a given displayed PDG matrix.

Hypothesis 2. When the type of strategy is ignored no difference among the groups in the frequency of cooperation will be due to clarity alone.

Hypothesis 3. Frequency of cooperative responding will be lower in subjects who face a partner employing a CM strategy than for subjects who face a partner employing a $C\overline{M}$ strategy.

Hypothesis 4. The frequency of cooperative responding will increase as the game progresses for subjects facing a partner employing a $C\overline{M}$ strategy and will decrease for subjects who face a partner employing a CM strategy.

These hypotheses represent gross predictions about the behavior of a subject operating in a mindful way as opposed to the behavior of a subject operating in an imitative way. But the theory is sufficiently precise that more rigorous predictions can be made about the trial to trial behavior of a subject.

Model. The model specifies that the behavior of the subjects can be divided into two psychological processes, the activation process and the decision process. The activation process describes the way in which four events or stimulus conditions are related to three strategies that are postulated to describe the intentions of an opposing player in the PDG. By intention is meant the meaning of another player's choices. The decision process describes the action that can be taken once the intentions of the other are known. In specifying the model for the PDG, four stimulus conditions are sufficient to activate three strategies or meanings which are then related to two choices in the decision portion of the psychological process.

The activation portion of the model is given by Equation 4. It is assumed that a subject uses the events from two trials as the basis for activating one of three possible strategy states. On any trial, n-1, the subject, S, can choose C or D in a PDG game. On any trial, n, the other player E can choose C or D. Then four possible joint stimulus events can be considered. A cooperative response by the other can follow a cooperative response by the subject ($C_{E,n}/C_{S,n-1}$); a cooperative response by the other can follow a defecting response by the subject ($C_{E,n}/D_{S,n-1}$); a defecting response by the other can follow a cooperative response by the subject ($D_{E,n}/C_{S,n-1}$); finally a defecting response by the other can follow a defecting response by the subject ($D_{E,n}/D_{S,n-1}$).

$$A = \begin{array}{c} \\ C_{E,n}/C_{S,n-1} \\ C_{E,n}/D_{S,n-1} \\ D_{E,n}/C_{S,n-1} \\ D_{E,n}/D_{S,n-1} \end{array} \begin{array}{c} \begin{array}{ccc} CM & C\overline{M} & \overline{CM} \end{array} \\ \begin{pmatrix} 1-s & s & 0 \\ s & 1-s & 0 \\ 0 & 1-s & s \\ 0 & s & 1-s \end{pmatrix} \end{array} \quad (4)$$

These stimulus conditions are given as starting the four rows on the right hand side of Equation 4. The three strategy states head the columns of the matrix in Equation 4. These strategies are represented by the labels CM, $C\overline{M}$, and $\overline{CM}$. Thus if on trial n-1 the subject chooses C and the other player follows with a C choice then the function designated by row one is in effect. That is, the other player is attributed with probability s to be using a $C\overline{M}$ strategy and with probability 1-s to be using a CM strategy. The model predicts the other player is never cast into the $\overline{CM}$ condition.

If on trial n-1, the subject chooses a D and this is followed by a C on the part of the other player then the second row of the transition matrix is brought into play. Under this rule the subject assigns the other player to the CM strategy with the probability s and with probability 1-s to the $C\overline{M}$ strategy. It is considered that given these stimulus conditions the other player is never attributed to being in the $\overline{CM}$ strategy by the subject. The A matrix can be examined for the remaining two rows by the same methods in order to acquire an intuitive understanding of the activation process.

The construct validity of the transition into the three postulated states is straightforward. If the programmed player follows a C response on the subject's part with a C response then the subject can infer that the other player is in an unremittingly cooperative state and that he is open for exploitation. This state is labelled CM for a cooperative martyr. The subject can also infer under other circumstances that the subject is in a cooperative state but will not tolerate a doublecross on the part of the subject. This state is labelled as $C\overline{M}$ for a cooperative but not a martyr strategy.

The $\overline{CM}$ label would characterize a strategy wherein the programmed other player is seen as being both uncooperative and not a martyr insofar as his playing style is concerned. A player who followed a subject's C choice with a C choice, according to the model would never be perceived as uncooperative and nonexploitable.

An analysis of the other stimulus conditions as presented in the rows of matrix A lead to similar formulations. The second row describes a stimulus condition that has the subject assigning the other player to the same two states as in row one, but with reversed probability. The necessary stimulus for this row is the occurrence of a D response by the subject on trial n-1. If the other player responds with a C on the next trial then the subject is construed as placing the programmed player with probability s into the CM strategy. With probability 1-s the programmed player is assigned by the subject to the $C\overline{M}$ strategy. The latter statement is warranted since the subject may see the other player as trying to lead them out of a dangerous mutual loss situation.

The third row of the A matrix specifies the function rule when the subject chooses C on trial n-1 and the programmed player follows with a D on the very next trial. The model calls for the subject to attribute a noncooperative and unmartyrlike strategy ($\overline{CM}$) with probability s to the programmed player. This combination of choices is seen by the subject as doublecrossing behavior on the part of the programmed other player. At the same time depending upon past events, such behavior can be interpreted by the subject as an attempt on the part of the other player to "get even." So with probability 1-s, under these conditions the programmed player is placed in the $C\overline{M}$ state.

The fourth row of the matrix specifies the mutual defection condition of the two players. If the other player follows a subject's D response with a D response of his own then the model predicts that with probability s he is being assigned a cooperative but nonmartyrlike strategy ($C\overline{M}$) by the subject. Under the same stimulus conditions the programmed player is cast into a noncooperative and nonmartyrlike strategy with probability 1-s.

Again depending upon the recent history of the game, the subject can assign the other player to what has been called the minimax strategy. Also depending upon the game history, he can assign the hypothetical other to a strategy which will not tolerate exploitation but will practice mutual cooperation ($C\overline{M}$).

While the A matrix specifies the hypothetical cognitions of the subjects it does not address itself to the way these cognitive states affect the subjects' own responses. A decision matrix (D) will be constructed which will predict the subject's choices as a function of his cognitions of the other player's strategy.

$$D = \begin{array}{c} \\ CM \\ C\overline{M} \\ \overline{CM} \end{array} \begin{array}{c} \begin{array}{cc} C & D \end{array} \\ \begin{pmatrix} 0 & 1 \\ q_n & 1-q_n \\ 0 & 1 \end{pmatrix} \end{array} \qquad (5)$$

The interpretation of this matrix is straightforward. Consider the first row. It can be presumed from previous experiments that if the other player was construed as a pacifist he would be exploited. Thus subjects could be expected to choose D with a probability 1.

At the same time such subjects would be unlikely to adopt a martyr role themselves. Thus if they found the other player uncooperative

as the third row of matrix D specifies, they would remain uncooperative themselves by choosing D with probability 1.

The second row of the D matrix denotes the intermediate strategy of cooperative but not a martyr. Under these conditions the subject who is out to maximize his gains can be expected to adjust his own level of X responses to that of his partner in an attempt to yield maximum gain. Such an adjustment is expected to be gradual as suggested by the subscript n affixed to the q in the D matrix. For the moment, the rate of change is assumed to be linear and will be specified in greater detail in the chapters to come.

Experiments 2 and 3: Problem and Hypothesis

Very few PDG experiments investigate the effect of varying the nature of the opponent upon subjects' choices. One study by Marlowe, Gergen and Doob (1966) found that the degree of humility of the opponent on a humility-egotism dimension affected cooperation. Subjects exploited the humble other player when no postgame interaction was anticipated but exploited the egotistical other person when postgame interaction was expected. Kanouse and Wiest (1967) could not find any significant difference in a one trial game that could be attributed to the sex of the other player or the sex of the subject. Rapoport and Chammah (1965b) found males to be more cooperative than females when they faced members of their own sex. This difference disappeared when the males and females faced a subject of the opposite sex. The game was played for a large number of trials and the other was not simulated Tedeschi, Lesnick and Gahagan (1968) found no difference due to sex of the subjects in cooperation over a 100 trial PDG. In this experiment the other was simulated and chose C 50% of the time.

In addition the game was highly competitive as measured by the incentive value of the matrix. Several studies (Komorita, 1965, Tedeschi, Lesnick and Gahagan, 1968, Bixenstine and O'Reilly, 1966, Rapoport and Chammah, 1965b, Bixenstine and Wilson, 1963) reviewed previously, found males to be more cooperative facing a tit-for- at strategy while females were more cooperative than males when the other was unconditionally cooperative. Little or no information is available about the effect of the sex of the simulated other on the choice behavior of males and females in a contingent and noncontingent PDG situation. Contrary to the findings of Tedeschi, Lesnick and Gahagan it is predicted here that males and females perform differently from one another with males being more cooperative against the contingent strategy while females are more cooperative against a noncontingent other. No predictions are made about the effect of the sex of the opponent.

Messick (1967) found subjects employed very effective counter strategies in a zero-sum game where subjects were told they were playing a computer. It has been reported that subjects come to suspect the other in a PDG where the choices of the other are arranged according to a simulated strategy. (Bixenstine, Potash and Wilson, 1963, Solomon, 1960) No effective assessment of this suspicion on the subject's choices has yet been achieved. One way of assessing the effect of the experimental deception is to compare the actual performance of subjects who are told they face a simulated other against the performance of subjects who are led to believe they are facing another subject.

In terms of Mead's theory and Scheff's theory of social consensus, communication of meaning or intent behind human actions is assumed possible. Therefore as iong as one assumes he is interacting with another human the meaning of an action must convey the subject's own intention to cooperate in order that the other does not retaliate. It is therefore expected that, for subjects playing against a supposed human other, less effective counter strategies will be used than if subjects are told they are playing against a simulated other.

To test the two exploratory hypotheses presented above, two experiments were carried out. Subjects were assigned to the experimental conditions as outlined in Chapter Two. For both experiments some of the experimental groups used in Experiment 1 were used in the data analysis. The apparatus is described in Chapter Two.

CHAPTER TWO

Method

Experiment 1: Method

Subjects. Subjects were recruited for the experiment by means of an advertisement placed in the Michigan State University newspaper over a two week period during Spring term, 1969. Undergraduate subjects who were interested in participating in a social game experiment, not taking more than one hour, were requested to call a given phone number. In return for their participation the advertisement promised that subjects could earn up to $2.50. When subjects called this number a secretary was available who recorded the student's name and telephone number. The caller was also classified by sex. The times when he (or she) was available for the experiment were recorded. He was then instructed by the secretary that an appointment would be arranged by phone within the following two or three weeks. This delay was explained to be necessary since the experiment involved a small group of people whose available times had to coincide. In response to any questions about the experiment she was told to state that the experiment involved no hypnosis or electric shock, that it was found to be interesting by the majority of people and beyond that, that, she (the secretary) did not know any details.

The sheets for male volunteers were then grouped by threes according to available times indicated on the sheet. Subjects were contacted by the experimenter and an appointment was arranged. It was stressed on this second call that it was extremely important that

a subject be there since a small group was necessary in order to run the experiment. The same procedure was used for the second experiment except that groups were formed in which there was one female and two males, or two females and one male, or three females, as the experimental design called for. In the third experiment any number of males was deemed acceptable but an effort was made to have at least two males run in each time period. On any given day there were ten available one hour periods in which the experiment was scheduled. Subjects were instructed to come to the experimental room in the Psychology Research building and were given appropriate instructions as to the location of the building and room. Within experiments, groups of subjects were randomly assigned to each of the experimental conditions.

Apparatus. The experimental room consisted of a main chamber and six side chambers, three on each side of the main chamber. All six chambers were interconnected by means of a conduit. Four of the side chambers were used in the experiment; one contained electronic equipment while the remaining three were each provided with one table, one chair, a pair of stereophonic earphones and a small display and response console designed to convey the subjects' responses to the Laboratory Control Apparatus (LCA) and to convey information from the LCA to the subjects by means of appropriately labelled lamps. The console was connected to the LCA by means of telephone-type fifty pin connectors fitted to both ends of a cable which ran from the console to the conduit in the wall and through the conduit to the LCA. The console was placed on the table in such a way that the subject response button labelled X, was on the left and the

button labelled Y was on the right. In terms of the traditional PDG labels the X button represented the cooperative (C) choice while the Y button represented the competitive (D) choice. Immediately above these two buttons and centered between them was an amber ready light, labelled "ready." The LCA automatically initiated each trial, after the subject's response had been made and recorded, and the appropriate feedback given to the subject. Feedback consisted of two types. The first type was delivered by a row of four lights situated in the middle of the box just above the ready light. Two of these lights were green and were equally spaced to the left of the vertical central line on a horizontal line in the middle of the box. The other two lights were red and were placed in the same way on the same horizontal midline but located to the right of the vertical centre line. This row of four lights was used to convey to the subject the outcomes for both subjects of any particular trial. If the subject had pressed button X and the other player had chosen X the leftmost green light in the middle row was turned on. Labels below this light indicated that both players had won 1¢ on that particular trial. If the subject had pressed button Y and the other player did so as well the rightmost red light was turned on. This informed the subject that both he and the other player had lost 1¢. In the event that the other player responded with an X on a trial and the subject responded with a Y the remaining green light was turned on and informed the subject that he had won 2¢ while the other player had lost 2¢. The remaining red light in this middle row was turned on when the subject responded with an X response while the other player pressed his Y button. The subject then knew that he had lost 2¢ and the other

player had gained 2¢ for that trial. Above the row of outcome lights were two more lights, one green and one red. These lights informed the subject of the other person's choice. The green light which was positioned to the left of the vertical centre line was labelled with an X and indicated, when on, that the other player had chosen his X button. The red light was on the right side of the vertical centre line and, when on, indicated that the other player had responded Y. A trial began with the onset of the amber light which was turned off in each room by the LCA after each subject's response. When the subjects who were present for that session had all responded, the LCA fed back information indicating the other player's choice and the outcome for each subject and his other player. The two lights giving feedback to the subject remained on for an arbitrary three second interval. Their onset immediately followed the last subject's response in that group. The amber "ready" light was turned on by the LCA one and one-half seconds following the offset of the feedback lights. The offset of the amber light was determined by each subject's response latency.

The LCA is a four by three by five foot portable electronic machine. Its inner workings contain a set of standard commercialized printed circuits which are connected to a 52 x 50 MAC Panel. The printed circuits are designed to perform a particular logical operation or a combination of logical operations. They have the capability of communicating with the MAC Panel through connecting wires. The MAC Panel itself can join these logical circuits by simply interconnecting the matrix of holes on the MAC Panel with a set of flexible wires. Output from the logical circuity was delivered from

the LCA to both the subject's console and a Friden paper tape punch. Input in the form of logical bits was received by the MAC Panel from an eight channel paper tape reader attached to the LCA and from the subjects' consoles. A description of the purely technical capabilities of the LCA as well as additional functions it can perform will be available in a forthcoming technical report. (Kenoyer, C. and Mendelsohn, G., technical report in preparation).

The LCA located in the experimental chamber served a number of functions for the present experiment. Primarily it was programmed to simulate for each subject the other player who played according to one of four possible preprogrammed strategies. The LCA received the subjects' responses and controlled a Friden eight channel paper tape punch. Thus each subject's response and that of the programmed other player could be automatically recorded for each trial. As already mentioned the LCA fed back to the subject, by means of the console, information about joint outcome, the choices of the other player and initiated the next trial. The LCA was also programmed to perform the above functions for experimental units of from one to three players.

The design of the study called for the choices of the other player to assume a certain conditional frequency. This conditional frequency had several values for the several conditions of the experiment. The LCA was programmed to allow the preprogrammed choices of the other player to be punched in channel one on a paper tape for the length of the game. Channel eight was also punched on all tapes prior to the first trial and just after trial 150. The experimental design also called for the game to be interrupted after trial 23 in one half the conditions and after trial 30 in all conditions.

Channel eight punches were inserted after the appropriate trials for each of the conditions. The paper tape reader mounted on the LCA recognized such channel eight punches as a cue for stopping the game and signalled the experimenter that such was the case. A signal from the experimenter to the LCA was necessary before the LCA would accept a new response from any of the subjects. The punches in channel one were recognized in different ways by the LCA depending upon a two position switch controlled by the experimenter. If the experimental design called for a group to be in the noncontingent condition then the switch was placed in position one. The LCA then recognized a punch in channel one of the paper tape as an X response on the part of the simulated other player. If no punch was present the LCA was programmed to play a Y response on the part of the simulated player. Thus, in the noncontingent condition all players in a given group were given the same X or Y response on the part of the other player. If the experimenter placed the switch in position two, the LCA was programmed to respond in a contingent manner to the subject. Under the contingent condition a punch in channel one of the paper tape meant that the programmed other player did what the subject had done on the previous trial. If the LCA read no punch it chose the opposite response to the response the subject had chosen on the previous trial.

For each of the two strategies two types of tapes were punched. The first type reflected a high clarity level of a particular strategy while the second type of tape reflected a low clarity condition. On a given tape, clarity was decreased by decreasing the frequency of punches in channel one. In the high clarity condition 90% of the

trials contained punches whereas under low clarity conditions only 70% of the trials contained punches. These tapes were punched by the experimenter prior to the start of the entire experiment. For each level of clarity under each strategic condition, two tapes were punched. These were subject to the clarity and strategy conditions but were generated by a random number table. These eight tapes contained a punch in channel eight before the first trial and just after trial 30 as well as after trial 150. A duplicate set of tapes, which added a channel eight punch after trial 23, was also constructed to allow for the introduction of a message just after this trial.

In addition to the LCA and its input-output devices the apparatus chamber contained a Wollensak tape recorder which was outfitted with a multiple output jack. This jack was connected to each of the subjects' sets of earphones by means of the conduit connecting the experimental chamber with each of the subjects' chambers. Also, the experimenter was equipped with a pair of earphones with which to monitor the output from the tape recorder. The tape recorder was used to convey pre-recorded instructions to all subjects participating in an experimental session.

Procedure. After arriving at the experimental room the subject was conducted to one of the side chambers. There he was instructed in the use of the earphones but told not to put them on until told to do so by the experimenter. He was told that four people were assigned to that particular time period but that as few as two could ensure that the hour would not be cancelled. All sessions were started (or cancelled) within ten minutes of the appointed time. If two appeared the subjects were informed of this fact and the session begun.

If three appeared, a pretence of a fourth subject was made and the session begun. That is, just after the third subject was admitted the experimenter went through the motions of seating a subject in the fourth chamber. (This was possible since the subjects had no visual contact with a fourth chamber, and by virtue of the fact that there was often a separate experiment being run in yet a fifth chamber.) If only one subject appeared the session was cancelled and the subject told he would receive by mail a full $2.50 for appearing.

When a group had been formed the subjects were instructed to put on their earphones as the experiment was about to begin. The experimenter then retired to the apparatus chamber and started the tape recorder with the instructions to the subjects as required by the experimental design. The instructions given to the subjects were as follows:

> If the volume level on your earphones is uncomfortable just adjust the two knobs on your earpieces until a comfortable level is reached. Now let us begin. You are about to play a game with another player of the same sex in one of the other rooms. He is now listening to the same instructions you are. Since there is more than one team playing at a time neither one of you will know who he is playing with. Both of you can make as much as $2.50 by playing the game.
>
> Before you is a small box that is connected electronically to a machine in another room. The other player has a similar box connected to the same machine. The purpose of the machine is to record both your response and the other player's response, and to record how much you both make and also to give you information.
>
> The first piece of information it will give you is when to respond. You respond when the yellow ready light goes on. You can then make a choice by pressing one of the two buttons which are labelled X and Y at the bottom of the box just below the ready light. When you and the other player have both responded the machine will supply two other pieces of information. First, one of the two top lights will light up indicating whether the other person made an X or a Y choice. Thus if the green light lights up that means the other player has chosen an X button. If the red light lights up that means he has pressed the Y button.

The final piece of information the machine gives is how much money both of you made. In the middle of your box are four lights in a row. Now if you press button X and the other person presses button X the leftmost light in the middle row will go on. Underneath this light is a sign with a 1¢ immediately below the light and another 1¢ just a little lower down. The first 1¢ tells you how much money he got and the second 1¢ tells you how much money you earned. This means that since both of you pressed X you both get 1¢. If you both press button Y the rightmost light will go on. Below this light is a -1¢ and below that is another -1¢. This means when you both choose Y you both lose 1¢.

Now the second light from the left in the middle row lights up when you choose Y and the other person chooses X. Below this light is a -2¢ and below this is a +2¢. This means that the other player loses 2¢ and you make 2¢. The third light from the left lights up when the other person has pushed button Y and you have pushed button X. Below this light is a +2¢ and below that is a -2¢. This means that he makes 2¢ and you lose 2¢.

You will be able to make as much as $2.50 for less than one hour of participation. However to do so you must play your cards right since how much you make will be determined both by your choices and the choices of the other player. Also, how much he makes is dependent on the choices you make. Some people make more than others, some less. To begin the game both of you will start with 50¢. The machine will keep track of how much you make and a check will be mailed to you for the correct amount.

Each of you will be allowed to communicate by note with the other one, early in the game, about how he feels the game should be played.

