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PERSONALITY, PAYOFF INFORMATION, AND BEHAVIOUR IN A TWO-PERSON BARGAINING GAME

A thesis submitted in fulfillment of the regulations governing the Degree of Doctor of Philosophy of the University of Stirling

by

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July 1969

ACKNOWLEDGEMENTS

I wish to thank all those students at The University of Stirling, Scotland, who acted as subjects for the investigation.

I gratefully acknowledge the receipt of a University of Stirling Post-Graduate Award for the period 1967-1969.

I also wish to thank Mr. Ranald R. Macdonald for his assistance with computer programming, Mr. John Rennie for photographic assistance, the staff of the Computer Unit, and Mrs. Margaret Warren, Dunblane, who typed the manuscript.

In particular I would like to record my thanks to Professor Peter McEwen for his help and encouragement, and to my supervisor, Mr. Michael F. Moore, for his continued advice and guidance which made the project possible.

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ABSTRACT

Previous studies of the influence of personality on behaviour in experimental games have provided conflicting and inconclusive results. The present investigation was designed to search on a broad front for personality correlates of behaviour in a two-person bargaining game, the one used being a derivation of the Deutsch and Krauss Trucking Game.

Five personality tests, covering fifty-three personality traits, were administered to 192 undergraduate students attending courses at The University of Stirling, and from these the experimental groups were randomly chosen, the only constraint being the sex of the subjects. The tests were The Sixteen Personality Factor Questionnaire, The Guilford/Zimmerman Temperament Survey, The Study of Values Test, The Edwards Personal Preference Schedule, and The Test of Social Insight.

The trucking game was played for 30 trials by two groups of subjects, each containing 24 male dyads and 24 female dyads, under two experimental conditions: Condition I, where subjects had access to full information regarding the other's payoffs, and Condition II, where only incomplete information of the other's payoffs was available.

It was hypothesized that behaviour in the game would be influenced by (i) amount of information available about the payoffs of the other; (ii) sex of the players (comparing single-sexed dyads); and (iii) players' personality.

No differences due to either amount of information available about the other's payoffs, or sex of the players, were found. An analysis of the data provided by the combined experimental groups, however, successfully located indications of personality effects on behaviour in the game, as measured by total joint payoff summed over 30 trials, total time taken, the number of concessions made to the other player, and first strategy-choice on individual trials.

The personality variables concerned were Emotional Stability and Radicalism/Conservatism, (Factors C and Q1 of The Sixteen Personality Factor Questionnaire); Personal Relations, (Factor P of The Guilford/Zimmerman Temperament Survey); Theoretical Value, (T scale of The Study of Values Test); Exhibition, ('exh' variable of The Edwards Personal Preference Schedule); and Cooperativeness, (Scale III of The Test of Social Insight). It is suggested that the relationship of these personality variables to game-playing behaviour should be the subject of further investigation.

SECTION ONE : A REVIEW OF THE RELEVANT AND RELATED LITERATURE

PART ONE : THE THEORY OF GAMES

CHAPTER ONE : INTRODUCTION

The ascription of importance to group participation in decision-making situations in the world of practical affairs has been accompanied by a proliferation of books and articles in the psychological literature. Diverse theoretical, technical, and experimental approaches to the decision-making process are represented in this proliferation. One source of constributions has been the experimental research on behaviour in small groups (cf. Hare, Borgatta, and Bales, 1955; Strodbeck and Hare, 1954; Raven, 1959; and Terauds, Altman, and McGrath, 1960). Here attempts have been made to study under controlled conditions aspects of decision-making long studied by case history.

In the experimental study of small groups, one well-defined precise approach has resulted from the development of the theory of games, and during recent years there has been considerable attention given to "mixed-motive" games (behavioural situations in which individuals must choose between responses which are assumed to serve different motives - that is, situations in which the goals of the players are partically coincident and partially in conflict).

The selection of such situations seems to be based on both theoretical and practical reasons. The major theoretical reason is that much research in this area stems from theories of small group behaviour in which a fundamental assumption is made that mutually cooperative behaviour between members leads to the formation and maintainance of groups, and mutually competitive behaviour results in the disruption of groups.[1]

The major practical reason for emphasis upon cooperation versus competition in the game situation is the interest by researchers in this field in problems of business and industrial economics, and international politics. The fundamental assumption

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1. These notions have been expressed by Thibaut and Kelley (1959), and by Homans (1961).

made here is that cooperation leads to the resolution of conflict, whereas competition leads to its continuation and intensification. On the business economics scene, this is amply illustrated in everyday life by the cut-price "wars" that rage between supermarkets.[1] At the international level, it is perhaps best epitomized in the "arms race" between the countries commonly referred to as world powers, This arms race is, in many ways, another version of the prisoner's dilemma game. There is no escape from paradox, but that the 'dilemma' is realized to exist and its implications understood is obvious. The late President John F. Kennedy of the United States, speaking of the arms race between Russia and his own nation at the Commencement, Americal University, Washington, D.C. in July 1963, said:

> "Today, should total war ever break out again - no matter how, - our two countries will be the primary targets. It is an ironic but accurate fact that the two strongest powers are the two in most danger of devastation..... and, even in the cold war .... our two countries bear the heaviest burdens. For we are both devoting massive sums of money to weapons that could be better devoted to combat ignorance, poverty, and disease.
> We are both caught up in a vicious and dangerous cycle with suspicion on one side breeding suspicion on the other, and new weapons begetting counter-weapons .....
> Both the United States and its allies, and the Soviet Union and its allies, have a mutually deep interest in a just and genuine peace in halting the arms race."

The rejoinder to this statement may well be found in

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1. An analogous example is provided by Cassady (1957), who recounts details of a price war which raged among taxicab companies in Hawthorne, California in 1949, in his paper "Taxicab rate war : counterpart of International Conflict".

President Lyndon B. Johnson's Defence Message to Congress (January 18th, 1965) :

> "But all our experience of two centuries reminds us that 'To be prepared for war is one of the most effectual means of preserving peace'."

In short, the dilemma has long been recognized and has been reiterated time and time again.

The Development of Game Theory

The new mathematical approach of game theory to the problem of interest conflict is generally attributed to Von Neumann in his papers of 1928 and 1937, although Frechet (1953) has raised a question of priority by suggesting that several papers by Borel (1953) in the early nineteen-twenties really laid the foundations of game theory.[1]

Regardless of any debateable priority, the fact remains that neither group of papers attracted much attention on publication. Other than those mentioned, there were almost no other papers before the publication of Von Neumann and Morgenstern's book in 1944.[2] For two decades much of the material lay forgotten, and it is to their great credit that Von Neumann and Morgenstern attempted to write their book in terms that could, with patience, be comprehended by the non-mathematical scientists. The result was highly successful if one is to judge from the attention subsequently given to the theory.

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1. These papers have been translated into English and republished with comments by Frechet and Von Neumann (1953).

2. The original edition of "Theory of Games and Economic Behaviour" appeared in 1944, but the revised edition of 1947 is the more standard reference, and it includes the first statement of the theory of utility.

The Approach of Game Theory

The term "theory of games" may well be decried as misleading, and indeed has been by many authors (e.g. Luce and Raiffa, 1957; Rapoport, 1960; Shubik, 1964). Although for many purposes the analogy is good, the word "game" carries with it many undesirable connotations. In the context of game theory, "game" is not meant to imply the lack of seriousness which might be associated with its usual meaning, but rather the idea that so-called "parlour games", (more appropriately called "games of strategy"), offer the purest examples of situations which are taken as prototypes in this new theory of conflict. In these situations "rationality" is central. A familiar example of such rationality is seen in the way people play, for example, chess. For each player there are three possible outcomes; win, draw, and lose. A player prefers win to draw and draw to lose, and so does his opponent, except for the opponent the outcomes are reversed. Each player makes his choice of moves on the basis of reasoning which goes something like this: "If I do this he is likely to do that, in which case I will have a choice of this or that ..." We consider a player rational who imputes rationality to his opponent.

Games of strategy[1] offer a good model of rational behaviour in situations where there are conflicts of interest with a number of alternatives open at each phase of the situation, and where people are in a position to estimate consequences of their choices, taking into consideration the very important

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1. A strategy in politics (or business or war or chess) can be defined generally as a general plan of action containing instructions as to what to do in every contingency.

circumstance that outcomes are determined not only by one's own choices but also by the choices of others, over whom one has no control.

What exactly, then, is game theory ? Basically, it provides a method for the study of decision making in situations of conflict. It deals with human processes in which the individual player (or decision-making unit)[1] is not in control of other players (or units) entering into the environment. It is addressed to problems involving conflict, cooperation, or both, at many levels; and "the stage may be set to reflect primarily political, psychological, sociological, economic, or other aspects of human affairs." (Shubik, 1964). Boulding (1962) has described game theory as "an intellectual X-ray" which reveals "the skeletal structure of those social systems where decisions interact, and ... therefore, the essential structure of both conflict and cooperation."

Although the concept of strategy is not relevant to certain forms of competition, (Namely, non-interactive contests in which contestants match prowess or skill, but are not permitted, or have no opportunity, to impede the efforts of their competitors, and which therefore fall outside the scope of game theory), the distinction is not one of which non-specialists are aware. Frequent mentions of game theory in popular writings on related subjects have given the impression that a basis has finally been found for uniting in a single conceptual scheme all situations where parties vie for positions of advantage or compete for prizes: points in a parlour game, profits or shares of the market in business competition, or, in the context of international relations, the real or imagined gaines in security, power, prestige,

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1. The decision unit may be an individual, a group, a formal or an informal organization, or a society. "The distinguishing feature of a player is that he or it has an objective in the game and operates under its own orders in the selection of its actions." (Shubik, 1964).

and strategic advantage in future contests. Once game theory is defined as the "science of rational conflict" (Rapoport, 1964), it is easy and tempting to conclude that a mastery of the theory makes one a successful competitor.

Presented in this way, the widespread interest in a theory which was first presented in an involved and abstruse mathematical treatise becomes understandable.

In an age of summit meetings, of action by the Joint Chiefs of Staff, of conferences within the United Nations Security Council, and of industry-wide collective bargaining with countrywide impact, social scientists can expect the pressure for knowledge concerning the decision-making process to increase, and it is not surprising therefore that game theory has attracted widespread interest, especially in the United States where, according to Rapoport (1964) that attitude of a faith in science as a tool for mastering the environment is prevalent. "Here game theory seems especially pertinent, for it purports to be a science of rational decision in conflect situations." (page 4).

CHAPTER TWO : SOME PREREQUISITES OF A THEORY OF GAMES

Utility

The game situation essentially requires each player to choose one of a number of alternatives. In game theory therefore, it is required that the outcomes are specified and that each player is aware of his preference for one outcome over another - that is, that he values each outcome differently.

It is assumed in game theory that all outcomes can be represented by numbers. For example, if the only outcomes are win, lose, or draw, 1 can stand for win, -1 for lose, and 0 for draw. How these numbers are assigned is not the concern of game theory.

While the actual determination of the payoffs is not the game theoretician's concern, he does specify the scale on which such determination should be made. In order to verify any rule produced by means of the theory, it is necessary to know the values (utilities) which people assign to outcomes and the probabilities of all the possible outcomes associated with each choice of action. It is then possible to compare the expected utility gain of the action taken with the expected utility gains of other actions.

Expected utility gains are sums of products of utilities and probabilities. This means essentially that utilities must be assigned numerical values, and not merely ordinal ranks. Von Neumann and Morgenstern (1947) in compiling their treatise on game theory felt it necessary to put utility theory on a rigorous basis, because numerical utilities played an essential part in the theory. In terms of modern concepts of rigor, this meant that a procedure had to be specified for ascertaining a given decision-maker's utility scale. In order to specify such a procedure Von Neumann and Morgenstern assumed that a preference can always be determined between any two 'risky' outcomes. Their method has the advantage of substituting preferences among probability mixtures of outcomes for the task of assigning numerical values directly to outcomes, and it is assumed that choice decisions of this sort can be obtained

experimentally. If enough of these choice decisions are elicited and if they are consistent and transitive, then, in principle a utility scale can be established for a given individual relative to some set of outcomes. As Rapoport (1964) points out :

> "Assuming that this can be done, there is no need to add the axiom to the effect that risky outcomes with greater expected utility are preferred, because the utility scale is defined by just such preferences ..... In short, the maximization of expected utility value has been built into the very definition of utility."

From the point of view of parsimony, the advantage of the Von Neumann/Morgenstern definition of utility is unquestioned. The difficult task of assigning numerical values to outcomes has been replaced by a seemingly easier one of ordering outcomes. In their scheme, people are simply assumed to maximize utility. Specifically, the existence of utility is assumed in game theory and also that various outcomes (the results of choices among alternative courses of action) have different utility values associated with them. If the various outcomes are the different payoffs which may accrue in a game, then the mathematical relation between the amount of the actual payoff (if it is measurable) and its utility constitutes the "utility function" of the individual concerned. As already pointed out, game theory also assumes that in every game situation the objective of a "rational" individual is to maximize the utility expectation accruing to him consistently with the constraint of the situation - that is, to get as much of this utility as it is possible to get, taking into account the efforts of all the other "rational" participants of the game, who are trying to do the same. Shubik (1964, page 9) puts it like this:

> "The problems faced in game theory are more complex than those of simple maximization. The individual must consider how to achieve as much as possible, taking into account that there are others whose goals differ from his own and whose actions have an effect on all. The decision-maker in a game faces a cross-purpose optimization problem. He must adjust his plans not only to his own

desires and abilities but also to the desires and abilities of others."

Rationality

A theory such as that under discussion cannot exist without assumptions about the individuals with which it purports to be concerned. One assumption has already been stated : that each player chooses in such a way as to maximize his utility. A second assumption of game theory is that each player is considered to know the numerical utilities of the other players involved, and which they are trying to maximize. (In other words, each player is assumed to know the preference patterns of all the other players).

This assumption, and others about the player's ability to perceive the game situation, are frequently summed under the phrase "the theory assumes rational players"[1] (Luce and Raiffa, 1957, page 5).

Though it is not always apparent, the term "rational" is far from precise and the different models of rational decision theory can and do mean different things in different situations. The models which must be distinguished are the formal, the prescriptive (or normative), and the descriptive (or empirical). Of these three the descriptive model is that most nearly related to the behavioural sciences.[2]

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1. Usually an individual is faced in a given situation with a certain number of choices or alternative courses of action, each course being likely to lead to a consequence or one of several possible consequences. "We call an individual rational if he takes into account the possible consequences of each of the courses of action open to him; if he is aware of a certain preference order among the consequences and accordingly chooses the course of action which, in his estimation, is likely to lead to the most preferred course of action that this individual will choose but also on courses of action which other individuals will choose, over whom he may have no control. In that case the preferences of those other individuals for the different outcomes may differ from his. We usually think of an individual as rational if he takes these matters into account". (Rapoport, 1960; pp. 107-108).
2. A descriptive theory seeks to find principles which guide real peoples' decisions. It must therefore rely on behavioural data.

Probability

In arriving at a decision (choosing the optimal strategy) a "rational" player must consider not only the utility values of the possible outcomes, but also the probability of occurence of those outcomes. Probability is such a common word that its meaning is widely assumed to be clear. A "probability" is supposed to carry a precise meaning, and numerical values are frequently assigned to probabilities. In such cases there is always a danger of extrapolating the precision of a concept from an area where it is justified to other areas where it is not. We may use the term "probability" in several different senses, but when we switch the meaning, we must give notice of such change. For example, using the argument of "insufficient reason", it might be said that the probability of a particular face, say six, of a die coming up after a single throw is 1/6. Here it is argued that there is no more and no less reason for a six to come up than for any other of the remaining five faces. Thus we justify the assignment of equal probabilities to events that seem alike in every other respect. Another possible way of estimating the probability of a six coming up would be to throw the die many times in succession and observe that the more times it is thrown, the more nearly 1/6 will be the fraction of times six will come up. Since this procedure resembles an experimental test and appears to provide an operational definition of probability, this method may appear more successful. However it should be noted that in using the term "the more nearly" we have abandoned precision. This attitude in many cases is perfectly acceptable for it may be argued that the concept of probability is needed only as a tool for making decisions and that we may trust our experience which shows that when a die, whose "fairness" we have no reason to suspect, is thrown, each number comes up with approximately the same frequency in a large number of throws. However, it must be recognised that in so doing

we have given up the concept of probability as something that has an independent existence, and that if we wish to define probability practically, that is, in terms of experience, we must define it in terms of an observed frequency. While such a restriction is largely acceptable, there are instances where we are forced to give yet another meaning to probability - for example, when we do not wish to give up assigning probabilities to events which by their nature can only occur once. (Such an event, for example, is the outbreak of a nuclear war).

The probability of such an event enters many discussions which are indeed rational (as opposed to emotional). It is said that decisions involving the probability of the outbreak of a nuclear war are based on "calculated risks" (which term implies calculations involving probabilities). Since the probability of such an event can have nothing to do with its frequency of occurrence (since none have yet occurred, and in all likelihood, only very few could occur), then either the phrase "the probability of the outbreak of a nuclear war" is meaningless, or else Wprobability" has another meaning - a sort of "degree of belief". Bernoulli (1713) was among the first to define probability as degree of confidence in a proposition of whose truth we cannot be certain. In his work Ars Conjectandi (The Art of Guessing) Bernoulli pointed out that since we cannot generally know with certainty whether or not an event will occur, we can only have a "degree of confidence" in the truth of the proposition that asserts its occurance. This degree of confidence, identified with the probability of the event, and dependent on the knowledge that the individual has at his disposal, has since been expressed by many authors (e.g. De Morgan, 1847; Keynes, 1921; Ramsay, 1926; Koopman, 1940; and Savage, 1954). It is illustrated by the following example :

> "In 1952 many people believed that Eisenhower had a bigger chance to be elected President than Stevenson, and so it turned out. In 1948, many people believed that Dewey had a bigger chance than Truman, but it turned out otherwise. The elections of 1952 and 1948

were unique events, and so their probabilities could not have been related to any frequencies. Yet neither belief was entirely unfounded, whether the final outcome justified it or not." (Rapoport, 1964, pages 25 - 26)

Since we have to deal with these degrees of belief in our investigations of human affairs, the notion cannot be excluded from our analysis of "rational decisions."

From all this it follows directly that the question "What is the probability of an event?" has no meaning as it stands, since probability has several different meanings. It can mean a number of possible cases. It can mean a number inferred from the observed frequency of an event in many supposedly "identical" situations. It can mean a degree of belief. Implied in this degree of belief is the notion that the probability of an event changes in the light of what we know, and therefore this kind of probability at least cannot reside "in the events" as such. That is, the something we call "the probability of an event" is not an objective property of the event but depends on the way we define the context in which the event is to be considered - this possibility depending on our attitudes and policies of action.

In short, arbitary components enter all calculations of probability. This is especially true when we have no information at all on which to base our estimates of probabilities but are found nevertheless to assign probabilities to events. From this it may be concluded that the "probability of an event" becomes (for us) the result of something we ourselves did - a result of a decision. Rational decisions are based on choice preferences, and in this light, probabilities which we assign to events become reflections of our preferences rather than of our knowledge.

What constitutes a Game ?

When decisions are made under certainty, the player (or decision-maker) has complete control over the outcome. Such situations, however, are exceptional and usually a choice of action

can lead to a number of different outcomes - that is, when the decision-maker faces an opponent who is also rational and informed of all the relevant facts; who can also make choices affecting the outcomes of the situation, but whose interests (that is, his ordering of preferences of the outcomes) are not the same. Game theory is concerned with problems of this type, the associated situations being called games of strategy.

In order to be described as a "game", these "associated situations" must exhibit certain characteristics. Firstly, in a game there must be two or more players (decision-makers) with at least partially conflicting interests. (Note that this immediately excludes solitaires, in which there is only one player with an "interest". There is a second player, Chance, but this may be disqualified as a bona fide player since Chance is indifferent to the outcome - she is a dummy player. Games against Nature, such as that of the "Commuter's chronic umbrella problem" cited by Rapoport, 1964, p.p. 31 - 32, are also thereby excluded).

Secondly, it is a prerequisite of a game that each of the players has a range of choices called strategies. (This excludes playing a slot machine. True, there is a conflict of interests, the man playing the machine against the "House", and also, the slot machine is a bona fide player, but the man is not. He is a dummy player since he cannot make choices, but merely insert a coin and pull a lever).

Thirdly, a play of the game consists of a single simultaneous choice of a strategy by each of the players, and fourthly, when each of the players has chosen his strategy, the outcome of the game is determined. (This is a direct consequence of the definition of strategy which allows the two-person game to be represented as a matrix in which the rows are the strategies open to one player, the columns are the strategies open to the other).

Finally to be described as a game, the situation must have associated with each outcome a set of payoffs, one to each player.

These five requirements constitute the scope of situations which can in principle be represented as games.

The mathematical theory of games distinguishes firstly between games involving two players and games involving more than two players. Among the former, there is an important distinction between zero-sum games and non-zero-sum games. The name "zero-sum" derives from the fact that the sum of the payoffs accruing to the players is zero regardless of what the outcome of the game is. It follows that in two-person zero-sum games, what one player wins, the other necessarily loses. The same is essentially true in "constant-sum" games, where the sum of the payoffs is the same in all outcomes.[1]

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1. Whether this sum is zero or not is irrelevant because the zero point of the utility scale on which the payoffs are determined is arbitary anyway.

CHAPTER THREE : ZERO-SUM GAMES, A DESCRIPTION.

The simplest game is one with two players whose interests completely coincide and who can communicate freely. This case, while championed by Marwell and Schmitt (1968) is trivial and rather uninteresting to the game theorist, since the two can be treated as one player (against "the world").[1] The next simplest case is where there are two players whose interests are diametrically opposed. This situation is called the two-person zero-sum game. Its analysis is the simplest, and, in the opinion of some, is the most basic problem in game theory, since the whole remaining theory was originally formulated on the basis of this analysis.

In such a game it is said that Players 1 and 2 are strict adversaries of each other and have strictly opposing preference patterns for the outcomes of the game. Many parlour games are strictly competitive in this sense - or at least the rules are designed to make them strictly competitive provided each player has a preference pattern that coincides with some natural quantity attached to the outcomes. As a more serious example one might be tempted to consider war as the most extreme example of interest conflict, but as Luce and Raiffa (1957) point out, at the global level war is probably not strictly competitive since both factions would presumably prefer a draw to mutual annihilation. However, an individual engagement within the context of a war can perhaps be considered a strictly competitive game.

From the point of view of seeking an optimal strategy,

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1. It is not meant to imply that these no-conflict games are devoid of psychological interest - merely that they are trivial from the game-theoretic point of view.

there are two classes of two-person zero-sum games : those with a saddle-point,[1] and those without.

Two-Person Zero-Sum Games with Saddle-Points

Let us consider a simple example :

There are two players, A and B. Player A has two choices of action, a_1 and a_2; Player B also has two choices, b_1 and b_2. There are therefore four possible outcomes: the choice pairs (a_1, b_1), (a_2, b_1), (a_1, b_2), and (a_2, b_2). These outcomes can be represented on a 2 X 2 matrix. Since in the zero-sum game A wins what B loses and vice versa, we need only enter A's gains (or losses) in the matrix, understanding that B's gains (or losses) will be the same numbers with the opposite sign attached. Let the payoffs for the four outcomes of our game be as represented in Matrix 1 :

	b_1	b_2
a_1	5	3
a_2	6	-4

MATRIX 1.

This means that if A chooses a_1, and B chooses b_1, A gains (B loses) 5; if A chooses a_1 and B chooses b_2, A gains (B loses) 3; if A chooses a_2 and B chooses b_1, A gains (B loses) 6; if A chooses a_2 and B chooses b_2, A loses (B gains) 4. We see that the best outcome for A is a gain of 6; the best outcome for B is a gain of 3. Moreover A can guarantee himself a gain of 3. If he

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1. A saddle-point is an outcome in which the payoffs to both players are the "best of the worst". The method whereby this is arrived at is known as the "minimax" strategy, (since it minimizes the maximum loss), and the outcome gives a sort of stable equilibrium.

chooses a_1 he is sure to get at least 3 and possibly 5 if B is so foolish as to choose b_1. Of course, A would like to gain 6 which is in the a_2 row but he knows it is foolish for him to choose a_2 in the hope of B choosing b_1. For why should B choose b_1? On the contrary, A is certain that B will choose b_2, because B is better off with b_2, no matter what A does. Being certain of this, A chooses a_1, because that is where he is best off, given that B chooses b_2.

Therefore we expect that (a_1, b_2) will be the pair chosen. A's gain is 3. He is assured this gain by the structure of the game and there is nothing B can do to prevent it. The best B can do is to make sure that A gets no more than 3. He is therefore also assured of the "best" possible outcome (the "least worst" from B's point of view, but mathematically the same thing).

The game just described is particularly simple since B's choice is obvious. He is not even tempted to choose b_2, because there is nothing for him in that column which is not bettered in the corresponding entry of the other column. Therefore B need not even try to figure out what A is likely to do. A, on the other hand, must resist the temptation of choosing a_2 (with its luring gain of 6 in b_1).

The case where both players must resist temptation is given by the game shown in Matrix 2 :

	b_1	b_2	b_3
a_1	9	-6	-11
a_2	1	-3	7
a_3	5	-2	6

MATRIX 2

Here A faces the temptation of choosing a_1, since his greatest payoff (9) lies there. Likewise B might be tempted to choose b_3 because his greatest payoff (11) is there. If both

yield to the temptation, then B's hopes are realized. However, if B is rational, (which implies that he will impute rationality to A), then he will not be tempted to choose b_3 since he will not assume that A will yield to temptation. The risk for A in playing a_1 is too great. Taking the opponent's reasoning into account it becomes clear that A will choose a_3 and B will choose b_2. Therefore (a_3, b_2) is an outcome that enjoys a certain stability: various chains of reasoning converge on it - it is the equilibrium point and the outcome is referred to as the maximin solution of the game.

This notion of an equilibrium pair, though abstractly arrived at, is not as might be suggested, " a figment of the theoretical mind"; it has its counterparts in such practical affairs as battles and military strategy. Two papers by Haywood (1950, 1954) have outlined the relation between military-decision policy and two-person zero-sum game theory. An actual example may befound in "the Battle of the Bismarck Sea", an incident which occurred in the course of World War Two.[1]

Two-Person Zero-Sum Games without Saddle-Points

Games like Chess and Checkers, in which no choices are concealed from anyone, are called games of perfect information. It is shown in game theory that the payoff matrices of zero-sum games of this sort always have saddle-points. Games which are not of perfect information may not have any saddle-point in their payoff matrix. In such cases, the straightforward choice of strategy (the maximin), which constitutes the solution of the two-person zero-sum game, cannot be applied, at least not in the same way.

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1. The Battle of the Bismarck Sea has been cited by Haywood (1954) and quoted by Luce and Raiffa (1957, pages 64-65).

There is, however, a way of re-establishing the maximin solution for a two-person zero-sum game, even if it has no saddle-point. Let us consider the game portrayed in Matrix 3 :

	b_1	b_2
a_1	1	3
a_2	4	-2

MATRIX 3

How should such a game be played ? Consider Player A's point of view. He would like 4, so a_2 is tempting. But -2 threatens there, For security's sake, a_1 is more attractive, it guarantees 1. The maximin principle would indicate a_1 since 1 is the better of the two worst outcomes, and so it seems then that a_1 should be Player A's choice.

Let us now consider Player B's viewpoint. He would like to win 2, and so he would play b_2, if he could be sure that A would play a_2. But he suspects that A will probably play a_1, because that is where A's maximin lies. If he were sure of A playing a_1, he would then play b_1. At this point a further suspicion enters B's mind. Suppose A is aware of his (B's) reasoning so far. Might not A then play a_2 and win 4 ? If B could be sure of <u>that</u>, then he would play b_2 and win 2, the most he can win in the game. However, suppose A has followed the argument right to this point, will A not then play a_1, (to save himself), so as to win 2 ? But if A does this, then B should play b_1 .....

At this point the argument becomes tautologous. Ordinary logic will not be sufficient to establish a "rational" strategy for either player. Suppose, however, that each player plays each of the available strategies at random, but in some definite ratio of frequencies. Suppose A plays a_1 35% of the time and a_2 65% of the time. We say that he is mixing his strategies

in the ratio 35:65. Von Neumann's minimax theorem (1928) states that "there is a definite ratio of strategy mixture for each player which has all the properties of a maximin". This will guarantee the most each player can get in the sense of long-run expected payoff, if the opponent follows the same policy and uses his maximin strategy mixture.[1]

Like the game with a saddle-point, the two-person zero-sum game without a saddle-point also has its practical applications. Rapoport (1960, pages 159-161) cites as an example a hypothetical military situation in which a munitions truck runs the risk of ambush. The truck passes over either of two roads every day. The enemy sends a detachment to ambush the truck, the detachment having the choice of blocking Road 1 which is good, or Road 2, which is poor. Assessing the utilities of each side for each payoff, and assuming strict opposition of interests, Rapoport suggests the following matrix to represent the payoffs to the truck :

		ENEMY	
		e_1	e_2
TRUCK	t_1	-1	5
	t_2	3	-5

MATRIX 4

Since there is no saddle-point, this is a game of mixed strategy. The best strategy mixtures (or, as they are sometimes called, "strategy recipes") are as follows : The truck should choose the Roads 1 and 2 in the ratio 4:3. The ambush party should choose the roads in the ratio 5:2. The value of the game to the

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1. It should be noted that if the opponent departs from the maximin mixture, he can do no better, but may do worse, if the first player sticks to his maximin mixture.

There is, however, a way of re-establishing the maximin solution for a two-person zero-sum game, even if it has no saddle-point. Let us consider the game portrayed in Matrix 3 :

	b_1	b_2
a_1	1	3
a_2	4	-2

MATRIX 3

How should such a game be played ? Consider Player A's point of view. He would like 4, so a_2 is tempting. But -2 threatens there, For security's sake, a_1 is more attractive, it guarantees 1. The maximin principle would indicate a_1 since 1 is the better of the two worst outcomes, and so it seems then that a_1 should be Player A's choice.

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truck is 5/7. In other words, these tactics, where each side does its best, will in the long run pay off 5/7 utiles (whatever these may be in the context of the game) per run to the truck. Neither the truck or the ambush party can improve their respective chances.[1]

Beyond the two-person games just described, a second major game class includes what are known as n-person games (that is, games in which there are three or more players). N-person games may be subdivided into two groups: negotiable (zero-sum games) and non-negotiable[2] (non-zero-sum games).

Negotiable Games.