In addition after you have played a number of trials I will ask you to fill out a form indicating what you feel the other player is doing.

To sum up, this is a game for two people played a large number of times. Each time the ready light goes on, just above the two choice buttons, you are to press either the X or Y button but not both. After the other player has made his choice the two lights in the top row will tell you whether he pressed the X or the Y button. The four lights in the middle tell you how much you both have made. For example if you both press Y, the light on the right will go on and you both lose 1¢. These lights will remain on for a short period of time and then go off. Then after a short period of time the ready light will come on and you make another choice. The machine will keep

track of your earnings. You can make as little as nothing or as much as $2.50 depending upon how you play the game. Take your time. There is no rush. Make your choice when the yellow ready light goes on.

The design called for half the groups to communicate written messages to the other player. The instructions for this condition were the same except for the sentence inserted indicating that notes would be exchanged.

After the instructions had been completed the experimenter initiated the experiment by activating the LCA and the Friden tape punch. Subjects responded to the "ready" light and the experiment was run off until the LCA signaled the experimenter that the game had been stopped according to the experimental plan. For one half the groups this occurred just following trial 23. At this point the experimenter delivered a blank sheet of paper and pencil to each subject and instructed each of them to write a note to the other player instructing him how the game was to be played. Each subject under this condition was informed that he would exchange these notes with the other player. The experimenter acted as a messenger and when out of sight from the subjects substituted one of the following notes depending upon which condition the group happened to be under. Subjects in the non-contingent condition received Note 1. Subjects in the contingent condition received Note 2.

Note 1. If we both choose X it seems to me that will give us the most money. Pressing button Y seems to be a hopeless situation so I will press X much more than Y no matter what you do.

Note 2. If we both choose X it seems to me that will give us the most money. Pressing button Y seems to be a hopeless situation but I won't continue to press X if you don't.

Subjects were allowed ample opportunity to read and write the notes but no subject received a note until he had written his. After the notes had been read they were collected by the experimenter who then returned to the experimental chamber. The game was then continued until the LCA stopped for all groups following trial 30. At this point the experimenter delivered the Semantic Attribution Scale (SAS) to each subject. This scale as it was given in the experiment is reproduced in Appendix A. The scale was designed to measure impressions that the subject held about the other player. Both the scales and the instructions were closely modelled after Osgood's semantic differential (Osgood, Suci, and Tannenbaum, 1957). Osgood et al have shown that a similar set of words are capable of yielding a multidimensional structure in a variety of contexts and when the analysis uses a variety of methods to yield the structure. The multidimensional structure usually factors into words reflecting subjects evaluations of the events rated and of their relative activity and potency. Both the words and instructions were modified to make them suitable for the present study.

After the scales were completely filled out by all subjects the experiment was continued and the game completed. After a total of 150 trials had been completed for all groups the LCA signalled the experimenter that the game was complete. The experimenter then asked the subjects to fill out a SAS form and final questionnaire. The SAS used was the one found in Appendix A and used early in the game. The final questionnaire is presented in Appendix B. Its composition was as follows: Part A of the questionnaire obtained the information needed in order to mail a check to the subject in

payment for his participation in the experiment. The four questions of Part B obtained the information from the subjects about their biographies that might be relevant to the data analysis. Questions 1, 4, 6 and 10 of part C were designed to get at the perception of the other person's strategy. Questions 2, 3, 5, 7, 8 and 9 were designed to elicit information about the subject's own strategy. Questions 11 through 16 were intended to elicit information about the experimental deception. After these final forms were filled out the subjects were permitted to leave and the apparatus was made ready for the next group of subjects. After the three experiments had been completed, checks were made up by the university business office for the entire $2.50. These were then mailed to all the subjects at the address they had indicated in the final questionnaire. Along with the check went an explanation of the Prisoner's Dilemma Game and the reasons for both the experiments and the experimenter's deception. This explanation is contained in Appendix C.

Design and analysis. The independent variables investigated in Experiment 1 were the effect of the other player's strategy, the clarity with which the other player presented that strategy, and a written communication verbalizing the strategy employed. Two levels were used for each of the independent experimental variables. The game was played 150 times by each subject. There were 15 subjects per cell for each of the eight independent cells in the experiment. Thus the design constituted a 2x2x2x150x15 factorial design with the last factor considered random and the first four as fixed. The fourth factor was trials and repeated measures were taken on the same subjects over all trials. These measures cannot be considered

as independent of one another. This fact introduces special problems for the quantitative analyses which will be discussed later.

The first factor in the experiment represented the strategy of the other player. Strategy was manipulated by changing the conditional probabilities with which the programmed player followed a subject's X or Y response. The probability that the programmed player played an X on trial n, given that the subject had chosen an X on trial n-1, was set equal to w. In notation, letting C stand for X and D for Y,

$$w=P(C_{n,E}/C_{n-1,S}) \qquad (6)$$

where the subscript E stands for the programmed other player and S denotes a subject. The probability that the other player would play an X on trial n following a Y by the subject was set equal to y. Thus:

$$y=P(C_{n,E}/D_{n-1,S}) \qquad (7)$$

Then by the laws of probability:

$$1-w=P(D_{n,E}/C_{n-1,S}) \qquad (8)$$

and $$1-y=P(D_{n,E}/D_{n-1,S}) \qquad (9)$$

To simplify notation for purposes of discussion the vector B_i is defined as:

$$B_i=(w,\ y,\ 1-w,\ 1-y) \qquad (10)$$

When w was set equal to y the programmed player was said to be playing a noncontingent strategy. When w was set equal to 1-y the preprogrammed player was said to be playing a contingent strategy. From Equations 6 and 7 it can be noted that the programmed player played X with probability w regardless of what the subject did when w was set equal to y. From inspection of Equations 6 and 9 it can be understood that the programmed player chose what the subject had chosen on the previous trial, with probability w when w was set equal to 1-y.

The second factor of the design was concerned with the clarity of the first factor. For the high clarity, noncontingent manipulation the values of w and y were determined as follows:

$$B_1=(.9, .9, .1, .1) \quad (11)$$

For the low clarity, noncontingent manipulation the values of a w and y were lowered as shown by Equation 12:

$$B_2=(.7, .7, .3, .3) \quad (12)$$

For the high clarity contingent condition the values of w and (1-y) were given in Equation 13:

$$B_3=(.9, .1, .1, .9) \quad (13)$$

For the low clarity contingent condition the vector B_4 was used.

$$B_4=(.7, .3, .3, .7) \quad (14)$$

The third factor represents the presence or absence of a message exchange condition after trial 23, where the programmed other player advocated increased usage of the X button.

The fifth factor was considered random and represented 15 subjects for each of the eight independent cells in Experiment 1. Since the LCA was capable of playing only one strategy per experimental session it was impossible to assign subjects at random to conditions. However groups of subjects were assigned randomly to the experimental conditions. A total of 297 subjects arrived for the three experiments. Seventeen of these subjects were not used because of apparatus failure or because only one subject appeared. Of the remaining 280 subjects 126 were used in Experiment 1. (The last six subjects were booked to complete groups and were excluded from the analysis to obtain an equal number of subjects per cell.) The analysis of the experimental data was divided into several parts according to the methodology and the

dependent variable. It was predicted by Mead's theory that the attributions made of the programmed player's behavior would be stabilized early in the game or, more specifically by the occurrence of trial 30. Consequently a 2x2x2x12 fixed effects analysis of variance was carried out on the number of times the subject pressed the X button. The first three factors of this design constitute the two levels of contingency, the two levels of clarity and the two message levels. The fourth factor referred to blocks of trials. A number for each block was arrived at by summing the number of X responses for the ten trials, starting with trial 31, making up the consecutive blocks. This design is essentially the Case II analysis of Winer where there are multiple factors and repeated measures on one of the factors (Winer, 1962). Conservative F-tests as outlined by Greenhouse and Geisser (1959) were employed with the F ratios of the repeated measures resulting from the usual analysis of variance procedures.

In addition to the tests of the general effect of the treatments more specific predictions of the trial to trial changes of the subjects' behavior were generated by a decision theoretic model shaped from the formulations of minded behavior as set forth by G. H. Mead (1934). The decision theoretic approach has been used successfully in models of signal detection behavior and was thought to be compatible with the present more molar approach to social behavior.

The theory as applied to the Prisoner's Dilemma suggests that the subjects are in one of three cognitive states depending upon how they perceive the other player's strategy for any two adjacent trials. In turn the theory specifies, by means of a decision matrix (see Equation 5), how these cognitions influence the subject's X and Y

choices. Furthermore the theory calls for these cognitions to arise relatively early in the game and to be two dimensional in character.

To assess these last predictions a multiple discriminant function analysis was performed on the 30 trial semantic attribution scale data. The discriminant analysis approach was first developed by Rao (1952) and is presented by Cooley and Lohnes (1962). This method can be applied to data for which there are several measures on groups of people known to differ on some a priori dimension such as sex or pathology. The first discriminant function finds the best weighted linear combination of the measures that will maximally discriminate among the groups. This is done by selecting those weights of the measures which maximize the ratio of the between groups variance to the pooled within groups variance. The variance due to this first function is then extracted from the measures and a second function is computed on the residual variance. If there are J groups J-1 functions can be derived. Rao has derived a chi-square test to ascertain whether the functions will reliably discriminate among the groups in a manner that cannot be due to chance.

Experiment 2: Method

This experiment varied the sex of the subject, the sex of his or her opponent and the type of strategy that the opponent employed. Both males and females were recruited as subjects and they were told that their opponent was either male or female. In reality the opponent was a simulated strategy of either the contingent or noncontingent type and that strategy was carried out under high clarity conditions. No notes were exchanged in this experiment. Thus 30 male subjects were led to believe that they faced a male opponent while another 30

believed that they were playing with a female. In fact 15 subjects from each of the two groups played against a simulated strategy that was contingent and another 15 in each group played against a noncontingent strategy. Sixty female subjects faced exactly the same experimental conditions. Subjects, as nearly as possible, were selected randomly for the experimental treatment groups. Groups were randomly assigned, within the limits of the design, to experimental conditions.

The same procedure was followed as in Experiment 1 with the exception that the instructions were modified on the tape recorder to take into account the sex of the opponent. For four of the groups the pronouns "he or she" were inserted in place of the pronoun "he" and the words "of the same sex" were changed to "of the opposite sex." For the two all female groups the pronoun "she" replaced the pronoun "he" throughout the main experimental instructions.

For purposes of the analysis of variance a 2x2x2x12x15 factorial design was utilized with repeated measures on the fourth factor, trials, and the last random factor representing subjects. The first factor (A) stood for the type of strategy (contingent or noncontingent) that the subject faced throughout the PDG. The second factor (B) was the sex of the subject while the third factor (C) represented the sex of the opponent. The fourth factor (D) was used for the 12 blocks of ten trials that were used.

Experiment 3: Method

For this study four experimental groups were created and compared with four comparable groups from Experiment 1. This experiment investigated the effect of facing a contingent-noncontingent strategy (Factor A), the effect of the subjects being led to believe they were playing a human or a machine opponent (Factor B), and the effect on

the subjects of receiving a note supposedly clarifying the strategy of the other versus those who received no note at all. The analysis of variance, a 2x2x2x15x12 design, was exactly the same as the previous two experiments. The second last factor represented the 15 subjects considered as randomly assigned to each of the cells and the last factor represented the last 12 blocks of trials of ten trials a piece. The dependent variable was the frequency of X choices across the trial blocks.

The same procedure was followed as the previous experiments with two exceptions for those subjects in the machine condition. First, if only a single subject appeared the experiment was still carried out. Out of a possible 60 subjects seven were run when no other subject was present. Second, subjects were assured by the experimenter before the instructions were read that they were playing against a machine. If they wished they were allowed to view the machine. The following instructions were then read to those subjects who were facing a machine.

> If the volume level on your earphones is uncomfortable just adjust the two knobs on your earpieces until a comfortable level is reached. Now let us begin. You are about to play a game with an electronic machine in another room. As many as three players can play against the machine at any one time. All of you are listening to these same instructions but in no way will you be playing with or against one another.
>
> The machine is capable of assuming several strategies or ways of playing the game. These strategies represent the ways that several different types of people play the game once they understand it. You can make as much as $7.50 by playing the game when the machine assumes these strategies. The strategies are simple and straightforward and involve no trickery or deceit on the experimenter's part. For example while the machine may or may not pay attention to the way you responded prior to any trial it does not have foreknowledge of your current choice. That is it must make its choice on any one trial without knowing what your choice is on that trial just as you don't know what choice it has made until you have made yours. Now I will explain the game itself.

Before you is a small box that is connected electronically to a machine in another room. In addition to being the other player for you, the machine can record your response and the amount that you make. Also it gives you some information.

The first piece of information it will give you is when to respond. You respond when the yellow light goes on. You can then make a choice by pressing one of the two buttons which are labelled X and Y at the bottom of the box just below the ready light. When you and the other players have responded the machine will supply two other pieces of information. First, one of the two top lights will light up indicating whether the machine made an X or Y choice. Thus if the green light lights up that means the machine has chosen an X button. If the red light lights up that means the machine has pressed the Y button.

The final piece of information the machine gives is how much money you and the machine make. In the middle of your box are four lights in a row. Now, if you press button X and the machine presses button X the leftmost light in the middle row will go on. Underneath this light is a sign with a 1¢ immediately below the light and another 1¢ just a little lower down. The first 1¢ tells you how much money the machine earned and the second 1¢ tells you how much money you earned. This means that since both of you pressed X you both get 1¢. If you both press Y the rightmost light will go on. Below this light is a -1¢ and below that is another -1¢. This means that when you both choose Y you both lose 1¢.

Now the second light from the left in the middle row lights up when you choose Y and the machine chooses X. Below this light is a -2¢ and below that is a +2¢. This means that the machine loses 2¢ and you make 2¢. The third light from the left lights up when the machine has pushed button Y and you have pushed button X. Below this is a +2¢ and below that is a -2¢. This means that the machine makes 2¢ and you lose 2¢.

You will be able to make as much as $2.50 for less than one hour of participation. However to do so you must play your cards right since how much you make will be determined both by your choices and the choices of the machine. Some people make more than others, some less. To begin the game you will start with 50¢. The machine will keep track of how much you earn and a check will be mailed to you for the correct amount. After you have played a number of times I will pass a note to you that a person who was playing such a strategy might write if he were communicating by note with you.

Remember you will be playing with a machine for a large number of times. In addition after you have played a number of trials I will ask you to fill out a form <u>as</u> <u>if</u> you were playing with another person.

To sum up, each time the ready light goes on just above the two choice buttons, you are to press either the X or the Y button but not both. After the machine has made a choice the two lights in the top row will tell you whether it pressed the X or Y button. The four lights in the middle row tell you how much you and the machine have made. For example if you both press Y

the light on the right will go on and you both lose 1¢. These lights will remain on for a short period of time and then go off. Then after a short period of time the ready light will come on and you can make another choice. The machine will keep track of both your earnings. You can make as little as nothing or as much as $2.50 depending upon how you play the game. The machine's strategies are simple and straightforward. They involve no trickery, deceit or foreknowledge on the machine's part. Take your time. There is no rush. Make your first choice when the yellow light goes on.

CHAPTER THREE

Results and Discussion: Experiment 1

Results

The results can best be presented in four sections. The first section deals with an analysis of variance of the data from Experiment 1. The second section will present the data regarding the perceptions of the other subject that the subjects held early in the game. The third section will present the decision theoretic model and an assessment of its accuracy. The fourth section will give the subjects' reactions to the experimental deception.

Assessment of the experimental manipulations. The statistical analysis of the frequency of the (subjects') X responses as a function of the three bilevel independent variables is given in Table 1. The independent manipulation involved a note-no note condition crossed with a contingent or noncontingent strategy which was communicated with high or low clarity across 12 blocks of ten trials apiece. It will be recalled at this point that the experimental hypotheses predict that: first, the clearer the other person's strategy is the more effect that strategy has on the cooperative choices of the subjects; second, the frequency of cooperation is not affected by the clarity level by itself; third, cooperation is lower for those groups who face a CM strategy than for those who face a $C\overline{M}$ strategy; fourth, over trials, when faced with a partner using a $C\overline{M}$ strategy subjects increase their cooperation and decrease it across trials when faced with a CM strategy.

In connection with the first hypothesis, the note was expected to clarify the other player's strategy. Thus in the contingent strategy it was predicted that the note condition would raise the frequency of (subjects') X responses above the no note condition. For subjects who faced a noncontingent other, those who received a note were expected to lower the frequency of their X responses below that level of responding shown by those who received no note. However no interaction of the note condition with any other condition reached an acceptable level of significance. Instead the exchange of notes itself operated to raise the frequency of X responses. By sending and receiving a note the frequency of X responses was raised from 4.49 to 5.19 in an average ten trial block.

From the between subjects portion of Table 1 it is seen that variations in the opponent's contingency pattern produced reliable differences in the subjects' X responses. Subjects who faced a contingent opponent chose X 5.96 times on the average trial block as opposed to only 4.44 such choices by subjects who faced a noncontingent other player. This finding has to be qualified by the significant interaction observed between type of contingency and the clarity of the strategy. Subjects who played with another who chose according to the high clarity contingent condition played X 6.93 times out of ten on the average while the subjects faced with a less clearly contingent strategy chose X 4.99 times out of ten. A clearly noncontingent condition resulted in subjects choosing X only 3.99 times out of ten while, faced with a less clear noncontingent condition, subjects made the X choice 4.90 times out of ten on the average block of ten trials. Subjects who faced a clearly noncontingent other player made fewer X

responses than those facing a less clearly noncontingent other when no notes were exchanged ($F=3.7$, $p<.08$, $df=1/112$) as was predicted by hypothesis one. This effect was only marginally significant when the note exchange condition was ignored. ($F=2.3$, $.25<p<.10$, $df=1/112$). Under both note and no note conditions subjects who faced a clearly contingent other were more cooperative than those who faced a less clearly contingent other ($F=10.4$, $p<.01$, $df=1/112$). No reliable difference was obtained between the group who faced a less clearly contingent other and a less clearly noncontingent other.

Hypothesis 1 was partially verified in that as the opponent's strategy became clearer the subjects' responses were increasingly affected in the expected direction. However the exchange of notes in the noncontingent condition produced an unexpected effect. Subjects who received a note expressing the noncontingency of the other increased their own level of cooperativeness.

Hypothesis 2 was verified in that the subjects who faced an other who performed his strategy in a relatively clear fashion did not behave differently from those subjects who faced an other with a strategy defined as less clear. On the other hand subjects who played with a contingent other exhibited more X responses than did those subjects facing a noncontingent other. This verifies the predictions of Hypothesis 3.

Effects taking place within subjects as the game continued are given in the second half of Table 1. Over all conditions there was a statistically significant decrease in the number of X responses. (From the first block to the last block the average number of X responses was as follows: 6.29, 5.58, 5.39, 5.08, 5.04, 5.18, 4.87, 4.78, 5.20,

5.15, 5.00, 4.86.) The type of contingency differentially affected the rate of change of X responses over blocks of trials as is shown by the significant contingency by trials interaction. The clarity by trials interaction indicated that subjects changed their response rate as the other person's strategy became more or less clear. Under low clarity conditions, disregarding the type of strategy, the rate of change is low while under high clarity conditions the rate becomes high. Finally the second order interaction of type of contingency and clarity of that contingency affected the rate of change across blocks of trials. The contingent strategy under the high clarity condition elicited a high degree of cooperation by the fourth block and maintained that high level with a slight decline in the middle block of trials. The contingent but less clear strategy started at an equal level of cooperation but this declined over trials. Both non-contingent strategies elicited about 54% to 55% X responses on the fourth block of trials. In the high clarity condition this had declined to 39% by the eighth block whereas it had remained at 54% on the low clarity noncontingent strategy. On the remaining trials six out of seven blocks remained at 45% or more X responses, whereas under the high clarity condition all seven blocks were 40% or less X responses. The low clarity conditions in both strategies do not appear to differ substantially across blocks of trials. This pattern of responses is not inconsistent with Hypothesis 1 although for the contingent low clarity condition it runs counter to Hypothesis 4. For that condition, it was expected that subjects would increase their X responses as the game progressed.

Table 1

Analysis of Variance of X Responses

in Blocks of 10 for Experiment 1.