The main feature of negotiable games is that with communication allowed, coalitions may be formed. Von Neumann and Morgenstern's (1947) theory of the n-person game has been treated essentially in this context. Once a coalition has been formed, the remaining players can do collectively no worse and generally can do better if they also form a coalition. The n-person zero-sum game then reduces to a two-person zero-sum game, where the theory is complete. The only new theoretical questions posed by the n-person negotiable game are therefore concerned with the process of coalition formation and the apportionment of the joint payoff among the members.

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1. The present author suspects Rapoport's hypothetical situation to be modelled on a real-life military situation involving the protection of civilian supply convoys in Malaya against attack by communist terrorists, reported fully by Beresford and Peston (1955) and cited by Shephard (1966).

2. N-person non-negotiable games are discussed in the succeeding chapter.

CHAPTER FOUR : NON-ZERO-SUM GAMES. A DESCRIPTION

More complex in their analysis, and much more intriguing are the non-zero-sum games (often referred to as mixed-motive games), where the interests of the two players partially conflict and partially coincide. There are two main categories of non-zero-sum games : the prisoner's dilemma game and related types; and coordination games and related types.

The Prisoner's Dilemma Game

The prisoner's dilemma game[1] is a typical illustration of how lack of mutual trust, coupled with perfectly "rational" considerations, leads to disaster.[2] The dilemma which the players face resides in their isolation and reluctant lack of mutual understanding.

In one of the more common numerical representations of the game shown in the following matrix :

	b_1	b_2
a_1	+5, +5	-4, +6
a_2	+6, -4	-3, -3

MATRIX 5.

Player A realizes that his a_2 strategy will give him a larger payoff than his a_1 strategy regardless of what Player B elects to do. Similarly, Player B realizes that his b_2 strategy dominates

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1. The name "prisoner's dilemma" derives from the anecdote, originally ascribed to A.W. Tucker, which is frequently used to illustrate the mixed motives which underlie the game. For a complete description see Luce and Raiffa (1957, page 94ff).

2. This point of view is supported by the work of Rekosh and Feigenbaum (1966).

his b_1 strategy. Each player therefore selects his second strategy, which places them in the a_2, b_2, cell of the matrix. This results in a payoff of -3 for each player. Luce and Raiffa (1957) have maintained that this unhappy state of affairs is indeed the only "rational" solution to the game.

If the game is played for a number of trials, the "rational" solution is still a consistent a_2, b_2 choice. Luce and Raiffa however, do not believe that such behaviour would actually occur. Over a series of trials, even without communication, a tacit agreement, they claim, should develop to stay in the a_1, b_1 cell. They recognize, however, that such an agreement is inherently unstable because unilateral defection from it will, for the defecting trial at least, increase the payoff of the player who defected.

Generally then the Prisoner's Dilemma may be described as a two-person non-zero-sum game, played without communication, for which the outcomes in the following matrix (Rapoport and Chammah, 1965a) :

	C_1	D_1
C_2	R, R	S, T
D_2	T, S	P, P

MATRIX 6

satisfy these four inequalities :

(1) $2R > (S + T) > 2P$

(2) $T > R$

(3) $T > S$

(4) $P > S$ [1]

The principle feature of this type of game then, is that for both players, strategy 2 dominates strategy 1. It should be noted that no nonambivalent normative prescription of strategy choice is possible in such cases, and therefore, even consistent strategy choices cannot be explained by rationality or non-rationality of the players. A convenient index of behaviour (that is, a dependent variable) in this sort of game is the relative frequency of choosing strategy 1 (or alternatively, strategy 2). This frequency can be calculated over a sequence of repeated plays of the same game by the same pair of players, or over several players in a one-shot experiment, or in a grand average over both plays and players. There are obvious objections to calculating averages of this sort, but the method can be defended on the ground of focusing on some <u>independent</u> variables other than experience or individual

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1. Rapoport and Chammah make the following comment :

> "The letters representing the payoffs in the above matrix are meant to be suggestive. R stands for reward; it refers to the payoff each of the players receives asreward for cooperating. S stands for sucker's payoff. This is the payoff received by the player who cooperated while the other defected. T stands for temptation, the payoff a player may hope to get if he can defect and get away with it. P stands for punishment, meted out when both players have defected."

propensity. For example, it allows for the study and manipulation of experimental conditions, payoff matrices, gross differences between populations of players, and so on. Many such studies have been reported in the literature. Of particular note are those reported by Rapoport and Chammah (1965a).

Modifications of the prisoner's dilemma game are effected by dropping one or more of the four conditions outlined earlier. In particular, the dominance of strategy 1 by strategy 2 can be dropped. Many experiments on such "weaker" forms of the prisoner's dilemma game have been reported. (Scodel et al, 1959; Minas et al, 1960; Lutzker, 1960;). A further modification may be effected by dropping the symmetry requirement.[1]

Coordination Games

In a pure coordination game, the interests of the players coincide. The problem arises from the fact that they cannot communicate with each other. While this sort of problem is not really directly related to the strategic problem with which game theory is mainly concerned, such situations, nevertheless, can be formally depicted as games in normal form. As such they are sometimes considered in the context of game-theoretical discussions. Notable in such discussions has been the contribution of Schelling (1960) who has brought out the role of prominence as a guide to strategy choice in coordination games. (When it is important for both players to "read each other's mind" in order for both to benefit, the prominence or distinctive character of certain choices plays, or ought to play, an important part).

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1. The symmetry requirement in the prisoner's dilemma ensures that the game "looks" exactly the same to both players.

As Shubik (1964) has pointed out, (page 289) :

> "Considerations of this sort belong to the psychology of 'tacit agreements', and, as already noted, have little to do with the principal concern of game theory. Still, it has been maintained, perhaps with justification, that in real-life situations which have been cast by strategic analysis into game form, considerations of this sort do play an important part. Therefore any method drawing on game theory and purporting to deal with real-life problems or with experiments in behaviour should include considerations derived from the existence of tacit agreements and 'telepathic communications' of this sort."

Beyond the two-person non-zero-sum games just described are the n-person games usually called non-negotiable games.

Non-Negotiable Games.

Non-negotiable n-person games are games in which the players are not allowed to communicate and hence cannot negotiate. (Thus no explicit coalitions with attending side deals can be made). The principal theoretical point to be made about n-person non-negotiable games is that there is a generalization of the minimax solution which has been shown to exist for all n-person zero-sum games, the so-called Nash equilibrium point (analogous to the minimax) cannot be considered as a normatively prescribed solution (since if a tacit agreement or coalition could be achieved among two or more of the players, the members could generally improve all of their respective payoffs by joint departure from the Nash equilibrium point). It follows that the experimental treatment of non-negotiable n-person games leads essentially to the same sort of questions which arise with similar treatment of two-person non-zero-sum games.

CHAPTER FIVE : SIMULATION AND GAMING.

A new technique which has grown up along with the development of the use of formal models in the behavioural sciences is simulation. As yet there is no generally accepted common terminology, but Shubik (1964, page 71) provides the following reasonable definition :

> "A simulation of a system or an organism is the operation of a model or simulator which is a representation of the system or organism. From studying the operation of the model, properties concerning the behaviour of the actual system are inferred."

and goes on :

> "Among the reasons for constructing a simulation are that the model is amenable to manipulations which would be too expensive, impracticable, or impossible to perform on the entity it portrays."[1]

As Coe (1964) has pointed out, computer simulation is a relatively new research tool. Like questionnaires, psychometric examinations, etc., it has certain limitations, but also great potential for the advancement of knowledge in social science. For example, one of the ever-present problems in social science research is control of variables. Simulation permits the examination of two-variable or multivariable relationships with the effects of confounding variables removed. Similarly, simulation permits rigor and precision through simulated measurement rarely found in field research. This, in turn, allows minute examination of complex relationships which under ordinary field conditions might not be separable. A further point is that simulation programmes are

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1. The word "simulation" and the phrase "manipulation of a model" are essentially synonymous, except that "manipulation of a model" might be taken to include analytical methods, whereas "simulation" is normally limited to operations by digital computer or analog devices.

perfectly reliable in that they produce exactly the same results every time. Finally there is the undoubted advantage of speed and accuracy. Simulated programmes are capable of producing results in a fraction of the time required by ordinary research methods, and apart from technical failure, the computer never commits mistakes (apart from those introduced by a human operator).

In addition to technical articles on computer simulations and the problems involved, like those of Harling (1958) and Conway et al (1959), in a small but growing body of literature, one can find references to studies of physical processes, traffic control, and the like, but there are as yet relatively few good examples of simulation in the social sciences.[1]

Simulation Games

In the field of psychology Newell and Simon (1959) have produced a programme for the simulation of human thinking, while Gyr, Thatcher, and Allen (1962) have produced a programme on cognitive organization. Within the realms of game theory a considerable number of computer simulations and analog devices have provided useful results. Specifically, Joseph and Willis (1963) have produced an experimental analog to two-party bargaining and Meeker et al (1964) have used a computer-based experiment to study the effects of threat on bargaining and negotiation behaviour.

Gaming is often confused with simulation, but there is a considerable difference. Gaming is a technique which may or may not make use of a simulated environment but is, without exception,

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1. There are exceptions however, such as the study by Orcutt, Greenberger, Korbel, and Rivlin (1961).

concerned with human behaviour.[1] While it has been common in the past to use the words "gaming" and "simulation" synonymously, much confusion can be caused by so doing. Generally, individuals in using the word "simulation" in reference to a game are referring to gaming in a simulated environment. The reference may be to the simulated role of the players, as for example when graduate business students fill the role of union or company representatives in a simulated labour dispute (Campbell, 1960; Bass 1966); or act the part of managers of abusiness firm in a "market" situation (Hoggatt, 1959). A number of studies have employed a simulated rather than a real player. For example, (in relation to the prisoner's dilemma game), Scodel (1962) used a stooge who played a predetermined strategy. That is, each subject actually played against a pre-programmed set of responses sent to him, either by the stooge (in the study by Scodel), or by the experimenter (in other studies by Solomon, 1960; Bixenstine et al, 1963; Bixenstine and Wilson, 1963, etc.), while believing that he was actually playing against a real opponent.

There are, then, many types of gaming and many purposes for which games can be used. All are of interest to the behavioural scientist and many do not require computers in order to play them. For example, some military games (manoevres such as NATO exercises) make use of a real environment, others use an analog simulation for the environment, such as a sand table. Several political gaming situations have been designed to be played with paper and pencil (for example, Iklē and Leites, 1962) and numerous other games have been used in recent experimental work within the framework of game

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1. In a simulation, the behaviour of the components is taken as given. Thus, while necessary to a gaming exereise, the actual presence of individuals is not necessary to a simulation.

theory, (For example, Hoggatt, 1959; Jensen and Terebinski, 1963; Krauss and Deutsch, 1966). In many investigations, as Shubik (1964) points out, the behavioural scientist is interested in three main aspects : (1) an adequate description of the environment in which the activity takes place, (2) an understanding of the plans, strategies, and motivations of the decision makers, and (3) an ability to predict what will happen if the decision makers carry out their plans, given the environment. A simulation takes the first two items as given and provides a method for obtaining the third. Gaming in a simulated environment may be used as a method whereby the first is taken as given, the outcome of the game is observed, and inferences are made concerning the intentions and motivations of the players. This is done in experimental gaming.

In operational gaming the environment may be taken as given and the players may then proceed to try out different plans and strategies in order to examine their outcomes.

An alternative method of classifying games concerns the degree of control and formalization in the structure of the game and the levels of richness of the environment. As Shubik (1964, page 74) points out :

> "Many of the psychologists' experimental games tend to be extremely impoverished in environmental setting and highly controlled with respect to the rules and manner of play.[1] At the other extreme, games designed as operational exercises for politico-diplomatic negotiations may be very loose in structure.[2] In the latter case, expert referees may decide on rules and permissible strategies as the game progresses. The experimental controls may

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1. The Prisoner's Dilemma Game or the Game of Chicken (fully described by Rapoport and Chammah, 1966) are examples of this extreme.

2. Many collective bargaining games fall into this category - for example, the studies of Campbell (1960), and Tuckman (1964).

be few or non-existent. The exercise may have more in common with a group psychodynamic process than with a formal theory of games."

Games as Predictors.

In the last few years simulations of diplomatic-cum-military systems have become common, especially in the United States. One of the chief aims of this development is evidently to provide some substitute for controlled experiment for the science of strategy, which purports to deal with such systems. However, since the connections between the simulations and the real processes are missing, there is little hope of making simulation of diplo-military procedures a useful tool for arriving at strategic decisions.[1] In fairness, however, it should be pointed out that the enthusiasts of simulation are well aware of this difficulty and that they evaluate the positive contribution of the simulation method from an entirely different point of view - the designers of simulations, gaming, and scenarios[2] are generally agreed that the principal value of these procedures is in furthering the development of theory, plans evaluation, and as teaching aids.

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1. There is little evidence that such applications are in fact made or recommended, although Schenck (1963) suggests that there is cause for concern at the possibility.

2. Scenario - "a term introduced by strategists to designate imagined situations (usually crises, wars, etc.) contrived for exercising strategic decision-making and to simulate the invention of alternative outcomes and courses of action." (Rapoport, 1964; pp 312 - 313)

Games as Teaching Aids.

The application of gaming to training and its use as a teaching aid is of much more ancient standing than is the mathematical theory of games.

By the sixteenth century many chess-like games had evolved which reflected the tactical principles of the age, and by the eighteenth century two French card games, one dealing with combat operations and the other with fortifications were played as a training aid in the basic instruction of military students. In this era also, the view of war as an exact science gained vogue. This approach of mathematical exactitude and its representation in games inevitably led to successively higher levels of detail, complexity of play, and sophistication in representation both of the combat elements and the field of battle.[1]

By 1812 the elder Von Reisswitz had developed the first game to use an actual terrain model built to scale and made of plaster. Used as a toy by the Prussian Royalty, it was later adapted by the younger Von Reisswitz to a scaled flat map, with refined rules. In 1824 he convinced the Chief of the German General Staff that it was not a game at all but a valuable trainer for actual operations.[2]

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1. For example, Helwig (1780) designed a game that included the use of single pieces to represent entire military units rather than individual troops, the representation of five terrain classes which could be used to build up an arbitary battle-field, differential rates of movement for the various types of arms, and an independent game director rather than a player, to apply the game rules to the player moves.

2. It is interesting to note that its main features were that it was a closed game directed by an independent umpire, and that the object of the game was not to win or lose, but for the players to attain sound tactical techniques.

Throughout the nineteenth century, the Von Reisswitz Kriegspiel went through cycles of complication and simplification which eventually led to German recognition of the Rigid Kriegspiel for low-echelon play, and the Free Kriegspiel for higher level play, both of which featured an umpire who was expert in warfare and war gaming. It is these games that have come down to us with little change, except as required to introduce new weaponry, and new documentation techniques.

Naval war gaming had its birth in the late 1700's in the ideas generated by an Englishman named John Clerk (1790) who used a a number of ship models in various dispositions.[1] Naval authorities encouraged the use of gaming as a training tool, and by the 1890's the English, Italian, and U.S. Navies were making use of the "Maneuver Board", "Chart Maneuver",[2] or "Naval War Game", as the game was variously known. At the United States Naval War College, Fleet-Tactical and Strategic Games were played more or less continuously from that time until 1958 when they were superceded by the Naval Electronic Warfare Simulator (NEWS).

The gaming of air operations had also become widespread since World War II, but any survey of this development is precluded by security considerations. It is sufficient to note that therein

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1. The first formalized naval war game, however, appears to have been invented about 1878 by Captain Philip H. Colomb of the British Navy.

2. For example, see McCarthy Little (1912).

lay the origin of the Lanchester Equations,[1] and that, since World War II, the gaming of air operations has been at least as active as that of land and sea conflict.[2]

It is hardly necessary to state that training games and map maneuvers are in extensive use today for military and naval training with varying degrees of sophisticated investments in electronic computer support.[3]

Games in Plans Evaluation

The Germans used their Kriegspiel to formulate and evaluate war and campaign plans from the Franco-Prussian War right through until World War II. The most notable of these instances were :

1) The plan of railroad mobilization and deployment of the Prussian army against France in 1870;

2) The Von Schlieffen Plan at the start of World War I (which almost won it for them at the outset);

3) The invasion of Poland in World War II;

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1. Named after their originator, F.W.Lanchester (1916), the equations, by expressing the relationships between victory, numerical superiority, and the superiority of firepower, predict the outcome and effectiveness of two opposing sides in a military situation.
2. Johnson (1968) - personal communication.
3. The NEWS facility occupies three floors of the centre wing of Sims Hall at the U.S. Naval War College. The complex electrical circuitry has over 4000 miles of wire and 13,000 electronic tubes installed. It represents an investment of approximately 10 million dollars. Seventy persons are assigned full-time to the War Gaming Department, which is responsible for the operation and maintainance of the NEWS

4) The proposed invasion of England in 1940 (the game showed up the difficulties involved); and

5) The invasion of Russia in 1941.

Not all of these operations were successful, but in most cases the gaming accurately indicated the events that ensued.

Both the Allied Forces and the Japanese did extensive gaming in support of war plans too, the most significant applications being the Invasion of Normandy and the attack on Pearl Harbour.

Again, owing to security restrictions, it is not possible to cite the post-World War II role of gaming in plans development and evaluation. That it continues to have an historical role is indicated by the revelation of the late Senator (then Mr) Robert Kennedy in 1963 that the Bay of Pigs operation in Cuba was war gamed, and by the steady trickle of reports issued under the auspices of the several military research establishments.

PART TWO: EXPERIMENTAL GAMING - A CRITIQUE

CHAPTER SIX: EVALUATION.

As has already been pointed out, game theory was conceived by mathematicians, and since the publication of Von Neumann and Morgenstern's treatise (1947), has been developed almost exclusively by them. Indeed, the theory can be correctly viewed as a self-contained branch of pure mathematics - a system of theorems built up from a set of postulates. As such, the theorems are logical consequences of the postulates and can only be wrong if errors have crept into the deductions. Thus, when the validity of the theorems, solutions, etc., has been checked, such a purely mathematical theory is practically immune to criticism.

However, as soon as the theory is proposed as pertinent to some aspects of the real world, (for example, as a basis for constructing models of human behaviour in conflict situations), an evaluation (as opposed to only a formal check on logical validity) is required. In such a situation, however, it is hardly proper to criticize a theory for not having accomplished something that it did not set out to accomplish. Our examination must be directed only towards the applications of, and the claims made for game theory by the non-mathematical scientists.

There have been many objections of both a theoretical and practical nature to the use of game theory in psychological inquiry, and in this connection, many of the theory's requirements have been brought into question. The theory assumes that the players in a game will act rationally (in the economic sense) - an assumption which is open to question. Even in the 2 X 2 prisoner's dilemma-type game, would the two players really be able to work out the "rational" solution to their dilemma ? If it is possible that they might not manage this deduction in the simple 2 X 2 game, is it not even more unlikely that the players would be able to identify the "rational" outcome in a 3 X 3 game, or in a game requiring the use of mixed strategies ? Even if a player did in all these cases recognize

the "rational" solution, there is no guarantee that he would in fact act rationally in this economic sense. A player might deliberately make an "irrational" choice. For example if the game is reiterated over a large number of trials, he might well become bored and change his strategy simply for the sake of change. Again, it is conceivable, for example, that a chess-player would rather risk losing a game than settle for a draw.

The requirement of game theory that all outcomes be specified numerically and that rationality is the maximization of these by the player, can quickly become a psychological pitfall. If, for example, the payoffs are in cash, it is quite possible that their worth to the player does not correspond to their numerical values. To win £1 in a poker game may, to a given poker player, be worth more than twice as much or less than twice as much as to win 10/-. Since the magnitudes of the payoffs play a part in defining the experimental game, such a game in reality remains undefined if we do not know what payoff values are assigned by the players to the various outcomes, even where this is specified in monetary terms. Another illustration of this point is the problem of the player who does not wish to maximize his "economic" payoff. A father playing dominoes with his young son, for instance, may have the ability to defeat him, but may allow the child to win. In this case the father's self-evalued payoff would possibly be deemed greater to him in the satisfaction of seeing the child's pleasure in winning, rather than in playing rationally in the game-theoretic sense.

In short, game theory describes "rationality" only in the economic sense, whereas human players may redefine rationality for themselves in entirely different terms. That is, the goal-directedness of players may be towards a psychological goal, real enough for the players involved, but entirely different from the game-theoretic principle of economy maximization.

This criticism that the player's actual goal may be different from that assumed by the theory has even deeped implications for reiterated versions of experimental games. Many persons who have experimented with games have made the assumption that 30 iterations of a game are merely 30 repetitions (or trials) of the same choice situation. It can be argued, and I think reasonably so, that this is not the case. It seems reasonable to assume that a win (or loss) of 5 numerical points will be psychologically greater to the player when he holds only 10 points than it will when he holds 210 points, and that the reinforcement he receives from a particular outcome will thus vary in degree according to the point in the game where the outcome obtains. Such a conclusion would lead to an expectation of sequential dependency of response, and, on the face of it, invalidate the results of experiments utilizing an iterated game. However, while it may be reasonably assumed that learning takes place in iterated plays (if the outcome of each play is known to the subject), there is evidence that subjects do not really "get the hang" of the game until they have played it a hundred times or so, with an opportunity to compare the results of different "strategies".[1] In addition, as Rapoport (1968) has pointed out, experiments with one-shot (non-iterated) plays present a problem of design efficiency. Since a decision in a 2 X 2 game takes only a short time, it is extremely inefficient to confine such an experiment to one play only - that is, to recruit a pair of subjects, give them instructions, etc., and only allow them to actually perform for a few moments.

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1. In this instance, "strategies" are understood to mean not simply the two choices available in the 2 X 2 game, but the different sequences of choices.

A natural way out is to gather data from the same pair of subjects on several different games, each played once. This however, raises other problems[1] although these in turn may be solved.

Despite all the foregoing objections it can still be argued that the theory of games in the form of the two-person non-zero-sum game does provide a method of studying mixed-motive conflict in the context of controlled laboratory experimentation. And it has been argued that such mixed-motive games provide a particularly useful model, answering a long-felt need in social psychology for a well-controlled interaction situation with an easily quantifiable and unambiguous dependent variable (the number of cooperative - or competitive - responses made by each subject), in addition providing an excellent framework within which problems of motivation, decision-making, personality, and person-perception can be studied.

Gallo and McClintock (1965, page 70) have further argued that :

> "Perhaps even more important is the fact that the decisions that have to be made by the subjects in the game are very similar to decisions that are made in real-life bargaining and conflict situations. The players have a real stake in cooperating, and yet at the same time there are realistic reasons why they should compete. Many researchers see the decisions and strategies in the Prisoner's Dilemma as prototypes of the more complex decisions and strategies in labour-management bargaining and international negotiations"[2]

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1. If the results of each play are fed back to the subjects, they may develop some "principles of play" abstracted from the results. If these principles are applied across all the plays in the experiment, the responses may contaminate each other.

2. Several texts dealing with these areas of study have appeared over the last two decades - by Chamberlain and Kuhn, who published their "Collective Bargaining" in 1951; by Williams, whose "Compleat Strategyst" appeared in 1954; and by many others, such as Blackwell and Girschick (1954); Dunlop and Healy (1955); Rapoport (1960, 1964); and Fouraker and Siegel (1963).

As is typically the case, the advantages of tractability and control are offset by the artificiality of the laboratory environment. Extrapolation of laboratory results to conclusions about real life are always hazardous, and as Rapoport (1968, page 461) has pointed out, it is not only the lack of realism of the situation depicted in the laboratory which makes the extrapolation unwarranted, but also the limited range of the results obtained.[1]

The more sceptical critics of experimental gaming may go so far as to argue that the artificiality of the experimental game makes nonsense of such research. It is undisputed that the experimental situation is artificial. That it is unrealistic is, however, open to debate. Harnett (1967) referring to business games, has argued that although the experimental environments and subjects may fail to correspond with business reality, behavioural laboratory simulation of market processes does possess unique advantages as a research strategy, often while retaining its relevance to natural settings.

There are few who would contend that laboratory simulation of bilateral monopoly and oligopoly are full-fledged representations of similar real world markets. Fouraker and Siegel (1963) were fully cognizant of the problems of applying conclusions based on laboratory simulations to more complex situations. There are indeed formidable problems associated with such extensions. Nevertheless, Harnett's view has been reiterated by many, including Johnston and Cohen (1967) who argued that the rationale for viewing properly designed and

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1. Even in the simplest case of the 2 X 2 game, there are at least eight independent variables within the game matrix. If we give each payoff just three distinct values, (low, medium, and high), we must perform 3^8 (that is, 6561) experiments to get a body of data for a comprehensive description of how the choices are influenced by the payoffs.

motivated laboratory experiments as effective means of studying economic behaviour is similar to that of the construction of abstract analytical models. The inability of the investigator to encompass the real world with either theoretical models or laboratory simulations forces him to utilize these simple, but useful, tools in his search. As Johnston and Cohen have noted :

> "The weaponry of science embraces such 'simple' techniques rather than some hypothetical, non-existent method whereby the complexity of the world can be grasped in its full splendour."

Both these authors endorse the conclusion of Schenitzki (1962) that the process which is found to operate in a 'minimal' social situation might well prove to be a basic mechanism operating in natural situations.

The further criticism that any results obtained from experiments utilizing university and college students as subjects must be invalid because of differences in age, and possibly educational level and vocational orientation, as well as in occupational status, between such students and those who, in real life, are engaged daily in negotiations, has been refuted by Siegel and Harnett (1964) who found that the behaviour of business and student subjects was essentially similar in all important respects; both groups exhibited similar bidding patterns and conformed to the predictions based on the theoretical models. Bartos, however, (1967) has stated that it does not seem profitable to conduct simple experiments with subjects who are not professional negotiators and generalize from their behaviour to that of professionals, if the code of behaviour (which he claims to be the most important) is missing from the experiments. Bartos concedes however, that the process of professionalization, the development of norms, and beliefs about negotiation itself can be legitimately studied in such experiments.

Games have also been used extensively in the study of international negotiations[1] where participants usually represent countries, and where they may be encouraged to play the "role" of the country, acting as they believe the country would act, or where they may simply be instructed to act in the best interests of the country they represent. As with war gaming, such games may be organized for research purposes, or as training, to give students experience in the complexities of international politics. Such games, organized for the benefit of students due to their particular suitability for bringing out the complexities of international politics and negotiations, are by no means limited to this end in their usefulness.[2]

While the more abstract and stylized games cannot pretend to provide experience in the practice of international negotiations, they may have a place in the theory. A game may be useful in revealing the structure of conflicts rather than the details. One kind of game may be used to elucidate a theoretical model, another to show its limitations.

Perhaps a more basic criticism of the application of game theory to psychological problems has been the argument that while the "drama" of games of strategy is strongly linked with the psychological aspects of conflict and cooperation, game theory is not, but is rather concerned only with the logical aspects of strategy. It has been further argued that, in prescribing the same line of

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1. A critical evaluation and overview of current psychological methods for studying international relations has been given by Tedeschi and Malagodi (1964).

2. This usefulness has been questioned by several authors, (by Singer, 1963; Harris, 1964; Haas, 1968; and by De Leon, MacQueen, and Rosecrance, 1969), all of whom have advocated the use of 'situational analysis' (the investigation of actual events) in order to avoid the pitfalls of contemporary qualitative analysis commonly encountered in the examination of laboratory simulations.

play against a master as it does against a beginner, when a strategic game is completely analysed by game-theoretical methods, nothing is left to the game. This, however, is not so. As Schelling has explained :

> "Even the most austere and economical theoretical model is unlikely to be fully determinate ..... among the processes that it leaves indeterminate will be some that inherently involve the interaction of two or more decision centres.
> For this reason there is likely to be, even within the simplified model, some scope for 'free activity' for bargaining, for the reading of understandings and misunderstandings, for accomodation and cooperation, and for conjectures about each other's decision processes, value systems, and informations."
> (Schelling, 1961, pages 48-49)

This scope for "free activity" is an important ingredient of such mixed-motive situations, for it permits the functioning of psychological factors which in real life situations are now generally admitted to be of considerable importance.[1] Until recently, when it became apparent that a great deal more was involved, bargaining was considered only in the context of legal and economic considerations. However, recent work has shown this view to be in error. Hoffman, Festinger, and Lawrence (1954) postulated that an important motivation in a bargaining situation was the individual's concern about his status in the activity relative to other members of the group and his desire to equal or surpass them. In substantiating this hypothesis, Hoffman et al found that the strength of the motivational factors involved depended not only on the degree of comparability between the group members, but also, in part, upon the importance of the

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1. A fact recognized by Stagner who in the course of interviewing workers, union officials, and business executives, was very much impressed by "the emotional colouring of many facts in the minds of both workers and executives." (1948, page 139)

task to the individuals involved.[1] Deutsch (1960) conducted an experiment to assess the effect of threat on bargaining in an experimental game, and concluded that a bargaining situation was a complex social situation in which the manifest substantive or economic matters at issue might, in certain circumstances, have little importance in determining the behaviour of the bargainers. Speaking of industrial strife, Cyriax and Oakeshott (1960) have commented that strikes are as much social or even political phenomena as economic ones; and Deutsch (1961) has explained this notion in terms of "threat to face" :

> "Whenever a bargaining situation has become 'pathological' - that is, whenever bargainers are unable to reach agreement despite the clear existence of a potential agreement that would leave the bargainers in a better position than their position of no-agreement - one may suspect that at least one of the bargainers feels that his face has been threatened and that an agreement would lead to loss of face."

The argument here is that, in effect, "threat to face" under certain circumstances may transform a mixed-motive situation into a competitive struggle wherein behaviour is regulated antagonistically rather than normatively.[2]

To help prevent such a deterioration in the bargaining process, there are no real formalized rules, but there is a generally

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1. This view is supported by Garfield and Whyte (1950a) who commented that those who look at bargaining simply in legal and economic terms fail to recognize that bargaining deals in the emotions of people as well as in logic and economic interests.

2. While the escalation of international conflicts may here spring to mind as the most glaring example, it should be realized that this notion holds true to an equal extent in industrial negotiations.

accepted modus operandi which should be followed. In this connection, Garfield and Whyte in a series of papers, (1950a, 1950b, 1950c, 1951), have contended that the bargaining process itself has a ceremonial function which serves a major role in bringing about an effective adjustment and resolution of conflict. This notion has been reiterated by Miller (1959), who, in considering the attitudes of an industrial union and management after a prolonged but satisfactory negotiation, reported that these attitudes of satisfaction reflect an institutionalization of a set of role expectations.