Source	df	MS	F
Between Subjects			
Note (A)	1	725.336	11.304**
Contingency (B)	1	825.069	12.859*
Clarity (C)	1	95.069	1.482
A x B	1	34.225	
A x C	1	63.336	
B x C	1	725.336	11.304**
A x B x C	1	55.225	
Error Between	112	64.165	
Within Subjects			
Trials (T)	11	20.207	5.855*
A x T	11	1.719	
B x T	11	8.562	2.481***
C x T	11	6.653	1.928****
A x B x T	11	1.781	
A x C x T	11	1.856	
B x C x T	11	12.401	3 593*
A x B x C x T	11	2.057	
Error Within	1232	3.451	

*p<.0005
**p<.001
***p<.005
****p<.05

A major difficulty with the use of analysis of variance procedures and the necessarily dependent measures taken repeatedly on the same subjects as the game continues is that the variance-covariance matrix must be symmetrical (Winer, 1962, p. 307). A conservative test has been developed by Greenhouse and Geisser (1959) which avoids assumptions about equal covariances in the pooled variance-covariance matrix. In their technique the same F ratios are used but the df used to consult tabled F values are modified by dividing the usual df for both the effect (numerator) and error (denominator) terms by the df associated with the main repeated measure (in this case df=11). This test is generally considered overly conservative. When applied to the present data the trials' effect remains significant at better than the .05 level of significance. The first order interaction of type of contingency by trials becomes only marginally significant ($F=2.48$, $p<.13$, $df=1/112$). The level of clarity by trials interaction also becomes marginally significant ($F=1.93$, $p<.25$, $df=1/112$). The second order interaction of type of strategy by clarity by trials remains significant ($F=3.59$, $p<.07$, $df=1/112$). This suggests that when the level of clarity is considered, Hypothesis four is essentially verified. That is subjects facing a CM strategy across trials decrease their cooperation level at a rate dependent upon the level of clarity. Facing the $C\overline{M}$ strategy subjects increase their cooperation when the level of clarity is high and decrease it when the level of clarity is low. Data will now be presented to show that the subjects' impressions of the other person are not independent of the other person's strategy.

Assessment of social perceptions. The purpose of the discriminant function analysis was to attempt to measure the subjects' impressions of the other as a function of his strategy. The strategy, it will be

recalled was expected to be subject to an error process as a function of the clarity of that strategy. Therefore to varying degrees it would be expected that the impressions of the other while clear would not be great. That is, while a noncontingent strategy is associated with the CM state, at the same time it has a positive probability of being assigned to the $C\overline{M}$ state. However it can also be expected that subjects reliably discriminate between strategies expressing the CM state and strategies reflecting the $C\overline{M}$ state. Post hoc analysis of the words involved in the discrimination should reflect the content of the CM and $C\overline{M}$ strategies. The SAS was administered to all subjects following trial 30. The subjects' ratings of the other player were then subjected to a multiple discriminant analysis utilizing a standard computer program (Thomas, 1968). For the eight groups this program extracted several discriminant functions of which the first two functions were found to discriminate among the eight groups in a statistically reliable way. The 30 bipolar variables and the standardized weights assigned to them by the first three discriminant functions are presented in Table 4.

Both of the two functions contain words loading heavily on Osgood's evaluative dimension. The chi-square of 71.4 for the first function was significant ($p<.01$, $df=36$) indicating that the groups discriminated reliably among the various strategies they were facing. As can be seen in Figure 3 three of the four noncontingent groups (noncontingent, no note groups for both high and low clarity levels and the noncontingent high clarity note group) and one of the contingent groups (contingent, low clarity, note group) are high on the first function relative to three of the contingent (contingent, no note groups at high and low clarity levels and the contingent, high clarity,

Table 2

Group Means on those Words that have the Highest Weights on Discriminant Function 1

	Function Weights		Noncontingent				Contingent				
			No Note		Note		No Note		Note		Group
	1	2	.7	.9	.7	.9	.7	.9	.7	.9	Mean
Believing Skeptical	.38	.14	3.8	2.9	3.8	2.7	4.3	3.7	4.3	4.1	3.7
Independent Yielding	-30	.09	4.3	4.9	3.7	4.4	2.7	3.3	3.7	3.5	3.8
Grateful Ungrateful	-30	.28	4.1	4.3	4.1	3.3	3.9	3.6	4.4	3.5	3.9
Trustworthy Untrustworthy	-29	.21	3.4	3.3	3.7	2.8	3.5	3.3	4.2	3.1	3.4
Formed Formless	.29	.01	3.4	3.1	3.7	3.5	3.5	3.7	3.6	3.6	3.5
Strong Weak	-28	-05	4.2	5.0	4.3	4.0	3.3	3.7	3.9	4.0	4.0
Meek Aggressive	.27	-05	3.8	3.3	3.8	4.1	5.2	5.1	4.4	4.3	4.0

note group) and one of the noncontingent groups (the noncontingent, low clarity, note group). Groups or persons who assigned the other a high negative score on this function felt that he was relatively "believing, yielding, ungrateful, untrustworthy, formed, weak, meek, calm, and bad." The group means for each of the first seven words along with their weights on functions are given in Table 2. It may be noted that two of the words "ungrateful and untrustworthy," load substantially (.20 or better) on the second function. Any interpretation of the first function of the group means on these two words is confounded by these two words' contribution to the second function. The following results use the overall mean as a point of reference. In all four contingent groups and the two low clarity noncontingent groups the other is seen by the subjects as "skeptical." For the two high clarity noncontingent groups he is perceived as "believing." All four contingent groups perceived him as "independent" while only the noncontingent low clarity note group thought him to be so. The other three noncontingent groups believed him to be "yielding." The groups do not separate into any distinct pattern when they rate the simulated other as formed or formless. However all four noncontingent groups rated the other as "weak" compared to all four contingent groups. In like manner all four noncontingent groups saw the other as "meek" as opposed to all four contingent groups who saw the other as "aggressive."

The second discriminant function indicated that six of the groups (all four noncontingent groups plus both high clarity contingent groups) perceived the other person as similar relative to perceptions of the other by subjects in the two low clarity contingent conditions. The chi-square for this function reached 50.8 ($p<.05$, $df=34$). The group means for the first eight words on this function are presented

Table 3

Group Means on those Words that have the

Highest Weights on Discriminant Function 2

	Function Weights		Noncontingent				Contintingent				
			No Note		Note		No Note		Note		Group
	1	2	.7	.9	.7	.9	.7	.9	.7	.9	Mean
Faithful Unreliable	-.01	-.37	3.1	3.1	3.3	2.7	4.2	3.2	4.5	2.9	3.4
Offensive Defensive	-.14	-.35	4.2	4.3	4.3	4.3	3.6	3.2	4.7	3.6	4.0
Masculine Feminine	.06	.33	3.7	3.7	4.3	3.2	2.9	3.1	3.3	3.4	3.4
Good Bad	-.25	-.28	3.6	3.2	3.3	2.6	3.4	3.1	3.8	2.7	3.2
Grateful Ungrateful	-.30	.28	4.1	4.3	4.1	3.3	3.9	3.6	4.4	3.5	3.9
Stingy Generous	.10	.26	4.7	4.7	4.1	4.9	3.8	3.9	3.1	4.4	4.2
Altruistic Self-serving	-.15	-.25	4.1	4.1	3.7	3.6	5.1	4.4	5.1	4.6	4.3
Disreputable Reputable	-.05	.23	4.8	4.7	4.7	5.2	4.3	4.9	4.3	4.8	4.7

in Table 3. Again two sets of bipolar adjectives "good-bad, grateful-ungrateful" load heavily on the first function and thus the group means for these words are considered uninterpretable. Both low clarity contingent condition subjects viewed the other as "unreliable" relative to the four noncontingent and the two high clarity contingent groups. Subjects in both no note contingent groups as well as the group who faced a clearly contingent other who exchanged a note judged the other as less defensive and more offensive than the other groups. All four of the contingent groups as well as the clearly noncontingent who exchanged notes saw the other as more masculine than the remaining noncontingent groups (both no note noncontingent groups as well as the noncontingent low clarity note group). The two contingent no note groups, the low clarity contingent note group and the less clearly noncontingent note group saw the other as "stingy." All four contingent groups but especially the two low clarity contingent groups saw the other as being "self-serving." These same two low clarity groups saw the other as being relatively "disreputable."

The third discriminant function yielded a chi-square value of 41.2 ($p<.11$, $df=32$). High loadings on this function indicated that the other subject was seen as "pessimistic, irrational, cruel, generous, meek and meaningful." Three of the noncontingent groups had high discriminant scores on this function. The noncontingent groups that were high on this function were both low clarity conditions and the high clarity no note condition. Of the contingent conditions only the low clarity no note condition was high on this function. Thus in three of the contingent conditions and the noncontingent, high

Table 4

Discriminant Standardized Weights of Three Functions

Differentiating the Eight Experimental Groups

Bipolar Adjectives	Function 1	2	3
good--bad	-.25	-.28	.11
trusting--skeptical	-.10	-.05	-.14
independent--yielding	-.30	.09	-.06
optimistic--pessimistic	-.04	.07	.36
sociable--unsociable	.17	.01	.08
unfair--fair	-.10	-.07	.14
meek--aggressive	.27	-.05	-.25
disreputable--reputable	-.05	.23	.13
passive--active	-.15	.21	-.10
grateful--ungrateful	-.30	.28	-.13
pleasureable--painful	.09	.11	-.10
severe--lenient	.09	.03	.08
irrational--rational	-.09	.17	-.45
believing--skeptical	.38	.14	.04
offensive--defensive	-.14	-.35	-.02
trustworthy--untrustworthy	-.29	.21	.04
stingy--generous	.10	.26	.29
strong--weak	-.28	-.05	-.23
masculine--feminine	.06	.33	.16
altruistic--self-serving	-.15	-.25	-.07
calm--excitable	.26	.15	.03
formed--formless	.29	.01	-.19
unsuccessful--successful	.06	-.09	.11
wise--foolish	.14	.13	.17
kind--cruel	.00	-.18	.31
changeable--stable	-.19	.05	-.20
meaningless-meaningful	-.02	.10	.26
cautious--rash	-.09	-.16	.12
competitive--cooperative	-.01	-.00	-.15
faithful--unreliable	-.01	-.37	-.04

Note. - Underlined weights are above .20 and are used for interpretation.

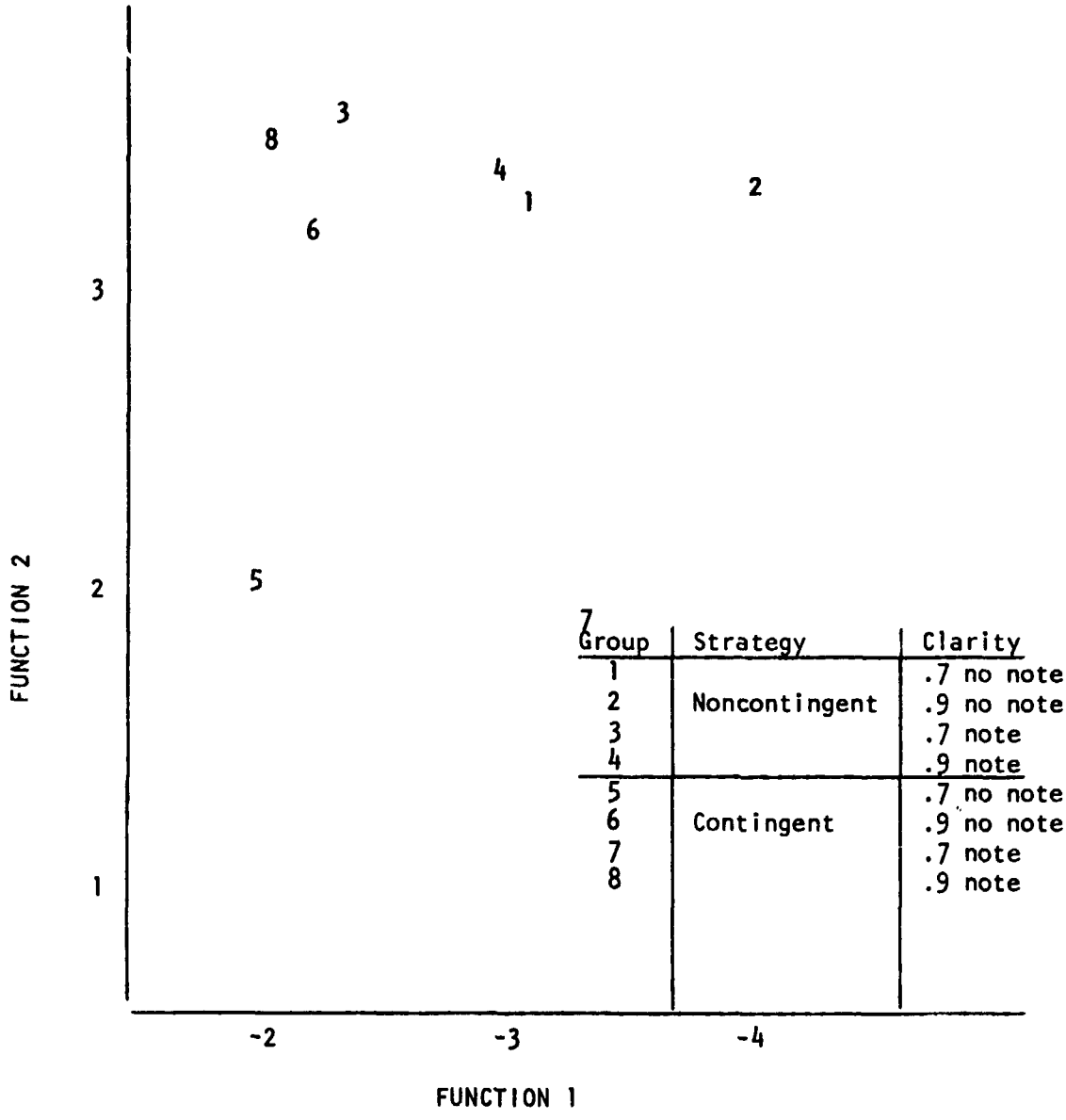


FIG. 3. Group centroids in discriminant space

clarity, note condition the opponent was seen as more "optimistic, rational, and kind."

Results of the decision theoretic model. Equations 4 and 5 of the first chapter specify the process by which a person's choices are related to the choices of the other person. If Equation 4 is post multiplied by Equation 5 then potentially observable chains of events can be deduced. Two intermediate cognitive events as specified by s and q_n are postulated to intervene between any trial n and trial n+1. The parameter s specifies the indeterminacy of the four possible stimulus conditions with respect to any two of three psychologically possible cognitive states. The psychological state then determines the responses of the subject. For this realization of the model the subject was expected to choose Y with probability 1 if he perceived the opponent to be in a CM or a $\overline{CM}$ state. If the opponent was perceived to be in a $C\overline{M}$ state then the subject was expected to choose X with some probability q_n. The model further states that the $C\overline{M}$ perceptual state is attained from any one of the four stimulus conditions whereas both the CM and $\overline{CM}$ conditions can be attained from two mutually exclusive pairs of stimulus conditions.

While the stimuli for the subject. that is the responses of the other player, were programmed to respond according to Equations 11 through 14 of Chapter two they were in themselves contingent upon the play of the subject. In order to generate the predicted performance matrix it is necessary to introduce the subject's own level of cooperative responding through a parameter L_{n-1}. It will be recalled that when w was set equal to 1-y in Equation 10 the preprogrammed player was said to be playing according to a contingent strategy. The subject's

stimulus conditions playing against this strategy are then given by:

$$R=[L_{n-1}w,\ (1-L_{n-1})\ (1-w),\ L_{n-1}(1-w),\ (1-L_{n-1})w]$$

The model specifies that the probability of obtaining a C response by any subject on any trial n can be found by multiplying the activation matrix. (Equation 4) and the decision matrix (Equation 5). The resulting 4x2 matrix then gives the probability of either a cooperative or defecting response occurring under the four activating stimulus conditions. Furthermore the probability of each of those stimulus conditions occurring is given by the vector R. When this is used to multiply the 4x2 matrix the result is a 1x2 matrix which gives the probability of a cooperative response on trial n as well as the probability of a defecting response.

In the contingent case the probability of a cooperative response is found to be:

$$L_n=Pr(C_{S,n})=q_n(1-w-s+2sw) \qquad (15a)$$

It will be found convenient to let:

$$D=(1-w-s+2sw) \qquad (15b)$$

Then Equation 15a becomes:

$$L_n=Pr(C_{S,n})=q_nD \qquad (15c)$$

For the contingent model it remains to specify the process by which q_n changes. That process is schematized in Figure 4. Here A_{n+1} is the probability of the programmed other emitting a cooperative response on trial n+1 and is given by:

$$\begin{aligned} A_{n+1}&=Pr(C_{E,n+1}/C_{S,n})+Pr(C_{E,n+1}/D_{S,n}) \\ &=wL_n+(1-w)(1-L_n) \\ &=1-L_n-w+2wL_n \end{aligned} \qquad (16)$$

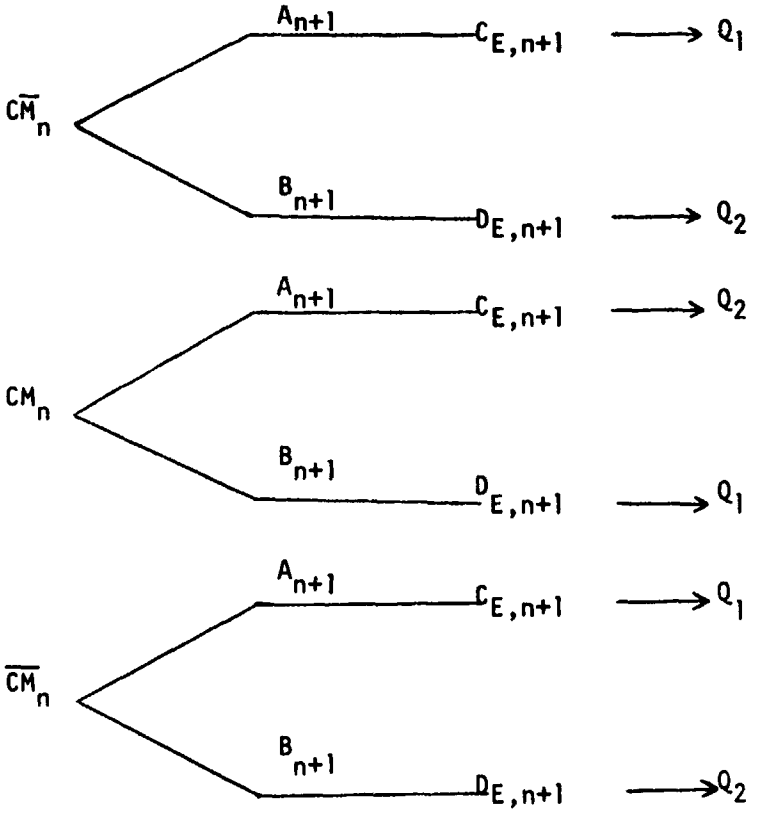


Figure 4. Schema for changes in q_n

Then the probability of the programmed other emitting a defecting response is given by:

$$B_{n+1}=1-A_{n+1} \tag{17}$$

In schematic form, Figure 4 specifies that two operators Q_1 or Q_2, change the value of q_n. Which operator is applied depends upon the subjects' perception of the programmed other's psychological state (CM or $C\overline{M}$ or $\overline{C\overline{M}}$) and whether the other's response ($C_{E,n+1}$ or $D_{E,n+1}$) on trial n+1 confirms the subject's perceptions or not.

This growth model postulates that changing the probability of the subjects emitting a cooperative response depends in part on what state the programmed partner is perceived to be in and what the programmed other does following that perception. For example if the other person is perceived to be in the cooperative but nonmartyrlike state ($C\overline{M}$) and this is followed by a cooperative response by the other player then the operator Q_1 is applied according to the following rule:

$$q_{n+1}=Q_1(q_n)=(1-t)q_n+t \tag{18a}$$

If the other person is perceived by the subject to be in the $C\overline{M}$ state and the other player follows this with a defecting response then the operator Q_2 is applied in the following way:

$$q_{n+1}=Q_2(q_n)=(1-t)q_n \tag{18b}$$

From Figure 4 the expected growth of q_n is a joint function of being in one of the three perceptual states and the probability of applying one of the two linear operators. With this model the change in q_n is given by:

$$\begin{aligned}E(q_{n+1})=&B_{n+1}Q_1[L_{n-1}w(1-s)+(1-L_{n-1})(1-w)s]\\&+A_{n+1}Q_1[sL_{n-1}w+(1-s)(1-L_{n-1})(1-w)+(1-s)(1-w)L_{n-1}]\\&+s(1-w)[L_{n-1}+s(1-L_{n-1})w+(1-s)(1-L_{n-1})w]\\&+A_{n+1}Q_2[(1-s)L_{n-1}w+s(1-L_{n-1})(1-w)]\end{aligned} \tag{19a}$$

$$+B_{n+1}Q_2[sL_{n-1}w+(1-s)(1-L_{n-1})(1-w)+(1-s)(w)L_{n-1}$$
$$+s(1-w)L_{n-1}+s(1-L_{n-1})w+(1-s)(1-L_{n-1})w] \qquad (19b)$$
$$=B_{n+1}Q_1(s-sL_{n-1}-sw+wL_{n-1})$$
$$+A_{n+1}Q_1(1-s+sL_{n-1}+sw-wL_{n-1})$$
$$+A_{n+1}Q_2(s-sL_{n-1}-sw+wL_{n-1})$$
$$+B_{n+1}Q_2(1-s+sL_{n-1}+sw-wL_{n-1})$$

Multiplying and simplifying this expression yields the following:

$$E(q_{n+1})=E(q_n+t[(s-sL_{n-1}-sw+wL_{n-1})(2q_nD+2w-wq_nD-1)$$
$$+(1-q_nD-w+2wq_nD)-q_n]) \qquad (20)$$

This expression is a nonhomogeneous, nonlinear difference equation and is thus not amenable to analytic solution. Instead estimation of the parameters t, q_{30} and s was accomplished by means of iterating the parameters through their range of possible values and establishing those that yielded a minimum chi-square value.

This procedure was carried out by means of a program for the CDC6500 computer and was done separately for each of the four contingent groups. The parameter estimations were made in two stages. First using Equation 15c, values of q and s were selected which minimized the chi-square values for observed and predicted cooperation in trials 28, 29, and 30. The values that produced minimum chi-square estimates are given in Table 5. Using these estimates of s and q, Equation 20 was used to estimate values of t which would minimize the chi-square values for predicted and observed frequency of cooperative responses on trials 31 through 35. The values of t which minimize this value are given in Table 5. Using these three estimates and Equations 15c and 20, estimates of the probability of cooperation were generated for the entire game and the graphs of the observed and predicted probability of cooperation are

presented in Figures 5, 6, 7 and 8 for the contingent conditions. By inspection the model predicts that cooperation will decrease very slowly throughout the game. The graphs also show that the level of expected cooperation stays in the same general region of observed cooperation for at least three of the four contingent groups throughout the course of the game.

The model for the noncontingent conditions was derived in the same manner as the contingent model. The stimulus conditions for noncontingent subjects becomes:

$$R'=[L_{n-1}w,(1-L_{n-1})w,\ L_{n-1}(1-w),(1-L_{n-1})(1-w)]$$

The probability of a subject emitting a C response is given by postmultiplying the R' vector by the product of being in the $C\bar{M}$ state and the probability of emitting the C response once in that state given by Equations 11 and 12. This leads to the following equation:

$$\begin{aligned} L_n=Pr(C_{S,n})&=[L_{n-1}wsq_n+(w-wL_{n-1})(q_n-sq_n)+(L_{n-1}-wL_{n-1})\\ &\quad (q_n-sq_n)+(1-L_{n-1})(sq_n-wsq_n)]\\ &=q_n[(1-D)+L_{n-1}(2D-1)] \end{aligned} \tag{21}$$

Exactly the same two linear operators Q_1 and Q_2 are applied to specify changes in q_n. Figure 3 also specifies the way in which q_n changes with the exception that $A_{n+1}=w$ and $B_{n+1}=1-w$. Then:

$$\begin{aligned} E(q_{n+1})&=wq_n+wt(s+w+L_{n-1}-2ws-2wL_{n-1}-2sL_{n-1}+4swL_{n-1})\\ &\quad -wtq_n \end{aligned} \tag{22}$$

Parameters s and q_{30} were estimated by the computer using Equation 21 so that they minimized the chi-square value between the predicted level of cooperation given by Equation 21 and the observed level of cooperation for trials 28, 29, and 30. These values are recorded in Table 5. Estimates were then made for t so that Equation 21 was

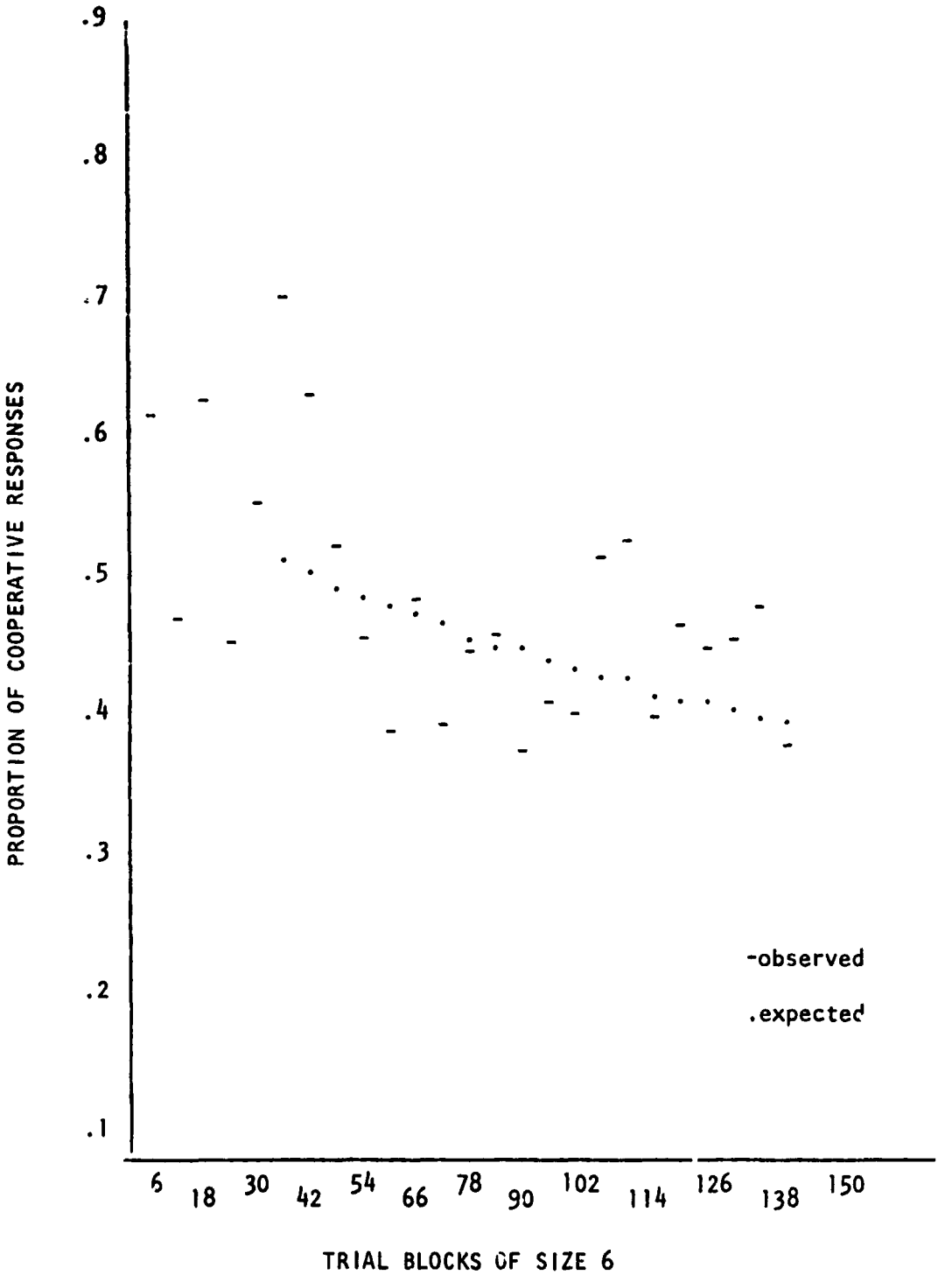


FIG. 5. Contingent .7 no note- observed and expected cooperation.

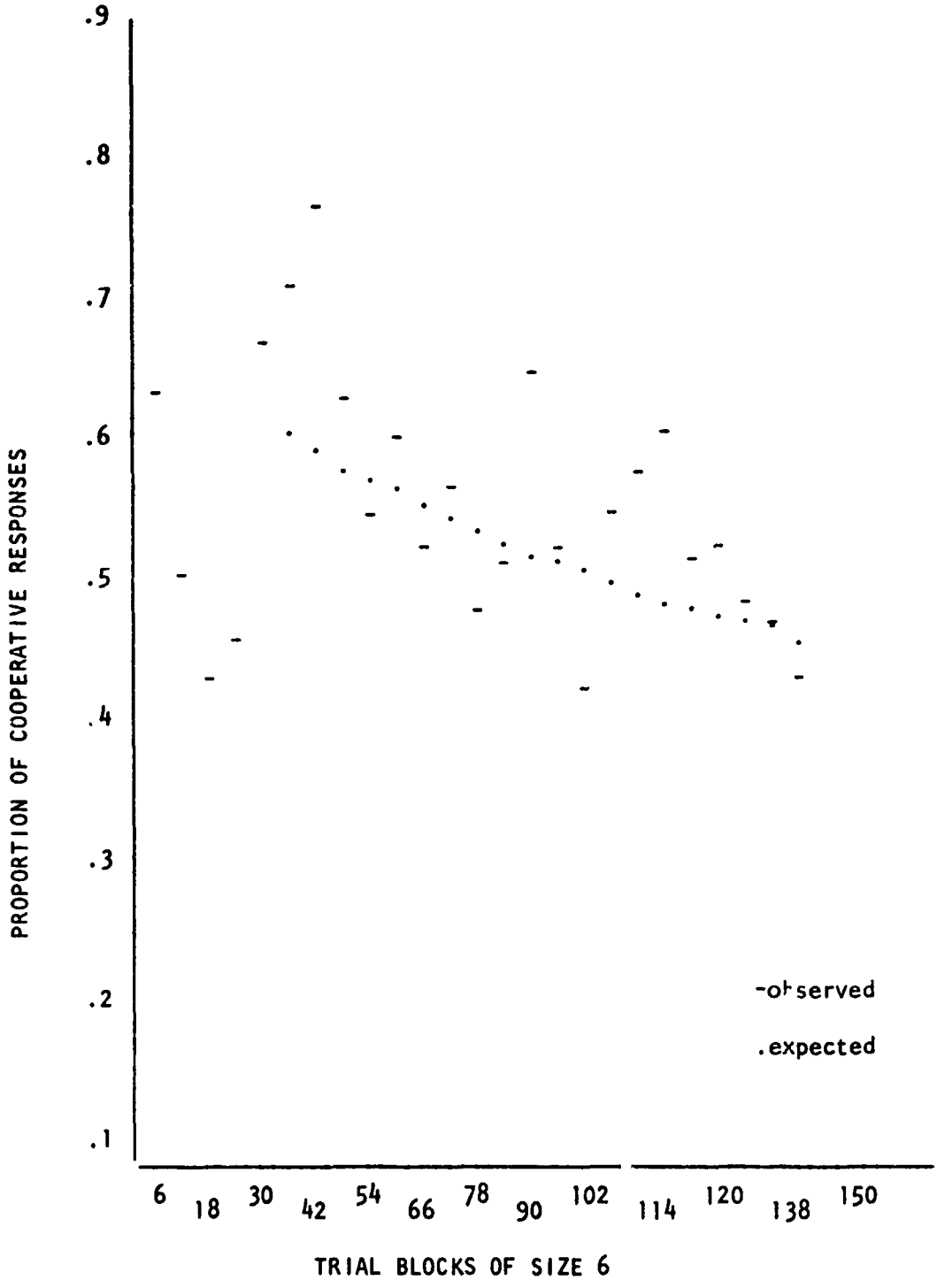


FIG. 6. Contingent .7 note- observed and expected cooperation.

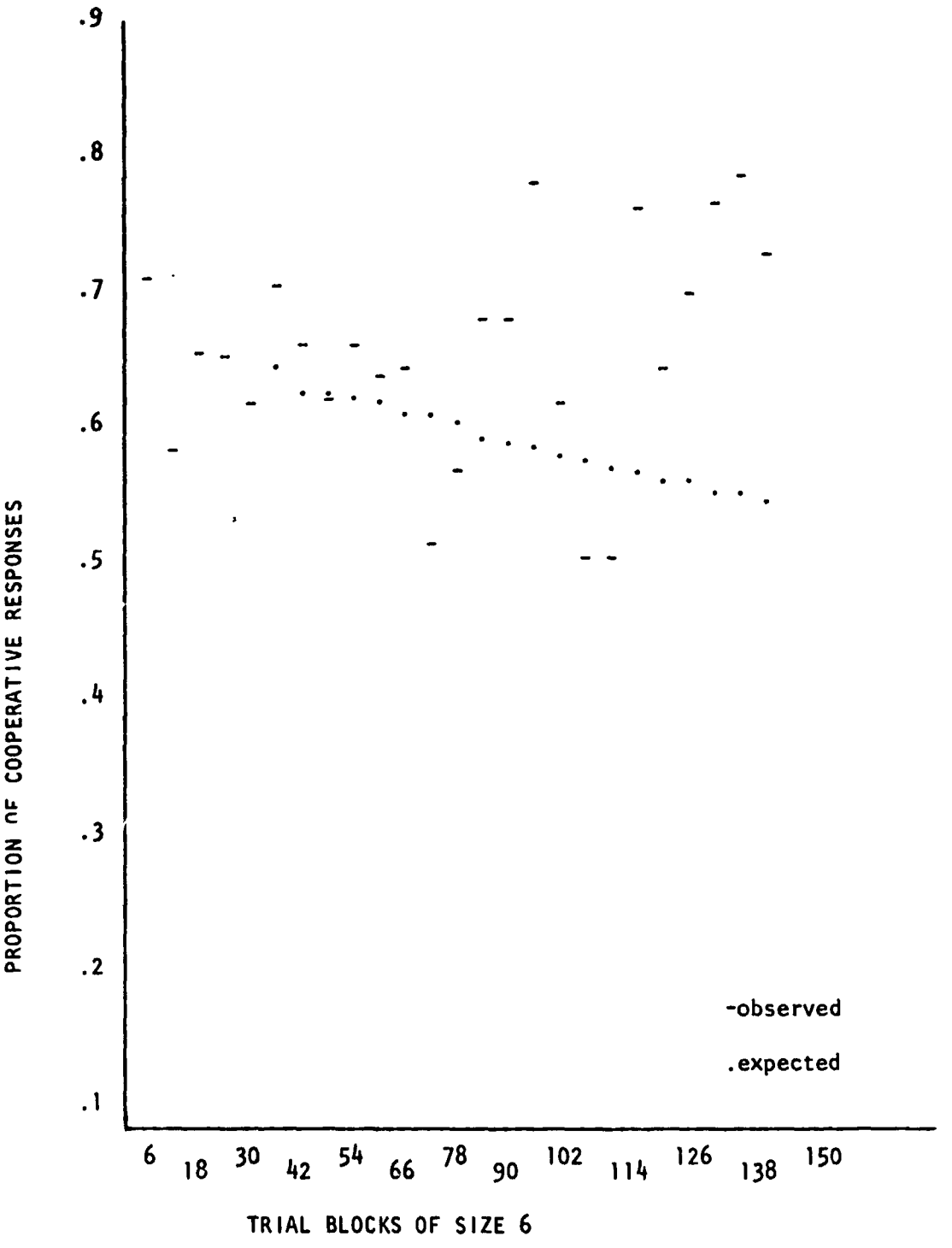


FIG. 7. Contingent .9 no note- observed and expected cooperation.

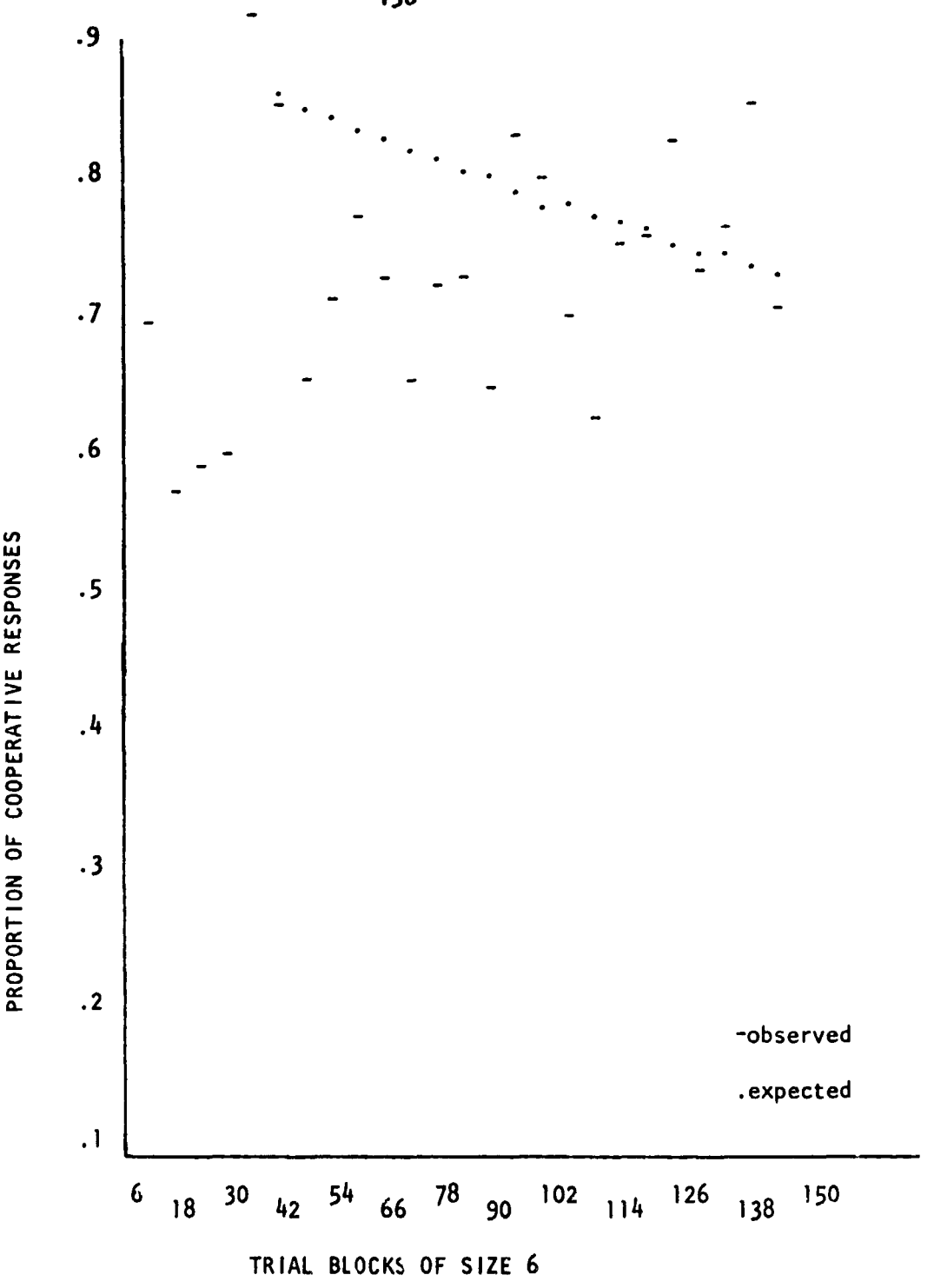


FIG. 8. Contingent .9 note- observed and expected cooperation.

minimized for trials 31 through 35. Values of the t estimates for the four noncontingent conditions are also given in Table 5.

Using these estimates of t, q_{30} and s, predicted values were generated by Equation 21 for the remainder of the game. Both the observed values and their estimates are graphed in Figures 8, 9, 10, and 11. From inspection of these figures it can be seen that the model predicts too many uncooperative responses both in terms of the rate of change of these responses and the level which they finally reach. In all conditions the model predicted that the subjects' responses would drop almost immediately to a near zero level.