That conjectures about the other's decision processes, value systems and information occur in real life situations is certain. The first steps in bargaining involve an exploratory process on both sides. In the preliminary "fencing", the bargainers size up the people across the table and try to sense the relative importance of each issue to the other party.

> "Out of this process comes the working consensus which, in its minimal form, specifies the general rules to be observed within the interaction, establishes the identity of each of the participants, and delimits their areas of choice of lines of action."
> (Weinstein and Deutschberger, 1964).

Ikle (1964) has provided us with a set of pointers for sizing up the bargaining reputation of the opposition - Is he a bluffer ? Is he firm ? Does he avoid tests of strength ?[1], and reminds us that the opponents view of our reputation is equally important. A reputation for not bluffing works much like a commitment: it creates a vested

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1. International negotiations are akin to those of industry in many ways, and tests of strength, bluffing, propaganda, and other ploys are commonly used. Spanier and Nogee (1962) and Nogee (1963) have suggested that such "gamesmanship" has been the major practice of disarmament debates - "the negotiations were characterized by a richness of maneuver that was at times crass and at times extremely subtle." (Nogee, 1963, page 521 CR, 615 AC) - though Jensen (1963) has disputed this.

interest in being consistent. If the opposing party takes you up on your threat, then the disadvantage of carrying it out is outweighed by the long-term damage to your reputation that would be caused by your failure to do so. Knowing this, your opponent may not challenge your threat.[1] Secondly, in negotiation, it is an advantageous ploy to make your opponent believe that he might just as well accept your terms since they will not become any better for him.[2] His expectations as to whether or not your position will remain firm depends not only on his image of your customary behaviour and your reputation for firmness in the past, but also on your interest in your future reputation. The more you can convince your opponent that giving in would impair your future bargaining strength, the more he will conclude that it is in your interest to have no agreement rather than to lessen your demands (even if, in the particular instance, 'softened' terms would be better for you than no agreement).

In short, what this means is that the involvment of your bargaining reputation can serve as a commitment to your negotiation position. The more you enjoy a reputation of always remaining firm, the more convincing to the opponent is the commitment. In a similar way, the maintaining of a reputation of strength is equally important in preserving a bargaining reputation. If you are the negotiator, you know that the other side's actions will be governed in part by his anticipations of your reactions. He bases these anticipations on

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1. A government acquires a reputation in much the same way an individual does. On the basis of its previous performances, other nations will impute to it a diplomatic style, motives and objectives, certain attitudes towards the use of force, and other attributes of power.

2. "It is what we think the world is like, not what it is really like, that determines our behaviour ..... we act according to the way the world appears to us, not necessarily according to the way it 'is'." (Boulding, 1959, page 121).

his image of you, concerning such attributes as your attitude toward risk-taking, your tendency to bluff, your evaluation of your own strength and his, your tendency to hold fast to a position, and so forth. Naturally, your opponent will assume a certain continuity in these attributes and base his estimates of them partly on your performance in previous negotiations. Knowing this you will act in every negotiation not only so as to obtain a favourable outcome at that time, but also so as to preserve or improve your negotiating strength in the future. As Ikle (1964, page 77) has emphasised :

> "The fact that these two considerations frequently conflict adds an important complication to the negotiating process."

(It is to be noted that this has relevance to reiterated plays of experimental games and lends credibility to the idea of sequential dependency of choices in such games).

Ikle continues that the influence of the bargaining reputation can be abstracted in the language of game theory: an international negotiation is never a self-contained "game", but is an instance vaguely related to an ever-continuing "supergame". Although each instance yields its own payoffs, the tactics used in it affect the other party's calculations in subsequent instances, and hence influence subsequent payoffs.[1] This "supergame", says Ikle, comes to an end only under exceptional circumstances : a government whose existence is at stake and which expects no continuity with its successor may contemplate the losing situation (but not the winning one) as the end of the supergame.

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1. This endorses the view of Pruitt (1962, page 17) who saw international relations as " a special case of 'inter-actor relations' i.e., relations between social units ('actors') at any level. The relationship between two actors can be treated as a larger game consisting of many individual subgames, an example of the latter being negotiation on a single issue.

However, in the words of Quandt (1961, pages 71-76) :

> "In applications of game theory ..... models of this kind are quite far removed from the realities of international relations ..... gaming models and other metamodels are thus left with basically two uses :
> (1) to test particular hypotheses about models: and
> (2) to enlarge the catalogues of possible outcomes and strategies. It is not possible, in general, to proceed from metamodel to reality."

Schelling (1961, page 49) has concurred with this viewpoint, stating that the theoretical model is usually not a comprehensive specification of how the participants behave, but rather of the framework within which they pursue certain objectives according to certain criteria. What the model leads to in terms of behaviour of the participants is usually beyond the reach of straight-forward analysis. Schelling qualifies this conclusion however, by saying that the game itself may be a fruitful way of developing a working acquaintance with a theoretical structure.

In summary, then, it may be seen that there are indeed many legitimate objections to the current usage of experimental games in psychological inquiry, but at the same time, the game-theoretical model is an attractive and potentially useful one. There is much to be learned about the dynamics of interaction in the playing of experimental games, (not least in the playing of iterated 2 X 2 games).

In view of the foregoing discussion and critique, however, we must conclude that, at present, it seems desirable to obtain this knowledge by a study of such games in their own right, postponing for the time being the question of how relevant this knowledge may be to an understanding of mixed-motive conflicts in real life. To ask this question in connection with every experiment may lead either to unwarranted conclusions, (by illogical extrapolation) or to a premature discouragement and rejection of the game-theoretical method of experimentation. What is worse, is that viewing the

laboratory method in terms of simulation of real-life conflicts leads to designs which are not guided by the logic of a systematic investigation. The value of the laboratory experiment in the context of the simple 2 X 2 game is in the opportunity it gives for building a systematic theory of that situation. What relation that theory may have to real life conflicts only time can tell. It can not be achieved until the concepts emerging from the descriptive theory of the 2 X 2 game have become stabilized as concepts of proven theoretical power.

Finally, while "realistic" simulations of conflict in the laboratory, such as disarmament games, "realistic" simulations of nuclear deterrence, and games which simulate "pacifist resistance", are all valuable for demonstrating situations of this sort, the present author concurs with the sentiment that a substantial portion of experimental gaming effort should be devoted to the simplest formats[1], which alone can make possible the systematic build-up of a theory.

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1. That is not to say, however, that in adhering to the simplest formats, researchers should thereby be limited to the investigation of only one or two specific games in order that research in the area might be cumulative. Assessment of comparability among experimental game studies have been aided by a two-dimensional geometric classification system (Rapoport and Guyer, 1966) for all 2 X 2 games "which look the same" up to a linear transformation to the two players. Harris (1969) has shown that Rapoport and Guyer's taxonomy is easily adapted to the classification of games on the basis of any interval-scale property of interest.

PART THREE : INDIVIDUAL DIFFERENCES IN GAME-PLAYING BEHAVIOUR

CHAPTER SEVEN : PERSON PERCEPTION AND INDIVIDUAL DIFFERENCES IN GAME PLAYING BEHAVIOUR

Having examined the arguments presented, it is clear that the behaviour generated by experimental games, and in particular by the two-person non-zero-sum games, cannot be adequately dealt with within the framework of normative rational decision theory without disregarding some of the more interesting aspects.

One of the more interesting (and important) features of these game situations is the fact that the individuals involved have some form of contact with each other, (even if only through knowledge of the other player's choices). There are obviously large individual differences in the characters and personalities of the players, and, even though we may be partly, or totally, unaware of it, these individual differences must to some extent at least affect the way in which the individuals play the game.

We may, of course, tend to discount these differences. Much of one's life is spent in what appears to be fairly well coordinated interaction with other people, and the relative smoothness of operation in day-to-day living reflects the fact that a person is in some degree aware of what another person does, feels, or wants to do. Asch (1952, page 139) has said that :

> "To act in the social field requires a knowledge of social facts - of persons and groups. To take our place with others we must perceive each other's existence and reach a measure of comprehension of one another's needs, emotions, and thoughts."

This measurement, or "sizing-up", of other people, important as it is in our existence, is largely automatic - one of the things we do without knowing very much about the "principles" in terms of which we operate. Regardless of the degree of skill a person may have in evaluating others, he does so most of the time without paying much attention as to how he goes about it.

How people perceive or know their human environment and how these processes are related to action are little understood in the scientific sense. In the analysis of interpersonal behaviour

this lack of knowledge is strongly felt. Despite this, however, the problem, central to the whole of social psychology, has not been directly and systematically attacked until relatively recent times. While Allport (1937) and others have been stressing its importance for some thirty years, no book had been written on the subject in English until the appearance of that by Tagiuri and Petrullo in 1958. Until then nearly all contributions consisted of occasional journal articles or brief discussions in texts devoted to other issues.[1]

What is person perception really about, and what do we mean by the term ? Through information gained via perception, we infer properties and potentialities that are not immediately given. When we speak of person perception it is to our observations of these properties in people (intentions, attitudes, emotions, ideas, abilities, traits, etc.) that we mostly refer - things that are inside the person. We make these observations as we follow the actions of persons, but we formulate the actions in strictly psychological terms. We rarely describe a persons bodily movements as such : rather we describe the person as friendly, fearful, hesitant, aggresive, and so on. On the basis that we know or assume a person is capable of watching, perceiving, remembering, and waiting for opportune circumstances, we can experience the person as directing himself towards us, with intentions, attitudes, and feelings.

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1. Allport (1937); Lindzey (1954); and Asch (1952), have all devoted chapters in their texts to this problem, and the 1958 edition of Readings in Social Psychology by Maccoby, Newcomb, and Hartley also contains a section on person perception. More recently, new texts completely devoted to social perception have appeared in print - for example, that by Toch and Smith (1968).

These conditions of perception form the basis for the interaction between one person and another, and in this case both the perceiver and the perceived have phenomenological representation of the environment. Each observes that the other directs himself towards him ; each can make known to the other that he is sensitive to the other's direction towards himself. These operations provide the basis for what has been called the "mutually shared" field of interaction between people - a prerequisite of all really social processes. Thus, by his own presence and behaviour in the situation the perceiver may alter the perceptual characteristics of the other person.[1]

It is clear from all this that in dealing with the problem of person perception (and hence, indirectly, with any interaction process) the actual personalities of the individuals must be taken into account, since personality must obviously affect not only how one person perceives another, but also how he himself is perceived by the other person (or persons).

It is not surprizing therefore that within the framework of experimental social psychology, a considerable amount of research has been undertaken in those areas where interaction comes to the fore - viz: risk-taking, decision-making, and small group behaviour. Gentile and Schipper (1966) looking at the behaviour of college students preselected on the personality variables need Achievement and manifest anxiety found that neither personality variable showed a consistent relationship to probability learning, decision-making, or risk-taking behaviour. Townsend and Smith (1964), however, concerned with the prediction of decision-making behaviour, administered a battery of personality tests (including the California Psychological Inventory) to a group of 66 subjects and found that in predicting 'goodness of decision' in a general situation, Intelligence, lack

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1. This aspect of the problem can of course be experimentally isolated by placing the perceiver behind a one-way vision screen, although Taguiri and Petrullo (1958) have pointed out that such an expedient may create more difficulties than it solves.

of Dominance, and Conscientiousness, appeared to be those cognitive and personality factors most clearly involved. Despite the fact that the results of their study were filled with significant correlations, they concluded that :

> "one must not neglect the fact that correlations can be significantly different from zero, but of little practical value in immediate prediction. It is the opinion of the authors that in well-controlled studies using normal, above-average-intelligence subjects, (who, by the way, seem to be the most important decision makers in our society) high correlations consistently obtained between personality variables and decision making are most improbable .... it appears that normal people in normal situations tend to act in a rational, logical, and goal-oriented way, and thus make decisions which are little influenced by personality."

On the other hand, Cameron and Myers (1966) investigating the effects of personality on risk-taking behaviour, found that subjects high in exhibition, aggression, or dominance, (as measured by the Edwards Personal Preference Schedule) tended to prefer bets with high payoff and low probability of winning, while subjects high in autonomy or endurance tended to prefer bets with low payoff and high probability of winning. Block and Petersen (1955) investigated the general hypothesis that personality variables were relevant for an understanding of decision confidence and decision time, and found a number of personality correlates of decision in a psychophysical situation. Werner (1955) found positive correlations between leadership, environment, and decision-making, while Gibby et al (1967) discovered relationships between dominance-needs and decision-making ability. Many attempts have also been made to relate measures of personality characteristics of individuals to their behaviour in interacting small groups, (e.g. Pepinsky et al, 1950; Ossorio and Leary, 1950; Haythorn et al, 1956; Marlowe, 1959; Hoffman, 1959; Tuckman, 1964).[1] As Toobert (1966) has pointed out,

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1. For an overall view of such early work, see Mann (1959).

however, significant correlations have not been high, and while some of the directional trends have been consistent, personality variables have not seemed to account for a large amount of the variance relating personality to interaction in groups. Although Toobert's own work revealed that emotionally stable, reality-centred individuals (as measured by the Guilford/Zimmerman Temperament Survey) are less likely to enter into contending relationships in the small group, while emotionally unstable individuals who test reality poorly are more likely to enter into such relationships, he concluded that, in general, personality measures are not stable predictors of behaviour in small groups.

Nevertheless, the work of Lieberman (1960), Marlowe (1963), Dryman (1966), and others, looking at behaviour in game situations, has suggested that factors other than those ordinarily considered relevant by game theorists do exert an influence on decision-making in a game situation. The analysis of bargaining behaviour within the context of two-person games has been the subject of considerable research in recent years; and in contrast with the early concern with economic and mathematical considerations (McKinsey, 1952; Luce and Raiffa, 1957) the more recent investigations have emphasized the interpersonal aspects of the game situation. These studies, viewing bargaining as a special instance of social interaction amenable to analysis within the framework of experimental social psychology, have investigated the possible effects of several non-mathematical, non-economic (in the game theory sense) factors. For example, Siegel (1957), Crowne (1966), and Kahan (1968), looking at "level of aspiration" in relation to an experimental bargaining situation found definite relationships between the level of aspiration of the subject and his behaviour in the game; Kahan concluding (page 159) that:

> "the level of aspiration of a subject, which will normally vary considerably from individual to individual, is a critical factor in the determination of how he will behave in the bargaining situation."

Krauss (1963, 1966) and Harsanyi (1966) concerned themselves with motivational and attitudinal factors. Krauss (1963) hypothesized that where the subject's motivational and attitudinal orientations were in conflict, (that is, competitive-positive or cooperative-negative), the strength of involvement would determine the extent to which the attitudinal orientation would affect interaction. His results provide evidence for the independent effects of both the motivational and attitudinal factors, along with the predicted interaction. In the further study Krauss (1966) postulated that interpersonal conflict creates a potential situation of intrapersonal conflict, and confirmed his earlier finding that conflict between behaviour and attitude leads either to attitude change or to a reorientation of behaviour so as to restore balance, while Harsanyi (1966) concluded that among all the non-economic motivational variables, striving after social status might well be the most important. Thibaut and Faucheux (1965) examined the effects of stress on the maintainance of a mixed-motive dyadic relationship, while the effects of unilateral and bilateral threat upon the ability of persons to reach agreement in a simulation game have been investigated by Deutsch and Krauss (1960, 1962), Borah (1961, 1963), and Shomer, Davis, and Kelley (1966), all using a game developed by Deutsch; and also by many others such as Meeker, Shure, and Moore (1964), Kelley (1965), and Hornstein (1966). The experiment conducted by Deutsch and Krauss (1960) was concerned with the effect of the availability of threat on bargaining in a two-person experimental bargaining game, where threat was defined as the expression of an intention to do something detrimental to the interests of another. Three experimental conditions were employed : No Threat (neither player could threaten the other); Unilateral Threat (only one of the players had a means of threat available); and Bilateral Threat (both players could threaten the other). The results indicated that the difficulty in reaching an agreement and the amount of (imaginary) money lost, individually as well as

collectively, was greatest in the Bilateral Threat condition and least in the No Threat condition, (the only condition where players made an overall profit). In the unilateral threat condition, the player with the threat capability did better than the player without it. Comparing the Bilateral and Unilateral Threat conditions however, Deutsch and Krauss found the results indicated that when facing a player who had threat capability one was better off not having than having the capacity to retaliate in kind. This finding fits in with the results of Meeker et al (1964) who found that "bargainers who resist the use of threats show the most favourable joint outcomes."

Borah's study (1963) first replicated the Deutsch and Krauss experiment and indicated that the earlier results were probably due to the spurious effect of the length of a longer pathway and the lack of comparability between conditions.[1] In a second experiment Borah found that the introduction of an electric shock - whether interpreted as a means of coercing the other to yield, interpreted as a means of threatening future unpleasantness, or given no interpretation, - did not significantly change the outcomes for the bargainers.

Meeker, Shure, and Moore (1964) utilized a computer for real-time experimental control and assessment of subjects at critical points during bargaining situations, in an investigation designed to study bargaining and negotiation behaviour, especially the dynamic

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1. In addition to Borah's criticism, the Deutsch-Krauss experiments have been challenged by several authors, (e.g. Borah 1963; Kelley, 1965; Gallo and McClintock, 1965), who have pointed out various difficulties surrounding the Deutsch-Krauss results with respect to threat.

   In devising a new test of the threat-efficiency relationships, Froman and Cohen (1969) attempted to avoid, as far as possible, the pitfalls pointed out by these authors. However their bargaining game (similar to the type used by Siegel and Fouraker, 1960) still produced data which strongly supported the proposition of Deutsch and Krauss, that the availability of threat reduces bargaining efficiency.

interaction process that takes place in mixed-motive (non-zero-sum) bargaining situations. The project goal was to develop a general computer-based experimental vehicle which would provide unique opportunities to study bargaining and negotiation behaviour and to relate it to social-psychological factors, (for example, threat, trust, cooperation, status, power), personality variables, and game strategic characteristics and tactical moves. Apart from the result already mentioned, Meeker et al found that a significantly lower mean joint payoff was earned by those pairs who used the threat bilaterally than by those pairs where one or both subjects avoided the use of threat; and that this appeared to be primarily related to the pairing of subjects with pregame cooperative dispositions.

> "Rather than spiralling hostilities, a posture of firmness and determination expressed in a consistent and rapid response to threat with counter-threat may contain a belligerent player. Lack of resolution, as expressed in delay and oscillations in employment of counter-threat to an aggressor, may significantly increase the likelihood of escalation of conflict." (page 123).

Gallo (1966) has investigated the effects of increased incentives upon the use of threat in bargaining while Shubik (1963) has outlined some of the important theoretical issues involved. Scodel, Minas, Ratoosh, and Lipetz (1959) and Minas et al (1960) examined bargaining behaviour in a two-person game under varying communication conditions, payoff values, and opponent strategies, while work of a similar nature has been carried out by Daniels (1967). Deutsch (1958, 1960) and Loomis (1959) related bargaining behaviour to the variables of trust and suspicion; while Solomon (1960) and Komorita, Sheposh, and Brauer (1968) have investigated the influence of power relationships and the use of power on bargaining strategies.

Generally the focus in the majority of these studies has been on the degree to which a person will cooperate with or exploit an opponent under varying stimulus conditions, and in general these investigations seem to indicate that unless cooperative strategies

are fostered through special experimental instructions or inter-subject communication, subjects will choose to compete with one another and will play in such a way as to maximize the difference between their own and their partner's payoffs.

Following the recent trend toward viewing economic bargaining as a form of social interaction, it has been only natural to seek personality and attitudinal correlates of bargaining behaviour, and such work has been attempted by a number of investigators. Using a two-person game of the Prisoner's Dilemma type, Deutsch (1960) reported that authoritarians (as measured by the F-scale) tended to be less trusting of the other player and to make more uncooperative choices. Marlowe (1963) found that passive-dependent persons were disposed to respond to unconditionally cooperative behaviour with cooperation on their own part. Lutzker (1960) reported that internationally oriented subjects as compared with isolationists were more cooperative in a two-person game, and this finding has been confirmed by McClintock, Harrison, Strand and Gallo (1963). Oskamp and Perlman (1965) found no consistent relationship between cooperation and friendship, and a similar finding was reported by Marlowe and Strickland (1964) in an unpublished paper. In a further study Oskamp and Perlman (1966, page 226) found the level of cooperation in a mixed motive game to be a complex phenomenon which was sensitive to a number of situational influences. Their results showed that under some circumstances friendship may lead to high cooperation and disliking to low cooperation, but under other circumstances very close friendship may allow a strongly competitive rivalry to develop.

Marlowe, Gergen, and Doob (1966), seeking to continue and broaden the emphasis in the social aspects of the bargaining situation by concentrating on two variables basic to most social relationships (opponent's personality, and expectation of future interaction), found that when no personal information regarding the

other player was available, and this other played a predominately cooperative game, there was a greater tendency to exploit this other when not expecting a later confrontation. However, when personal information was available regarding the other, the role of the confrontation variable (expectation of future interaction) was reversed :

> "Specifically, when the other person is perceived to be egotistical and self-centred, he is more likely to be exploited when future interaction is anticipated than when it is not." (Marlowe et al, 1963, page 211).

Another personality variable that may be related to game-playing behaviour is the measure of "flexible ethicality" developed by Bixenstine, Potash, and Wilson (1963). This scale measures the extent to which an ethical hero is approved on reasonably workable grounds (N) or on the basis of rigid and unreasoning obedience to ethical values (F). The actual measure is N minus F. Bixenstine et al (1963) found that subjects high in (N - F) made significantly more cooperative choices than those who scored medium or low in this measure. In a follow-up study (Bixenstine and Wilson, 1963) the relationship of this variable to behaviour reached only the 0.10 level of significance, while a still later study by Bixenstine, Chambers, and Wilson (1964) failed to demonstrate any relationship between this variable and behaviour. It is to be noted however that the latter two studies were quite complex and that the second used an assymetric game.

In a previous study (Mack, 1967) I have already shown that personality factors operate in the extreme Prisoner's Dilemma. The reinterated prisoner's dilemma game was played (in true form) for 300 trials by three groups of subjects, each containing 12 single-sexed pairs: a group of high-dominance pairs, another of low-dominance pairs, and the third of mixed pairs. It was found that high dominance pairs, but not low-dominance pairs, locked-in sooner than mixed pairs; and that they had a larger proportion of competitive responses and of locks-in on the competitive choice than either mixed-dominance or

low-dominance pairs. Sermat (1968) has also investigated the effect of dominance-submissiveness (as measured by the M.M.P.I. Dominance Scale) on competition in a mixed-motive game. He concluded that the personality characteristics of the subject and those of his partner may interact to influence the subject's game stratety.

On the results of an earlier study of 3-person games, Rapoport, Chammah, Dwyer, and Gyr (1962) commented that :

> "The more subjects one runs with the Prisoner's Dilemma type game, the more one becomes aware that personality factors have much to do with the subject's behaviour ... . In general we are led to suspect that individuals have cooperative or non-cooperative patterns of behaviour that might be related to measurable personality patterns."

This suspicion is the subject matter of the investigation reported in the following chapters.

SECTION TWO : AN ACCOUNT OF THE INVESTIGATION UNDERTAKEN

CHAPTER EIGHT : THE EXPERIMENTAL BARGAINING GAME.

Despite the fact that findings relating personality to behaviour in experimental bargaining situations are relatively few in number, there remains a substantial body of consistent evidence indicating that reliable differences in behaviour in such situations are associated with the personalities of the players involved.

The present investigation was initiated to investigate this finding on as broad a front as possible, attempting to relate personality factors to bargaining behaviour in a simple experimental game situation.

The Two-Person Bargaining Game

The validity of gaming as a research technique in psychology has, as already stated, often been attacked in the past, not only by psychologists, but also by economists. Among the most persistent of their criticisms of the theory's application is that the game has little or no bearing on reality, and, as an entirely artificial situation, can only produce misleading results. Their argument is usually based on three main factors : firstly that the atmosphere attempted by the experimental situation requires a great deal more imagination than the subject can provide - that is, that the subject is generally unable to play adequately the role the experimenter requires of him; secondly, that the experimental situation is unreal in the sense that it generally remains constant for the duration of the game, whereas in real life, the situation is constantly changing - less demand for goods, increased rates of interest for loans, and so on; thirdly, that the amount of information available regarding the other player is also unreal. (In experimental gaming the subject has normally either complete knowledge of the other's payoffs, or no information at all. Critics contend that both these situations are unreal). Given these constraints on the

experimental situation in addition to those required for bargaining[1], it can be seen that the development of a satisfactory bargaining game is in itself difficult.

The game employed in the present investigation is a variation of the Deutsch and Krauss Trucking Game devised by Morton Deutsch (1960) in corroboration with R.M.Krauss. Deutsch and Krauss devised an ingenious two-person experimental game which answered at least some of the earlier objections to the use of game situations in bargaining simulation, and which has been used in numerous experimental bargaining studies since, (for example, Borah, 1963; Shomer, Davis, and Kelley, 1966; Krauss and Deutsch, 1966). In this game, subjects were asked to imagine themselves to be in charge of a trucking (road haulage) company, carrying merchandise over a road to a destination. For each trip completed they made 60 cents, minus their operating expenses which were calculated at the rate of 1 cent per second. So, for example, if it took 20 seconds to complete a particular trip, the player's profit was (60 - 20) cents - a net profit of 40 cents. Each subject was assigned a name, ACME or BOLT. As the 'road map' indicates (See FIGURE 1), both players start from separate points and go to different destinations. For part of the way, however, they have a common route. This is the section of road labelled "one lane road", which is only one lane wide so that two trucks, heading in opposite directions, could not pass each other. If one moves back, the other can move forward, or both can move back, or both can remain in position, blocking the road. There is another

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1. "The essential features of a bargaining situation exist when:
   1. Both parties perceive that there is the possibility of reaching an agreement in which each party would be better off, or no worse off, than if no agreement were reached.
   2. Both parties perceive that there is more than one such agreement that could be reached.
   3. Both parties perceive each other to have conflicting preferences or opposed interests with regard to the different agreements that might be reached."
   (Deutsch and Krauss, 1960, page 181).

way for each subject to reach the destination on the map - the "alternative route". The paths of the players do not cross on this route. Subjects are told that they can expect to lose at least 10 cents each time they use the alternate route.

The Deutsch and Krauss study was concerned with the effect of threat on interpersonal bargaining[1], and to provide the threat potential, a system of gates was introduced into the basic situation outlined above. At either end of the one-lane section of road, was a gate under the control of the player to whose starting point it was nearer. By closing the gate, one player could prevent the other from travelling over that section of the main route.

In the present game however, a game matrix was presented in place of a road map. The idea of presenting the bargaining situation in terms of a 3 x 3 matrix came initially from the work of Walton and McKersie (1966), but more specifically from that of Gallo (1966). Walton and McKersie were interested in developing more correspondence between the characteristics of real-world mixed-motive situations and the game structures which were treated as their analogues. In order to find an appropriate abstraction of the dilemmas created by such real-world conflict situations, they investigated behaviour in several on-going social settings. Their tentative answer to the problem was in the form of a game matrix.

Gallo (1966), also interested in the effects of threat on bargaining in experimental situations, in a logical analysis of the structure of the Deutsch and Krauss Trucking Game, indicated that in the no-threat condition, (described on pages 75 - 76 of this thesis), players are actually faced with only three basic decisions : at any given time the player must decide either to go down or stay on the short one-lane route; to wait at the start or back up to the start on the one-lane route so that the other player's truck can go first; or to take the alternative route to the goal. Thus, by this analysis

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1. The findings of this study have been discussed elsewhere in the present thesis.

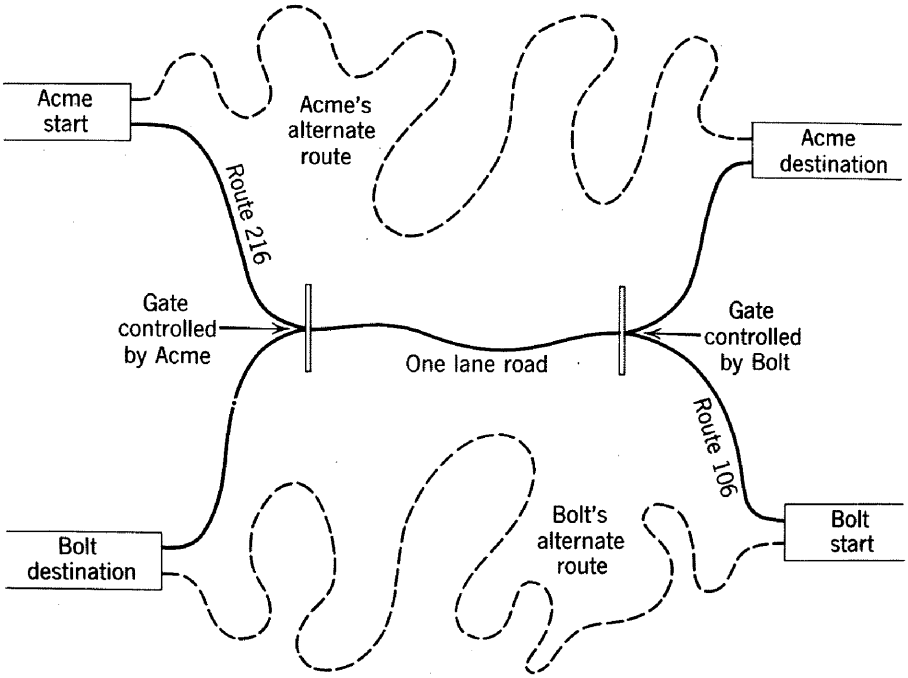

FIGURE 1. Subject's road map.

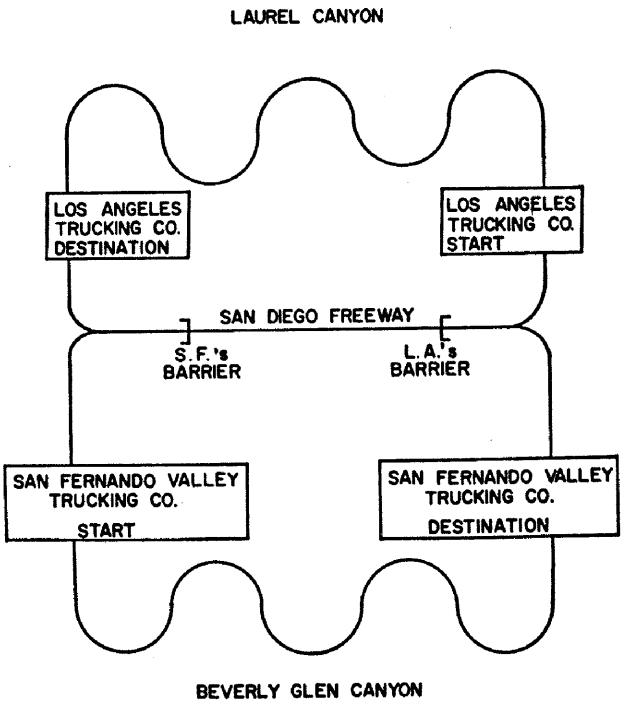

FIG. 2. The road map used in the game.

the game can be represented by a 3 X 3 matrix. The game actually used by Gallo incorporated such a game matrix (See MATRIX 7), used in conjunction with a road map which had been suitably amended to identify with the locality (Southern California), (See FIGURE 2).