Table 5

Parameter Estimates for the Model

Conditions	s	q_{30}	t
Contingent-.7-no note	.625	.925	.01
Contingent-.7-note	.800	.975	.01
Contingent-.9-no note	.750	.900	.01
Contingent-.9-note	.975	.975	.01
Noncontingent-.7-no note	.025	.975	.50
Noncontingent-.7-note	.975	.975	.01
Noncontingent-.9-no note	.325	.725	.01
Noncontingent-.9-note	.975	.975	.01

From Table 5 it will be observed that for seven of the eight conditions the learning parameter t was equal to .01 while in one condition it was abnormally high. The parameter q_{30} was in general quite high as one might suppose it to be. In seven out of eight

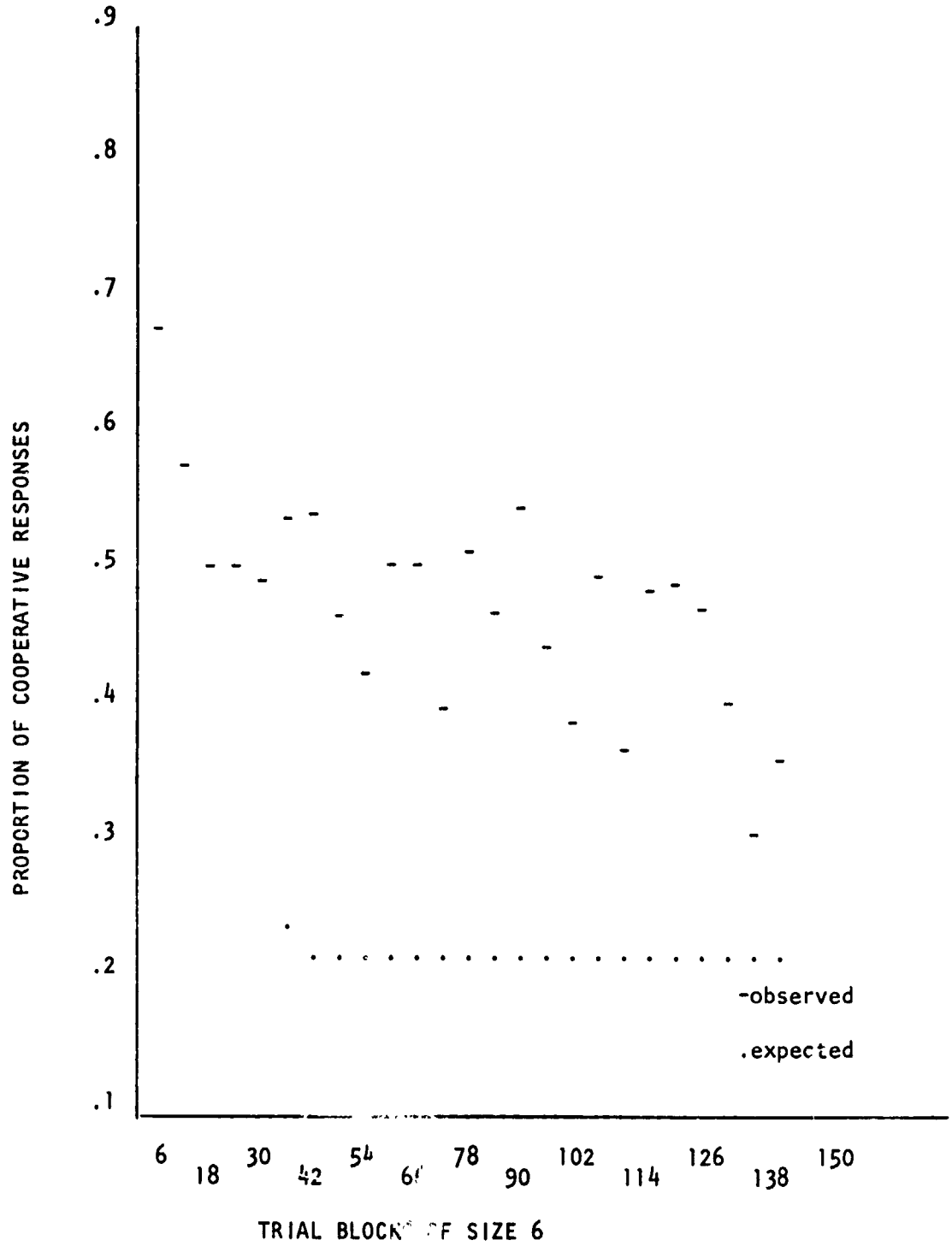


FIG. 9. Noncontingent .7 no note- observed and expected cooperation.

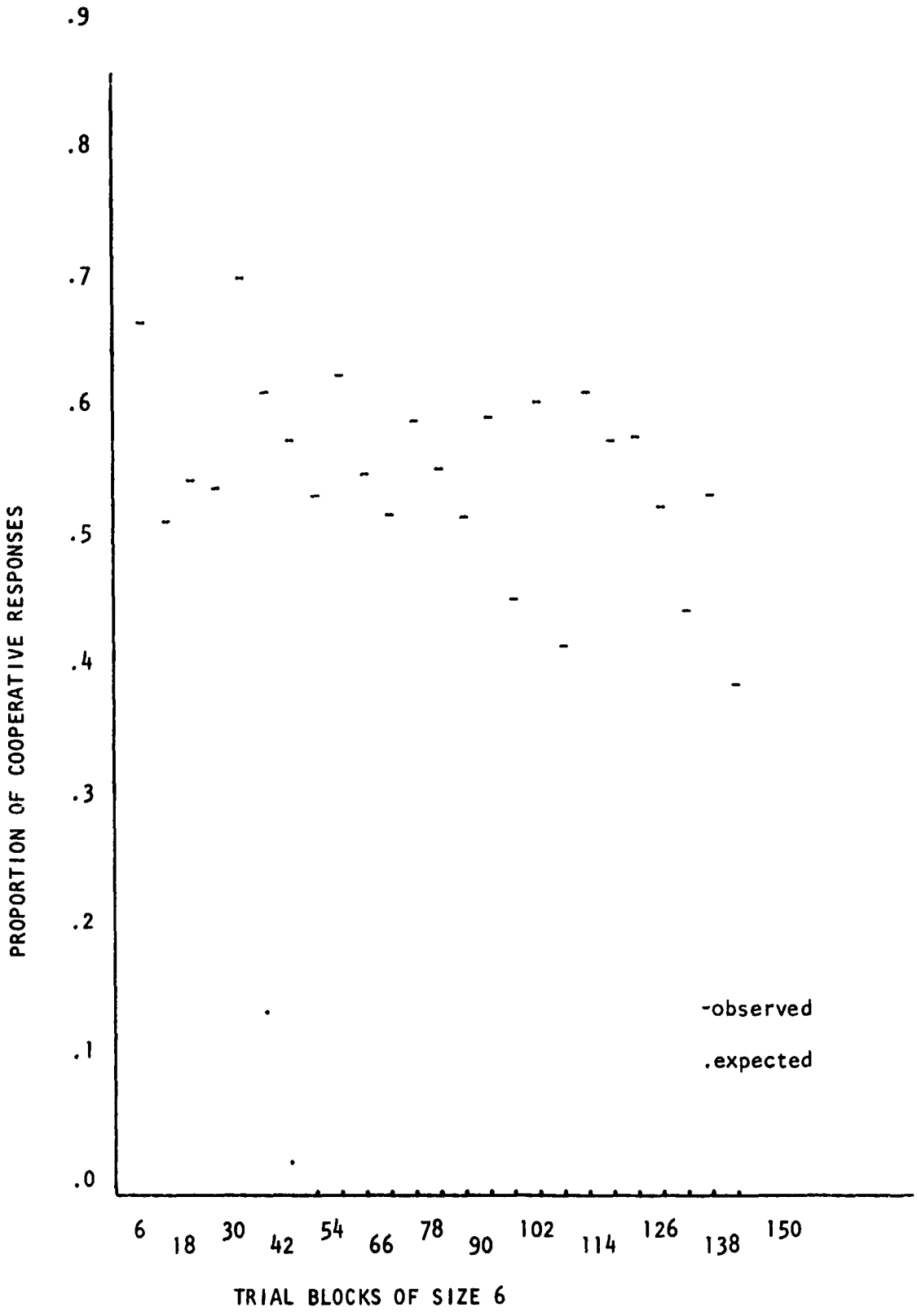


FIG. 10. Noncontingent .7 note- observed and expected cooperation

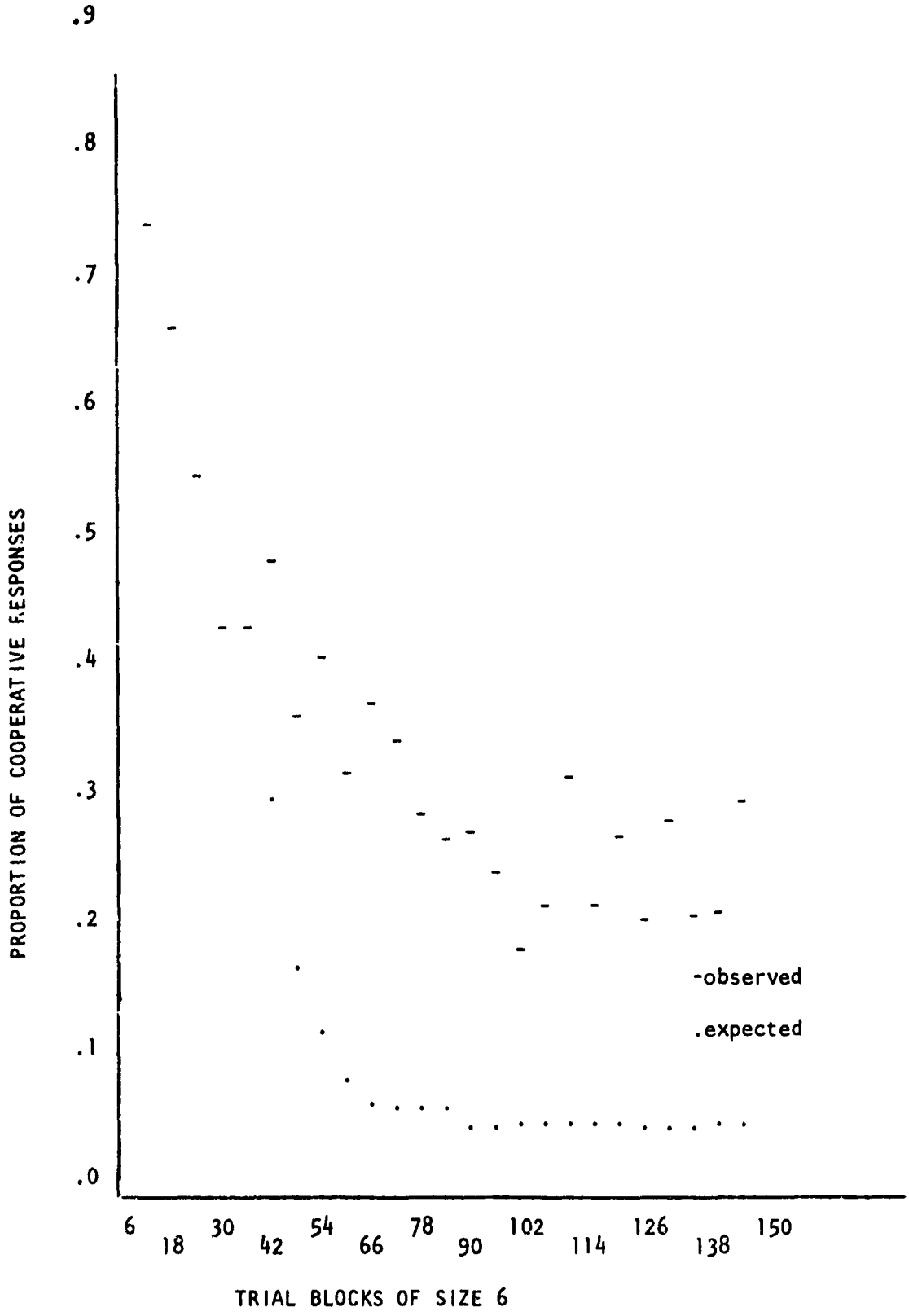


FIG. 11. Noncontingent .9 no note- observed and expected cooperation.

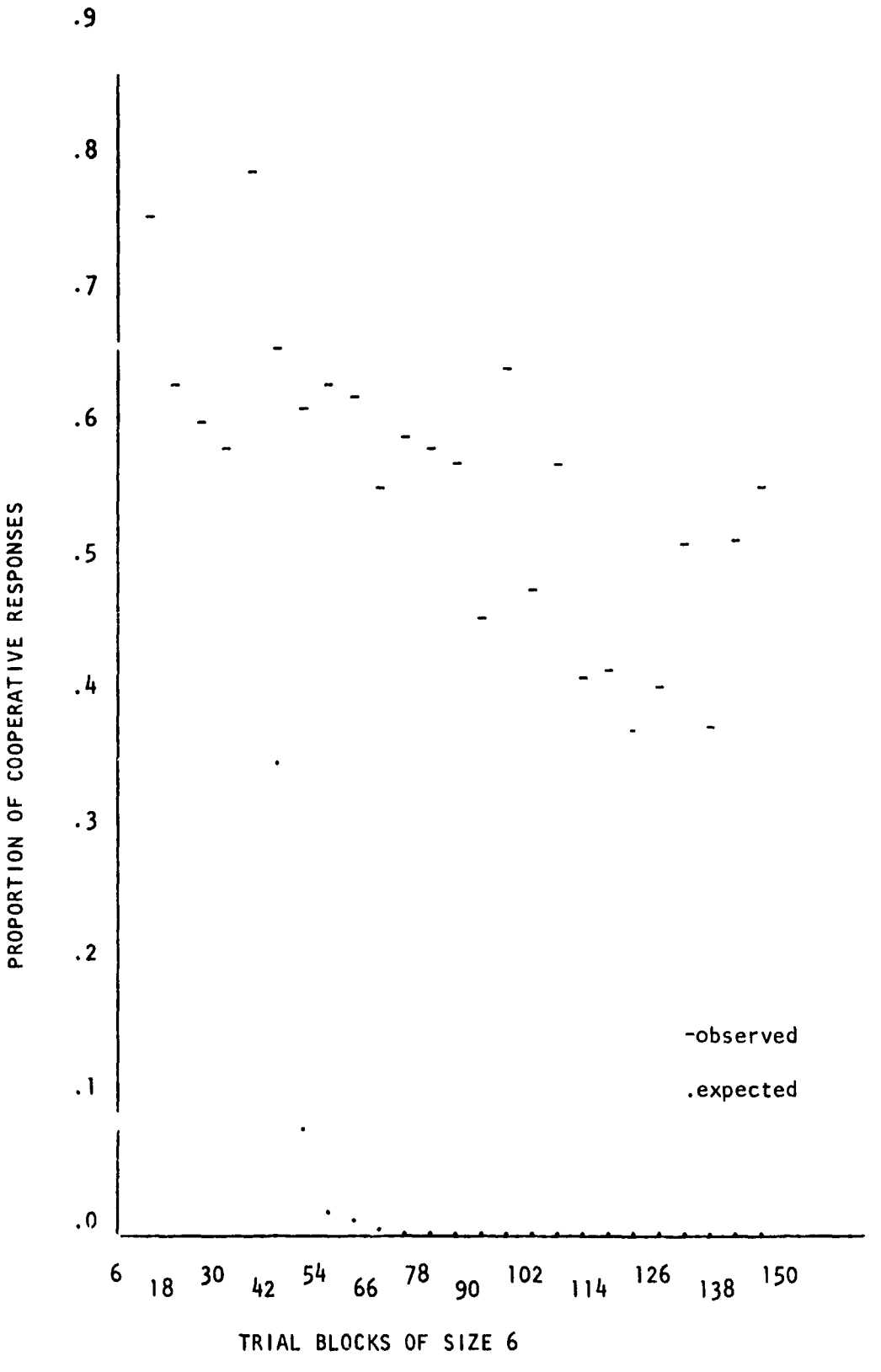


FIG. 12. Noncontingent .9 note- observed and expected cooperation.

conditions it was .90 or better. In the noncontingent, .9, no note condition it reached only .725. Estimated values of s were quite consistent with the theoretical predictions. In the four contingent conditions s took on the two lowest values for the no note subconditions and was highest (.975) when both the behavior of the other was clear (.9) and the other had sent a note clarifying his strategy.

In the four noncontingent conditions s was again lowest for both of the no note conditions but was well below .5 for both of them. According to Equation 9 the latter is not to be expected. In the noncontingent conditions a cooperative response by the other most often has followed a defecting response by the subject. From the second row of Equation 9 it can be seen that a low value of s would then send the subject into the $C\overline{M}$ state which is the only state from which a cooperative response can be made. Thus the low values of s in these two conditions probably reflect the mechanical attempt of the model to raise the level of predicted cooperation for the subjects in these two groups.

Assessment of the experimental deception. Question 16 of the final questionnaire was analyzed and subjects were classified according to their responses into whether or not they thought the experiment had involved deception. Three categories of "yes, uncertain and no" were used to classify the subjects according to their response. The frequency of the responses to each category for each experimental condition are presented in Table 6. This frequency table was subjected to a method developed by Sutcliffe (1957) for analysis of frequency data for multiple classification designs. None of the chi-square values for the higher order interaction was significant beyond the .25 level. However when all the strategy conditions were classified according to whether they

Table 6

Frequency of Deception Responses

to the Experimental Conditions

	Noncontingent				Contingent			
	No note		Note		No Note		Note	
	.7	.9	.7	.9	.7	.9	.7	.9
Yes	2	4	4	6	3	5	1	2
Uncertain	4	2	3	3	1	1	2	0
No	9	9	8	6	12	9	12	14

were contingent or noncontingent the chi-square value was 7.7 ($p<.025$, $df=2$). This suggests that the frequency of "yes, uncertain and no" responses was not independent of whether the subject faced a contingent-noncontingent strategy. Inspection of Table 6 snows that subjects had more yes and uncertain responses to the noncontingent strategy (a total of 27) than they did to the contingent strategy (a total of 15).

To ascertain the effects of the response to deception on the subject's X choices the uncertain responses of the subjects were reclassified into the yes and no categories on the basis of their answers to the other deception questions. The subjects' explanations of their uncertain response was used to reclassify "uncertain" answers. Thus an answer that indicated that all psychology experiments were deceptive was reclassified into the no category whereas an answer that mentioned the other subject changed his mind in a peculiar way was placed in the yes category. For this analysis only those subjects who

were used in the main analysis were retained. This meant dropping the six subjects who were used to fill out the groups in the final stages of the experiment, for a total of 120. This is presented in Table 7. The chi-square value for this table was computed and found to be equal to 5.2 ($p<.025$, $df=1$). As indicated by the test of significance the frequency of yes and no responses was not independent of the strategy that the subject faced. The effect of this lack of independence was investigated by means of an analysis of variance of the data for Experiment I. For computational reasons the trials effect was ignored and the category of yes-no was added. Thus subjects were classified according to

Table 7

Frequency of Reclassified Reactions

to the Deception Questions

	Contingent	Noncontingent
Yes	15	27
No	45	33

the type of strategy they faced (contingent or noncontingent), the level of clarity (high or low) with which the strategy was implemented, whether or not a note was exchanged, and finally, the subjects postgame response to the deception questions. The dependent variable was the subjects' number of cooperative responses. Since the subjects' responses to the deception questions were markedly unequally distributed among the experimental conditions an analysis of variance technique employing the least square algorithm to correct for unequal n was used. The results

of this analysis are given in Table 8. Reaction to deception was found to affect cooperation depending upon the type of strategy the other adopted and the clarity with which he presented that strategy. For subjects who faced an other who was clearly contingent subjects who felt they were deceived chose cooperatively an average 94 times out of 120 while those who felt they weren't deceived chose cooperatively 78 times. Those who faced a less clearly contingent other chose cooperatively 67 out of a possible 120 times when they responded "yes" to the deception questions while if subjects responded "no" they chose cooperative 58 times on the average. In the clearly noncontingent condition subjects who responded "yes" to the deception questions chose cooperatively 39 times. Subjects who responded "no" chose cooperatively 57 times out of a possible 120 choices. In the less clearly noncontingent condition subjects who felt deceived chose cooperatively 72 times while the non-deceived group chose cooperatively 51 times. When appropriate F tests were run on the meaningful, simple interaction effects only the last difference was found to be significant ($F=4.27$, $p<.05$, $df=1/104$). That is, in the less clearly noncontingent condition the 12 subjects who responded "yes" to the deception question cooperated more than the 18 subjects who responded "no."

It can be concluded then that the experimental deception affected subjects differently depending upon the type of strategy they faced. Subjects who faced a noncontingent strategy were more suspicious than that group who faced a contingent other. With respect to the effect on the dependent variable of perceived deception it was found that subjects in the low clarity, noncontingent condition who admitted deception cooperated more than those who did not feel deceived.

Table 8

Effect on Cooperation Choices of the Various Experimental Conditions and Subjects' Reaction to Deception

Source	df	Mean Square	F
Contingency (A)	1	9095.9	12.2*
Note (B)	1	7281.9	9.7**
Clarity (C)	1	565.2	
Deception (D)	1	1146.5	
A x B	1	281.4	
A x C	1	7728.9	10.35**
A x D	1	743.0	
B x C	1	890.1	
B x D	1	45.6	
C x D	1	1583.9	
A x B x C	1	1109.8	
A x C x D	1	3168.1	4.24***
A x B x D	1	121.4	
B x C x D	1	118.2	
A x B x C x D	1	320.2	
Error Between	104	746.9	

*$p < .001$

**$p < .002$

***$p < .05$

Discussion

The effect of the note, the level of cooperation observed in the noncontingent conditions of the experiment, and the level of cooperation observed in this and other experiments where a contingent strategy was used provides evidence that the imitation hypothesis of Rapoport and Chammah is inadequate to explain cooperative behavior in a wide variety of PDG situations.

The effect of the noncontingent strategy points out that subjects did not adopt any simple imitation rule in selecting their choices. Rather than imitating an other who adopted a noncontingently cooperative strategy subjects exploited the simulated other. There was no evidence that the subjects even adopted a strategy of matching their exploitive choices to the frequency of the other's cooperative choices since in the clearly noncontingent no note condition the subjects' cooperative choices were greater than the 10% a matching explanation would demand. Furthermore in the less clearly noncontingent condition where no notes were exchanged, subjects chose cooperatively at better than a 30% rate.

Within the four noncontingent conditions two of the conditions called for the subject to exchange a note with the simulated other. Compared to the no note exchange condition the level of cooperation was increased for those groups who exchanged notes. This effect cannot be explained by the imitation hypothesis since, at best, one expects subjects to match their cooperative choices or their exploitive choices to the noncontingent strategy. However the note had the effect of having subjects choose cooperatively at much less than the frequency with which the simulated other chose X. Subjects' exploitive choices also decreased in frequency - a direction that was opposite to what

would be expected if subjects were matching their exploitive choices to the other's cooperative choices.

Rapoport and Chammah (1965a) have described just how the contingent strategy condition fits their imitation explanation. For a bona fide game they consider an automata with a perfect imitative response tendency and show that, under the assumption that subjects want to maximize their own payoff, they will end up in the mutual cooperation cell. In their experiments, males in a real game situation (where the other is a male) respond cooperatively to the extent that 26% of the variance is accounted for by an index that the authors say measures tit-for-tat tendency. In other experimental conditions the variance declines until the imitative index explains just below 16% of the variance for males facing women or women facing either sex. As a matter of fact, Rapoport and Chammah limit their concluding conjecture to a statement that the men's higher cooperative response frequencies were due to their greater tendency to give tit-for-tat in social situations similar to the PDG.

If this be so then some of the data presented in this experiment are inexplicable. The imitation index of Rapoport and Chammah is in reality the phi coefficient. It measures the extent to which the responses of one player match the immediately preceding response of the other ayer. In contingent PDG experiments, including the present one, this index is well controlled. The low clarity contingent condition represented a subject or an automata whose propensity to imitate the other (or phi coefficient) was set at .4. This is less than the average propensity to imitate (.5) that Rapoport and Chammah found among 70 male

pairs. Under the low clarity contingent conditions there was a decline in cooperation from 71% for trials 31 to 40 and 56% for trials 41 to 50, to 47%, 45% and 44% on the final three blocks of trials. This is consistent with Rapoport and Chammah's theory. Inspection of their graphs show that when the imitation index on the average is .51 cooperative performance rose from 50% to between 60% and 70% for equivalent trial blocks. However when males faced females the men encountered an imitation index of .35 and their cooperation was found to rise from 41% to just over 50% by the final block of trials. That is, when faced with a .35 imitation index in the Rapoport and Chammah experiment, male subjects increased their cooperation. When faced with a .40 imitation index in the present experiment subjects decreased their cooperation from over 50% to about 46%. When the other had an imitation index of .8 in the contingent high clarity condition, cooperation rose to about 74% by the final block of trials.

In summary the relationship between the imitation index and frequency of cooperation is complex. When the imitation index is zero as it is for both noncontingent conditions cooperation is found to decrease but in the low clarity noncontingent condition it remains at about a 45% level of cooperation. This rate of decline is not that deviant from one where the imitation index was set at .40 in Experiment 1. The latter, in turn, is deviant from the pattern of cooperation that Rapoport and Chammah found for males who faced an imitation index of .35. Subjects in the Rapoport and Chammah experiment increased their cooperation to above the 50% level. When facing an imitation index of .51 in a bona fide game subjects cooperated about 68% of the time by the last block of trials. An increase in the imitation index to .81 in

the present experiment had increased the level of cooperation by only 6% to 74% by the last block of trials.

While the data do not support the imitation hypothesis the data are consistent with the idea that subjects form impressions about the other's strategy early in the game. First, the responses of the subjects were in a direction consistent with what would be expected of subjects who were prepared to maximize their gains in the face of a contingent or a noncontingent strategy. That is, the noncontingent strategies were expected to reflect a martyrlike strategy and thus elicit less cooperation than the contingent strategies which were expected to reflect a cooperative but nonmartyrlike approach. As each of these two basic strategies became clearer it was postulated that subjects show less confusion in assigning the noncontingent strategy to the martyr status and the contingent strategy to the basically cooperative status. Thus the strategies of the other as they were constituted for the present experiment can be ordered along a dimension of strategies that increasingly demand the cooperative response in order to ensure that the person is successful at winning money in the PDG. The rank order among the groups of the average number of cooperative responses was in accordance with this ordering. However with respect to the two non-contingent conditions this effect was only present in a statistically reliable way where no notes were exchanged between the players.

The subject's ratings of the person they played with supports the ordering of the other's strategies. The subjects discriminated along two dimensions among the various strategies they faced. In addition, the content of the adjectives suggests that the hypothetical strategies underlying the four stimulus conditions had merit in terms

of content validity. Thus where the simulated other employed an unconditional strategy he was seen as "believing, yielding, formed, weak, meek, calm and bad." These words are consistent with the martyrlike strategy which three of the four groups above the median on this function were predicted to perceive. The fourth noncontingent group that was below the median on this function was the low clarity noncontingent group that also exchanged a note. The effect of the simulated other's note seems to have been to raise the probability of the subject entering the $C\bar{M}$ state. That is, he enters a state inconsistent with seeing the other as "meek, believing, yielding etc." This same relationship that exists between the noncontingent low clarity note and no note groups holds between the two high clarity noncontingent groups. Thus, the high clarity group who received a note saw the other as less "believing, yielding, etc." than the comparable group that received no note.

Why the low clarity, contingent, note group was rated highly on the meekness dimension is not entirely clear. However it may be noted that for the low clarity contingent group the information provided by the choices of the other was probably minimal since the other matched the subjects' choices only 70% of the time if they were cooperative and, 30% of the time if they defected. Subjects would receive the least information about the strategy of the other if they were choosing randomly. On the six trials just preceding the note exchange the low clarity contingent note group was choosing X about 45% of the time. On the six trials following the note exchange but just prior to the rating, subjects were choosing cooperatively 67% of the time. This increase had the effect of increasing the subject's earnings and

decreasing his losses. At the same time the other was perceived in a more favorable light since his cooperation was perceived to be increasing. Finally, the note, a fairly clear statement emphasizing cooperation appeared in a situation where the subject faced maximal uncertainty until the note came. The ratings were then done within seven trials of the note. The strong effect of the note and the initial promise it offered in increased earnings is verified by the score of 4.3 on the "cooperative" adjective that the contingent, low clarity, note group gave the other as opposed to the score of 2.7 that the contingent, low clarity, no note group received for the same adjective. While in the high clarity condition the note increased information and earnings, the net effect was less than in the low clarity conditions.

The second function separated the eight groups of subjects into six groups who saw the other as "faithful, offensive, feminine, good, etc." versus two groups who saw the other at the opposite extreme for these words. The common feature of the latter two groups was that given the strategy of the simulated other there was no way that these subjects could make very much money. In terms of the model the second discriminant function separated those subjects who faced a $\overline{CM}$ strategy from those subjects who faced either a $C\overline{M}$ or a CM strategy. While the low clarity contingent conditions had been expected to reflect a $C\overline{M}$ strategy, in retrospect they were more representative of a $\overline{CM}$ strategy. To see this one can consider a subject who chose cooperatively 100% of the time when faced with a contingent strategy. This is the one strategy that maximizes gains for a subject. Even so the subject would make only 1¢ in an average ten trials because on three trials he would lose a total of 6¢ while on the remaining seven trials he would make 7¢. (This

would account for the unexpected decline in cooperation over trials of the low clarity contingent groups.) The two words "ungrateful and untrustworthy" load heavily on this discriminant function. In terms of content it is difficult to reconcile these two adjectives with "reputable and altruistic" which are also present in the second function. However both of these troublesome words may reflect perception of the two contingent groups who employed a $C\bar{M}$ because one would be unlikely to trust very much a person who would drive such a hard bargain as represented by a predominantly tit-for-tat strategy. Nor would one expect to find such a person grateful for any favors done for him.

To conclude, relatively early in the game a subject comes to form impressions of the other just from the strategy with which he makes in his PDG choices. The relative values of the eight groups on the two functions are consistent with the hypothetical strategies underlying the choices of the other. The majority of the words that have the highest function weights on each function explain the discrimination made among the groups. The interpretation of each of the two functions is imperfect because of two words "ungrateful and untrustworthy" both of which have high weights on the first two functions. Other than this the most heavily weighted words on the first function described an essentially cooperative passive other. The second function included words that were more indicative of a cooperative, as opposed to a destructive, other.

The model as it is constituted in Chapter One had mixed results. It fitted not too badly in the four contingent conditions both with respect to the difference between the predicted and the observed mean level of cooperation and with respect to the relationship among the

value of s. It is notable that in both of these respects the model falls short in the noncontingent condition. First of all it predicted a lower level of cooperation than the subjects actually attained in the noncontingent condition. Second the values of s do not have sufficient "power" in this condition to withstand the tendency of the model to predict noncooperation. The values s can take on range from 0 to 1. It was observed in the present experiment that the note exchange increased cooperation even for the noncontingent conditions. To account for this moderate increase the values of s underwent an increase that spanned the range of possible values. Thus in the low clarity noncontingent condition where cooperation increased on the average from 44% for the no note group to 54% for the note group, the s values increased from .025 to .975. In the high clarity noncontingent condition an average increase from 27% in the no note condition to 53% in the note condition brought about an increase in s values from .325 to .975. The assumption is that the model, in trying to predict a higher level of cooperation forces the subject into the $C\overline{M}$ state which is the one state from which a cooperative response can be made.

These two facts suggest that subjects in the CM state either because of guilt, passivity, imitation, response style, or some unknown reason choose C with some probability not equal to zero or one. This receives empirical support from Rapoport's (1968) report of an unpublished finding by Chammah to the effect that about half the subjects who faced a 100% unconditionally cooperative strategy adopted a cooperative strategy themselves while the remainder exploited such a strategy.

This points out a major gap in Mead's theory. There is no specification of the responses that the subject will select in any particular situation. The theory states only that the subject is

capable of forming a relationship between the early part of the other person's behavior and what will occur later by means of the inferences that the subject makes about the earlier behavior. The nature of those inferences and the type or frequency of the responses can be ascertained only from an investigation of the particular situation in which they occur. This is not necessarily a bad feature of a theory especially one which claims to have generality apart from any given situation. It can be expected that research about the situation itself will supply information sufficient to fill in the gaps of the theory.

To return to the problem at hand there is reason to believe that the response matrix needs to be modified. One practical modification would be to have the subjects respond cooperatively with some probability q_n when they are in the CM state. When in the $C\overline{M}$ state subjects would not respond cooperatively with some probability q_n but with probability one. This would be consistent with the present finding that q_{30} was .9 or better for seven of the eight groups. The net effect of this change would be to make it easier for a cooperative choice to follow from the CM state without substantially changing the rate of cooperation that the $C\overline{M}$ state would produce. This would also reflect Chammah's finding that a certain proportion of subjects responded cooperatively when faced with a pacifist strategy. The $\overline{CM}$ state would remain the same with the probability of a cooperative response being zero as it was with the old model.

This brings up one other difficulty with the model or rather the theory behind it. It is still unspecified how independent variables like type or clarity of strategy, sex of the player, and message exchanges operate on the two parameters s and q. In the analogous

perceptual decision model, the parameter equivalent to s is assumed to be determined by the physical aspects such as the signal to noise ratio. The parameter equivalent to q_n on the other hand is felt to be determined by experimental conditions such as the presentation schedule, information feedback and the outcome structure. However the exact relationships between these two parameters and the independent variables remains to be proven. While the present model is similar in form to the signal detection model it is similar in content to a model developed by Rapoport (1967) and Rapoport and Cole (1968). It will be recalled that in their model subjects estimate their opponent's propensities on the basis of their own and the opponent's joint choice on any given trial. The propensity is assumed to be determined by the policy of the other player. Unlike the present model Rapoport speculates that subjects foresee that their choice on any particular trial affects the policy of the other player. As a consequence of this assumption Rapoport's model produces a cumbersome mathematical formulation.

While not using this feature of the Rapoport model the present model incorporates one of Rapoport and Cole's post hoc findings that subjects form their estimate of the policy of the other on the basis of the choices that are made by the other one trial after their own. Their original model called for the estimate to be made from the joint occurrence of their own and the other's choice on the same trial.

The strong effect of a note whose referent was the strategy of the programmed other was established in this experiment. Gahagan and Tedeschi (1968) rightly point out that note effects had been previously established only for very short games. They ran subjects in a rather lengthy game where the referent to a note was the play on the next

trial of a programmed other. Specifically the other promised to cooperate on the next trial and followed through on that promise 30%, 50% or 90% of the time. They found that the strategy of the other elicited differential overall cooperation only when the credibility of the other's promises were at their two lowest values. That is, the note was involved in an interaction with the credibility of the other's strategy. In the present experiment where the note's referent was the strategy of the programmed other no such interaction was observed. That is, the note raised cooperation independently of the clarity or credibility of the other's strategy and without regard to the type of strategy the other employed. This effect was postulated for the contingent condition but was unexpected for the noncontingent condition. This could be considered as evidence against the relationship between the note and its referent. However for the noncontingent conditions it was possible for subjects to enter the $C\overline{M}$ state. In addition it is also possible under the proposed new model for the note to operate on q_n indirectly by the fact that subjects in the CM state can choose cooperatively.

As has been explained previously an imitation explanation could not explain the note effect. The model as formulated in Chapter Two could have had the effect of increasing the probability of entering the $\overline{M}$ state for all conditions. In the contingent conditions this explanation was borne out by an increase in s which, for the most frequent stimulus occurrences in the contingent conditions, ($C_{E,n}/C_{S,n-1}$ and $D_{E,n}/D_{S,n-1}$), increases the probability of entering the $C\overline{M}$ state. There was an increase in s in the noncontingent conditions which is explicable for one of the relevant stimulus conditions for the

noncontingent case ($C_{E,n}/C_{S,n-1}$) since an increase in s increases the probability of entering the $C\bar{M}$ state. However for the other stimulus condition ($C_{E,n}/D_{S,n-1}$) which occurs frequently under the noncontingent strategy an increase in s increases the probability of the subject entering the CM state. As the original model stands the subject is not able to respond cooperatively from this state.

Some modification of the model might bring the predicted level of cooperation closer to the noncontingent empirical data in which case the parameter s could reflect the effect of the note. The possibility exists that the note as it was constructed conveyed information that prevented subjects from entering the CM state and thus exploiting the pacifist other. After all, the other person's note could be divided into two parts. The first part indicated that the other would play X while the second part gave information about the conditionality for doing so. In the noncontingent note condition the note expressed an unconditional plan to choose X. If subjects could react to the note according to a primacy effect then the second piece of the note's information could be expected to have little or no effect on subjects' choices. The results from Experiment 3 which are discussed in the next chapter argue against such an interpretation since subjects who played against a machine that adopted a noncontingent strategy chose cooperatively less often when a note was exchanged as opposed to when no note was exchanged, while for those who played with a male the reverse was true.

One other finding is of interest with respect to the high and low clarity noncontingent conditions. When no note was exchanged the amount of cooperation was less for those subjects who faced an other playing a clearly noncontingent strategy than it was for those who faced

a similar but less clear strategy. This parallels the finding of Gahagan and Tedeschi (1968) that subjects react differently to different noncontingent strategies but only under conditions of relatively low credibility. Thus both Experiment 1 and the Gahagan and Tedeschi finding call into question Rapoport's (1968) contention that a differential noncontingency does not elicit a differential response from subjects.

Any conclusion drawn about this or any other Prisoner's Dilemma study must take into account the effects of the subjects' response to the deception. Subjects in the present study were more suspicious of a noncontingent than a contingent strategy. A post hoc analysis of these deception responses found that the effect of the response to the deception was related in a reliable way to the choice responses of the subject. The relationship was complex however in that both the frequency and the type of contingency interacted to affect the player's responses. When examined, this interaction was found to be determined by one meaningful comparison. Facing an unclear, noncontingent strategy, subjects who felt deceived cooperated more as compared to subjects who did not. It is difficult to understand why subjects who were responding cooperatively to a cooperative other felt that they were deceived by the experimenter. It is possible that such subjects adopted a cooperative response set themselves and when the other double-crossed them for a large percentage of the time they realized that their expectations of earning $2.50 were being thwarted. It could be that these subjects then felt deceived in terms of their failure to carry away from the experiment the money that was promised to them.

This line of reasoning leads to an important point about any inferences which are to be made about the effects of the response style upon subject' reaction to deception. As in any post hoc analysis there

is the question of the directionality of the cause effect relationship. That is awareness of the deception could have brought about a shift in the manner in which the subjects chose. But it is equally plausible that the subjects' level of cooperation caused them to be more aware of the other's programmed strategy. This would be especially the case in the contingent case where the further the subjects' responses deviated from a random pattern the clearer was the strategy of the other. This explanation would fit both the contingent conditions and the clearly noncontingent condition. In the contingent case subjects who felt deceived chose more cooperatively than those who did not feel deceived although this difference did not reach an acceptable level of statistical significance. This argument is strengthened by the finding in Experiment 3 (to be discussed in the next chapter) that subjects who knew they were playing against a machine strategy cooperated less than those subjects who thought they were facing a male other.

Any analysis of the response to deception must go lacking in the present experiment for want of an appropriate control group. That is, one must consider what proportion of subjects would have responded affirmatively to the deception question even if they were playing with a real other person. This could arise from the demand characteristics of the questionnaire, the general suspicion surrounding the psychological

periment, disappointment over not making $2.50, as well as other similar reasons. The intent of the present experiment was to assess the differential effect of the two strategy styles on the responses to deception and the effect this had on the subjects' choices.

CHAPTER FOUR

Results and Discussion: Experiments 2 and 3

At the end of Chapter One it was pointed out that only in a very few studies was the nature of the opponent in PDG investigated. Consequently in Experiment 2 the effect on both males and females of having a contingent or noncontingent opponent who is either a male or female is looked at. In addition, Experiment 3 investigates the effect, on males only, of playing against a machine that adopts a contingent or noncontingent strategy.

Experiment 2: Results.

The effect of the experimental variables on the cooperative choices of the subjects in Experiment 2 is presented in Table 9. In this experiment the simulated other chose according to either a clearly contingent or clearly noncontingent strategy (Factor A). Also the sex of the subject (Factor B) was varied. In addition the subject was faced with an opponent of either the same or opposite sex (Factor C) as determined by the instructions. From inspection of Table 9 the type of strategy that the other player employed was found to be only marginally significant. However when the sex of the player is considered the contingent-noncontingent strategy has differential effects as indicated by the significant A x B interaction. Males playing against a contingent strategy chose X an average of 65% of the time while an independent group of males who faced a noncontingent other chose X 37% of the time. Females who played a contingent other chose X 48% of the time whereas females who played a noncontingent other chose X, on the

average, 61% of the time. When the appropriate tests of simple effects are made it is found that males who faced a contingent other were more cooperative than males who faced a noncontingent other ($F=21.5$, $p<.01$, $df=1/112$). Females were more cooperative with the noncontingent other ($F=4.7$, $p<.05$, $df=1/112$) than were females who faced a contingent other. Males were more cooperative than females facing a contingent other ($F=8.0$, $p<.01$, $df=1/112$) while the reverse was true when the two sexes faced a noncontingent other ($F=15.6$, $p<.01$, $df=1/112$).

Disregarding the type of strategy of the other player, females were more cooperative when playing against a supposed male than were males ($F=4.2$, $p<.05$, $df=1/112$). There was only marginal evidence that males playing against a female other were more cooperative than when they played a male other ($F=3.1$, $p<.10$, $df=1/112$).

There was a difference in cooperation across the trial blocks. Inspection of the average amount of cooperation in blocks of trials suggested that cooperation oscillated about the 50% level with four of the blocks having cooperation just below this level and eight of the blocks being above. With the exception of the first block, subjects chose the cooperative response less than 55% of the time. In the first block subjects chose X 63% of the time.

The level of cooperation across trials was contingent upon the sex of the player and the type of strategy he or she was faced with ($F=5.35$, $p<.0005$, $df=11/1232$). Males were most responsive to the opponent's strategy. They predominantly chose X when faced with a contingent other and they increased their cooperation as the game progressed. In their final block of trials they were cooperating 71% of the time. In contrast males faced with a noncontingent strategy

Table 9

Analysis of Variance of X Responses for Experiment 2

Source	df	MS	F
Between Subjects			
Contingency (A)	1	207.03	3.04***
Sex of Player (B)	1	41.34	
Sex of Opponent (C)	1	10.00	
A x B	1	1579.21	23.16*
A x C	1	96.10	
B x C	1	304.34	4.46**
A x B x C	1	25.07	
Error Between	112	68.19	
Within Subjects			
Trials (T)	11	20.11	5.14*
A x T	11	5.79	
B x T	11	2.27	
C x T	11	3.32	
A x B x T	11	20.96	5.35*
A x C x T	11	4.59	
B x C x T	11	2.45	
A x B x C x T	11	2.41	
Error Within	1232	3.92	

* $p<.0005$

** $p<.05$

*** $p<.10$

ended up cooperating 30% of the time. Females facing a contingent other chose cooperatively about 45% of the time on the last block of ten trials. In the same block of trials, females playing against the noncontingent other chose X 63% of the time.

Experiment 3: Results

The F values for the factors and their possible interactions are presented in Table 10. The dependent variable is the amount of cooperation. Factor A represents the high clarity contingent or non-contingent strategy of the other. Factor B stands for the nature of the other in terms of whether subjects faced a man or a machine. Factor C indicates whether or not a note was exchanged between the dyad. The first two main effects are significant and indicate that the subjects are more cooperative when they are playing against a contingent strategy as opposed to a noncontingent strategy. For the former on the average they chose X 62% of the time while for the latter they chose X 30% of the time. They are also more cooperative when playing another man than when playing a machine (55% versus 38%). There was only marginal statistical evidence that an exchange of notes increased cooperation. On an average block of ten trials subjects increased their cooperation from 42% to 51% when they exchanged a note. However it would appear that the nature of the opponent is important in determining the effect of the note. Thus for both the note and no note conditions subjects playing against a machine chose cooperatively only 36% of the time. When a note was exchanged with a human opponent the X button was chosen 64% of the time as opposed to only 45% of the time when no note exchange took place. This latter difference is statistically significant at better than the 1% level.