		SAN FERNANDO VALLEY TRUCKING CO.		
		Freeway	Wait	Canyon
LOS ANGELES TRUCKING CO.	Freeway	Trucks blocking one another. Choose again.	Both reached destination.	Both reached destination.
	Wait	Both reached destination.	Trucks both waited, then moved out at same time. Are blocking one another. Choose again.	Both reached destination.
	Canyon	Both reached destination.	Both reached destination.	Both reached destination.

MATRIX 7.

Every attempt was made by Gallo to keep the behavioural alternatives identical to those available in the original game. However the fact that the two games are logically equivalent does not automatically ensure that they will be actually equivalent in terms of motives and behaviours produced, since game-playing behaviour can be influenced by such non-logical factors as mode of presentation, timing, etc. Gallo therefore undertook a pilot study to determine whether the new procedure would replicate the earlier results of Deutsch and Krauss. He found that his results indicated

> "a pattern of play that was in close correspondence to that obtained by Deutsch and Krauss."

The behavioural alternatives having been kept identical to those available in the original game, Gallo decided that the revised game was "a suitable vehicle to use." (1966, page 16).

In the present investigation the road map is omitted and the game matrix is presented alone. In addition, the game's "background atmosphere" is moved from road haulage to rail transport. In this new version of the game, each subject is asked to play the role of owner of a manufacturing company. The companies have each gained a contract to deliver its goods to a buyer in the south of England. Profits on the contract depend entirely on how quickly the goods are delivered - the quicker the delivery, the higher the profits. Only two suitable ways of transporting the goods are available : by Freightliner, which is a fast, efficient container service; and by normal Goods Train which is slower and less reliable. While it is thus to the financial advantage of both companies to send their goods by Freightliner wherever possible, there are, however, not enough containers available to convey both companies' goods by Freightliner at the same time. Should both companies attempt to send their goods by Freightliner at the same time, then, because there are not enough containers available, a blockage will occur.

This blockage will inevitably mean a delay will ensue, and since profits depend on speed of delibery, the blockage will mean a lowering in potential profit. Each company may thus opt for the third choice - to wait and allow the other company to consign its goods by Freightliner first, before sending its own. This choice means that the company making it will gain an intermediate amount of profit (less than when goods are sent directly by Freightliner, but greater than when they are consigned by Goods Train). Should both companies decide to wait, however, a delay will also occur and again profits will be lowered. The general matrix is given below (MATRIX 8) :

		Player 'B'		
		FREIGHT LINER	WAIT	GOODS TRAIN
Player 'A'	FREIGHT LINER	Not enough containers - CHOOSE AGAIN	Goods delivered	Goods delivered
	WAIT	Goods delivered	Delay and blockage - CHOOSE AGAIN	Goods delivered
	GOODS TRAIN	Goods delivered	Goods delivered	Goods delivered

MATRIX 8.

When a blockage occurs, the players are required to make a further attempt at sending their goods, when the payoffs will be lower (because of the supposed delay in delivery caused by the blockage). This further attempt is presented in a second matrix which shows the new decreased payoffs. In keeping with Gallo's experimental design, six attempts (choices) are permitted per batch of goods. Six matrices are thus required, each successive matrix having a

smaller payoff than its predecessor. If at the end of six choices the players have not reached agreement (that is, they continue to block one another) then the trial is terminated and each player suffers a considerable loss. Since the present experiment is not specifically concerned with the role of threat in bargaining, the gates and barriers used by earlier experimenters have been omitted from the experimental situation. The actual payoff values available to each player on each attempted delivery are given in TABLE 1 :

ATTEMPT NO.	PAYOFFS		
	FREIGHTLINER	WAIT	GOODS TRAIN
1	20	15	10
2	15	10	5
3	10	5	0
4	5	0	-5
5	0	-5	-10
6	-5	-10	-15
PENALTY FOR BLOCKING ON THE SIXTH ATTEMPT : - 25			

TABLE 1.

The matrix layout for the first attempt on each trial of this game was thus as follows (See MATRIX 9) :

		Player 'B'		
		FREIGHT LINER	WAIT	GOODS TRAIN
Player 'A'	FREIGHT LINER	Not enough containers - CHOOSE AGAIN	20, 15	20, 10
	WAIT	15, 20	Delay and blockage - CHOOSE AGAIN	15, 10
	GOODS TRAIN	10, 20	10, 15	10, 10

MATRIX 9.

This presentation, allowing each subject complete information as to his own and the other player's payoffs, is the one normally used in experimental bargaining games. Where this is not the case, one often finds that the game is played with a complete lack of information about the other player's payoffs. The present investigation disregarded this latter course, and instead manipulated the payoff matrices of the game just described in such a way as to create a game of imperfect information with respect to the payoffs of the other. This new game (which we shall call "GAME II") is played under the same rules as that previously described (which we shall call "GAME I") but under the new system the payoffs accrueing to Player 'B' are uncertain to Player 'A', and vice-versa. The present author feels that this situation of imperfect information regarding the other's payoffs approximates more closely to real-life

than do those situations which incorporate complete information, or complete lack of such information.

In real-life situations it is generally reasonable to suppose that one company can estimate approximately the probable profit of another in the same line of business on a given contract. However, it is unrealistic to suppose that the company can estimate this profit exactly (as is inferred from the presentation of the payoff matrices normally used). It is much more reasonable to assume that this estimation will be only approximate. That is, it seems much more likely that while a company can roughly estimate another's profits on the basis of the company's own experience in the market, it is unlikely that a company will be able to say whether the other will make more or less profit than the company itself would make on the same contract - simply because the exact figures (production costs, overheads, etc) of the other company are unavailable.

In GAME II then, the subject is given some idea of the other's payoffs, but he does not know what they are and cannot establish them definitely. While in actual play the payoffs to both subjects are in fact exactly equal (as in GAME I), the subjects are given imperfect information as to the payoffs of the other by introducing into each matrix cell three possible payoffs for the other player, one payoff being equivalent to what the subject himself would receive given that he made the same choice; a second payoff being larger than the player's own possible payoff on the same choice; and a third payoff being smaller than that which the player himself would receive on the same choice.

The payoffs possible to the other player on each attempted delivery (as presented to each player in the game) are

given in TABLE 2 :

ATTEMPT NO.	POSSIBLE PAYOFFS TO OTHER		
	FREIGHTLINER	WAIT	GOODS TRAIN
1	25 or 20 or 15	20 or 15 or 10	15 or 10 or 5
2	20 or 15 or 10	15 or 10 or 5	10 or 5 or 0
3	15 or 10 or 5	10 or 5 or 0	5 or 0 or -5
4	10 or 5 or 0	5 or 0 or -5	0 or -5 or-10
5	5 or 0 or -5	0 or -5 or-10	-5 or-10 or-15
6	0 or -5 or-10	-5 or-10 or-15	-10 or-15 or-20
PENALTY FOR BLOCKING ON THE SIXTH ATTEMPT : -25			

TABLE 2.

The matrix layout presented to Player 'A' for the first attempt on each trial of GAME II was thus as follows (MATRIX 10) :

		Player 'B'		
		FREIGHT LINER	WAIT	GOODS TRAIN
Player 'A'	FREIGHT LINER	Not enough containers - CHOOSE AGAIN	20, 20 / 15 / 10	20, 15 / 10 / 5
	WAIT	15, 25 / 20 / 15	Delay and blockage - CHOOSE AGAIN	15, 15 / 10 / 5
	GOODS TRAIN	10, 25 / 20 / 15	10, 20 / 15 / 10	10, 15 / 10 / 5

MATRIX 10.

The equivalent matrix for presentation to Player 'B' is as shown in MATRIX 11 :

		Player 'B'		
		FREIGHT LINER	WAIT	GOODS TRAIN
Player 'A'	FREIGHT LINER	Not enough containers - CHOOSE AGAIN	25 20, 15 15	25 20, 10 15
	WAIT	20 15, 20 10	Delay and blockage - CHOOSE AGAIN	20 15, 10 10
	GOODS TRAIN	15 10, 20 5	15 10, 15 5	15 10, 10 5

MATRIX 11.

CHAPTER NINE : THE PERSONALITY TEST BATTERY

The making up of the test battery proved difficult, though the task was made somewhat easier when several criteria of suitability were imposed: firstly, a large number of subjects was required by the experimental design. This made individual testing impracticable and group test administration was thus considered a first essential. This ruled out any use of the M.M.P.I. (Individual Form) and all the other obvious Individual Tests. Secondly, tests which required interpretation in scoring were considered unsuitable, since scorer's inexperience could lead to mistakes, or, equally inadmissable, scorer's prior acquaintance of a subject might lead to a "halo" (or other) effect. (The new University of Stirling in 1967-1968 had only 165 enrolled students, and only a total of 283 in 1968-1969. Acquaintance with a number of subjects was therefore inevitable). Factors such as these meant that the use of tests like the Thematic Apperception Test, Rosensweig Picture Frustration Study, or the Rorschach Inkblot Test were undesirable for the purposes of the present investigation. Accordingly a short-list of possible (and available) tests for battery use was compiled as follows :

i) Bernreuter Personality Inventory,
ii) Cattell's Sixteen Personality Factor Test,
iii) Edwards Personal Preference Schedule,
iv) Guilford/Zimmerman Temperament Survey,
v) M.M.P.I. (Group Form),
vi) Minnesota Personality Scale,
vii) Study of Value Test,
viii) Test of Social Insight.

From this list, on the bases of usefulness, administration time, and availability, the Bernreuter Personality Inventory, the M.M.P.I., and the Minnesota Personality Scale were omitted. The Bernreuter test was omitted on several grounds : it has a cumbersome scoring system, and reviewers have been consistently sceptical about its value. Veldman (1965) described it as representative of another era in test construction. Considering that the normative data provided with the manual are dated 1938 and that

the most recent attempt at scale revision included in the manual is a 1935 factor analysis of the form scales, it is not surprising that Veldman considered the inventory as "no more than a landmark" in the development of personality assessment techniques. Tyler (1953) pointed out that scores can be easily faked by intentional bias on the part of the respondent, and this view is reinforced by the findings of Wesman (1952), Shaw (1962), and many others. Becker (1965) found all these to be grounds for criticism of the test, "besides its failure to do anything well enough to justify its existence." (page 345).

The M.M.P.I. was omitted from the test battery both on the grounds of administration time[1], and on the basis of its inadequacy as a general test of personality, (Lingoes, 1965; Benton, 1949). As Adcock (1965, page 313-314) has explained,

> "(The M.M.P.I.) does not pretend to provide basic personality dimensions but to predict the currently accepted psychiatric categories. These may be basic in their own right but this is beside the point ..... Because the test is one of the few multi-dimensional tests, some people have thought of it as a useful test for a general survey of personality. For this it was not designed. It may draw attention to possibly disabling degrees of mental disorder and indicate the form of such disorder, but whether the pattern of disorder tendencies has any significance when none of the scores falls outside the normal range is another matter altogether."

Of the six remaining tests, the Minnesota Personality Scale was omitted on account of its length, the administration time involved, and the fact that a more comprehensive test of general

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1. Although "untimed", the test commonly takes well over one hour to complete. Eysenck (1949) has cited cases where administration time was a much as five hours.

personality (the Cattell Sixteen P.F. Questionnaire) remained for use in the test battery. In addition, the test was not readily available to the author. Thus the five remaining tests, which together made up the test battery used in the present investigation, were the Sixteen Personality Factor Questionnaire, the Guilford/Zimmerman Temperament Survey, the Test of Social Insight, the Edwards Personal Preference Schedule, and the Study of Values Test. A brief description of each test is given below.

The Sixteen Personality Factor Questionnaire.

The 16 P.F. Questionnaire is, according to the manual, the psychologist's answer, in the questionnaire realm, to the demand for a test giving fullest information in the shortest time about most personality traits. Being not merely concerned with some narrow concept of neuroticism or 'adjustment', or some special kind of ability, it sets out to cover planfully and precisely all the main dimensions along which people can differ, according to basic factor analytic research. The test covers 15 personality factors: reserved v. outgoing (A); affected by feelings v. emotionally stable (C); humble v. assertive (E); sober v. happy-go-lucky (F); expedient v. conscientious (G); shy v. venturesome (H); tough-minded v. tender-minded (I); trusting v. suspicious (L); practical v. imaginative (M); forthright v. shrewd (N); placid v. apprehensive (O); conservative v. experimenting (Q1); group-dependent v. self-sufficient (Q2); casual v. controlled (Q3); relaxed v. tense (Q4); and also purports to give a measure of Intelligence (B).

Despite the fact that Harsh (1953) found it unlikely that the 16 P.F. could give an assessment of personality much superior to that of other multi-factor paper tests, and Lubin (1953) reported it as having no known validated use, it has been generally well received. Wittenborn (1953), recognizing the test's limitations, concluded that the questionnaire as it stood was not a finished tool,

yet represented a very worthwhile and ambitious beginning. Since then the test has been revised and extended to three forms and an ever-increasing wealth of data about the predictive significance of its scores has become available. Keeping this in mind, and given the fact that the test is not unweildy, and is easy to administer and score, Adcock (1959) predicted that the 16 P.F. was likely to become the standard questionnaire-type personality test of the future. And Lorr (1965) grudgingly admitted it to be "the best factor-based personality inventory available" (page 368), declaring it to be "still primarily a research instrument."

The Guilford/Zimmerman Temperament Survey

The stated purpose of this survey was to combine the findings of the Guilford series of personality inventories[1] into a single battery and thus obtain scores on 10 personality traits from the administration of a single booklet.

The traits are : general activity (G), restraint (R), ascendance (A), sociability (S), emotional stability (E), objectivity (O), friendliness (F), thoughtfulness (T), personal relations (P), and masculinity (M). The reliability with which each of the traits is assessed is shown to be of the order 0.80; and their intercorrelations are, as the authors say, "gratifyingly low", the implication being that all are approximately orthogonal in factor terms, (that is, that 'unique traits' are involved).

The test has met with some degree of indifference. For example, Saunders (1959), while admitting that

> "it seems fair to say that studies using this survey have done much to demonstrate the potential advantages of the factor-analytic approach to personality measurement",

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1. The Nebraska Personality Inventory (SEM), the Guilford-Martin Inventory of Factors GAMIN, the Guilford-Martin Personnel Inventory (O Ag Co), and the Inventory of Factors STDCR.

found the instrument itself to be "neither fish nor fowl" so far as practical applications were concerned. Nevertheless, the test has overall been well received since its inception. Schaffer (1950) commented that as the outstanding omnibus instrument based primarily on factor analysis, the survey would be useful for screening, rapid evaluation, and research.

Stephenson (1953) found the survey, its data, and supporting norms to be adequate, thorough, and factually orientated, and concluded that for the purposes for which such inventories were used it was probably better than most; while Van Steenberg (1953), reviewing the Survey found it to give (page 97) :

> "a very favourable impression of a well rounded, carefully worked out method of evaluating an important portion of the total personality. It is easy to administer and to score, and if interpretation of the obtained measures is difficult, it is a function of the complexity of personalities rather than a function of the survey."

The Study of Values Test.

The Study of Values Test aims to measure the relative importance of six basic interests or motives in personality : the theoretical, economic, aesthetic, social, political, and religious. The classification is based directly upon Spranger's "Types of Men" (1925), a work which defends the view that the personalities of men are best known through a study of their values or evaluative attitudes.

Despite the fact that Spranger may be said to have held a somewhat flattering view of human nature in that he did not allow for formless or valueless personalities, nor for those who follow an expedient or hedonistic philosophy of life, the Study of Values Test, originally published in 1931, has been widely accepted as being of value. Meehl (1949), reviewing the test, reported that

> "Considering its a priori method of construction, the problematic validity of its theoretical foundation (Spranger's types), and the relatively small number (45) of items which are used to measure six value dimensions, this seems to be a remarkably good test ..... with suitable caution as to its use with the less educated, and as to the intrustworthiness of the social value score, this test can be recommended as one of the few structured personality devices having considerable value." (page 200).

In 1951 the test was revised, increasing the diagnostic power of the items, simplifying the wording and eliminating outdated and over-specific cultural references. In addition the scoring system was revised and shortened, fresh norms were provided, and the reliability of the test as a whole was increased. The most important improvement, however, was in the redefinition of the social value. The old social value, which had proved unreliable because of adherence to Spranger's excessively broad definition, was now redefined in terms of altruistic or philanthropic interest. This edition too was well received. Gough (1953) found it to be a "dependable and informative instrument", possessing "considerable merit and utility"; Schaffer (1951) described it as an "excellent new revision"; and Gage (1959), looking ahead to the 1960 revision, concluded that "for research on a wide variety of psychological questions, the test is already very good."

The 1960 edition made no further changes in the test items, but presented improved norms. Thus, although Spranger's value types have what Radcliffe (1965a) called an"armchair" rather than an "empirical" basis, and despite the fact that in some cases the test may fail to distinguish between value and interest, the Study of Values Test has remained a useful research instrument.

In 1965 yet another edition, standardized for use with a British population, was formulated, and this latest (British) edition has been employed in the present investigation. Since some of the original items were not appropriate for people living in this country, the British Edition uses a new set of items, though the general plan of the original test is followed as closely as possible.

The Test of Social Insight.

The Test of Social Insight, developed by R.N.Cassel in 1959, purports to appraise the characteristic mode of reaction the individual uses in resolving typical adult interpersonal (social) problems. A basic assumption underlying the test is that "social insight" is related to intelligence (primarily through the ego function), and to personality (through cognitive and emotional activity). The test consists of 60 multiple-choice items, each having five alternatives. Each alternative offers one of the following modes of resolution of the problem expressed in the item; withdrawal, passivity, cooperation, competition, aggression. The characteristic pattern of the individual is determined from the frequency of modes of solution chosen.

The test has not, however, enjoyed the popularity associated with the other tests included in the present test battery. Reviewers have generally been critical, (Black, 1965; and Pierce-Jones, 1965; in particular), but even Black had to admit that the items were well written and ingenious, and that the subscales represented appropriate categorizations of response tendencies in human interactions. Pierce-Jones, despite his criticisms and misgivings about the test's reliability concluded that it was a promising effort to measure variables of obvious interest and importance to research psychologists.

Despite the many criticisms of reviewers and the present author's own reservations regarding the test's validity and reliability, the test was incorporated in the experimental test battery since the whole project was basically one concerned with interpersonal behaviour and the scales of the Test of Social Insight are claimed to appraise the mode of reaction the individual uses in resolving such interpersonal problems.

The Edwards Personal Preference Schedule.

The manual of this test states that it was designed primarily as an instrument for research and counselling purposes, to provide quick and convenient measures of a number of relatively independent normal personality variables.

The items in the EPPS and the variables that these items measure have their origin in H.A. Murray's list of "Manifest Needs" (1938); and the names assigned to the variables are those used by Murray. In addition to providing a measure of test consistency, the EPPS provides measures of 15 personality variables : achievement (ach), deference (def), order (ord), exhibition (exh), autonomy (aut), affiliation (aff), intraception (int), succorance (suc), dominance (dom), abasement (aba), nurturance (nur), change (chg), endurance (end), heterosexuality (het), and aggression (agg).

Many inventories have the drawback that subjects tend to endorse desirable and reject undesirable items. The EPPS has attempted to minimize this influence by means of a specific kind of forced choice. Each item of the test consists of two statements. The subject is forced to choose in each pair of statements the one which is most characteristic of himself. The two statements in each pair represent different personality variables, but they have at the same time a comparable degree of social desirability. While such an arrangement constitutes "a technically optimal practice" (Fiske, 1959), the forced-choice format does carry with it certain disadvantages : the resultant scores are slightly interdependent, tending to have small negative intercorrelations because the sum of the 15 scores is a fixed quantity. This is a slight disadvantage for those who wish to use the several scales separately. Another consequence of the forced-choice technique is the narrow range of content involved in the assessment of each variable. (In the test nine statements are utilized for each variable, most of the statements being used three times). The manual (and hence the test itself) has been criticized

for lack of validating evidence by Gustad (1956), Bordin (1959), Strickler (1965), Radcliffe (1965b) and others. Nevertheless the schedule has the advantage of being based on a more sophisticated theoretical formulation than most inventories, and the fact that it has been carefully constructed to minimize the natural tendency of examinees to choose face-saving or socially desirable responses makes it "an ingenious and novel instrument for personality assessment." (Schaffer, 1955, page 156).

The selection of tests for inclusion in the test battery, as can be seen, was not an easy task. The number of points for consideration in the selection (viz: the factors measured, administration time, reliability, validity, availability, and so on), meant that some sort of compromise on one or more of these had to be reached in respect of each test. Despite such compromises and the best possible effort being made, the resulting test battery leaves much to be desired. Discounting any faults inherent in the individual tests, the battery considered as a whole is unweildy in a practical sense. Taken together, the five tests constitute 817 items, rendering scores on 54 variables, and taking an average of 3½ to 4 hours administration time per subject. Several of the scales are duplicated (for example, there are three measures of dominance, two of aggression, two of emotional stability, and several dealing with sociability and personal relations), and the information gleaned by many of the remainder can only be redundant as far as the present investigation is concerned. That a test battery specifically oriented towards use in experimental bargaining studies is needed is obvious. However, since such a manufacture would in itself require considerable research, the present author has had to be content with the battery as constituted above.[1]

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1. A Personality/Attitude Schedule specifically designed to assess the role of personality and attitudinal differences in bargaining behaviour has been developed (by Shure and Meeker, 1967). Its use was precluded in the current study, however, since many of the items were applicable only to an American population, and, in any case, publication of the test came after the present investigation had been initiated.

CHAPTER TEN : THE EXPERIMENT

Hypotheses

The aims of the investigation were threefold: to investigate the effects of amount of information available about the payoffs of the other on players' behaviour in the game; to investigate the effects of sex on game-playing behaviour; and to investigate the effects of personality on behaviour in the game.

A. Information of the other's payoffs.

With regard to the degree of information about the other subject's payoffs, we must ask whether or not differences are to be expected between behaviour in GAME I and behaviour in GAME II. Since the experimental situation in both games requires subjects to maximize only their own payoffs, and this point is stressed in the instructions given to both subjects; and since, in addition, a total of six prizes are offered to those who make most profit, there is no game-theoretic reason to suppose that any reference to the other player's payoffs would be taken into account by subjects in the game, regardless of whether this information was complete (as in GAME I) or imperfect (as in GAME II). However, it can be argued that the additional uncertainty found in GAME II because of imperfect information of the other's payoffs, might well have an effect on behaviour and that differences in behaviour in GAME I and GAME II should be expected as a result.

As has already been noted, almost all experimental studies of gaming have ignored the possible effect of the amount of information about each other's payoffs on the decisions of the players. However, there have been a few exceptions. Shubik (1962) stressed the importance of the information variable, but did not attempt to manipulate it experimentally. Siegel and Fouraker (1960), who did manipulate the information variable, ran a study of bilateral monopoly which confirmed the hypothesis that deviations from the Paretian optima[1] are minimized as the amount of information about the payoff

1. The set of prices which includes the best profit position of both parties and from which it is impossible to move without worsening the profit position of at least one of the parties.

matrices available to the bargainers is maximized. Swensson (1967), attempting to duplicate Siegel and Fouraker's situation using a prisoner's dilemma game in which players were given assymetric information about each other's payoffs, reached inconclusive results. Messick and Thorngate (1967) on the other hand, showed that subjects playing a two-person non-zero-sum game do more poorly (in terms of their own gain) when they have knowledge of the other's payoffs than when they only know their own payoffs; and their results are reinforced by Amnon Rapoport's (1969) finding that as the amount of information possessed about the payoffs of the other player decreased, the percentage of cooperative choices increased, as did the difference in gain within dyads.

On the basis of these empirical findings then it might be expected that the degree of information available about the other's payoffs would cause differential behaviour in the game situation. The following hypothesis was thus formulated :

1. Where only partial information regarding the other's payoffs is available to players in the game, more cooperative behaviour will occur than when there is complete information.

B. Sex differences in game-playing behaviour.

The results of Vinacke (1959), Bond and Vinacke (1961), and Uesugi and Vinacke (1963) have all pointed to sex differences with respect to competitive spirit (men being more competitive than women). While several experimenters, such as Lutzker (1961) and Sampson and Kardush (1965) have found no sex differences in behaviour in game situations, sex differences have been found by others. Rapoport and Chammah (1965b) in an experiment involving 300 plays of the Prisoner's Dilemma reported large differences in behaviour between male and female pairs, the principal difference here being in the considerably greater overall frequency of cooperative choices by men. In a previous paper, (Mack, 1967), the present author has also reported sex differences in game-playing behaviour, ascendant females being more competitive than ascendant males. In view of these reports,

a second hypothesis related to sex differences in game-playing behaviour was postulated with respect to the present investigation :

2. Male subjects and female subjects will behave differentially in the game situation.

C. Effects of Personality on game behaviour.

Since the investigation was initiated on a broad front, no hypotheses regarding specific personality measures were postulated. On the basis of the literature reviewed, however, general hypotheses regarding behaviour in the two-person bargaining game were formulated as follows :

3. The first strategy choice on the first run of the game will be dependent on the personalities of the players involved, as measured by the personality test battery.

Regarding the effects of personality on behaviour in the remainder of the game, three possibilities exist: that the effects of personality will increase as the game continues; that the effects will decrease; or that they will remain constant.

The argument in favour of an increasing effect of personality on behaviour as the game proceeds is based on the assumption that while personality traits may occasionally be so marked in an individual as to affect behaviour when it occurs in isolation, (as, for example, on the first strategy-choice point in the bargaining game - see Hypothesis 3, above), they are rarely so grossly manifest, and generally remain 'hidden' until some sort of interaction takes place. Given that personality characteristics do operate in this way and become manifest only with the advent of extended interaction, in the present ex perimental situation, while the interaction is admittedly minimal, we might indeed nevertheless expect these personality characteristics to develop and the effects of personality to increase as the game progresses.

On the other hand, however, it might be argued that, while the dominating personality traits of an individual may have an

initial effect on behaviour in the game, the minimal interaction situation, coupled with the "rational" solution provided by the game and the constraints of the game itself, would prevent the development of the underlying less dominant personality traits, and that any initial effects that personality might have on game-playing behaviour would be weakened by reinteration over a number of trials.

And it might be argued that both possibilities may occur. That is, that for a certain type of player, (say one who scores highly on the "theoretical" variable of the Study of Values Test), the effects of personality would diminish as the game continued; while for another type, (say one who scored low on the "theoretical" scale, or highly on the "social" scale), the effects of personality would increase as the game progressed. In either case we would not expect the effect of personality to remain constant throughout the game.[1]

Up to this point it has been possible in the light of published research and the literature reviewed to make directional hypotheses regarding behaviour in the game. In the present instance, however, the author could find no support in the literature either for the argument that predicts an increase, or for that which predicts a decrease in the effects of personality on behaviour in the game. Thus, since both these possibilities remain equally likely, no formal hypotheses relating the effects of personality to behaviour in the game subsequent to the first strategy choice have been formulated. However, since the whole investigation was by its nature an exploratory one, it was decided to look at behaviour over the 30 iterations of the game in search of personality effects on behaviour.

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1. Should no effect of personality be found, it is not argued that the increasing effect of some personality variables on the one hand, and the decreasing effect of some other variables on the other, have 'cancelled each other out', but rather merely that none exists.

Method

All subjects first completed the personality test battery and were then randomly assigned to the experimental groups where they were randomly paired with a member of the same sex.

Each dyad played 30 iterations of the two-person bargaining game, the object for each player being to gain as many points for himself as possible. The number of points held by each player was registered on a digital counter and adjusted after every trial.

A detailed record was kept of all the responses made by both subjects in each dyad.

In order to provide incentive for the subjects to work for, six prizes of £1 each were offered, to be given to the six subjects who amassed the greatest number of points in the experiment as a whole.

Experimental Groups

Two experimental groups were used in order to test Hypothesis 1. Each experimental group contained forty-eight pairs of subjects, twenty-four pairs being male and twenty-four pairs being female. Within these constraints subjects were assigned to the experimental groups randomly, and within each group the dyads were also assigned at random. (All subjects were listed alphabetically and then assigned to one or other of the two groups by tossing a coin. Within each group dyads were formed simply by pairing any two subjects who were available at the same time to participate in the experimental session). Since the groups were constructed by this random method, no real differences of age and personality will exist between the groups. However, because of the large number of variables involved (55), it is to be expected that, merely by chance, some differences will appear statistically significant. To demonstrate that these expected "significant" differences do occur, and to establish which particular variables are involved (so that account may be taken of the fact in any later analysis of the game), a series of t-tests were conducted by computer (See APPENDIX 1 for programme).

The results of these are given in the following tables. (In each case the figures presented are the obtained values of 't'. M and F refer to male and female subjects respectively; I and II refer to GAME I and GAME II respectively).

Age

Factor	MI v. MII	FI v. FII
Age	0.5150	1.7347

No significant differences at 0.05 level

TABLE 3

Sixteen Personality Factor Questionnaire

Factor	MI v. MII	FI v. FII
A	-1.4030	0.0000
B	-0.2506	1.3015
C	-0.4204	0.5871
E	-1.7050	-0.0444
F	-0.5261	-0.8859
G	-1.3159	1.5020
H	-1.0900	0.4126
I	-0.0294	-0.4844
L	1.1838	0.4661
M	0.1347	0.2435
N	-0.4230	1.2636
O	2.6109 *	-0.5770
Q1	-2.2300 *	-0.0359
Q2	-0.1989	-0.8295
Q3	-1.9072	1.0558
Q4	1.0646	-0.7047

* Significant at 0.05 level

TABLE 4.

Guilford/Zimmerman Temperament Survey

Factor	MI v. MII	FI v. FII
G	-1.7115	-0.8741
R	-1.6442	1.5056
A	-2.7922 **	0.1905
S	-1.3717	0.6622
E	-0.7814	0.1537
O	-1.4781	0.3517
F	-0.2101	0.6102
T	-2.1741 *	0.1506
P	-1.7226	0.3556
M	-0.4408	0.3020

** Significant at 0.01 level
* Significant at 0.05 level

TABLE 5

Study of Values Test

Factor	MI v. MII	FI v. FII
T	-1.0551	0.8425
E	1.9430	0.3951
A	0.6411	0.1125
S	0.7110	0.5259
P	0.1786	-1.2950
R	-1.7720	-0.2437

No significant differences at 0.05 level.