Table 10

Analysis of Variance of X responses for Experiment 3

Source	df	MS	F
Between Subjects			
Contingency (A)	1	3657.66	48.20*
Man-Machine (B)	1	962.03	12.68**
Note-No Note (C)	1	290.70	3.83****
A x B	1	23.26	
A x C	1	22.25	
B x C	1	318.28	4.19***
A x B x C	1	323.95	4.27***
Error Between	112	75.88	
Within Subjects			
Trials (T)	11	13.59	3.69*
A x T	11	13.88	3.77*
B x T	11	2.29	
C x T	11	2.37	
A x B x T	11	4.12	
B x C x T	11	1.67	
A x C x T	11	6.61	1.80***
A x B x C x T	11	2.04	
Error Within	1232	3.68	

* $p<.005$

** $p<.001$

*** $p\leq.05$

**** $p=.053$

The significant three way interaction of type of contingency by type of opponent by note conditions indicates that the type of strategy of the opponent and whether or not the opponent exchanged notes with them, were both important in determining how subjects responded to the nature of their opponent. Faced with a contingent strategy, subjects who were led to believe they were facing another male became more cooperative when notes were exchanged. Subjects who faced a machine playing contingently likewise became more cooperative when notes were exchanged. The former group of subjects increased their cooperation from 64% to 75%. The latter group increased their response level from 50% to 61%. Subjects who were led to believe they were facing a male other and the other played a noncontingent strategy chose X 53% of the time when a note was exchanged but chose X only 27% of the time when no note was exchanged. Likewise subjects faced with an unconditionally cooperative machine chose X 27% of the time when no note was exchanged but chose X only 15% of the time when a note was exchanged. Thus it appears from inspection that an exchange of notes for subjects facing a noncontingent other increased cooperation if subjects felt that they were playing with a male but decreased it or had no effect if subjects felt they were playing against a machine. When no notes were exchanged in the noncontingent condition subjects on the average chose X with exactly the same frequency whether or not they played against a man or a machine.

The significant interaction of type of contingency and note conditions with blocks of trials suggests that the subjects' performance curves took a different form depending upon their experimental conditions. The contingent note group chose X with relatively the same frequency

across blocks of trials. The other contingent group gradually increased their cooperation as the game progressed but their average level of cooperation was always below that of the note group. Similarily the note noncontingent group reached their asymptotic level of cooperation by about trial 50 and stayed at that level for the remainder of the game. The group who faced a noncontingent other but did not exchange notes continued to choose X less and less as the game progressed. Furthermore, on the average the latter group cooperated less than the noncontingent group that exchanged notes.

Discussion. The results of Experiment 2 suggest that there is no unequivocal way of asserting that females are more or less cooperative than males. Thus the finding of Rapoport and Chammah (1965a) that females are less cooperative than males is true in this study but only when the other is contingently cooperative. When the other is non-contingently cooperative females are observed to be more cooperative than males. Vinacke's (1969) assertion that the laboratory renders males less exploitive and females more exploitive has to be qualified since the demand characteristics of the PDG coupled with unconditional cooperation would invite exploitiveness. If as Vinacke suggests, females are cooperating with the demand characteristics set up by the experimenter by becoming exploitive then there is no reason to see why males would not exploit the simulated other when it appeared unconditionaliy cooperative. As Tedeschi, Lesnick and Gahagan (1969) postulated Experiment 2 showed that under intermediate levels of conflict intensity, as measured by CI, sex differences among subjects become paramount. These differences probably become even more apparent when the strategy of the other is more "rational" or predictable as the

strategy of the other was in the present experiment. The strategy of the other in the Tedeschi et al study was to randomly choose the X button 50% of the time.

Contrary to the findings of Rapoport and Chammah, the sex of the other had no appreciable effect either alone or in combination with other effects on the way that subjects selected from their two choices. The above two authors found that in a real two person game males competed more against a female than when they faced a male other. The reverse relationship held for females. In the present study it was found that males cooperated with males significantly less often than females cooperated with males. There was no statistically significant difference between groups faced with the same or opposite sex when the sex of the player is held constant. Such a finding must be interpreted with caution since a major difference between the Rapoport and Chammah experiment and the present one is that the other was simulated. Furthermore it was simulated at a high level of clarity. This may have mitigated the effects that the other's sex could have under conditions of lower clarity. This would be implied by Jones and Davis' contention that the individual characteristics of the other person cannot convey more information about the other than the intentions of the other. Thus if the intentions of the other were less clear from his choices then one would expect that information about the other would have proportionately greater effect. Thus in a much shorter game where the clarity of the other person's strategy was less than in the present study, Marlowe, Gergen and Doob (1966) found that manipulated attributes of the other had an effect on subjects' choices in the PDG.

In Experiment 3 it appeared at first glance that whether the opponent was a computer or a human affected the way subjects responded. In the contingent, no note condition subjec s chose X 64% of the time when they faced a male and 50% of the time when they faced a machine. This difference was not statistically significant. When the note exchange condition was added to the experimental treatments of these latter two groups it had the effect of increasing their levels of cooperation by 11%, to 75% for the male other group and to 61% for the machine other group. The group who faced a noncontingent male other chose X 27% of the time as did the group who faced a noncontingent machine other. When notes were exchanged the noncontingent male other group increased their cooperative choices to 53%. When notes were exchanged with a noncontingent machine cooperative choices decreased from the 23% level to 15%. Thus under noncontingent conditions a note had the opposite effect of decreasing or holding constant cooperation when a machine was the opponent and of increasing cooperation when a male was the opponent.

In terms of the second exploratory hypothesis, playing against a male other led to a counterstrategy which was nonsignificantly different from the counterstrategy adopted against a machine when the other adopted a contingent strategy. This is contrary to the hypothesis as formulated in the introduction. As postulated in the explanation given ove the strategy was sufficiently clear about the intentions of the other that any information gained from a knowledge of the characteristics of the other would be superfluous. In the noncontingent no note condition there was also no difference in the way subjects played against a male other and a machine other. Again it can be expected that the behavior of the subject was dictated by the high level of

clarity with which the strategy was played. In the noncontingent, note condition cooperation was higher for those who faced a male other than for those who faced a machine other. Thus, for the noncontingent, note, male other group the hypothesis was verified. That is knowledge that the other was a human subject under the note exchange condition led to a less effective counterstrategy.

Across all conditions subjects played less cooperatively against a machine than they did against a male other ($F=12.68$, $p<.001$). Thus three of the four groups who faced a machine other cooperated on the average at least 14% less than comparable groups who faced a male other. Disregarding specific experimental treatment combinations, it appears that the type of opponent is important in ascertaining how subjects will choose. Subjects cooperate more with humans than they do with a machine.

CHAPTER FIVE

Summary and Conclusions

This dissertation set out to investigate the cognitive components of social interaction. A class of theories appropriate to such an investigation has recently been advanced under the general rubric of attribution theories. Three of these formulations were outlined and discussed in Chapter One.

The first of these formulations, Heider's Theory of Interpersonal Relations (Heider, 1958) is really an attempt to bring some order to a variety of interpersonal examples drawn from everyday situations. He observed that people over a wide range of varying social situations are interested in attributing to others such qualities as "can," "trying," and "want." He drew attention to the analogy between the social attribution problem and the phenomenon known as perceptual constancy in the psychology of perception. That is in perception a large number of proximal stimuli are capable of mediating the perception of a distal stimulus. Similarly a wide variety of social situations are capable of rendering the same attribution. While the theory is comprehensive enough to be classed as a methatheory it seems to lack sufficient specificity to test its major tenents.

A variation of Heider's theory has been presented by Jones and Davis (1965). Their main assumption is that the social perceiver seeks to find sufficient reason why an action on the part of another person took on a particular form. In particular the person tries to establish links between stable individual dispositions and observed action. Jones and Davis introduce the term "correspondence" to refer to the

extent that the intended actions and the underlying characteristic or attribute are similarly described by the inference of the perceiver. A particular version, called "hedonic relevance," of social perception occurs when the actions of the other affect the perceiver in a positive or negative way.

Kelley's theory (Kelley, 1967) was put forward as the third attribution theory. For Kelley, attribution refers to the process of inferring or perceiving the dispositional properties of entities in the environment by one or more observers observing at any one time or over periods of time. Kelley also details sources of systematic errors that can be made in attributions.

A fourth account of cognitive behavior, Meads theory of social interaction (Mead, 1934), was introduced as an alternative to the general class of attribution theories. While it contains some of the same features as the attribution formulations it introduces the notion of the act, the gesture and the significant symbol. The present dissertation was directed towards a test of Mead's theory using a standard laboratory situation the well known Prisoner's Dilemma Game.

The PDG is well suited to test out theoretically derived hypotheses since the degree of communication between two interactants can be well controlled. Furthermore compared to other social situations a large number of facts have accumulated which enable one to control for certain conditions. For example, as was shown in Chapter One, paper and pencil measures of personality differences tend not to predict behavior in PDG experiments. Yet real life variables such as the sex of the participants influences such behavior considerably. Finally it was shown in Chapter One that no adequate explanation of peoples' behavior

in PDG situations has yet been advanced. A number of studies especially ones which utilize a simulated other whose choices are determined by a preset strategy have hypothesized that impressions of the other are important in determining choice However until now few attempts were made to measure these impressions and no attempts were made to systematically relate the impressions to response choices.

The present thesis postulated that broad classes of simulated strategies can be placed into two specific classes. A noncontingent strategy was postulated to be associated with impressions of martyrdom on the part of the simulated other. A contingent strategy was supposed to signify an other who was cooperative but unwilling to be a martyr. If this impression of the other was correct then subjects motivated to win money were expected to choose cooperatively to the extent that the other's strategy was considered to be clearly contingent. The clarity of the other person's strategy was manipulated by changing the frequency with which the choices of the other were consequent upon the choices of the subject. In addition clarity was manipulated in Experiment 1 by having the simulated other pass a note to the subject which expressed the essential contingency or the essential noncontingency of the strategy employed.

To verify the postulated relationship between the simulated other's strategy and the impressions that the subject formed about the other, a 30 item bipolar semantic attribution scale was administe ed to all subjects in Experiment 1. The items were selected to reflect a basic martyrdom orientation on the part of the other as well as to be able to assess a cooperative but unmartyrlike approach.

Finally in Experiment 1 a specific model was advanced based on a decision theoretic approach. This model postulated that, dependent upon what contingent event appeared on any two adjacent trials, the subject thought the simulated other was either a martyr, or cooperative but not a martyr, or finally was not at all cooperative. The latter state was assumed to be necessary since at low frequency levels of the contingent strategy the subject is exploited on a number of occasions throughout the game.

The responses of the subject were assumed to be meaningfully related to the impressions formed about the other. Specifically, motivated subjects were expected to choose noncooperatively to the extent that the other impressed the subject as being exploitive. To the extent that the subject inferred the other to be cooperative but not a martyr then the model of the subject's behavior hypothesized that the subject chooses cooperatively with some positive probability.

To implement the experimental design 120 male subjects were assigned to Experiment 1 which had a total of eight different experimental conditions. These conditions varied the contingency or noncontingency of the other simulated person's strategy, the clarity, high or low, with which that strategy was carried out, and whether or not the simulated other exchanged a note with the subject. Fifteen subjects were randomly assigned to each combination of experimental conditions. The PDG was then played for 150 trials with the simulated other. The other person was in fact a preprogrammed electronic machine.

Subjects were found to choose more cooperatively if they faced a contingent than if they faced a noncontingent strategy. Moreover the clearer the strategy of the other the stronger was the reaction

of the subjects to that strategy with the exception of the noncontingent note condition where the response to the note was nondiscernable from that where no note was exchanged. The rate of change in cooperation over the last 120 trials was dependent upon both the strategy of the other and the clarity with which it was played. Finally the exchange of notes had the effect of increasing cooperation across all other conditions. While this effect was expected for the contingent conditions it was unexpected in the noncontingent ones.

The data for both the noncontingent and contingent strategy was more consistent with a cognitive approach to PDG interaction than it was with an imitative explanation. In particular the other person's strategies which a priori could be classed as eliciting an impression of the other as a martyr or not, elicited cooperation in accordance with these hypothesized impressions

That these two dimensional impressions had some basis in fact is made clear by a discriminant function analysis of the subjects' impressions of the other early in the game. The first two functions were found to discriminate among the groups. The first function separated the contingent from the noncontingent conditions (with the exception of contingent, low clarity, note condition). The second function separated the two low clarity contingent conditions from all others. This latter finding hile not expected, made sense in that, in retrospect, these two conditions prevented subjects from winning money. They would thus be more consistent with a $\overline{CM}$ strategy.

The model did not explain the behavior of the subjects with the exception of the two low clarity, contingent conditions. Decline of cooperation for all the noncontingent conditions as predicted by the

model was too abrupt and drastic to fit the data. In the high clarity contingent conditions the model predicted a level of cooperation in the same general region as the data provided. However there was a predicted gradual decline in the subjects' cooperative choices which was not at all evident in the data. In the light of some recent research results of Chammah's a proposed modification of the model was made.

Subjects were asked to indicate in a postexperiment questionnaire the extent to which they felt they were deceived. A post hoc analysis of the subjects' responses to this deception question indicated that they were more likely to be suspicious if they faced a noncontingent strategy. Further analysis of the cooperative choice data taking into account whether the subject felt deceived or not, revealed that affirmation of deception affected cooperation. However this relationship held only for one meaningful comparison. That i reaction to deception only made a difference in the low clarity noncontingent condition. Subjects who felt they were deceived responded more cooperatively than those subjects who did not. An explanation for this finding centered around the fact that subjects expected they would receive $2.50. If subjects adopted a cooperative strategy in the low clarity noncontingent condition their expectation would be far from being met.

All of the findings from this first study were limited to a population of male subjects. The literature revealed that the sex of the opponent and the sex of the player were important determinants of how the PDG is played. These two findings had not been previously established for simulated other PDG's which ran for a large number of trials. Accordingly, the second experiment using the same procedure

as the first, varied the sex of the player and the sex of the simulated opponent. While the sex of the player was found to be an important factor in how the game was played the sex of the opponent played little or no role in the outcome of the game. Specifically males were found to react to the strategy of the other more than females. Furthermore the direction of the reaction was dependent upon the type of strategy the other adopted and the sex of the player. Males cooperated more when facing a contingent strategy than when facing a noncontingent one. Females cooperated more while facing a noncontingent other.

The t ird experiment found that the nature of the other was important in determining male subjects' reactions to it. Males across a variety of experimental conditions, cooperated more with a human than with a computer. However this difference while present in every condition reached statistical significance only when the other adopted a noncontingent strategy and told the subject he was doing so by way of a note.

In retrospect several conclusions can be drawn from the three experiments and the theory that underlies them. No evidence was found that an imitation explanation was sufficient to explain PDG choice. There is evidence that subjects form multidimensional impressions relatively early in a repeated PDG based on the strategy that the other chooses. The nature of these impressions is not excessively strong s one would predict from the decision theoretic model which in turn was based on Mead's theory of the significant symbol.

The specific predictions generated by Mead's theory resulted in a model of the PDG which fit the observed data well in two out of eight conditions. In two out of the remaining six it fit only moderately well. But in all four noncontingent conditions the model did not represent the

data at all. Suggestions were taken from the recent experimental literature to improve the model. The choices of the subjects in each of the experimental conditions were consistent with an a priori ordering of the strategies in terms of the impressions these strategies must have exerted. That is subjects who faced a clearly noncontingent other played more exploitively than a group of subjects who faced a less clearly noncontingent other. This latter group in turn cooperated about as much as a group that faced a contingent other who played a relatively unclear strategy. The group that faced a clearly contingent other cooperated more than the group that faced the less clearly contingent other.

The experimental procedure used to vary the clarity of the other person's strategy was to increase the frequency with which the simulated other matched the choices of the subject in the contingent condition or the frequency with which he chose cooperatively in the noncontingent condition. The exchange of notes had been expected to clarify the basic strategy of the other. This effect is present for the contingent condition but is not for the noncontingent condition where cooperation is observed to increase. It is concluded, however, that subjects are capable of reacting to the underlying PDG strategy of the other when it is verbally communicated even though that reaction may be inappropriate.

In two ancillary experiments it was found that the sex of the opposing player in a simulated game is unimportant in determining cooperation although the nature of the other plays a role in promoting cooperation. That is, neither females nor males change their level of cooperation when they face a male or female. Females are more cooperative with a noncontingent other as opposed to a contingent other whereas

males are more cooperative with a contingent other. This calls into question Vinacke's assertion that females are cooperating with the demand characteristics of the experiment whereas males are resisting these same demands.

Finally the first experiment shows that male subjects are more likely to be suspicious of a noncontingent strategy than they are of a contingent one. The effect of this suspicion on their PDG choices is not altogether clear since closer inspection of the data reveals that a reaction is present for only the group who faced a less clearly noncontingent strategy. Furthermore the subjects that admit awareness of deception cooperate more than the subjects who make no such assertion.

BIBLIOGRAPHY

Axelrod, R. An axiomatic approach to the Prisoner's Dilemma. Journal of Conflict Resolution, 1967, 11, 87-99.

Bandura, A., & Walters, R. Social learning theory and personality development. New York: Holt, Rinehart & Winston, 1963.

Baxter, J., Winters, E., & Hammer, R. Gestural behavior during a brief interview as a function of cognitive variables. Journal of Personality and Social Psychology, 1968, 8, 303-307.

Bixenstine, V., & O'Reilly, E. Money versus electric shock as payoff in a Prisoner's Dilemma Game. The Psychological Record, 1966, 16, 251-264.

Bixenstine, V., Potash, H., & Wilson, W. Effects of level of cooperative choice in a Prisoner's Dilemma Game: Part I. Journal of Abnormal and Social Psychology, 1963, 66, 308-313.

Bixenstine, V., & Wilson, W. Effects of level of cooperative choices in a Prisoner's Dilemma Game: Part II, Journal of Abnormal and Social Psychology, 1963, 67, 139-147.

Bobbitt, R. Internal external control and bargaining in a Prisoner's Dilemma Game. Dissertation Abstracts. 1967, 27, 9B, 3266-3267.

Cooley, W., & Lohnes, P. Multivariate procedures for the behavioral sciences. New York: Wiley, 1962.

Crowne, D. Family orientation, level of aspiration and interpersonal bargaining. Journal of Personality and Social Psychology, 1966, 3, 641-645.

Deutsch, M. The effect of motivational orientation upon trust and suspicion. Human Relations, 1960, 13, 123-139. (a)

Deutsch, M. Trust, trustworthiness, and the F scale. Journal of Abnormal and Social Psychology, 1960, 61, 138-140. (b)

Dolbear, F., & Lave, L. Risk orientation as a predictor in the Prisoner's Dilemma. Journal of Conflict Resolution, 1966, 10, 506-515.

Druckman, D. Dogmatism, prenegotiation experience, and simulated group representation as determinants of dyadic behavior in a bargaining situation. Journal of Personality and Social Psychology, 1967, 6, 279-290.

Duncan, S. Nonverbal communication. Psychological Bulletin, 1969, 72, 118-137.

Evans, G. Effect of unilateral promise and value of rewards upon cooperation and trust. Journal of Abnormal and Social Psychology, 1964, 69, 587-590.

Evans, G. & Crumbaugh, C. Effects of Prisoner's Dilemma format on cooperative behavior. Journal of Personality and Social Psychology, 1966, 3, 486-488. (a)

Evans, G. & Crumbaugh, C. Payment schedule, sequence of choice and cooperation in the Prisoner's Dilemma Game. Psychonomic Science, 1966, 5, 87-88. (b)

Faucheux, C. & Moscovici, S. Self esteem and exploitive behavior an a game against chance and nature. Journal of Personality and Social Psychology, 1968, 8, 83-88.

Gahagan, J. & Tedeschi, J. Strategy and the credibility of promises in the Prisoner's Dilemma Game. Journal of Conflict Resolution, 1968, 12, 224-234.

Gallo, P. & McClintock, C. Cooperative and competitive behavior in mixed motive games. Journal of Conflict Resolution, 1965, 9, 68-78.

Gouldner, A. The norm of reciprocity: a preliminary statement. American Sociological Review, 1960, 25, 161-178.

Grant, M. & Sermat, V. Status and sex of others as determinants of behavior in a mixed-motive game. Journal of Personality and Social Psychology, 1969, 12, 151-157.

Greenhouse, S., & Geisser, S. On methods in the analysis of profile data. Psychometrika, 1959, 24, 95-112.

Gumpert, P., Deutsch, M. & Epstein, Y. Effect of incentive magnitude on cooperation in the Prisoner's Dilemma Game. Journal of Personality and Social Psychology, 1969, 11, 66-69

Guyer, M. Response-dependent parameter changes in the Prisoner's Dilemma Game. Behavioral Science, 1968, 13, 205-219.

Haas, H. & Maehr, M. Two experiments on the concept of self and the reaction of other. Journal of Personality and Social Psychology, 1965, 1, 100-105.

Halpin, S., & Pilisuk, M. Probability matching in the Prisoner's Dilemma. Psychonomic Science, 1967, 7, 269-270.

Harford, T , & Solomon, L. "Reformed sinner" and "lapsed saint" strategies in the Prisoner's Dilemma Game. Journal of Conflict Resolution, 1967, 11, 104-109.

Harford, T. & Solomon, L. Effects of a "reformed sinner" and "lapsed saint" strategy upon trust formation in paranoid and nonparanoid schizophrenic patients. Journal of Abnormal Psychology, 1969, 4, 498-504.

Harris, R. Note on "Optimal policies for the Prisoner's Dilemma." Psychological Review, 1969, 76, 363-375.

Harrison, A., & McClintock, C. Previous experience within the dyad and cooperative game behavior. Journal of Personality and Social Psychology, 1965, 1, 671-675.

Heider, F. The psychology of interpersonal relations. New York: Wiley, 1958.

Heller, J. The effects of racial prejudice, feedback, strategy, and race on cooperative-competitive behavior. Dissertation Abstracts: 1967, 27, 7B, 2507B-2508B.

Horai, J. & Tedeschi, J. Effects of credibility and magnitude of punishment on compliance to threats. Journal of Personality and Social Psychology, 1969, 12, 164-169.

Israel, J. Experimental change of attitude using the Asch-effect. Acta Sociology, 1963, 7, 95-104.

Johnson, T., Feigenbaum, R., and Weiby, M. Some determinants and consequences of the teacher's perception of causation. Journal of Educational Psychology, 1964, 55, 237-246.

Jones, E. & Davis, K. From acts to dispositions. In L. Berkowitz (Ed.), Advances in Experimental Social Psychology. Vol. 2. New York: Academic Press, 1965, 219-266.

Jones, E., & Harris, V. The attribution of attitudes. In H. Kelley, Nebraska Symposium on Motivation. Lincoln, Nebraska: University of Nebraska Press, 1967.

Jones, E., Steele, M., Gahagan, J., & Tedeschi, J. Matrix values and cooperative behavior in the Prisoner's Dilemma Game. Journal of Personality and Social Psychology, 1968, 8, 148-153

[illegible]an, J. Effects of level of aspiration in an experimental bargaining situation. Journal of Personality and Social Psychology, 1968, 8, 154-159.

Kanouse, D., & Wiest, W. Some factors affecting choice in the Prisoner's Dilemma. Journal of Conflict Resolution, 1967, 11, 206-213.

Kelley, H. Attribution theory in social psychology. In D. Levine (Ed.), Nebraska Symposium on Motivation. Lincoln Nebraska: University of Nebraska Press, 1967.

Kelley, H., Thibault, J., Radloff, R., & Mundy, D. The development of cooperation in the minimal social situation. Psychological Monographs, 1962, 1-19, No. 538.

Knapp, W., & Podell, J. Mental patients, prisoners, and students with simulated partners in a mixed motive game. Journal of Conflict Resolution, 1968, 12, 235-241.

Komorita, S. Cooperative choice in a Prisoner's Dilemma Game. Journal of Personality and Social Psychology, 1965, 2, 741-745.

Komorita, S. & Mechling, J. Betrayal and reconciliation in a two-person game. Journal of Personality and Social Psychology, 1967, 6, 349-353.

Komorita, S., Sheposh, J., & Braver, S. Power, the use of power, and cooperative choice in a two-person game. Journal of Personality and Social Psychology, 1968, 8, 134-142.

Krausse, R., Vivekananthan, P., & Weinheimer, S. "Inner speech" and "external speech": Characteristics and communication effectiveness of socially and nonsocially encoded messages. Journal of Personality and Social Psychology, 1968, 9, 295-300.

Loomis, J. Communication, the development of trusts, and cooperative behavior. Human Relations, 1959, 12, 305-312.

Lumsden, M. Perception and information in strategic thinking. Journal of Peace Research, 1966, 3, 257-277.

Lutzker, D. Internationalism as a predictor of cooperative behavior. Journal of Conflict Resolution, 1960, 4, 426-431.

Marlowe, D., Gergen, K., & Doob, A. Opponents personality, expectation of social interaction, and interpersonal bargaining. Journal of Personality and Social Psychology, 1966, 3, 206-213.

Marwell, G., Ratcliff, K., & Schmitt, D. Minimizing differences in a maximizing difference game. Journal of Personality and Social Psychology, 1969, 12, 158-163.

Mead, G. Mind, self and society. Chicago: University of Chicago Press, 1934.

Messé, L., Dawson, J., & Lane, I. Equity as a mediator of the effect of reward level on behavior in the Prisoner's Dilemma Game. Unpublished manuscript. Michigan State University, 1970.

Messick, D. Interdependent decision strategies in zero sum games: A computer controlled study. Behavioral Science, 1967, 12, 33-48.

McClintock, C., & McNeel, S. Reward and score feedback as determinants of cooperative and competitive game behavior. Journal of Personality and Social Psychology, 1966, 4, 606-613.

Mckeown, C., Gahagan, J., & Tedeschi, J. The effect of prior power strategy on behavior after a shift of power. Journal of Experimental Research in Personality, 1967, 2, 266-233.

Miller, R. No play: A means of conflict resolution. Journal of Personality and Social Psychology, 1967, 6, 150-156.

Minas, J., Scodel, A., Marlowe, D., & Rawson, H. Some descriptive aspects of two person non-zero-sum games II. Journal of Conflict Resolution, 1960, 4, 193-197.

Murdock, P. Exploitation, accommodation and social responsibility in a bargaining game. Journal of Personality, 1968, 36, 440-453.

Natsoulas, T. Locus and orientation of the perceiver (ego) under variable, constant, and no perspective instructions. Journal of Personality and Social Psychology, 1966, 3, 190-196.

Orne, M. On the social psychology of the psychological experiment: With particular reference to demand characteristics and their implications. American Psychologist, 1962, 17, 776-783.

Osgood, C., Suci, G., & Tannenbaum, P. The measurement of meaning. Urbana: University of Illinois Press, 1957.

Oskamp, S., & Perlman, D. Factors affecting cooperation in a Prisoner's Dilemma Game. Journal of Conflict Resolution, 1965, 9, 359-374

Oskamp, S., & Perlman, D. Effects of friendship and disiiking on cooperation in a mixed motive game. Journal of Conflict Resolution, 1966, 10, 221-226.

O'Toole, R., & Dubin, R. Baby feeding and body sway: An experiment in George Herbert Mead's "Taking the role of the other." Journal of Personality and Social Psychology, 1968, 10, 59-65.

Pilisuk, M., Potter, P., Rapoport, A., & Winter, J. War hawks and peace doves: Alternate resolutions of experimental conflicts. Journal of Conflict Resolution, 1965, 9, 491-508.

Pruitt, D. Reward structure and cooperation: The decomposed Prisoner's Dilemma Game. Journal of Personality and Social Psychology, 1967, 7, 21-27.

Pylyshyn, Z., Agnew, N., & Illingworth, J. Comparison of individuals and pairs as participants in a mixed motive game. Journal of Conflict Resolution, 1966, 10, 211-220.

Quigg, H., & Pitt, L. Inquest into a photograph. United Press International, The State Journal, Lansing, Michigan, June 29, 1969.

Radlow, R. An experimental study of "cooperation" in the Prisoner's Dilemma Game. Journal of Conflict Resolution, 1965, 9, 221-227.

Radlow, R., & Weidner, M. Unenforced commitments in "cooperative" and "noncooperative" non-constant-sum games. Journal of Conflict Resolution, 1966, 10, 497-505.

Rao, C. Advanced statistical methods in biometric research. New York: Wiley, 1952.

Rapoport, A. A note on the index of cooperation for Prisoner's Dilemma. Journal of Conflict Resolution, 1967, 11, 100-103. (a)

Rapoport, A. Optimal policies for Prisoner's Dilemma. Psychological Review, 1967, 74, 136-148. (b)

Rapoport, A. Editorial comments. Journal of Conflict Resolution, 1968, 12, 222.

Rapoport, A., & Chammah, A. Prisoner's Dilemma. Ann Arbor: University of Michigan Press, 1965. (a)

Rapoport, A., & Chammah, A. Sex differences in factors contributing to the level of cooperation in the Prisoner's Dilemma Game. Journal of Personality and Social Psychology, 1965, 2, 831-838. (b)

Rapoport, A., & Cole, N. Experimental studies of interdependent mixed motive games. Behavioral Science, 1968, 13, 189-204.

Rosenberg, S., & Cohen, B. Referential processes of speakers and listeners. Psychological Review, 1966, 73, 208-231.

Rosenthal, R., Experimenter effects in behavior research. New York: Appleton Century Crofts, 1966.

Sampson, E., & Kardush, M. Age, sex, class and race differences in response to a two person non-zero-sum game. Journal of Conflict Resolution, 1965, 9, 212-220.

Schacter, S., & Singer, J. Cognitive social and psychological determinants of emotional states. Psychological Review, 1962, 69, 379-399.

Scheff, T. A theory of social coordination applicable to mixed-motive games. Sociometry, 1967, 30, 215-234.

Sermat, V. The effect of an initial cooperative or competitive treatment upon a subject's response to conditional cooperation. Behavioral Science, 1967, 12, 301-313. (a)

Sermat, V. The possibility of influencing the other's behavior and cooperation: Chicken versus Prisoner's Dilemma. Canadian Journal of Psychology, 1967, 21, 204-219. (b)

Shure, G., Meeker, R., & Hansford, E. The effectiveness of pacifist strategies in bargaining games. Journal of Conflict Resolution, 1965, 9, 106-117.

Solomon, L. The influence of some types of power relationships and game strategies upon the development of interpersonal trust. Journal of Abnormal and Social Psychology, 1960, 61, 223-230.

Steele, M., & Tedeschi, J. Matrix indices and strategy choices in mixed motive games. Journal of Conflict Resolution, 1967, 11, 198-205.

Sutcliffe, J. A general method of analysis of frequency data for multiple classification designs. Psychological Bulletin, 1957, 54, 134-137.

Swensen, R. Cooperation in the Prisoner's Dilemma Game I: The effects of asymmetric payoff information and explicit communication. Behavioral Science, 1967, 12, 314-322.

Swingle, P. Effects of the emotional relationship between protagonists in a two person game. Journal of Personality and Social Psychology, 1966, 4, 270-279.

Swingle, P. Effects of prior exposure to cooperative or competitive treatment upon subject's responding in the Prisoner's Dilemma. Journal of Personality and Social Psychology, 1968, 10, 44-52.

Swingle, P., & Coady, H. Effects of the partner's abrupt strategy change upon subject's responding in the Prisoner's Dilemma. Journal of Personality and Social Psychology, 1967, 5, 357-363.

Swingle, P., & Gillis, J. Effects of the emotional relationship between protagonists in the Prisoner's Dilemma. Journal of Personality and Social Psychology, 1968, 8, 160-165.

Tedeschi, J., Aronoff, D., Gahagan, J., & Hiesler, D. The partial reinforcement effect and the Prisoner's Dilemma Game. Journal of Social Psychology, 1968, 75, 209-215.

Tedeschi, J., Lesnick, S., & Gahagan, J. Feedback and "washout" effects in the Prisoner's Dilemma Game. Journal of Personality and Social Psychology, 1968, 10, 31-34.

Terhune, K. Motives, situation and interpersonal conflict within Prisoner's Dilemma. Journal of Personality and Social Psychology, 1968, 8, (Monogr. suppl. 3)

Toch, H. Violent men. Chicago: Aldine Publishing Co., 1969.

Thomas, S. Discrim 2. Technical Report No. 33. Computer Institute for Social Science Research, Michigan State University, 1968.

Valins, S. Cognitive effects of false heart-rate feedback. Journal of Personality and Social Psychology, 1966, 4, 400-408.

Vinacke, W. Variables in experimental games: Toward a field theory. Psychological Bulletin, 1969, 71, 293-318.

Wilson, W. & Insko, C. Recency effects in face-to-face interaction. Journal of Personality and Social Psychology, 1968, 9, 21-23.

Winer, B. Statistical principles in experimental design. New York: McGraw-Hill, 1962.

Wrightsman, L. Personality and attitudinal correlates of trusting and trustworthy behavior in a two-person game. Journal of Personality and Social Psychology, 1966, 4, 328-332.

APPENDICES

Appendix A

Semantic Attribution Scale

The purpose of this scale is to measure the communication effect in experiments. Please base your judgments on the X and Y choices of the other person and how much he has made from the way he has played. Immediately after these instructions there is a set of 30 scales. You are asked to rate the other person on each of these scales in order. Here is how you are to use these scales.

If you feel that the other person is very closely related to one end of the scale, you should place your check mark as follows:

beautiful x / / / / / / ugly

or

beautiful / / / / / / x ugly

If you feel that the person is closely related to one or the other end of the scale (but not extremely), you should place your check mark as follows:

beautiful / x / / / / / ugly

or

beautiful / / / / / x / ugly

If the concept seems slightly related to one side as opposed to the other (but is not really neutral), then you should check as follows:

beautiful / / x / / / / ugly

or

beautiful / / / / x / / ugly

The direction toward which you check, of course, depends upon which of the two ends of the scale seem most characteristic of the other person.

If you consider the person to be neutral on the scale, both sides of the scale equally associated with the concept or if the scale is completely irrelevant, unrelated to the other person, then you should place your check mark in the middle space.

Important:

(1) Place your check-marks in the middle of the space.

(2) Be sure to check every scale.

(3) Just check once for every scale.

(4) Do not try to remember how you checked earlier items.

Make each scale a separate and independent judgment.

(5) Do not puzzle over individual judgments. Give your first impressions based on the person's choices. Remeber, think about his choices as he played them in this game then check the words in a way that best describes the kind of person he is.

1. good	/ / / / / /	bad
2. trusting	/ / / / / /	skeptical
3. independent	/ / / / / /	yielding
4. optimistic	/ / / / / /	pessimistic
5. sociable	/ / / / / /	unsociable
6. unfair	/ / / / / /	fair
7. meek	/ / / / / /	aggressive
8. disreputable	/ / / / / /	reputable
9. passive	/ / / / / /	active

10. grateful / / / / / / ungrateful
11. pleasureable / / / / / / painful
12. severe / / / / / / lenient
13. irrational / / / / / / rational
14. believing / / / / / / skeptical
15. offensive / / / / / / defensive
16. trustworthy / / / / / / untrustworthy
17. stingy / / / / / / generous
18. strong / / / / / / weak
19. masculine / / / / / / feminine
20. altruistic / / / / / / self-serving
21. calm / / / / / / excitable
22. formed / / / / / / formless
23. unsuccessful / / / / / / successful
24. wise / / / / / / foolish
25. kind / / / / / / cruel
26. changeable / / / / / / stable
27. meaningless / / / / / / meaningful
28. cautious / / / / / / rash
29. competitive / / / / / / cooperative
30. faithful / / / / / / unreliable

Appendix B

Final Questionnaire

A. In order to pay you by check and to explain the experiment to you we need to know how to reach you by mail. Please fill out that information below.

Name _____

Address _____

_____

Telephone No. _____

Social Security _____

B. In order to analyze the data from these experiments some more information is needed.

1 I am ☐ male

☐ female

2. I am ☐ freshman

☐ sophomore

☐ junior

☐ senior

3. I have taken the following number of credits in psychology (approximately).

___ 0 - 12

___ 12 - 18

___ 18+

4. I have participated in an experiment similar to this one on previous occasions

___ Yes

___ No

5. If the answer to 4 was yes briefly describe how it was similar.

C. Now we would like to ask you some questions about how the game was played.

1. What percentage of the time do you think most accurately describes how often the other person pushed the X button.

___ 25%

___ 45%

___ 55%

___ 70%

___ 90%

2. Briefly describe the way you played the game.

3. Estimate how much money you think that he made.

___ less than 75¢

___ 75¢ to $1.25

___ $1.25 to $1.50

___ $1.50 to $1.75

___ $1.75 to $2.00

___ $2.00 or more

4. I have participated in an experiment similar to this one on previous occasions

___ Yes

___ No

5. If the answer to 4 was yes briefly describe how it was similar.

C. Now we would like to ask you some questions about how the game was played.

1. What percentage of the tim do you think most accurately describes how often the other person pushed the X button.

___ 25%

___ 45%

___ 55%

___ 70%

___ 90%

2. Briefly describe the way you played the game.

3. Estimate how much money you think that he made.

___ less than 75¢

___ 75¢ to $1.25

___ $1.25 to $1.50

___ $1.50 to $1.75

___ $1.75 to $2.00

___ $2.00 or more

4. Estimate how much money you made.

___ less than 75¢

___ 75¢ to $1.25

___ $1.25 to $1.50

___ $1.50 to $1.75

___ $1.75 to $2.00

___ $2.00 or more

5. Some people adopt a particular pattern of "idea" in choosing X or Y. Some people don't. Describe as best you can how you chose X or Y throughout the game.

6. Do you think he adopted some pattern or strategy throughout the game. Describe what it was if there was one.

7. Do you think the other player saw you as having a strategy for playing X or Y.

___ Yes

___ No

8. If the answer to 7 was "yes" please describe how he might have seen you, pointing out any differences between your own strategy and how he might have perceived it.

9. Below are ten squares. Fill in the squares with an X as you think the other player would have played X during an average 10 trials.

1 2 3 4 5 6 7 8 9 10

10. Below are ten squares. Do the same for yourself. That is put in an X where you feel you would have chosen X for an average 10 trials.

1 2 3 4 5 6 7 8 9 10

11. What did you think the experiment was trying to accomplish?

12. Do you think the other player had any special advantage over you?

___ Yes

___ No

13. Did you feel that your partner played the game in any unusual way?

___ Yes

___ No

14. If the answer to 13 was yes, briefly describe what was unusual about it.

15. Subjects feel that because experiments are on human beings that they are being secretly watched or subtly manipulated or deceived in any number of ways. Do you feel now that this experiment was designed to deceive you in any way?

___ Yes

___ No

16. If your answer to 15 was "yes" please explain.

Appendix C

Letter

To the people who took part in the experimental game:

The following is a brief explanation of the three experiments that were conducted in the past month. You participated in one of the three. These belong to a class of experiments which go under the name of the Prisoner's Dilemma Game. Each of the three experiments had several different conditions within it so it will be impossible to go into the details behind the experiment. However I hope from the general description given here that you will be able to tell by yourself what type of experimental condition you were playing under.

The name of Prisoner's Dilemma is given because of the real life example used to explain the experimental situation. (Similar examples can be constructed around conflicts between married couples, de-escalation in the Viet Nam war and other conflicted social situations.) The example of the Prisoner's Dilemma is as follows. Two criminals have committed a robbery. However the police have no evidence against either one. The police know they must obtain a confession from at least one of the suspected men in order to secure a conviction. They bring the two in for questioning and place them in separate rooms. They offer each one a deal. If he confesses he gets no prison sentence and also a small reward. The one who doesn't confess gets a maximum jail sentence. If both confess both get a light jail sentence. Both men know that if neither confess they both get off free.

In the experimental situation you will remember that both people could make either an X or Y choice. The Y choice corresponds to "confession" on the part of the men. If you chose Y you could make as much as 2¢ or lose 1¢ depending upon what the other person did. If you chose X (not to confess) then you could make as much as 1¢ or lose 2¢. One major difference between the experiment and the example is that the prisoner's had an opportunity for only one choice whereas the experimental game allowed a large number of repeated choices.

When there are such a large number of choices a form of communication is possible. That is, subjects can form "expectations" of how the other person will behave, what kind of person he is etc., just from the way he makes his choices. These "impressions" or "expectations" of the other person will then determine the course of the game. In order to control for the way the other person played a machine was preprogrammed to adopt two basic strategies with several variations on the two strategies. In the one strategy the machine was set to play X a large part of the time regardless of what button the subject pressed. Under this condition the subject was expected to exploit the machine by pressing Y a majority of the time. In the second major strategy the machine was programmed to make the choice that the subject made on the last trial. Thus if the subject played X for 100 trials the machine would choose X an average of 80 times. If the subject chose Y 100 times the machine would choose Y an average of 80 times. Under this strategy it was predicted subjects would gradually learn to push X. Since some of the strategies were more unfair than others it was decided to give all subjects the maximum amount $2.50, that could have been earned under the best of conditions in this game. Enclosed is a

check for this amount. It was impossible to tell subjects that they would make the full $2.50 since it was necessary to maintain the incentive value of the game as much as possible. Similarly in order to maintain the simulation to a realistic game as much as possible we did not tell the subjects in the first two experiments that they were playing against a machine.

Dr. Phillips and I would like to thank all the subjects for their participation in the experiment. We both wish all of you success in your studies.

Paul O'Grady (Department of Psychology)