TABLE 6

Test of Social Insight

Factor	MI v. MII	FI v. FII
W	1.3958	0.1526
P	1.0521	1.4178
C	-1.2630	0.7874
Com	-.0.1788	-0.7772
Ag	-0.2279	-2.6322 *
Total	-0.3159	-2.0482 *

* Significant at 0.05 level

TABLE 7

Edwards Personal Preference Schedule

Factor	MI v. MII	FI v. FII
ach	-1.0926	0.5747
def	2.3080 *	1.8969
ord	1.5226	1.2762
exh	-0.1057	-0.3477
aut	-1.9751	-1.4526
aff	0.3258	1.3502
int	-0.1469	1.1148
suc	0.9097	0.1026
dom	-1.2734	-2.2452 *
aba	0.4164	0.2795
nur	0.7846	-0.1241
chg	0.0449	0.5639
end	-0.6795	1.3579
het	0.6369	-1.6950
agg	-1.2678	-2.4314 *
con	0.4572	-1.1208

* Significant at 0.05 level

TABLE 8

It can be seen from these tables that male subjects and female subjects in the two experimental groups differ "significantly" on only five and four variables respectively : (Males on the 'O' and 'Q1' factors of the Sixteen P.F. Questionnaire, and 'A' and 'T' variables of the Guilford/Zimmerman Temperament Survey, and the 'Deference' scale of the Edwards Personal Preference Schedule; Females on the 'Aggression' and 'Total' scores of the Test of Social Insight, and on the 'Dominance' and 'Aggression' scales of the Edwards Personal Preference Schedule). A table giving mean scores and standard deviations for male and female subjects on each variable measured is listed in APPENDIX 2. The computer programme for obtaining these measures constitutes APPENDIX 3.

Subjects

Ninety six male and ninety-six female undergraduate students, following courses at the University of Stirling, Scotland, took part in the investigation. Their help was enlisted by means of a letter sent to 240 randomly selected students which outlined the format of the investigation and asked for their help in carrying it out. "Reminders" were sent out one month later. As a result of these letters (See APPENDIX 4), 202 students volunteered to assist with the project (a response rate of 84.17%), and of these 192 completed all five questionnaires of the test battery and the experimental session.

Experimental Situation

The experimental sessions were conducted in the Communications Laboratory of the Department of Psychology, University of Stirling. The laboratory, specially designed for use in situations where control of communication between subjects is required, contains six cubicles with full facilities for handling up to twelve subjects at any given time. (Each cubicle accomodates two subjects).

Each cubicle is semi-soundproofed and equipped with a table and stool. The door of each cubicle accomodates a panel of

shadow-glass which allows the experimenter to observe subjects without himself being observed by them.

The general plan of the laboratory is shown in FIGURE 3.

For the present experiment only two cubicles, (Cubicle 2 and Cubicle 5) were used. In addition to the table and stool, the apparatus required for the present study (namely a microphone, a headset, a matrix-board, and a four-digit counter - all controlled from the experimenter's console), was positioned in each cubicle as shown in FIGURE 4.

The Console

The console, by means of which the experiment was conducted and controlled, is shown in FIGURE 5, and described briefly below. Essentially the console provides the experimenter with a means of communication (one-way or two-way) with all six cubicles, either simultaneously, in any combination of cubicles, or individually in isolation from one another. To facilitate these connections, four separate communication channels are provided together with a microphone and headset for the experimenter's use. In addition, to facilitate the recording of instructions and data, two four-speed, two-track tape recorders have been built into the console with provision for the use of a third recorder should circumstances demand it.

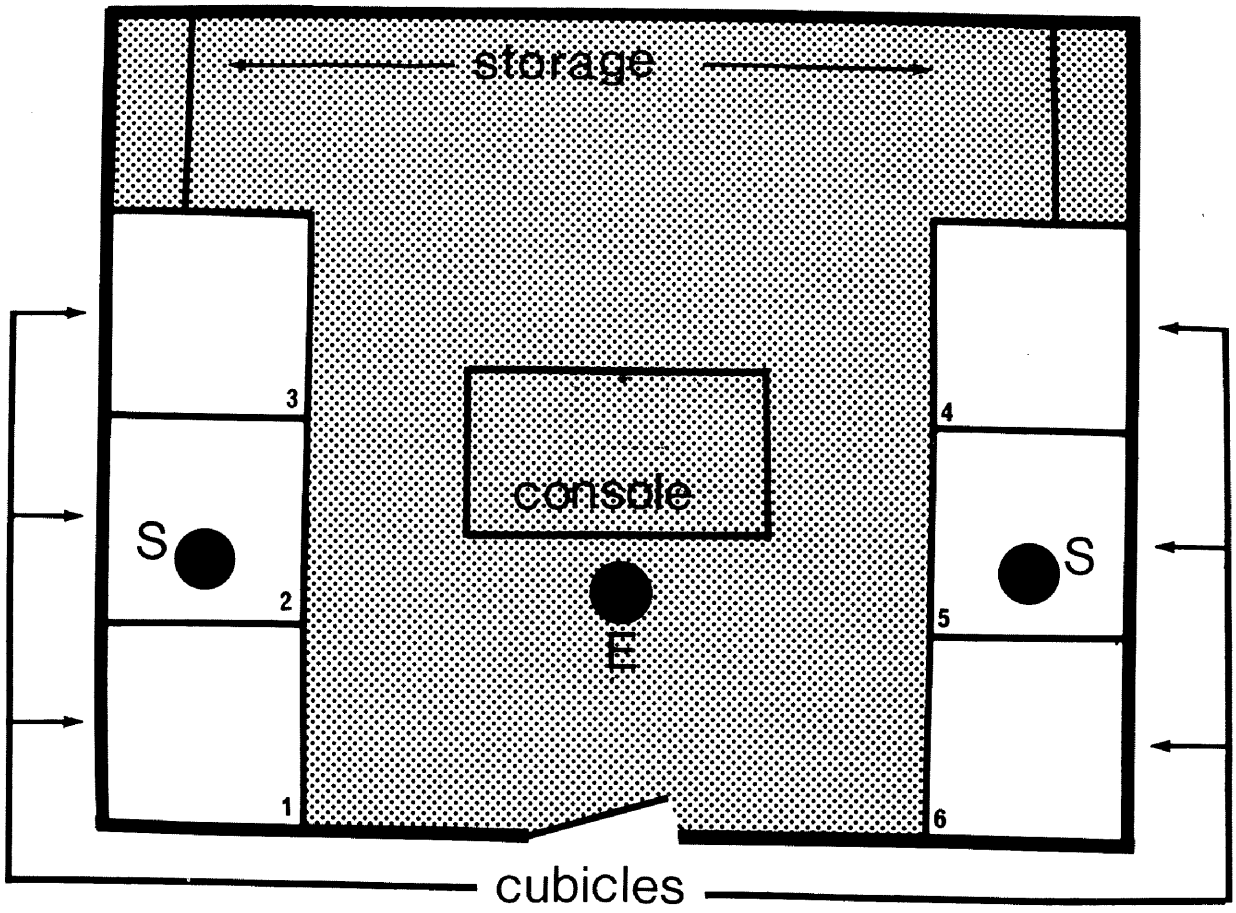


FIGURE 3

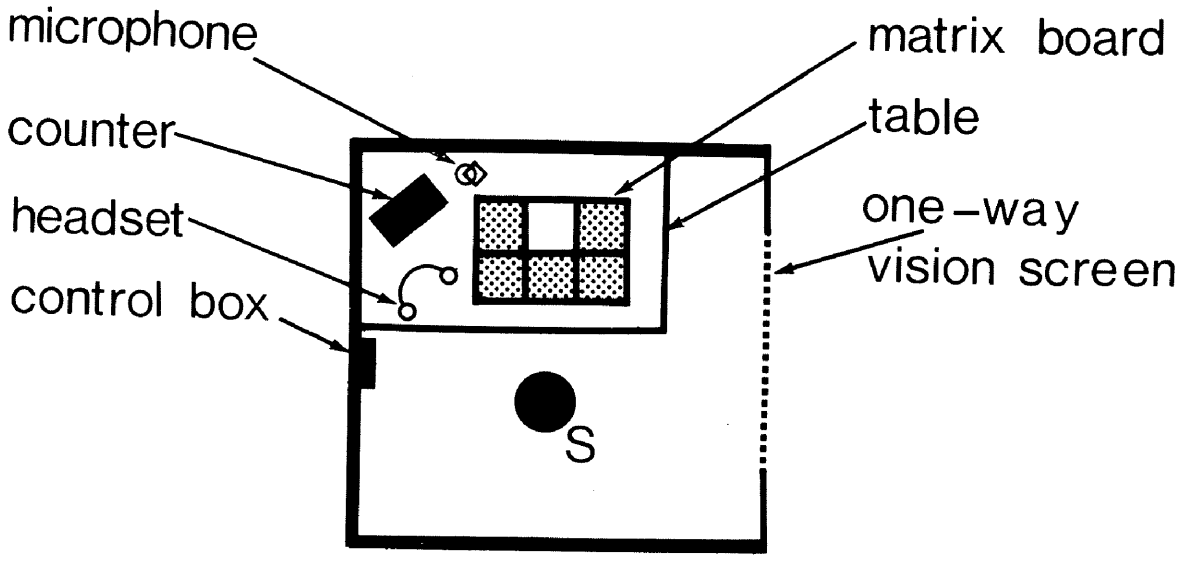
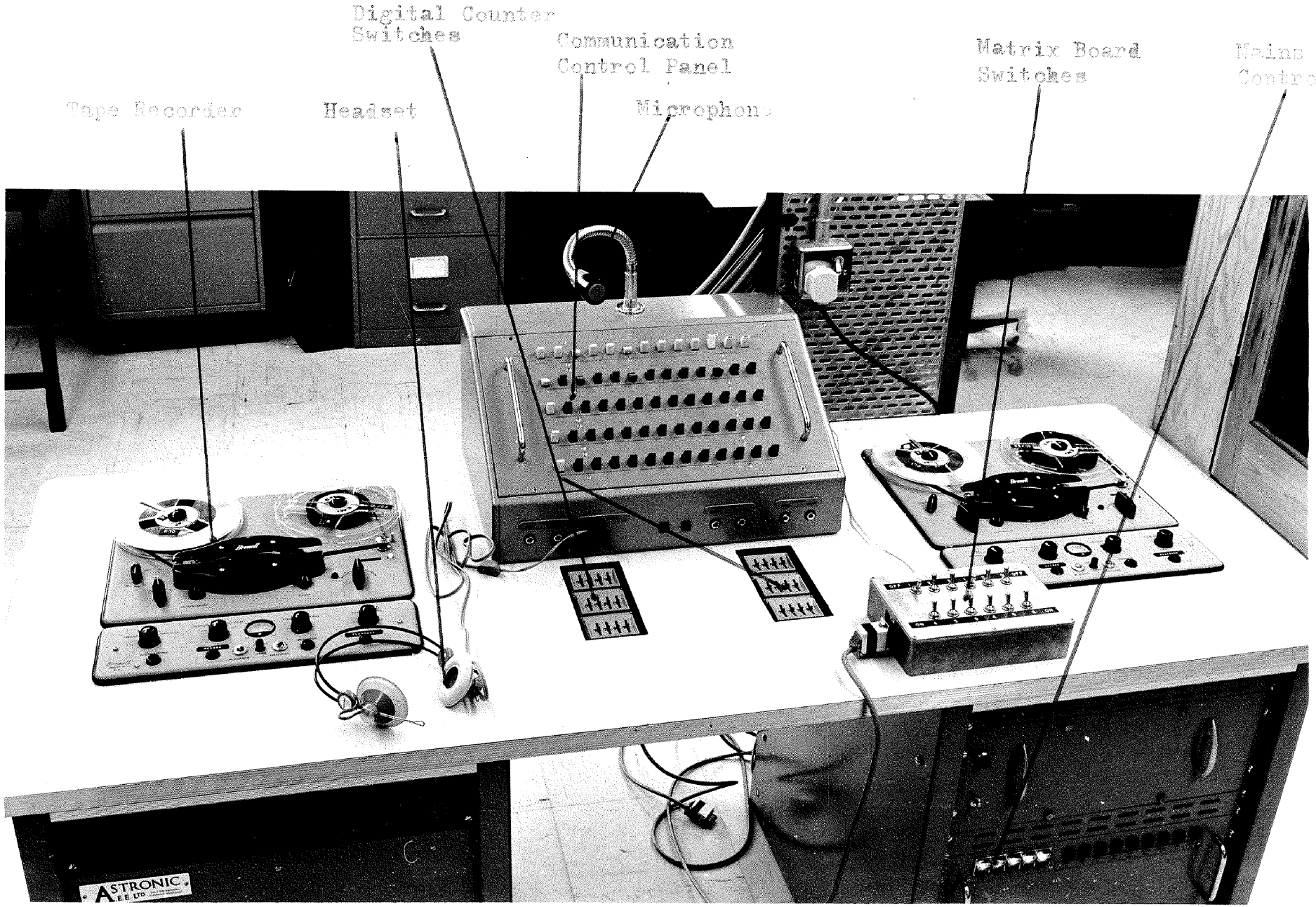


FIGURE 4

FIGURE 5


Digital Counter Switches
Communication Control Panel
Matrix Board Switches
Mains Control
Tape Recorder
Headset
Microphone
ASTRONIC E.E. LTD

The Matrix-Boards

The matrix-boards provided for the subjects were of elementary construction, being simply a wooden box with sloping front, with six shallow compartments each painted while inside and fitted with a 12 volt, 1 watt bulb. Each matrix-board was fitted with a perspex cover and four holding clips, used to secure the actual game matrices which were printed on paper and inserted over the perspex. A sketch diagram of the matrix-board is given in FIGURE 6.

The manipulation of the matrix-boards again required only elementary electrics - namely a switch connected to each bulb so that illumination of the compartments could be achieved individually. The wiring diagram is given in FIGURE 7. The switches controlling the illumination of the matrix-boards were located on the console, as were the switches for the four-digit counters.

A wiring diagram of the communications apparatus is not included here because of its complexity, but some further explanation of its workings is given in the Procedure.

The Digital Counter

The digital counter provided in each cubicle was made-up from four In-Line Digital Display units. Each single unit is capable of displaying 10 different numbers. Each unit contains an assembly of miniature incandescent lamps at the back, a negative with an equal number of message displays, a series of lenses, and a front viewing screen. On lighting one or more of the lamps the corresponding part

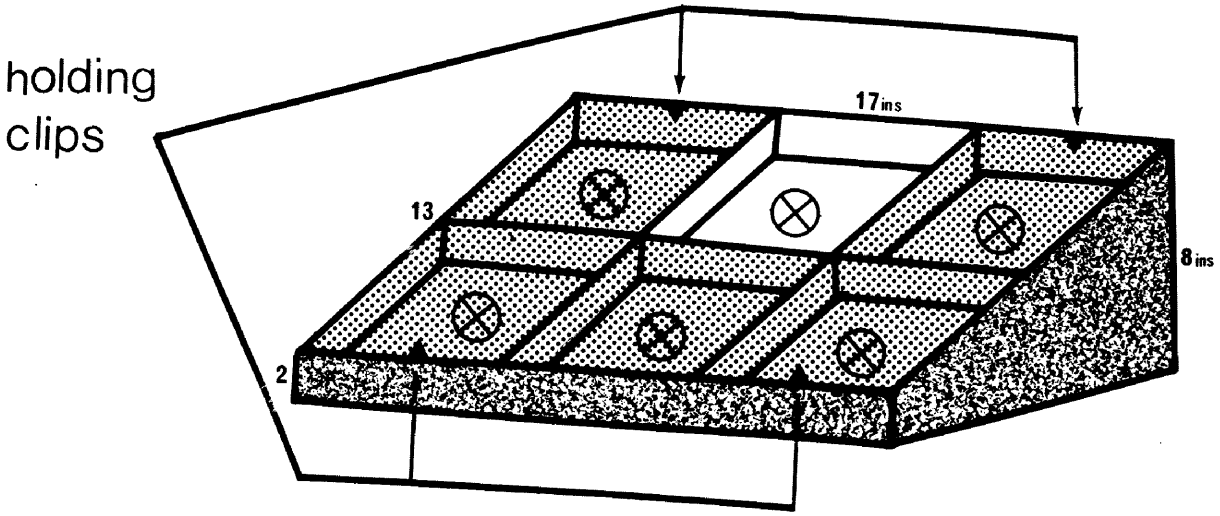


FIGURE 6

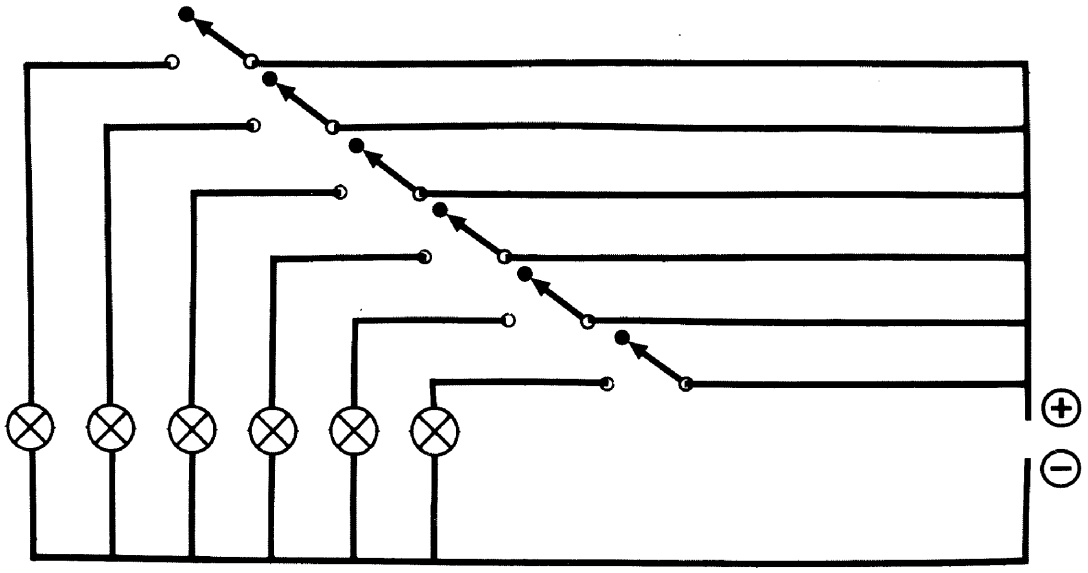


FIGURE 7

of the negative is illuminated and projected through the lens system on to the viewing screen giving an image one inch high.

The displays are connected in assemblies and plug into a housing mounted in each cubicle. This is permanently wired, with the connection for the lamps extending to a series of one-channel ten-way thumbwheel switches mounted on the console (one switch per display unit).

Beyond the materials required for the personality test battery, and in addition to that described above, the only material required was a supply of Data Recording Sheets mounted on a clip-board. (A specimen Recording Sheet is shown in APPENDIX 5).

Procedure

The experimental procedures for GAMES I and II were identical. In order to facilitate the administration of the experiment, in both games the matrices presented to Player B (normally as shown in MATRIX 9 and MATRIX 11) were rearranged so that for all subjects the presented matrix listed him (or her)-self to the left of the matrix with the other player listed above. The layout of Player B's matrices for the first attempt on each iteration of the games was thus as shown in MATRICES 12 and 13.

This feature facilitated the administration of the experiment by allowing precisely the same instructions to be given to both players in every dyad, in addition ensuring that the visual matrix display was identical for every subject, regardless of whether he (or she) played the part of Player A or Player B.

Player 'A'

Player 'B'	FREIGHT LINER	WAIT	GOODS TRAIN
FREIGHT LINER	Not enough containers - CHOOSE AGAIN	20, 15	20, 10
WAIT	15, 20	Delay and blockage - CHOOSE AGAIN	15, 10
GOODS TRAIN	10, 20	10, 15	10, 10

MATRIX 12.

Player 'A'

Player 'B'	FREIGHT LINER	WAIT	GOODS TRAIN
FREIGHT LINER	Not enough containers - CHOOSE AGAIN	20 20, 15 10	15 20, 10 5
WAIT	25 15, 20 15	Delay and blockage - CHOOSE AGAIN	15 15, 10 5
GOODS TRAIN	25 10, 20 15	20 10, 15 10	15 10, 10 5

MATRIX 13.

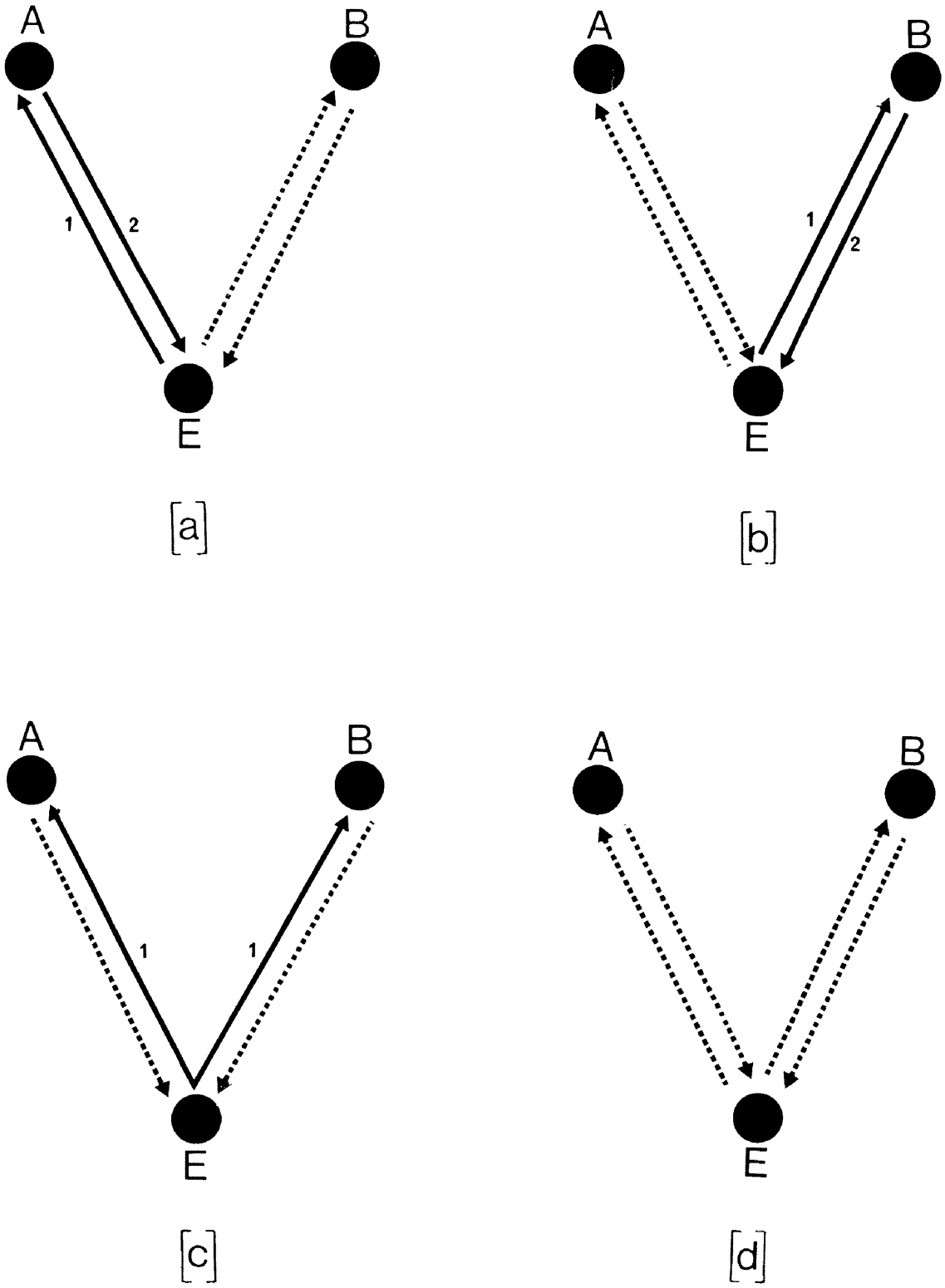


FIGURE 8

On being introduced into the experimental situation (See FIGURE 3) each subject was placed in a cubicle and fitted with the headset provided. Both subjects were then asked to listen to a playback of pre-recorded instructions (See APPENDIX 6).

Having ascertained that the subjects understood the workings of the matrix board and what was required of them, the experimenter proceeded to conduct thirty runs of the game, recording the choices of both subjects, and their payoffs on each iteration. Each subject's every attempt to deliver a batch of goods necessitated several manipulations of the communication channels by the experimenter. Firstly, Player B was closed out of the communication channel and Player A asked for his (her) choice of transport. Player A then informed the experimenter of his (her) choice (See FIGURE 8a). On receiving Player A's choice, Player A was then closed out of the communications channel and the procedure repeated for Player B, his (her) choice being asked for and received (See FIGURE 8b). On receiving Player B's choice, the experimenter then switched Player A back into the channel and informed <u>both</u> subjects of their respective choices (FIGURE 8c). Both players were then closed out of the circuit (FIGURE 8d) and the experimenter recorded the choices (and payoffs where appropriate) of both subjects on the Data Recording Sheet. (When a trial was completed the experimenter adjusted the digital counters for each player appropriately to register their new holdings; when an attempt was unsuccessful, the illumination of the matrix board was moved to the next matrix). After this procedure had been completed another attempt (or trial) was initiated. After 30 iterations the game was declared finished and subjects were allowed (after being sworn to secrecy) to discuss the experiment with the experimenter.

Finally, when all subjects had completed the experiment, the data (listed in APPENDIX 7) was analysed as described in the following chapters.

CHAPTER ELEVEN : RESULTS AND ANALYSIS

Results : The Measures Employed

As already stated, during the course of the experiment strategy-choice on each step of the game and payoff on each iteration (trial) was recorded for each subject in all dyads. From this data, for the purposes of analysis, several further measures were obtained for each dyad.

In view of the comprehensive study and treatment of the original trucking game given by Deutsch and Krauss in their papers of 1960 and 1966, and the statistical treatments of the derivatives of the original game given by Borah (1963), Gallo (1966), and Shomer, Davis, and Kelley (1966), it was decided to analyse the data following as closely as possible the methods previously employed by the several experimenters mentioned above.

In the version of the trucking game developed for the present investigation, the best single measure of the difficulty experienced by the bargainers in reaching agreement is, as with the earlier versions of the game, the sum of each dyad's profits (or losses) on a given trial. The higher the sum of the payoffs to the two players on a given trial, the less time (fewer steps) it took them to arrive at a procedure for sharing the Freightliner facilities. (It was, of course, possible for one or both of the players to decide to send their batches of freight by "Goods Train" so as to avoid a protracted stalemate during the process of bargaining. This, however, always resulted in at least a 5 points smaller joint payoff if only one player chose the Goods Train facility, than an optimally arrived at agreement concerning the use of the Freightliner facility).

A second, more gross, measure of the difficulty experienced by the bargainers in reaching agreement is given by the time taken (that is, the number of steps required) to complete the game. (By the structure of the game, the more steps or choices required to complete a trial, the smaller the payoff. Since, in the economic sense at least, bargaining success is measured by magnitude of profit, the time taken to complete the game must reflect the difficulties experienced by the players).

While this measure of time taken, or number of steps to criterion (30 iterations), gives a gross measure of the difficulty experienced by the bargainers, it is to be noted that during the course of the game time may be lost by a player in two different ways. Time is lost either when both players choose to wait simultaneously (strategy choice 2) or when they both choose "Freightliner" at the same time. Borah (1963) used the "time lost in standoffs" by players in the game as a measure when comparing his experimental groups. His index was basically "the time spent by both subjects actively insisting by their presence upon going first through the common section of the shorter pathway." (page 40). Since in the present experiment this is equivalent to a simultaneous "Freightliner" choice by both members of the dyad, time lost in standoffs is represented in the present analysis by the number of blockages on the "Freightliner" choice only, this being a more precise measure of the difficulty experienced by the subjects in reaching agreement.

Thus, following the lines taken by the earlier users of the various forms of the Deutsch and Krauss trucking game, the following measures were obtained for each dyad from the data recorded during the actual running of the experiment :-

1) Total Joint Payoff summed over 30 trials, (See APPENDIX 8);

2) Total Joint Payoff for each of 6 blocks of trials : 1-5, 6-10, 11-15, 16-20, 21-25, 26-30, (See APPENDIX 8);

3) Median Joint Payoff over 30 trials, (See APPENDIX 9);

4) Median Joint Payoff for each of 6 blocks of trials: 1-5, 6-10, 11-15, 16-20, 21-25, 26-30, (See APPENDIX 8);

5) Total Number of Steps taken summed over 30 trials, (See APPENDIX 10);

6) Total Number of Steps taken in each of 6 blocks of trials: 1-5, 6-10, 11-15, 16-20, 21-25, 26-30, (See APPENDIX 10);

7) Total Number of simultaneous Strategy 1 Choices ("Freightliner" blockages) summed over 30 trials, (See APPENDIX 11);

8) Total Number of simultaneous Strategy 1 Choices in each of 6 blocks of trials: 1-5, 6-10, 11-15, 16-20, 21-25, 26-30, (See APPENDIX 11).

By way of summarizing the results, the Mean and Median Joint Payoffs for each of 6 blocks of trials are presented in the graphs which follow, (FIGURES 9 and 10 respectively.)

Analysis of Results

For the analysis, it was decided to look first for differences in behaviour between the experimental groups due to experimental conditions and sex, and then to investigate for possible effects of personality on behaviour in the game.

The Search for Group Differences

It is to be noted that the measures listed in the previous section are all concerned with the joint performance of players in each dyad and not with players as individuals. This is because during the course of the game, the total time spent by a player on any given trial (and hence his payoff) is partially controlled by the other member of the pair. (It might be argued that a player does have control over his own payoffs, since at any point in a run of the game he can either choose to use the "Goods Train" facility and automatically ensure successful delivery, or he can choose to take the risk of non-delivery by opting for the freightliner facility, using either the "Wait" or "Freightliner" strategies. However, the present experimenter would argue that this is no real choice since the "Goods Train" strategy-choice payoff is always 5 and 10 points inferior to the "Wait" and "Freightliner" choices respectively, except, perhaps, on the sixth step of a trial where it may be considered superior because of the threat of 25 penalty points on blockage).

Additional to, and perhaps more important than these partial controls by the other on time taken and payoff, is the possible effect of knowledge of previous choices in the game on

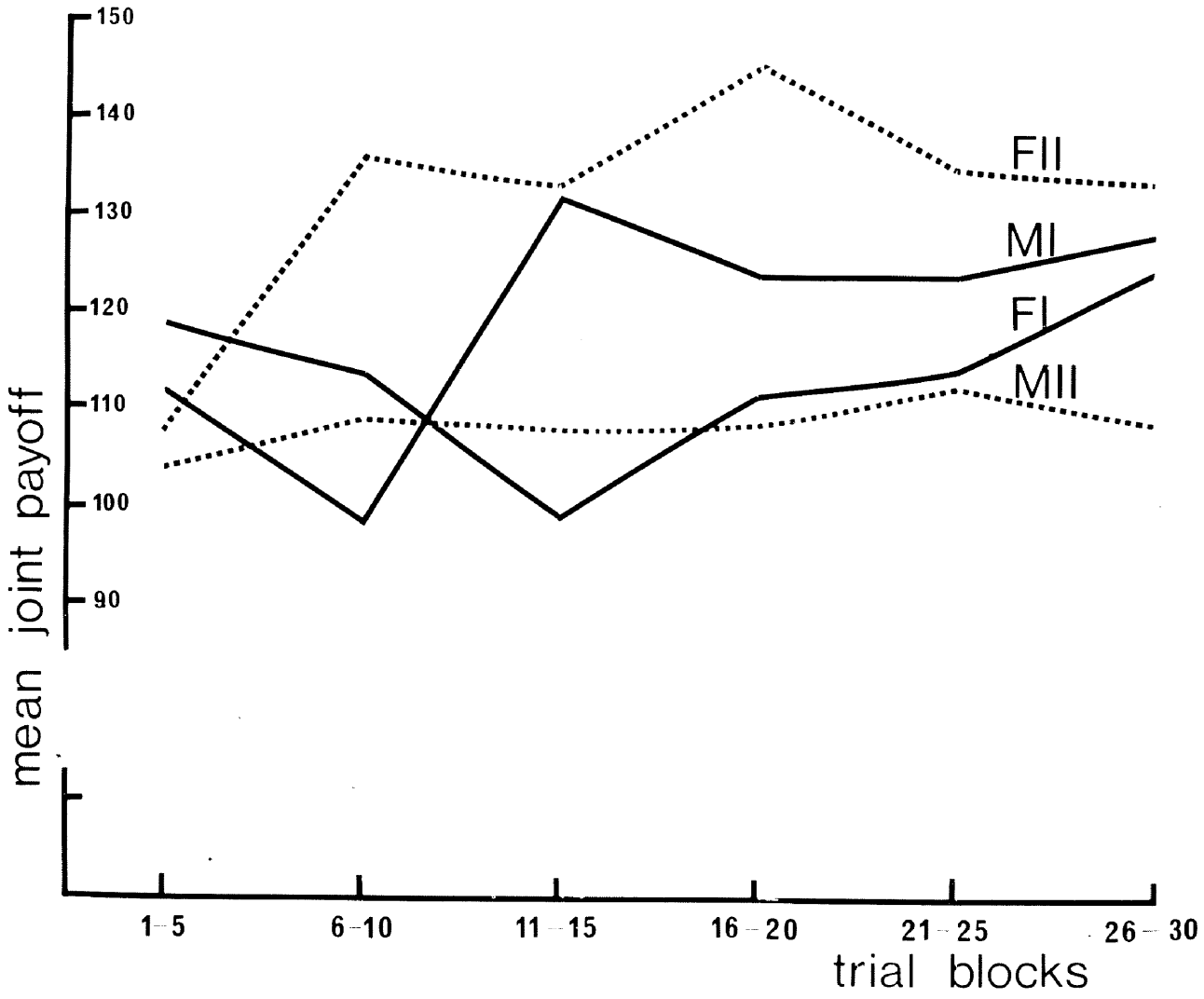

150
140
130
120
110
100
90
mean joint payoff
FII
MI
FI
MII
1-5
6-10
11-15
16-20
21-25
26-30
trial blocks

FIGURE 9

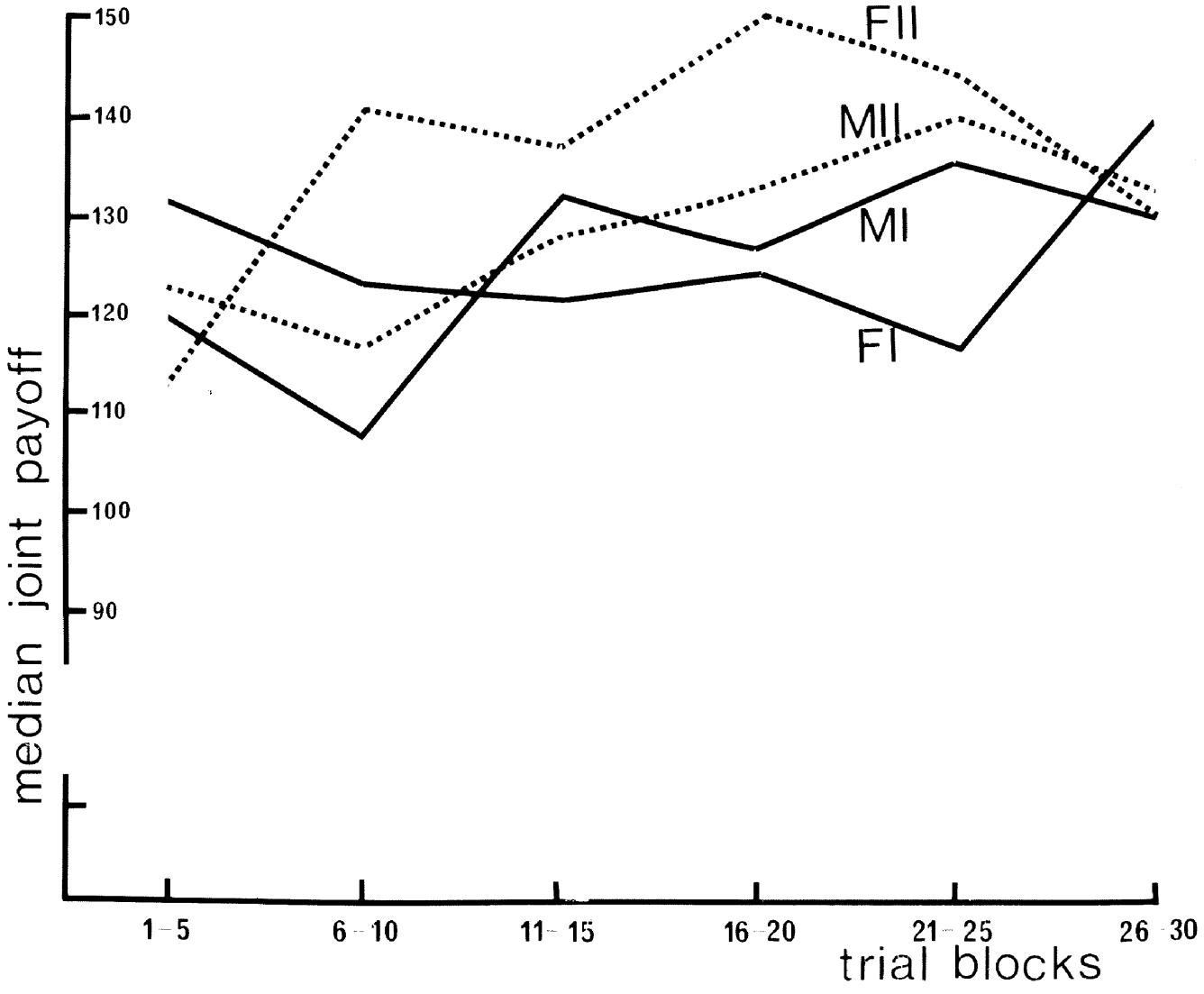

150
140
130
120
110
100
90
median joint payoff
FII
MII
MI
FI
1-5
6-10
11-15
16-20
21-25
26-30
trial blocks

FIGURE 10

behaviour. At any point in the game (except the very first strategy-choice point) the strategy-choice of a player will almost certainly be influenced by the previous choices made by both players on earlier trials of the game. In short, there is interaction between the players throughout the course of the experimental session. The only point where this is not the case is the very first strategy-choice in the first trial of the game, when no choices have been made and, hence, no knowledge of any strategy-choices of the other can be available to either member of the dyad.

In comparing the experimental groups for differences in behaviour, it was decided to look first at the strategy-choice of each player on the first step of certain trials of the game (in order to test for trends in choice over time), in addition to investigating the measures of joint behaviour. The trials chosen were the first in the game, plus the last trial included in each of the six blocks of trials - that is, trials 1, 5, 10, 15, 20, 25, and 30.

The frequency of each strategy-choice on the first step of the first trial of the game for players in each of the four experimental groups is given in TABLE 9, below :-

Strategy Choice	Group			
	MI	MII	FI	FII
1	30	32	31	26
2	13	13	9	9
3	5	3	8	13

TABLE 9

Since the F test requires at least interval measurement of the variables involved, the analysis of variance technique was not appropriate to the above data, and in order to test for over-all significant differences, a partition of chi square was made, following the method outlined by Winer (1962). This 2 X 2 X 3 chi square is depicted diagramatically in FIGURE 11 :

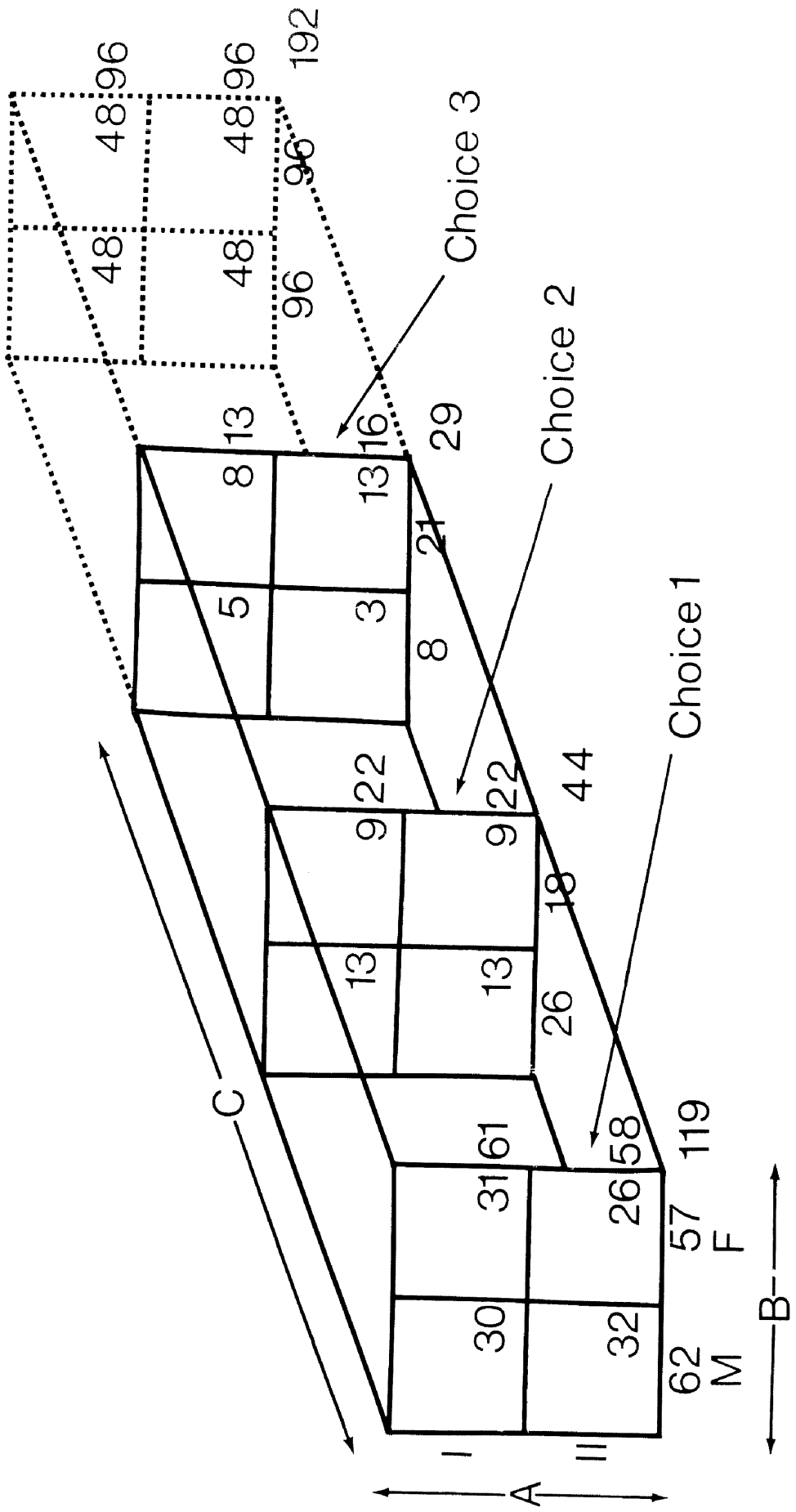

192
96
96
48
48
48
48
96
96
Choice 3
Choice 2
Choice 1
29
16
13
8
13
21
8
5
3
44
22
22
9
9
18
13
13
26
119
58
61
31
26
57
F
62
M
30
32
C
I
II
A
B

FIGURE 11

From the computations TABLE 10 was formed :

Source	Chi square	df	x^2 critical value at α =0.05
Total	78.500	11	19.680
A	0.0	1	3.84
B	0.0	1	3.84
C	72.6563	2	5.99
AB	0.0	1	3.84
AC	0.2812	2	5.99
BC	4.0312	2	5.99
ABC	1.5313	2	5.99

TABLE 10

From the table it may be seen that a significant difference is detected only with regard to variable C (the frequencies with which strategies 1, 2, and 3, are chosen within each of the groups). By reference to the appropriate statistical tables it may be seen that this difference is highly significant (beyond the 0.001 level). It is to be noted, however, that this difference is expected, since by the structure of the game, players should not choose each strategy with equal frequency. No other differences are detected, however, either between experimental conditions or between sexes.

A partition of chi-square for frequency of strategy-choice on the first step of trials 5, 10, 15, 20, 25, and 30 in each case revealed variable C as being highly significant, but as with trial 1, no other differences were detected either between experimental conditions or between sexes. (The strategy-choice frequencies and computations of the chi-square for these trials are given in APPENDIX 12).

As already stated, the best single measure of the difficulty experienced by the members of a pair in reaching agreement is the joint payoff to the dyad. In order to test further for differences between experimental conditions and between the sexes within each condition, the Kolmogorov-Smirnov Two-Sample Test (two-tailed) was used in preference to either the x^2 test or the median test since it seems more powerful in all cases, (Siegel, 1956, page 136). Since the two-tailed test is sensitive to any kind of difference in the distributions from which the samples are drawn, including differences in location, (central tendency), the test was used with two separate measures: the total joint payoff (the amount earned by both subjects summed over all the trials) achieved by each group, and the median joint payoffs (the median value for each group over the 30 iterations).

The results of this analysis are presented in TABLE 11 :-

Measure	Comparison	D	K_D
Total Joint Payoff	MI v. MII	5/24	5
	FI v. FII	6/24	6
	MI v. FI	4/24	4
	MII v. FII	7/24	7
Median Joint Payoff	MI v. MII	2/24	2
	FI v. FII	4/24	4
	MI v. FI	4/24	4
	MII v. FII	4/24	4

TABLE 11.

Since for the two-tailed test, and N = 24, the critical value of K_D at $\alpha = 0.05$ is $K_D = 10$, it can be seen from the above table that no differences are detected either between conditions or between sexes.

Since the Kolmogorov-Smirnov tests showed no sex differences within either experimental group for either the total joint payoff achieved by the dyads, or the median joint payoffs, the two sexes were combined for an analysis of variance. The analysis was made of (i) the mean total joint payoff scores, and (ii) the median joint payoff scores; using in each case a breakdown of the data into six blocks of trials (1-5, 6-10, 11-15, 16-20, 21-25, and 26-30) in order to test for trends. The means for the 12 cells in the analysis of variance of the mean total joint payoff for each condition by trial blocks are given in TABLE 12 :

Condition	TRIALS					
	1-5	6-10	11-15	16-20	21-25	26-30
I	114.90	105.73	114.90	111.26	118.65	126.04
II	105.83	122.29	119.90	126.46	123.13	120.94

TABLE 12

The analysis of variance, as computed from the above table is shown in TABLE 13 :

Source	MS	F
Experimental Condition	61.065	1.138
Trial Block	44.928	< 1
Within Cells	53.649	

TABLE 13

The medians for the 12 cells in the analysis of variance of Median Joint Payoff for each condition by trial blocks are presented in TABLE 14 :

	TRIALS					
Condition	1-5	6-10	11-15	16-20	21-25	26-30
I	121.00	116.00	129.58	125.31	130.00	137.50
II	116.25	132.50	133.57	142.50	142.00	131.00

TABLE 14

The computed analysis of variance is shown below in TABLE 15 :

Source	MS	F
Experimental Condition	123.0721	2.2527
Trial Blocks	93.5684	1.7127
Within Cells	54.6335	

TABLE 15

The critical value of the F distribution at $\alpha = 0.05$ for the experimental conditions is 6.61 (df=1/5) and for the trial blocks is 5.05 (df=5/5). From inspection of the F values in Tables 13 and 15 it can be seen that no significant differences between the experimental conditions, and no trends over time within conditions, are found for either the mean total joint payoff or the median joint payoff to dyads in the game.

Two further measures of behaviour remained, (the number of steps required to reach criterion, and the number of blockages on strategy-choice 1). Again the Kolmogorov-Smirnov Two-Sample test (two-tailed) was employed because of its power-efficiency. Once again no significant differences between groups were found for either measure. The results of the Kolmogorov-Smirnov tests are summarized in TABLE 16 below. As before, where N=24 and $\alpha = 0.05$, the critical value of K_D for the two-tailed test is 10.

Measure	Comparison	D	K_D
Number of steps required to reach criterion	MI v. MII	5/24	5
	FI v. FII	6/24	6
	MI v. FI	4/24	4
	MII v. FII	6/24	6
Number of blockages on strategy-choice 1	MI v. MII	6/24	6
	FI v. FII	6/24	6
	MI v. FI	5/24	5
	MII v. FII	8/24	8

TABLE 16

Combining the sexes for an analysis of variance, and again utilizing six trial blocks to test for trends, the means for the twelve cells for the analysis of the mean number of steps required to reach criterion are given in TABLE 17 :

Condition	TRIALS					
	1-5	6-10	11-15	16-20	21-25	26-30
I	9.417	10.313	9.417	9.438	9.271	8.917
II	9.917	8.958	9.271	8.604	8.708	9.042

TABLE 17

The computed analysis is presented in TABLE 18, below :

Source	MS	F
Experimental Condition	0.4300	1.8893
Trial Block	0.2086	< 1
Within Cells	0.2276	

TABLE 18

The means for the 12 cells for the analysis of variance of the mean number of Freightliner (strategy-choice 1) blockages for each condition by trial blocks are displayed in TABLE 19 :

Condition	TRIALS					
	1-5	6-10	11-15	16-20	21-25	26-30
I	3.875	4.688	4.063	4.146	3.917	3.479
II	4.208	3.438	3.938	3.333	3.542	3.583

TABLE 19

The analysis of variance is shown in TABLE 20 :

Source	MS	F
Experimental Condition	0.3770	2.1568
Trial Blocks	0.0932	< 1
Within Cells	0.1748	

TABLE 20

The critical value of the F distribution at $\alpha = 0.05$ for the Experimental Conditions is 6.61 (df=1/5), and for the Trial Blocks is 5.05 (df=5/5). Once again, from inspection of the F values in TABLES 18 and 20, it can be seen that no significant differences between the experimental conditions, and no trends over time within conditions are found, either for the mean number of steps required to reach criterion or for the mean number of blockages on strategy-choice 1.

Thus the entire statistical analysis, using (i) a partition of chi-square to investigate first choice behaviour in the game; (ii) Kolmogorov-Smirnov Two-Sample tests to test for differences due to experimental condition or sex of the players in (a) Total

Joint Payoff, (b) Median Joint Payoff, (c) Number of steps to criterion, and (d) Number of strategy-choice 1 blockages; and (iii) Two-Way Analyses of Variance to investigate for trends over time utilizing a breakdown into trial blocks of measures (a), (b), (c), and (d), all failed to find any inter-group differences due to amount of information available about the other's payoffs in the game were found. Additionally, no statistically significant intra-group differences due to sex of the players were found.

The Effects of Personality on Behaviour in the Game

Since, in the foregoing analysis, no differences due to either the amount of information available about the other's payoffs, or sex of the players in single-sexed dyads, were found, the four experimental groups were combined for an investigation of the relationship between personality (as measured by the test battery) and behaviour in the game, as measured by (1) Total Joint Payoff summed over 30 trials; (2) Total Number of Steps required to reach criterion (30 trials); and (3) Total Number of Concessions[1] made to the other member of the dyad.

.....

1. This score more accurately represents the number of times a player was "bested" by the other member of the dyad - that is the number of trials on which the other made a larger profit (or a smaller loss) than the player himself. It is to be noted that such a criterion does not necessarily give a true "Number of Concessions" score, since in a dyad playing optimally, the choices of each player will alternate between "Freightliner" and "Wait" and this "Wait" is not, strictly speaking, concessionary, merely an optimal choice chosen to maintain the players own payoff level in the extended version of the game.

Since these measures of behaviour are not independent measures of the performances of individual players, but rather by the nature of the experimental situation are in some degree dependent on the performances of both members of the dyad, only data relevant to one member (randomly chosen) of each pair were included in the following analysis. Thus, in the search for personality correlates of behaviour in the game, the total number of subjects was 96, being made up of 24 from each experimental group.

Product-moment correlations of each of the three measures of game behaviour with the scores obtained on each of the variables of the personality test battery produced correlations which, when tested independently of each other, gave the following 'significant' values at $\alpha = 0.05$ and $\alpha = 0.01$:-

The Sixteen Personality Factor Questionnaire

Variable	Measure		
	Total Payoff	Number of Steps to criterion	Number of Concessions
A			
B			
C			
E		*	(-)*
F			
G			
H			
I			
L			
M			
N			
O			
Q1	(-)**	**	
Q2			
Q3			
Q4			

TABLE 21

In the table above and in those which follow, * indicates significant at $\alpha = 0.05$, ** indicates significant at $\alpha = 0.01$, and (-) indicates that the obtained correlation has a negative value.

The Guilford/Zimmerman Temperament Survey

Variable	Measure: Total Payoff	Measure: Number of Steps to Criterion	Measure: Number of Concessions
G			
R			
A		*	
S			
E			
O			
F			
T			
P			
M	(-)*	*	

TABLE 22

The Study of Values Test

Variable	Measure: Total Payoff	Measure: Number of Steps to Criterion	Measure: Number of Concessions
T			(-)**
E			
A			
S			
P			
R			

TABLE 23

The Edwards Personal Preference Schedule

Variable	Measure: Total Payoff	Measure: Number of Steps to Criterion	Measure: Number of Concessions
ach			
def			
ord			
exh			(-)*
aut			
aff			
int			
suc			
dom		*	
aba			
nur			
chg	*		
end			
het			
agg			

TABLE 24

The Test of Social Insight

None of the correlations between the variables of this test and any of the three measures of behaviour in the game, when regarded as independent, reached significance at the 5% level.

For the product-moment correlations performed, the significance level employed was that appropriate to a two-sided significance test, since no directional hypotheses were postulated and no assumptions regarding specific personality variables made,

due to the conflicting nature of earlier reported studies dealing with personality and game-playing behaviour.

Using the 5% and 1% levels of significance for a two-sided statistical test, and treating each significance test of a correlation as an independent event, disregarding the existence of all the other correlations while performing that test, we have the following summary table of statistically significant correlations:-

Measure	Statistically significant beyond	
	$\alpha = 0.05$	$\alpha = 0.01$
Total Payoff	3	1
Number of Steps to Criterion	5	1
Number of Concessions	3	1

TABLE 25

A critical evaluation of these significances is presented at the end of the present chapter.

These indications of personality effects on behaviour having been found by correlation of the personality variables with the gross measures of behaviour in the game taken as a whole, it was decided to investigate beahviour more closely, examining first strategy-choice behaviour on certain trials, for personality effects, using a one-way analysis of variance technique. Once again trials 1, 5, 10, 15, 20, 25, and 30 were examined, and, as before, all groups were combined and only that data relating to one member of each pair, randomly chosen, was used in the analysis, ($N = 96$). The following statistically significant differences were found:-

The Sixteen Personality Factor Questionnaire

Variable	Trial 1	5	10	15	20	25	30
A							
B							*
C	**						
E							
F							
G							
H							
I							
L							
M					*		
N							
O							
Q1	*						
Q2							
Q3							
Q4							

TABLE 26

In the above table and in those which follow, * indicates significant at $\alpha = 0.05$, ** indicates significant at $\alpha = 0.01$.

The Guilford/Zimmerman Temperament Survey

	Trial						
Variable	1	5	10	15	20	25	30
G							
R							
A							
S							
E							
O							
F			*				
T					*		
P				**			
M							

TABLE 27

The Study of Values Test

	Trial						
Variable	1	5	10	15	20	25	30
T					*		
E			*				
A							
S	*						
P	*						
R							

TABLE 28

The Edwards Personal Preference Schedule

	Trials						
Variable	1	5	10	15	20	25	30
ach							
def				*			
ord							
exh						**	
aut							
aff							
int							
suc							
dom							
aba							
nur							*
chg							
end							
het	*						
agg			*				

TABLE 29

The Test of Social Insight

	Trial						
Variable	1	5	10	15	20	25	30
I							
II							
III				**			**
IV							
V							
VI							

TABLE 30

Thus, treating each significance test as an independent event, the number of significant differences found in the investigation of personality effects on the first strategy-choice on each of these trials is as shown in TABLE 31 :-

TRIAL	Statistically significant beyond $\alpha = 0.05$	$\alpha = 0.01$
1	5	1
5	-	-
10	3	-
15	3	2
20	3	-
25	1	1
30	3	1

TABLE 31

Looking at the statistical analysis carried out in search of personality correlates of behaviour in the game, our conclusions must depend on the light in which we view the investigation. On the one hand, it can be argued that the experimental procedure has utilized only one sample of subjects chosen from the general population and that the personality variables represent no more than different attributes of the members of this sample; and further, some of the intercorrelations between the personality variables are high, indicating lack of independence. Therefore, in examining the correlations found, the usual significance levels are appropriate.

On the other hand, however, it can be emphasised that while some of the intercorrelations between the personality variables are high, slightly more than one third of them are less than 0.1; and that, not only are the subjects sampled but so are the personality attributes also. In this light, we would expect a number of significant values to occur by chance - namely two or three at the 5% level, and possibly one at $\alpha = 0.01$. Looking at the investigation in this way, and treating the variables as independent, it can be seen from

TABLES 25 and 31 that the actual number of correlations and variances to reach this level of significance is not much more than that which would be predicted by chance.

However, if we look back at the primary purpose of the investigation, it is seen that the aim was to search for any possible effects of personality on behaviour in the experimental game, in order to provide a pointer for further, more specific, research. While the author inclines towards the latter, more "commonsense" view of the significance testing outlined above, to accept the extreme and severe view that each variable should be treated as independent (and thus discount all the apparently significant findings as statistical artifacts) would be to defeat the whole purpose of the investigation.

For the purposes of reporting, therefore, it is felt that at least we should accept as significant those values which reach the 1% significance level - namely, factors C (Emotional Stability) and Q1 (Radicalism/Conservatism) of the Cattell Sixteen Personality Factor Questionnaire, factor P (Personal Relations) of the Guilford/Zimmerman Temperament Survey, the Theoretical Value scale of the Study of Values Test, the Exhibition scale of the Edwards Personal Preference Schedule, and the Cooperativeness trait of the Test of Social Insight.

CHAPTER TWELVE : DISCUSSION AND CONCLUSIONS

Discussion

Looking overall at the analysis then, while there might appear to be some indication of personality correlates of game-playing behaviour (notably dominance-ascendance and cooperativeness), the investigation has failed to locate any differences in behaviour due to sex of the players in single-sexed dyads, and has further failed to show any effect of the amount of information available about the payoffs of the other on player's behaviour in the game.

It may be that no differences due to either sex of the players or experimental conditions exist. Should this be the case, it calls into question the results of Messick and Thorngate (1967) and of Amnon Rapoport (1969) who did find differences in game behaviour due to the information variable. On the other hand, it may be that no differences between the experimental groups have been found because of the nature of the "Freightliner" game. In the version of the trucking game used in the present investigation the measures of overall behaviour are somewhat gross. In particular, the "fixed sum" payoffs available through each choice may not have allowed sufficient discrimination between the strategies adopted by the players, and the magnitude of the payoffs (up to 20 points per trial) may have rendered the game less meaningful to the players in that the threat of blockage (with potential loss of 5 to 25 points) may not have represented any real threat - especially to a player whose holdings may have amounted to several hundred points. It may therefore be that the lack of significant differences between the experimental situation was of itself not altogether satisfactory.

Turning to the statistical analysis of the possible influence of personality on behaviour in the game, we first note that from the nature of the game, where profits depend on speed of

delivery, we would predict an inverse relationship between the total payoff in the game and the number of steps required to complete 30 trials. The actual correlation was found to be - 0.8767. The two measures are thus highly interdependent. In view of this, it is only to be expected that where a statistically significant correlation occurs between one of these measures and a given personality variable, there is a tendency for a corresponding statistically significant or near-significant, correlation in the opposite direction to exist between that personality variable and the other measure of behaviour in the game. This corresponding correlation was found to reach the same level of significance in two cases out of six, and to approach significance in each of the remaining four.

Looking more closely therefore at one of these measures, the "Number of Steps to Criterion", we find that the personality variables which correlate, with significance beyond the 0.05 level, are the E and Q1 factors of the Cattell Sixteen Personality Factor Questionnaire, the A and M factors of the Guilford/Zimmerman Temperament Survey, and the Dominance scale of the Edwards Personal Preference Schedule. Of these five significantly correlated variables, three are measures of dominance-ascendance, one is a measure of radicalism, and that remaining provides a measure of masculinity.

Looking at what these variables represent psychologically, their statistical significance might well seem plausible. A high score on Factor Q1, for example, according to the test manual (pages 18-19) indicates an inclination to experiment with problem solutions, and less inclination to moralize. "The actual items express an interest in breaking the crust of custom and tradition, and in leading and persuading people ..... In group dynamics the Q1+ (high-scoring) person contributes significantly more remarks to discussion, a high percentage being of a critical nature." Such an individual we might well, in retrospect, expect to be dissatisfied with optimal-choice play, and to try (by continued "Freightliner" choices) to

persuade the other to concede. Additionally, we might expect highly ascendant or dominant players to choose "Freightliner" excessively in an attempt to dominate the other, and hence the positive correlations with "Number of Steps required to Criterion" and negative correlations with Total Payoff might appear to be satisfactorily explained. Looking at factor M (masculinity), and noting that a high score on this variable gives a measure of how hardboiled and resistant to fear the individual is, (as opposed to sympathetic, fearful, and emotionally expressive) , we might conclude that this significance concurs with those already examined.

However, before embarking on such a theory, we should enquire into the independence or otherwise of these variables. Since three of the variables are measures of the same trait (dominance-ascendance) we would <u>not</u> expect them to be independent. The actual correlations between the five variables are given below in TABLE 32, (N = 192) :-

	E	Q1	A	M	dom
E		.1511	.6837	.4419	.5518
Q1			.1380	.1276	.1086
A				.4026	.5836
M					.3380
dom					

<u>TABLE 32</u>

From TABLE 32 it can be seen that the three measures of dominance-ascendance <u>are</u> highly intercorrelated (E v. A = .6837; E v. dom = .5518; and A v. dom = .5836). Additionally, it can be seen that the M (masculinity) variable is fairly highly correlated with all these three.

Out analysis so far, then, has uncovered statistically significant correlations which at least give indications of the effects of some personality traits (namely, factor Q1 of the Cattell Sixteen Personality Factor Questionnaire, and the Theoretical Value scale of the Study of Values Test), on behaviour in the bargaining game.

From examination of the further analysis employing first strategy-choice on certain trials as the measure of behaviour in the statistically significant variances are found throughout those trials investigated number 18 in all. Looking at what they mean psychologically, it can be seen that, as with the statistically significant correlations of personality with the three overall measures of game behaviour, plausible explanations can be given to many. Looking at first trial behaviour, the following appear significant :- factors C and Q1 of the Sixteen Personality Factor Questionnaire, values S and P of the Study of Values Test, and the heterosexuality scale of the Edwards Personal Preference Schedule. Factor Q1 has already been explained. The possible relevance of factor C, (known as Emotional Stability or Ego Strength), which is described as one of dynamic integration and maturity as opposed to general emotionality, and whose high scorers maintain better group morale and are far more frequently leaders, can also be appreciated. Examination of the S (Social) value scale of the Study of Values Test, showw the high scorer to be one who prizes other persons as ends, and is therefore himself kind, sympathetic, and unselfish. Thus the factor's possible influence on game behaviour is plausible, in that the person scoring high on social value might well prove less competitive towards the other member of the dyad than might low scorers. High scorers on value P (Political) are described as primarily interested in power and leadership, and thus the relevance of this factor also could be accepted. While any relevance of the heterosexuality score (on the Edwards Personal Preference Schedule) to first trial behaviour may seem obscure, the significances found for subsequent trials can generally be successfully interpreted. The possible influence of measures of cooperativeness (the P scale of the Guilford/Zimmerman Temperament Survey, and scale III of the Test of Social Insight, where the high scorer is described as one who initiates an active

and positive endeavour directed at the solution of the problem), is apparent. The possible influence of the Theoretical and Economic values (The Study of Values Test), where the interests of the theoretical man are described as empirical, critical, and rational, and the economic man is characteristically interested in the production, marketing, and consumption of goods, ... and in the accumulation of tangible wealth; aggression (the 'agg' scale of the Edwards Personal Preference Schedule); and acceptance of dominance as measured by the F scale of the Guilford/Zimmerman Temperament Survey, should again, in retrospect, be obvious. The relevance of the Exhibition scale of the Edwards Personal Preference Schedule may seem somewhat less plausible, however, as indeed may the measures of deference and nurturance on the same test, and factor M (absentmindedness) of the Sixteen Personality Factor Questionnaire.

Nevertheless, indications of the influence of personality on strategy-choice behaviour throughout the game are clearly apparent. While no trends over time can be claimed with confidence, it is to be noted that there is an indication of an increasing effect of cooperativeness in the second half of the game (first apparent on Trial 15) when the earlier effects of emotional stability, radicalism, aggression, and economic values have all but disappeared.

Overall, then, accepting the 1% level of significance, it can be seen that six different personality variables influence behaviour in the bargaining game: Emotional Stability, Radicalism/Conservatism, Personal Relations, Theoretical Value, Exhibition, and Cooperativeness. From the foregoing discussion, the possible relevance of the majority of these factors is understandable.

It is suggested that these should be the subject of further investigation. It may be that some of these pointers would, in the event, prove spurious (possibly the Exhibition scale would seem most likely here). Nevertheless, at our present state of knowledge of the influence of non-economic factors on game-playing behaviour, those personality traits which have proved to significantly affect behaviour in the presently investigated game, would appear to be valuable indicators of the direction future research in the area should follow.

Conclusions.

The present investigation failed to substantiate the hypotheses relating game playing behaviour to (a) amount of information available regarding the other's payoffs (HYPOTHESIS 1); or (b) sex of the players in single-sexed dyads (HYPOTHESIS 2), and thus in each case the null hypothesis is accepted.

Statistically significant personality correlates of behaviour in the game when taken as a whole, and specifically on particular trials (including Trial 1) were found. HYPOTHESIS 3 was thus substantiated, though no trends over time were observed.

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THE PERSONALITY TEST BATTERY

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APPENDIX 1

"Student's T" - a computer programme designed to perform t tests on 55 variables of two sets of data, each set having 48 scores.

```
STUDENTS T TEST;
"BEGIN""INTEGER"I,J,M,N,A;
"REAL"X,TX,SUMSQX,Y,TY,SUMSQY,K,L,P,Q,S,R,T;
"REAL""ARRAY"YA{1:48,1:55},XA{1:48,1:55};
"FOR"I:=1"STEP"1"UNTIL"48"DO"
"FOR"J:=1"STEP"1"UNTIL"55"DO"
"READ"XA{I,J};
"FOR"I:=1"STEP"1"UNTIL"48"DO"
"FOR"J:=1"STEP"1"UNTIL"55"DO"
"READ"YA{I,J};
A:=0;
RETURN:
A:=A+1;
TX:=TY:=SUMSQX:=SUMSQY:=0;
M:=N:=48;
"FOR"I:=1"STEP"1"UNTIL"M"DO"
"BEGIN"X:=XA{I,A};
TX:=TX+X;
SUMSQX:=SUMSQX+X↑2;
"END";
"FOR"J:=1"STEP"1"UNTIL"N"DO"
"BEGIN"Y:=YA{J,A};
TY:=TY+Y;
SUMSQY:=SUMSQY+Y↑2;
"END";
K:=TX/M;
L:=TY/N;
P:=M*(K↑2);
Q:=N*(L↑2);
S:=SQRT((SUMSQX+SUMSQY-P-Q)/(M+N-2));
R:=SQRT((M+N)/(M*N));
T:=(K-L)/(S*R);
"PRINT"T,  SAMELINE  ,´´S3``,A;
"IF"A=55"THEN""GOTO"NEXT"ELSE""GOTO"RETURN;
NEXT:
"END";
```

APPENDIX 2

A set of Tables showing the means and standard deviations of scores obtained on the Personality Test Battery by male and female subjects. Where comparable norms are given in the test manuals, these have been included here for readers' convenience.

MEANS AND STANDARD DEVIATIONS OF AGE OF SUBJECTS (IN YEARS).

Stirling University Sample

	MEAN		STANDARD DEVIATION	
	Men	Women	Men	Women
	20.50	19.92	4.78	4.53
N =	96	96	96	96

MEANS AND STANDARD DEVIATIONS FOR THE TRAIT SCORES OF THE CATTELL 16 P.F. QUESTIONNAIRE.

Stirling University Sample

TRAIT	MEANS			STANDARD DEVIATIONS		
	Men	Women	Both	Men	Women	Both
A	8.95	11.06	10.0	3.06	3.24	3.32
B	9.38	8.99	9.2	1.64	1.99	1.84
C	12.67	12.43	12.5	3.36	4.24	3.83
E	14.67	11.45	13.1	4.35	4.56	4.74
F	14.38	15.67	15.0	4.70	5.19	4.99
G	9.00	10.25	9.6	3.88	3.63	3.79
H	10.83	10.27	10.6	4.74	5.36	5.07
I	11.10	12.98	12.0	3.47	3.49	3.60
L	9.80	9.08	9.4	3.41	3.08	3.27
M	14.17	13.71	13.9	3.82	3.37	3.61
N	10.04	9.79	9.9	2.88	3.42	3.16
O	11.06	12.82	11.9	3.81	4.11	4.06
Q1	10.80	9.70	10.3	2.42	2.75	2.65
Q2	12.42	11.92	12.2	3.09	3.37	3.25
Q3	7.79	8.43	8.1	2.72	3.01	2.88
Q4	13.63	15.81	14.7	4.89	4.38	4.77
N =	96	96	192	96	96	192

MEANS AND STANDARD DEVIATIONS OF THE TRAIT SCORES FOR THE EDWARDS PERSONAL PREFERENCE SCHEDULE

Manual Norms for College Sample

TRAIT	MEANS			STANDARD DEVIATIONS		
	Men	Women	Both	Men	Women	Both
ach	15.66	13.08	14.38	4.13	4.19	4.36
def	11.21	12.40	11.80	3.59	3.72	3.71
ord	10.23	10.24	10.24	4.31	4.37	4.34
exh	14.40	14.28	14.34	3.53	3.65	3.59
aut	14.34	12.29	13.31	4.45	4.34	4.53
aff	15.00	17.40	16.19	4.32	4.07	4.36
int	16.12	17.32	16.72	5.23	4.70	5.01
suc	10.74	12.53	11.63	4.70	4.42	4.65
dom	17.44	14.18	15.83	4.88	4.60	5.02
aba	12.24	15.11	13.66	4.93	4.94	5.14
nur	14.04	16.42	15.22	4.80	4.41	4.76
chg	15.51	17.20	16.35	4.74	4.87	4.88
end	12.66	12.63	12.65	5.30	5.19	5.25
het	17.65	14.34	16.01	5.48	5.39	5.68
agg	12.79	10.59	11.70	4.59	4.61	4.73
con	11.53	11.74	11.64	1.88	1.79	1.84
N =	760	749	1509	760	749	1509

Stirling University Sample

TRAIT	MEANS			STANDARD DEVIATIONS		
	Men	Women	Both	Men	Women	Both
ach	15.5	13.0	14.3	4.12	3.85	4.17
def	10.4	10.3	10.3	3.47	3.87	3.67
ord	9.5	9.5	9.5	4.98	4.86	4.92
exh	13.8	13.1	13.4	3.86	3.68	3.78
aut	16.8	14.6	15.7	4.43	4.42	4.57
aff	14.1	16.7	15.4	4.05	4.41	4.44
int	17.2	17.4	17.3	5.49	4.30	4.93
suc	12.3	14.3	13.3	4.87	4.90	4.99
dom	12.7	8.9	10.8	5.15	4.23	5.08
aba	11.8	15.2	13.5	5.09	4.87	5.27
nur	15.5	17.7	16.6	5.18	4.16	4.82
chg	15.8	17.7	16.7	4.49	4.49	4.59
end	12.8	12.5	12.6	5.62	5.52	5.57
het	18.3	17.0	17.7	6.14	5.48	5.86
agg	13.5	12.1	12.8	4.99	4.49	4.80
con	12.1	12.0	12.1	1.78	1.79	1.79
N =	96	96	192	96	96	192

MEANS AND STANDARD DEVIATIONS OF THE TRAIT SCORES FOR THE GUILFORD/ZIMMERMAN TEMPERAMENT SURVEY

Manual Norms

TRAIT	MEANS			STANDARD DEVIATIONS		
	Men	Women	Both	Men	Women	Both
G	17.0	17.0	17.0	5.64	5.20	5.46
R	16.9	15.8	16.4	4.94	4.73	4.89
A	15.9	13.7	15.0	5.84	5.52	5.82
S	18.2	19.6	18.8	6.97	6.33	6.56
E	16.9	15.5	16.3	6.15	5.76	6.02
O	17.9	16.8	17.4	4.98	5.37	5.18
F	13.8	15.7	14.6	5.07	4.79	5.06
T	18.4	18.1	18.2	5.11	4.70	4.90
P	16.7	17.6	17.1	5.05	4.88	5.00
M	19.9	10.8	16.1	3.97	4.12	6.05
*N =	523	389	912	523	389	912

*For all except score T, for which the N's were 116, 136, and 252.

Stirling University Sample

TRAIT	MEANS			STANDARD DEVIATIONS		
	Men	Women	Both	Men	Women	Both
G	14.2	14.8	14.5	5.04	5.89	5.49
R	15.1	14.8	15.0	5.07	4.74	4.91
A	15.0	12.1	13.5	6.44	5.34	6.10
S	13.9	16.1	15.0	6.32	6.46	6.49
E	14.4	11.6	13.0	6.03	5.77	6.06
O	16.2	14.1	15.2	5.44	5.40	5.53
F	13.1	14.6	13.8	5.66	4.45	5.15
T	19.0	19.3	19.1	5.39	4.55	4.99
P	13.1	14.5	13.8	4.44	4.88	4.72
M	18.6	11.3	15.0	4.29	3.70	5.43
N =	96	96	192	96	96	192

MEANS AND STANDARD DEVIATIONS OF THE TRAIT SCORES OF THE STUDY OF VALUES TEST

Manual Norms for British Sample

TRAIT	MEANS			STANDARD DEVIATIONS	
	Men	Women	Both	Men	Women
Theoretical	32.82	30.80	31.81	6.48	5.95
Economic	30.29	26.38	28.32	7.15	7.10
Aesthetic	24.34	27.94	26.15	7.82	7.83
Social	38.90	40.97	39.94	7.51	5.49
Political	26.42	21.64	24.02	7.23	6.82
Religious	27.21	32.27	29.76	12.49	12.76
N =	324	326	650	324	326

Stirling University Sample

TRAIT	MEANS			STANDARD DEVIATIONS	
	Men	Women	Both	Men	Women
Theoretical	32.4	31.7	32.1	6.26	5.50
Economic	31.3	28.6	29.9	8.16	6.32
Aesthetic	28.5	29.5	29.0	9.66	8.26
Social	36.5	41.1	38.8	6.68	6.52
Political	29.5	24.9	27.2	7.32	6.74
Religious	21.9	24.1	23.0	12.07	10.94
N =	96	96	192	96	96

The Standard Deviations for "Both" (i.e. Males and Females combined) are not given in the Test Manual, and are not therefore cited for the Sample from Stirling University.

MEANS AND STANDARD DEVIATIONS OF THE TRAIT SCORES OF THE TEST OF SOCIAL INSIGHT

Manual Norms for College Students and Adults.

TRAIT	MEANS		STANDARD DEVIATIONS	
	Men	Women	Men	Women
Withdrawal	4.39	5.42	2.38	5.10
Passivity	10.96	12.83	4.08	4.43
Cooperativeness	31.45	33.23	4.87	6.01
Competitiveness	6.36	5.63	2.90	2.26
Aggressiveness	6.37	3.49	3.62	2.34
Total Score	21.39	17.36	6.01	5.04
N =	350	350	350	350

Stirling University Sample

TRAIT	MEANS		STANDARD DEVIATIONS	
	Men	Women	Men	Women
Withdrawal	3.85	3.86	2.41	1.96
Passivity	12.88	12.89	4.90	3.68
Cooperativeness	27.39	29.77	5.72	5.03
Competitiveness	7.44	6.80	2.87	2.77
Aggressiveness	8.42	6.66	3.53	2.77
Total Score	26.10	23.30	6.78	5.66
N =	96	96	96	96

APPENDIX 3

"Percor" - a computer programme designed to calculate the Mean and Standard Deviations of the scores for 96 subjects on each of 55 variables; and to perform all possible intercorrelations for these scores.

```
PERCOR;
"BEGIN"
"INTEGER"I,J,P,Q;
"REAL"K,X2T,Y2T,XYT;
"REAL""ARRAY"BM{1:2},C{1:2,1:96},R{1:55,1:55},SD{1:2},A{1:55,1:96},
B{1:2};
"FOR"I:=1"STEP"1"UNTIL"2"DO"
B{I}:=0;
"FOR"I:=1"STEP"1"UNTIL"55"DO"
"FOR"J:=1"STEP"1"UNTIL"55"DO"
R{I,J}:=1;
P:=1;
Q:=2;
"FOR"J:=1"STEP"1"UNTIL"96"DO"
"FOR"I:=1"STEP"1"UNTIL"55"DO"
"READ"A{I,J};
START:
B{1}:=0;
B{2}:=0;
"FOR"J:=1"STEP"1"UNTIL"96"DO"
"BEGIN"
B{1}:=B{1}+A{P,J};
B{2}:=B{2}+A{Q,J};
"END";
"FOR"I:=1"STEP"1"UNTIL"2"DO"
BM{I}:=B{I}/96;
"IF"P=1"THEN""BEGIN"
"IF"P=1"AND"Q=1"THEN""GOTO"STOP;
"PRINT"´´L` M `,SAMELINE,P,Q,´´S2``,BM{1},´´S2``,BM{2};
STOP:
"END";
"FOR"J:=1"STEP"1"UNTIL"96"DO"
"BEGIN"
C{1,J}:=A{P,J}-BM{1};
C{2,J}:=A{Q,J}-BM{2};
"END";
X2T:=0;
Y2T:=0;
XYT:=0;
"FOR"I:=1"STEP"1"UNTIL"96"DO"
"BEGIN"
X2T:=X2T+(C{1,I}↑2);
Y2T:=Y2T+(C{2,I}↑2);
XYT:=XYT+(C{1,I}*C{2,I});
"END";
"IF"P=1"THEN""BEGIN"
"IF"P=1"AND"Q=1"THEN""GOTO"BACK;
SD{1}:=SQRT(X2T/96);
SD{2}:=SQRT(Y2T/96);
"PRINT"´´L` SD `,SAMELINE,´´S2``,SD{1},´´S2``,SD{2};
BACK:
```

```
"END";
K:=(1/2);
R{P,Q}:=XYT/((X2T*Y2T)↑K);
R{Q,P}:=R{P,Q};
Q:=Q+1;
"IF"Q=56"THEN"
"BEGIN"
P:=P+1;
Q:=P+1:
"END";
"IF"P=55"THEN""GOTO"FIN;
"IF"P=2"AND"Q=3"THEN""PRINT"´´L` D MACK - CORRELATIONS `;
"GO TO"START;
FIN:
"FOR"P:=1"STEP"1"UNTIL"55"DO"
"FOR"Q:=1"STEP"1"UNTIL"55"DO"
"PRINT"´´L` R`,SAMELINE,P,Q,´´S4``,R{P,Q};
"END";
```

APPENDIX 4

Letters sent to all subjects.

DEPARTMENT OF PSYCHOLOGY

Dear

I am writing to ask for your help in some research on which I am presently working. The work for which I require your help consists of two sessions for the completion of five questionnaires, followed at a later date by one experimental session. Each session will last approximately 1½ hours.

The questionnaires give an assessment of various personality traits, and the results are, of course, confidential. (If you wish, your own score will be given to you personally, but it will not be available to anyone else.) At the present stage I cannot disclose the nature of the experiment, but will be quite happy to discuss it with you in the future when the work is completed. In the meantime I would be grateful for your help in completing the questionnaires.

If you are prepared to help, I would like you to come to the Main Lecture Theatre for the two questionnaire sessions on :-

.... at ..... p.m.

and .... at ..... p.m.

While I realize that the time involved is considerable, the work is not at all stressful or over-demanding, and it provides an opportunity whereby you can compare various aspects of your own personality with the norm of the student body as a whole.

If you cannot attend the first session, please leave a note or come and see me in Block D Room 13, so that we can arrange an alternative time.

Trusting you will be sufficiently interested to take part in this research project, I am

Yours sincerely,

David Mack.

DEPARTMENT OF PSYCHOLOGY

Dear

Since I last wrote to you asking for your help in my research project, on searching through the questionnaires completed at the testing sessions, I notice that you were not present at the times requested. I realize that you may simply have forgotten, or that the times suggested were inconvenient for other reasons.

It is important that as many students as possible are tested and I would still like you to take part in the project. As the entire research project cannot be completed without these results, I would stress that your help is vital, and I ask you to make every effort to help. Please complete the attached slip and return it to me as soon as possible.

Thanking you for your help, I am,
Yours sincerely,

David Mack
Room D10

.....

.... (a) I shall be willing to help and will complete the remaining questionnaires (in Room D10) on :-

.... at .....
(day) (date) (time)

.... (b) I do NOT wish to give any further help in the research project.

(Signed): ..... Student Registration No.: .....

DEPARTMENT OF PSYCHOLOGY

Dear

I would like to thank you for your help already given, and to ask if you are willing to help again. The results so far obtained from you can only be useful if they are combined with data gathered from the experimental session.

The session will last for approximately 30 minutes and will be held in the Communications Laboratory (Room D.10). As it is best that you approach the experimental session with an "open mind", I cannot disclose the nature of the experiment at present, but will be quite happy to discuss it with you at a later date when the work is completed. In the meantime I would be grateful if you would call at Room D.10 to arrange a suitable time for the experimental session.

It is important that you try to call within the next few days as I want to distribute scores before the end of the present semester and this cannot be done until everyone has completed the tests.

Thanking you for your help, I am

Yours sincerely,

David Mack

APPENDIX 5

A sample Data Recording Sheet.

DATA RECORDING SHEET

GAME:

Player 'A': ..... Score: ..... SEX :

GROUP :

Player 'B': ..... Score: .....

ATTEMPT

TRIAL	1		2		3		4		5		6	
	A	B	A	B	A	B	A	B	A	B	A	B
1												
2												
3												
4												
5												
6												
25												
26												
27												
28												
29												
30												

APPENDIX 6

Instructions to subjects. In the following instructions round brackets, ( ) indicate that with female subjects the word inside the brackets is substituted for that immediately preceeding it.
Square brackets, [ ], indicate steps to be taken by the experimenter at that particular stage in the administration of instructions to subjects.

INSTRUCTIONS GIVEN TO ALL SUBJECTS

"For the experiment today, I want you to take part in an experimental game involving two people - yourself and one other male (female). For the purposes of the game I want you to imagine yourself as the representative of a local manufacturing company which has just won a valuable contract from a buyer in the south of England. As the firm's representative, your job is to ensure that its profits are as high as possible. The profits on the present contract depend entirely on how quickly you can deliver the goods to the buyer - the quicker you deliver them, the more profit you make. There are only two suitable ways of transporting the product - by Freightliner, which is a fast efficient service, and by normal Goods Train which is slower and less reliable.

A second company, represented by the other player in the game, also has a contract for the delivery of goods where profits also depend on speed of delivery, and the same methods of transport are available. Now, while it is obviously to the advantage of both companies to send goods by Freightliner, there is a problem in that there are not enough containers available to take both companies goods by Freightliner at the same time. As a result, during the course of the game you must come to some arrangement with the other player over the use of the transport available.

In addition to the two methods of transport, a third choice is available - to Wait and allow the other person to send his (her) goods by Freightliner first and then to send your goods by Freightliner afterwards. Because there are not enough containers available, should both players choose Freightliner at the same time, a blockage will occur. This blockage means a delay will ensue and, since profits depend on speed of delivery, the profits to be made on the batch of goods will be smaller. Similarly, should both players choose to Wait at the same time,

a blockage and delay, accompanied by a loss in potential profit, will occur. This is because Player 'A' decides to Wait and allow Player 'B' to use Freightliner first; Player 'B', at the same time, and unknown to Player 'A', also decides to Wait. As a result both players wait and then, later, try to send their goods by Freightliner simultaneously. Once again, there are not enough containers available and a blockage and delay occurs. The plan of the game is shown on the matrix board in front of you. There you will see six matrices. The top left-hand one is illuminated. You will find yourself listed at the left-hand side of the matrix together with your three available choices - Freightliner, Wait, and Goods Train. The other player is listed at the top of the matrix. To calculate your possible profit, you read across the matrix in rows, taking the left-hand figure in each square as the amount you may gain. Thus you can see that if you choose Freightliner, then you will gain 20 points, unless the other player also chooses Freightliner, when a blockage will occur. Likewise, if you choose to Wait, you will gain 15 points unless the other player also chooses to Wait, when a blockage will occur. If you choose Goods Train, then you will gain 10 points, regardless of what the other player may choose.

As has already been explained, if both players choose Freightliner at the same time, or Wait at the same time, then a blockage occurs and the potential profit is lowered. This delay and blockage giving a lower profit is represented by moving to the second matrix which I have illuminated for you now. [Here the experimenter shifts the illumination from Matrix 1 to Matrix 2]. Here you can see that the situation is exactly the same as before - you are listed in the same place and have the same three choices as before, the only difference is that the possible profits are lower. Whereas before you could gain 20, 15, or 10 points, now you can only gain 15, 10, or 5 points. Since you still have three

alternatives from which to choose, it is possible that you may block again, in which case you move down to the next matrix which I have illuminated for you now. [Here the experimenter shifts the illumination from Matrix 2 to Matrix 3.] Here you can see that the situation is again the same as before, but the profits are lower still - 10, or 5, or nothing at all. Should you block again, we move down another matrix, [Here the experimenter shifts the illumination to Matrix 4], where the profits are again lower. And, each time you block, we continue to move down a matrix [Experimenter moves illumination to Matrix 5], and each time the profits decrease; until finally we arrive at the sixth matrix in the bottom right-hand corner of the matrix board which I have illuminated now [Here the experimenter shifts the illumination to Matrix 6.] Here you can see that no matter what you do, you are going to suffer a loss : -5, -10, or -15. Obviously the best you can do here is to make the loss as small to yourself as possible. If on this sixth attempt you still fail to send the goods - that is, you both choose Freightliner or Wait and cause yet another blockage - then, remembering that by the time you arrive at the sixth matrix you have already had five delays in trying to send the same batch of goods, we invoke a penalty clause in the contract which states that for failing to deliver a batch of goods on time, each player suffers a loss of 25 points. That is, if you block on the last matrix you lose 25 points. Now, when you have sent a batch of goods, whether it be on the first attempt, or the third attempt, or the sixth attempt, or if you don't manage to send goods and suffer a loss of 25 penalty points, then we always return to the top-left-hand corner and the first matrix and begin sending another batch of goods. [Here the experimenter returns the illumination to the first matrix]. You will be required to send several batches of goods in this way.

To keep an account of your own profits and losses throughout

the game, you will find beside the microphone a counter which registers 100 points. This hundred points is given to you as a sort of working capital and, as we go through the game, when you make a profit we will add to it; when you make a loss we will subtract from it, so that at any point during the game you can see how well or how badly you are doing. At the end of the game this 100 points will be subtracted so that the counter will show the amount which you yourself have won or lost in the course of the experiment.

Regarding the actual running of the experiment, there are one or two minor points. Firstly, we always work on the illuminated matrix, so that you can see at a glance the possible profit you can make from your next choice. Secondly, you always choose independently of the other player. That is, each player chooses without knowing what the other player is choosing. What happens is that I will ask you for your choice, you'll give it; I'll ask the other player for his (her) choice, he (she) will give it; then I will come back and tell you how both players chose, for example, "Player 'A' went Goods Train, Player 'B' went Goods Train." Whereupon I will adjust your counter, in this example by adding 10, and then we will begin another new batch of goods".

SUPPLEMENTARY INSTRUCTIONS FOR SUBJECTS IN GAME I ONLY

"I have explained to you how to calculate your own profit; as yet I haven't said anything about the other person's profit. To calculate this you read the matrix from the opposite direction. For your own profit, you read across the matrix in rows and take the left-hand figure as I have already explained. To calculate the other person's profit, you read down the matrix in columns and take the right-hand figure to represent his (her) potential profit. You can see that if you yourself choose Freightliner then you will gain 20 points unless there is a blockage. Reading the other way for the other person's profits, if he (she) chooses Freightliner, then reading down in columns and taking the right-hand figure, you can see that he (she) will also get 20 points unless there is a blockage. Similarly, if you choose to Wait then you will gain 15 points unless there is a blockage. If the other person chooses to Wait then you can see that he (she) will also get 15 points unless there is a blockage, and so on throughout the game.

Finally I want to stress that your object in the game is to make as much profit as possible for yourself. There are six cash prizes for the six people who make most profit over the whole experiment. Your object is to do well enough in order to win a prize for yourself."

SUPPLEMENTARY INSTRUCTIONS FOR SUBJECTS IN GAME II ONLY

"I have explained to you how to calculate your own profit; as yet I haven't said anything about the other person's profit. To get some idea of this you read the matrix from the opposite direction. For your own profit, you read across the matrix in rows and take the left-hand figure as I have already explained. To calculate the other person's profit you read down the matrix in columns and take the right-hand figure to represent his (her) potential profit. However, you will see that there are three right-hand figures in each square. All this really means is that you don't know quite how much the other person will get. You can see that if you yourself choose Freightliner then you will gain 20 points unless there is a blockage. Reading the other way for the other person's profits, if he (she) chooses Freightliner, then reading down in columns and taking the right-hand figure, you can see that he (she) will get either 25 points, or 20 points, or 15 points - you don't know which. That is, he (she) may get the same as you, or he (she) may get a bit more, or he (she) may get a bit less. Similarly, if you choose to Wait then you will gain 15 points unless there is a blockage. If the other person chooses to Wait, then you can see that he (she) will get either 20, or 15, or 10 points; and so on throughout the game. The important thing to remember is that the other person always works at the same level of profit. That is, if he (she) gains 25 points by using Freightliner, then he (she) will gain 20 by waiting, and 15 by using Goods Train. If he (she) gains 15 points by using Freightliner then he (she) will gain 10 by waiting and only 5 by using Goods Train. In other words, he (she) works at the same level of profit all the way through. He (she) either gets the top figure, or the middle figure, or the bottom figure. Also while you know your own profit and have some idea of how much the other person gets, the other person knows his (her) own profit and has some idea as to how much you get.

Finally I want to stress that your object in the game is to make as much profit as possible for yourself. There are six cash prizes for the six people who make most profit over the whole experiment. Your object is to do well enough in order to win a prize for yourself."

APPENDIX 7

In the appendix which follows, the choices made by the players in each dyad are given in the order in which they occurred (reading by row). In each case, the choices are listed alternately, the first figure referring to the first subject listed, the second figure to the second subject listed, the third to the first subject, the fourth to the second subject, and so on.

The numerals 1, 2, and 3 indicate the choices "Freightliner", "Wait", and "Goods Train" respectively. Where the figure 4 occurs it indicates the end of a single trial; 5 indicates the termination of the experiment for the dyad.

GAME I - MALE SUBJECTS

KNOWLES, D.M., BISHOP, G.

1 2 4 2 1 4 1 1 1 1 1 2 4 2 2 3 1 4 1 1 1 1 2 1 4 2
2 2 2 2 2 2 1 4 2 2 1 1 1 1 1 1 2 2 2 1 4 1 1 1 2 4
2 1 4 2 1 4 1 2 4 1 2 4 1 1 2 1 4 2 2 2 2 1 2 4 1 1
1 1 2 1 4 2 2 1 2 4 1 1 3 1 4 1 1 1 1 1 1 1 1 2 1 4
2 2 1 2 4 2 1 4 2 2 2 2 1 2 4 1 1 1 1 1 1 1 1 1 1 1
1 4 1 1 2 1 4 2 2 1 2 4 1 1 2 1 4 1 1 2 1 4 2 2 1 2
4 1 2 4 1 1 1 1 1 1 2 1 4 1 3 5

MITCHELL, G.R., WATT, A.

1 1 3 3 4 2 2 1 1 1 3 4 2 1 4 1 2 4 1 1 1 1 1 1 1 1
2 1 4 1 2 4 1 1 3 2 4 2 2 2 1 4 1 1 1 1 1 3 4 1 1 2
2 1 1 2 2 1 1 1 1 4 2 1 4 1 2 4 1 3 4 2 1 4 2 1 4 1
2 4 1 1 2 1 4 1 1 1 1 2 1 4 1 1 3 1 4 2 2 2 1 4 1 1
1 1 3 1 4 1 2 4 1 2 4 1 1 1 1 2 2 2 2 1 1 2 1 4 1 1
1 1 3 1 4 2 2 3 1 4 1 1 2 1 4 1 2 4 1 1 1 1 1 1 2 1
4 1 1 2 2 2 1 5

DONALD, A.P., KOREN, J.H.

3 2 4 2 1 4 3 2 4 1 3 4 1 1 1 1 1 2 4 3 3 4 2 1 4 2
2 3 1 4 1 1 1 1 1 1 1 3 4 1 3 4 2 1 4 3 2 4 1 3 4 1
2 4 2 1 4 1 2 4 1 1 3 2 4 3 3 4 3 1 4 3 2 4 2 3 4 2
2 1 1 2 1 4 1 1 1 1 1 1 1 1 1 1 1 1 4 3 1 4 2 1 4 3
1 4 1 1 1 2 4 1 1 3 2 4 2 1 4 1 1 3 2 5

EAVES, R.M., SCOTT, J.

1 1 1 1 1 1 1 1 1 1 2 1 4 2 1 4 2 1 4 2 1 4 3 1 4 2
1 4 1 1 3 1 4 2 1 4 2 1 4 1 1 1 1 2 1 4 1 1 2 1 4 2
1 4 1 1 2 1 4 1 1 1 1 2 1 4 1 1 2 1 4 1 1 1 1 1 1 2
1 4 2 1 4 2 1 4 2 1 4 2 1 4 2 1 4 1 1 2 1 4 2 1 4 2
1 4 2 1 4 2 1 4 2 1 4 2 1 4 2 1 4 2 1 5

WIGHT, J.S., BENNIE, T.

1 1 1 3 4 3 2 4 1 1 1 1 1 1 1 2 4 2 2 2 2 1 1 1 1 1
2 4 2 1 4 1 1 1 1 2 2 1 1 1 1 1 2 4 3 1 4 1 1 1 2 4
2 2 2 2 2 2 2 1 4 1 1 1 1 1 2 4 1 1 2 2 2 1 4 1 2 4
2 1 4 2 1 4 1 1 1 1 1 1 1 1 1 2 4 2 1 4 1 1 3 2 4 1
1 1 1 1 2 4 1 2 4 1 1 1 2 4 1 2 4 1 1 2 1 4 1 2 4 2
1 4 1 1 1 1 1 2 4 2 1 4 1 1 1 1 1 1 1 2 4 1 1 2 2 2
2 2 1 4 1 1 1 1 1 2 4 2 2 2 1 5

LALOR, J.G., HENDRY, A.

2 1 4 3 2 4 2 1 4 1 1 2 1 4 1 2 4 2 3 4 2 2 1 2 4 1
1 2 1 4 1 2 4 1 1 1 2 4 1 1 1 1 1 2 4 3 1 4 2 1 4 1
2 4 2 3 4 2 2 1 1 1 1 1 1 1 2 4 1 2 4 2 1 4 1 3 4 3
1 4 1 1 1 1 1 2 4 1 2 4 2 1 4 2 1 4 1 1 2 2 1 2 4 1
1 2 2 1 1 1 1 1 1 1 1 4 2 3 4 2 2 1 1 1 2 4 1 1 1 2
4 1 2 5

JONES, D.J., RANKIN, E.W.

1 2 4 1 1 1 1 1 2 4 2 1 4 1 1 1 1 1 1 1 2 4 2 3 4 2
1 4 1 1 1 3 4 1 2 4 2 1 4 1 1 1 2 4 1 3 4 1 1 1 1 1
1 1 1 1 1 1 1 4 1 2 4 2 1 4 1 1 1 2 4 2 1 4 1 1 1 2
4 2 2 1 2 4 2 1 4 1 1 1 3 4 1 1 1 2 4 2 1 4 1 2 4 2
1 4 1 1 1 3 4 1 1 2 1 4 1 1 1 1 1 1 2 4 2 1 4 1 1 1 1
1 2 4 2 1 5

MYLES, A.B., LEWIS, P.A.

2 1 4 1 3 4 2 1 4 1 1 1 1 1 1 2 1 4 1 1 1 1 1 1 1 1
1 1 1 1 4 1 2 4 1 1 1 1 1 1 1 1 2 4 1 1 1 1 1 1 1 1 2
1 4 2 1 4 1 2 4 2 1 4 1 1 1 1 1 1 1 2 4 2 1 4 1 1 1
2 4 2 1 4 1 1 1 1 1 2 4 2 1 4 1 2 4 2 1 4 1 2 4 2 1
4 1 1 1 1 1 1 1 1 1 2 1 4 1 1 1 1 1 2 4 1 1 2 2 2 1 4
1 1 1 2 4 2 1 4 1 2 4 2 1 4 1 2 4 2 1 5

HEWITT, M.H., SMITH, K.A.

1 2 4 2 2 2 2 1 1 3 1 4 3 2 4 3 1 4 1 1 2 1 4 2 1 4
1 1 1 1 3 1 4 2 1 4 3 2 4 1 1 2 2 1 1 2 1 4 3 1 4 2
1 4 1 1 1 1 1 1 1 1 2 1 4 2 1 4 2 1 4 1 1 2 1 4 2 1
4 1 1 2 1 4 2 1 4 2 1 4 3 2 4 1 1 3 1 4 1 1 1 1 1 1
1 3 4 1 3 4 2 3 4 1 1 1 1 3 1 4 2 3 4 3 1 4 2 2 2 1
4 1 1 3 2 5

WELSH, T., McLUSKY, D.

2 1 4 1 1 1 3 4 2 1 4 1 1 1 2 4 2 1 4 1 1 1 1 1 3 4
2 2 1 1 1 1 2 2 2 1 4 1 2 4 2 1 4 1 1 1 3 4 2 1 4 1
2 4 2 1 4 1 1 1 2 4 2 1 4 1 2 4 2 1 4 1 1 1 1 1 3 4
2 1 4 1 2 4 2 1 4 1 2 4 2 1 4 1 2 4 2 1 4 1 2 4 2 1
4 1 2 4 2 1 4 1 2 5

SMALL, D.B., CREGEEN, M

2 1 4 1 1 3 1 4 1 1 1 1 1 1 1 1 1 2 4 1 2 4 1 2 4 1
1 2 2 1 1 1 2 4 1 1 1 1 3 1 4 1 1 1 1 1 1 1 2 4 1 2
4 1 1 1 1 1 2 4 1 1 1 1 1 1 1 1 1 3 2 4 1 1 1 2 4
1 2 4 1 2 4 1 2 4 1 1 1 1 2 1 4 1 2 4 1 2 4 1 1 1 1
2 1 4 1 1 1 1 2 1 4 1 1 1 1 1 1 1 1 1 1 1 4 1 1 1
2 4 1 2 4 1 2 4 1 2 4 1 2 4 1 2 4 1 2 4 1 2 4 1 2 5

SHORT, J.J.O., THOMAS, K.H.

1 1 1 1 2 1 4 1 1 1 1 1 1 1 1 1 3 4 1 1 1 1 1 1 1 1
1 1 2 1 4 1 2 4 1 1 1 1 1 1 1 1 2 1 4 1 1 1 1 2 1 4
1 1 1 1 1 1 1 1 1 1 1 1 4 1 2 4 1 1 1 1 1 1 2 2 1 1
1 1 4 1 2 4 1 1 1 1 1 2 4 1 1 1 1 2 1 4 1 1 1 1 1 2
4 1 1 2 1 4 1 1 1 1 1 2 4 1 1 1 1 1 1 2 1 4 1 1 1 1
1 1 1 2 4 1 1 2 1 4 1 1 1 1 1 2 4 2 1 4 1 2 4 1 1 1
1 1 1 1 1 1 1 1 1 4 1 1 2 1 4 1 2 4 1 1 1 1 1 1 1 1
1 2 4 1 1 2 1 4 1 1 1 1 1 2 4 1 2 4 1 1 1 1 1 1 2 1
4 1 1 1 1 1 2 5

FOSTER. W.F.R., HOTCHKIS. R.

1 1 1 1 1 2 4 1 1 2 1 4 1 2 4 1 1 2 1 4 1 2 4 2 1 4
1 1 1 1 1 1 1 1 1 1 1 1 4 1 1 2 1 4 2 1 4 1 2 4 2 1
4 1 1 2 2 1 3 4 2 2 1 2 4 1 1 2 1 4 2 1 4 1 1 1 1 2
1 4 1 1 1 1 1 1 1 1 1 1 3 2 4 1 1 2 1 4 2 1 4 2 2 1
1 1 1 2 1 4 2 1 4 2 1 4 1 1 1 1 2 1 4 1 1 2 1 4 2 1
4 2 1 4 2 1 4 2 1 4 2 1 4 2 1 5

THOMPSON, E.S., HERON. D.

2 1 4 1 1 1 3 4 2 1 4 2 3 4 2 2 2 2 1 2 4 1 3 4 1 1
1 1 1 1 1 1 1 1 2 1 4 2 1 4 2 1 4 1 3 4 2 3 4 2 2 2
3 4 1 1 1 2 4 2 1 4 2 1 4 1 1 1 2 4 1 1 1 2 4 2 3 4
1 1 1 1 2 1 4 1 1 2 2 1 1 2 1 4 2 1 4 2 1 4 1 2 4 1
3 4 2 3 4 2 1 4 1 1 1 2 4 1 2 4 1 1 2 1 4 2 1 5

DYAS, W.A., HUNTER, A.C.J.

1 1 3 1 4 1 1 1 1 1 1 2 2 2 1 4 2 1 4 2 2 1 2 4 3 1
4 1 1 2 1 4 1 1 1 1 1 1 1 1 1 1 1 4 2 1 4 1 2 4 3
1 4 1 1 1 1 1 2 1 4 1 1 2 1 4 1 2 4 3 1 4 1 2 4 2
1 4 2 1 4 1 2 4 1 1 3 1 4 1 1 1 1 1 1 2 1 4 1 1 2 1
4 1 2 4 2 1 4 2 1 4 1 2 4 1 1 2 1 4 1 1 1 1 3 1 4 1
1 2 1 4 1 1 1 1 1 1 1 1 1 1 2 4 1 1 1 1 1 2 5

McILROY, J.F., MARTIN, P.A.

1 1 3 3 4 1 1 3 2 4 1 1 3 1 4 2 1 4 1 1 2 1 4 1 1 1
1 1 1 3 1 4 2 1 4 2 1 4 2 1 4 1 1 1 1 2 1 4 2 1 4 1
1 2 1 4 2 1 4 2 1 4 1 1 2 1 4 2 1 4 2 1 4 2 1 4 2 1
4 2 1 4 2 1 4 2 1 4 2 1 4 2 1 4 2 1 4 2 1 4 2 1 4 2
1 4 2 1 4 2 1 5

CLEGG, F.G., MAIR, A.C.C.

3 1 4 1 1 2 3 4 1 1 3 2 4 2 2 1 1 2 2 1 1 3 2 4 1 1
2 1 4 3 2 4 2 1 4 1 1 2 1 4 3 1 4 2 1 4 1 1 1 1 1 3
4 3 1 4 1 1 2 1 4 3 1 4 2 1 4 1 1 1 1 1 1 2 1 4 3 2
4 1 1 2 1 4 1 1 3 1 4 3 1 4 1 2 4 1 1 1 1 1 3 4 2 1
4 3 1 4 1 1 1 1 1 1 1 2 4 2 1 4 1 1 2 2 1 1 1 1 1 1
2 2 4 1 1 3 2 4 2 2 1 2 4 1 1 1 1 1 1 1 2 5

MACLEOD, A.M., LAING, D.

2 1 4 1 2 4 3 2 4 1 2 4 1 1 2 1 4 1 1 3 2 4 1 1 2 3
4 2 1 4 1 2 4 2 2 1 1 2 1 4 1 2 4 2 1 4 1 2 4 2 2 1
3 4 2 1 4 2 1 4 1 2 4 1 2 4 2 1 4 2 1 4 2 1 4 1 2 4
1 2 4 1 1 3 1 4 1 2 4 1 1 1 1 3 1 4 1 2 4 2 2 1 2 4
1 1 3 1 4 2 1 5

MUNRO, R.J.B., BOYD, E.R.

1 1 1 1 3 1 4 2 3 4 2 1 4 1 1 1 2 4 1 2 4 1 1 2 1 4
1 1 1 1 1 1 2 1 4 1 1 1 2 4 1 1 2 1 4 1 2 4 1 1 1 1
3 1 4 1 1 1 2 4 2 1 4 3 2 4 2 1 4 1 2 4 1 1 1 1 2 1
4 1 2 4 1 1 1 1 1 1 2 1 4 1 1 2 1 4 2 1 4 2 2 1 1 2
1 4 1 1 2 1 4 2 1 4 1 1 2 1 4 1 1 2 1 4 2 1 4 2 1 4
2 1 4 2 1 5

HARRISON, A.J., TODD, R.

3 2 4 1 1 1 1 2 1 4 1 1 2 2 2 1 4 3 1 4 1 2 4 1 1 1
1 1 1 3 1 4 1 2 4 2 2 1 1 1 1 1 1 1 1 1 1 4 1 1 2 3
4 2 2 1 2 4 2 1 4 3 2 4 1 1 2 2 1 1 1 2 4 2 1 4 1 1
1 2 4 3 1 4 1 2 4 1 1 2 1 4 1 2 4 1 1 1 1 1 3 4 1 1
2 1 4 1 2 4 1 1 1 1 1 1 1 2 4 2 1 4 3 2 4 1 2 4 1 2
4 2 1 4 1 1 1 1 1 2 4 3 1 5

PATRICK, J.G., CLARK, D.P.

1 1 2 2 1 1 1 1 1 2 4 3 2 4 1 1 3 1 4 1 1 1 1 1 1 1
2 4 2 1 4 1 1 1 2 4 2 1 4 1 1 1 2 4 1 1 1 1 1 2 4 2
1 4 1 1 1 2 4 1 1 1 1 1 2 4 1 2 4 1 1 1 2 4 1 1 1 1
1 1 1 1 1 1 1 2 4 2 1 4 2 1 4 1 1 1 2 4 1 2 4 1 1 1
1 1 2 4 2 1 4 2 1 4 1 1 1 2 4 2 2 1 1 3 2 4 1 2 4 2
2 2 1 4 1 1 1 2 4 2 1 4 1 1 1 1 1 2 4 2 1 5

QUINN, T.N., COWNARTY, M.

2 1 4 1 3 4 3 1 4 2 1 4 1 2 4 3 1 4 1 1 1 1 1 1 3 1
4 1 1 2 2 1 1 1 1 1 1 1 2 4 2 1 4 1 2 4 3 1 4 2 1 4
1 3 4 3 1 4 2 1 4 2 3 4 1 2 4 2 1 4 1 3 4 1 1 2 1 4
2 1 4 1 3 4 2 1 4 1 2 4 3 1 4 2 1 4 1 2 4 1 1 3 1 4
2 1 4 1 2 5

WOOLASTON, G.E., BURNETT, G.

1 3 4 1 1 1 1 2 2 3 2 4 2 1 4 2 2 1 3 4 1 1 1 1 1 1
1 1 1 2 4 3 1 4 3 2 4 1 2 4 2 1 4 1 1 1 3 4 2 1 4 1
2 4 1 1 2 1 4 3 1 4 2 2 3 2 4 1 1 1 1 1 2 4 2 2 1 1
1 1 2 2 1 1 3 2 4 1 3 4 1 1 2 2 1 1 3 3 4 2 2 1 1 1
3 4 1 3 4 2 1 4 2 2 2 1 4 1 1 1 1 1 3 4 2 1 4 2 1 4
1 2 4 2 2 2 3 4 1 1 1 1 1 1 1 2 4 2 2 1 1 1 3 5

HAMILTON, R.T., WOOD, A.

2 3 4 3 1 4 3 1 4 2 1 4 1 1 2 1 4 2 1 4 1 1 1 1 2 1
4 1 1 1 2 4 2 2 1 2 4 2 3 4 1 2 4 2 1 4 1 1 1 1 2 1
4 2 1 4 1 1 1 1 2 1 4 1 1 2 2 1 2 4 1 2 4 2 1 4 1 1
1 1 1 1 2 1 4 2 1 4 1 1 1 2 4 2 1 4 1 1 1 1 1 2 4 1
2 1 4 1 1 2 1 5

GAME I - FEMALE SUBJECTS

LEE, J., BLAKEMAN, J.

2 1 4 1 3 4 2 1 4 1 3 4 2 2 2 1 4 1 1 1 1 1 1 2 1 4
1 2 4 2 3 4 1 1 1 3 4 2 1 4 1 2 4 2 1 4 1 2 4 2 3 4
1 1 1 2 4 2 1 4 1 3 4 1 1 1 1 1 2 4 1 1 1 1 3 1 4 1
1 2 3 4 2 1 4 1 2 4 2 1 4 1 2 4 2 1 4 1 2 4 2 1 4 1
2 4 2 1 4 1 2 5

BAXTER, M.I.M., MURPHY, P.A.

1 1 1 1 3 1 4 2 3 4 1 3 4 2 1 4 1 1 3 2 4 2 1 4 1 3
4 2 2 1 2 4 2 1 4 1 1 3 2 4 2 3 4 2 2 2 3 4 2 2 3 2
4 2 1 4 1 3 4 3 3 4 2 2 2 1 4 1 1 3 1 4 1 1 2 3 4 3
3 4 2 1 4 1 2 4 2 1 4 3 2 4 2 1 4 1 3 4 2 2 2 2 2 1
4 1 1 1 1 1 3 4 2 1 4 1 2 5

NOLAN, F.J., ROBERTS, J.

1 1 3 1 4 1 2 4 1 1 1 1 1 1 1 2 4 1 3 4 1 1 1 1 2 2
2 2 1 1 1 1 4 1 2 4 2 1 4 1 1 2 1 4 1 2 4 1 1 1 1 1
1 1 1 2 2 3 2 4 1 1 1 1 2 2 1 1 1 1 1 1 4 1 1 2 2 1
2 4 3 2 4 3 2 4 2 2 3 2 4 3 1 4 1 2 4 3 2 4 1 1 3 1
4 1 1 3 2 4 1 2 4 1 2 4 1 2 4 3 2 4 1 1 3 1 4 1 1 3
2 4 2 1 4 1 1 1 2 4 1 2 4 1 1 1 2 5

SWAN, C.S., BLACK, J.

1 1 3 2 4 3 1 4 2 1 4 1 2 4 3 1 4 2 1 4 1 1 1 1 1 1
1 3 4 3 3 4 1 2 4 3 1 4 1 1 3 2 4 3 1 4 1 1 1 2 4 2
2 1 1 1 3 4 3 1 4 1 1 2 1 4 1 1 1 3 4 2 1 4 1 1 3 1
4 1 1 1 1 1 3 4 3 1 4 1 1 1 1 1 2 4 2 1 4 1 1 2 2 2
3 4 3 1 4 1 1 3 2 4 2 1 4 1 1 1 1 1 1 1 2 4 2 1 4 1
2 5

HOOD, M.A.E., CAMPBELL, J.I.

2 1 4 1 1 1 1 2 3 4 1 2 4 2 1 4 2 3 4 1 2 4 1 1 3 1
4 1 3 4 1 1 1 3 4 2 2 2 1 4 1 2 4 3 3 4 1 2 4 1 1 1
3 4 1 1 3 1 4 1 2 4 1 3 4 1 1 2 1 4 1 2 4 2 1 4 1 2
4 1 1 1 1 2 3 4 1 2 4 2 1 4 1 2 4 1 1 3 1 4 1 1 2 3
4 2 2 2 3 4 1 2 4 1 1 2 1 5

LAWSON, P.I., PEARCE, J.

2 1 4 1 1 2 1 4 1 1 3 3 4 2 1 4 1 3 4 3 1 4 2 3 4 1
1 2 1 4 2 1 4 1 1 1 3 4 2 2 2 1 4 1 2 4 2 1 4 3 1 4
1 1 2 1 4 1 1 2 1 4 3 1 4 1 1 2 1 4 1 1 2 1 4 3 1 4
1 1 2 1 4 2 1 4 2 1 4 2 2 1 1 2 1 4 2 1 4 1 1 2 1 4
1 1 2 3 4 2 1 4 3 3 4 2 1 5

KYLES, B.E., STOCK, J.

3 1 4 2 1 4 1 1 1 1 2 1 4 1 1 2 2 1 1 1 1 1 1 1 1 4
3 1 4 2 1 4 1 1 1 3 4 1 1 2 1 4 1 1 1 1 2 1 4 1 1 1
1 1 1 1 2 4 2 1 4 1 1 1 1 1 1 1 1 1 1 3 1 4 1 1 2 1
4 1 1 1 1 1 2 4 1 1 1 1 1 1 1 1 1 1 1 4 2 1 4 1 1
1 1 1 1 1 2 4 1 1 1 1 1 1 1 1 1 1 2 2 4 2 1 4 1 2 4
2 1 4 1 2 4 2 1 4 1 2 4 1 1 1 1 1 1 1 1 1 1 1 4 1
1 1 2 4 1 1 1 1 1 1 2 1 4 1 1 1 2 4 2 1 4 1 2 5

MACDONALD, A.M., THORBURN, L.

2 2 1 2 4 1 2 4 3 1 4 1 3 4 2 1 4 1 3 4 1 1 3 1 4 1
2 4 1 1 1 1 1 1 3 2 4 1 1 2 2 2 1 4 1 2 4 2 1 4 1 2
4 2 1 4 1 2 4 2 1 4 1 2 4 1 1 2 1 4 1 2 4 2 1 4 1 2
4 1 1 2 2 2 1 4 1 2 4 1 1 1 1 1 1 1 1 1 1 1 1 4 2 2
1 1 1 1 2 2 1 2 4 3 1 4 1 1 1 2 4 2 1 4 1 2 4 1 1 1
2 5

FORD, C.L., SOUTAR, F.

1 1 1 1 1 2 4 1 2 4 3 1 4 1 1 1 2 4 1 1 1 2 4 1 1 1
1 1 1 1 2 4 1 1 1 2 4 1 3 4 1 3 4 1 1 1 2 4 1 1 1 1
1 1 1 1 1 1 1 1 4 1 1 1 1 1 2 4 1 2 4 1 1 1 2 4 1 1
1 1 3 1 4 1 1 1 1 1 1 1 1 1 1 1 1 4 1 1 1 1 1 1 1 1
1 1 1 1 4 1 2 4 1 2 4 1 2 4 1 1 1 2 4 1 2 4 1 1 3 2
4 1 1 1 1 3 2 4 1 1 3 1 4 1 1 2 1 4 1 1 1 1 1 1 1 2
4 1 1 1 1 1 1 2 2 3 1 4 1 1 1 1 1 1 1 2 4 1 1 1 2 5

SAVAGE, K.A., CHANCE, A.

3 1 4 2 2 1 2 4 2 1 4 1 3 4 2 1 4 1 3 4 1 3 4 2 1 4
1 3 4 1 1 2 2 1 2 4 1 1 3 3 4 2 2 3 2 4 1 1 1 1 1 3
4 1 1 1 1 1 1 1 2 4 2 3 4 2 1 4 1 1 2 3 4 1 3 4 2 2
1 3 4 1 1 1 1 1 3 4 1 1 1 2 4 2 1 4 2 2 1 2 4 1 1 1
1 1 1 1 1 1 1 2 1 4 2 1 4 2 1 4 1 1 2 2 1 1 3 1 4 1
2 4 1 2 4 1 2 5

KESSON, M.McG., STFERGUSSON, A.

3 1 4 1 1 1 2 4 2 1 4 1 2 4 2 1 4 1 1 3 1 4 1 2 4 2
1 4 1 2 4 2 1 4 1 2 4 2 1 4 1 2 4 2 1 4 1 2 4 2 1 4
1 2 4 2 1 4 1 2 4 2 1 4 1 2 4 2 1 4 1 2 4 2 1 4 2 2
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HOBBIS, A.M., DYKES, M.

3 1 4 1 1 3 2 4 3 1 4 3 2 4 1 1 1 2 4 3 1 4 1 1 1 2
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CAIRNS, J.K., MURRAY, N.H.

1 1 1 1 2 1 4 3 1 4 1 1 2 2 1 1 2 1 4 2 1 4 1 1 2 1
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TUDOR, L.L., McLEOD, W.R.

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GRANT, J.M., WHITTON, G.

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BELL, B.J., PRENTICE, V.

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2 5

DENOVAN, M.M., MALCOLM, J.V.

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SZANEL, H.M., SOMMERVILLE, C.

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WILKIE, S.J., SMITH, M.L.

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MACDUFF, J.M., MACDOUGALL, L.

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RAINFORD, A.E., JOHNSON, M.A.

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NEILL, A.P., MUNRO, W.

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JESSIMAN, E.D., CLOUGH, M.

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BREAKES, F.S., HOLROYD, I.

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GAME II - MALE SUBJECTS

McLEAN, I.D., REYNOLDS, M.S.

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NAYSMITH, J.H., DAVIDSON, R.A.

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MAXWELL, R., WADDELL, G.

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ANNAN, I.T., DAVIDSON, N.F.

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1 1 1 1 1 1 1 1 1 1 5

WALDEN, N.G., COMRIE, A.

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DAWSON, R., FORD, G.E.

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JOHNSTONE, D., DALRYMPLE, J.F.

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2 2 1 4 2 1 4 1 2 4 2 2 3 1 4 1 3 4 1 2 4 2 1 4 3 1
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O'HANLON, J., SWORDS, M.D.

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SPOWAGE, A.F., LINDSAY, W.F.C.

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REILLY, D.P., NETHERCOTT, J.

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BATHGATE, A.A., NICOLSON, J.L.

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MACKENZIE, G.P., LAUDER, M.

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STEWART, G.J., CLARKE, E.

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SMART, K., MACDIVITT, A.

3 1 4 2 1 4 2 3 4 1 3 4 3 2 4 2 2 1 1 1 1 1 1 1 1 1
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STEVENSON, A.G., ELLIOTT, A.T.

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3 1 4 2 2 1 1 2 1 4 1 2 4 2 1 4 2 1 4 1 2 4 1 1 1 2
4 1 1 2 1 4 2 2 2 1 4 1 1 1 2 5

HALL, R.R., GORDON, J.H.

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2 1 4 2 1 4 1 1 1 1 3 1 4 1 1 1 1 1 1 2 1 4 1 2 4 1
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1 4 1 1 1 1 1 2 4 1 3 4 2 1 4 1 1 2 1 4 2 1 4 1 2 4
2 1 4 1 1 2 1 4 2 1 4 1 1 2 1 5

HENDERSON, A.W., SMITH, T.A.

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2 5

QUINN, J.G., GENTLEMAN, A.

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2 1 1 2 1 4 1 1 2 1 4 1 1 1 1 1 1 1 1 1 1 2 1 4 1 1
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2 1 4 1 2 4 1 1 1 1 1 1 1 1 1 1 1 1 4 1 1 1 1 1 1 1
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2 1 4 1 2 5

McNAIR, A.E., MAIR, G.L.R.

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2 1 4 1 2 4 3 3 4 2 3 5

CARMICHAEL, A., GIBSON, I.

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MORGAN, J.G., EVERETT, M.

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SWAN, W.J., COWIE, R.I.D.

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MACDONALD, A., KAY, N.M.

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ELCOCK, D.D., HOLDEN, W.P.

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GAME II - FEMALE SUBJECTS

McEWAN, E., SHIELLS, J.

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PICKEN, K.J., BUCHANAN, M.K.

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4 1 1 2 1 4 1 1 1 3 4 1 1 1 1 1 1 2 1 5

McFARLANE, J.E., ANNAN, M.E.

1 3 4 1 1 1 1 2 3 4 1 1 2 2 2 2 1 1 1 1 1 2 4 2 3 4
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1 2 1 4 1 2 4 2 1 5

ORR, M.C., DOYLE, M.B.S.

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1 5

HEARD, V.E.J., ADAMS, M.

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MILLS, M.E., STONE, S.

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WISHART, D.A., CONNOLLY, B.S.

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McPHERSON, R., ROBERTSON, M.

1 3 4 2 1 4 1 3 4 3 2 4 2 1 4 1 2 4 2 1 4 1 3 4 3 1
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1 2 4 2 1 4 1 2 4 2 1 5

DEANS, M.A., SCOTT, E.A.

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3 1 4 3 1 4 3 1 4 3 1 4 3 1 4 3 1 5

WALLACE, A.D., TURNER, F.J.

3 3 4 1 3 4 2 1 4 1 2 4 2 1 4 3 2 4 2 3 4 1 2 4 2 1
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2 1 4 1 2 4 2 1 4 1 2 5

HARDY, C.W.M., YOUNG, M.J.

1 3 4 2 1 4 2 3 4 1 3 4 1 1 3 3 4 1 3 4 2 1 4 1 3 4
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1 3 4 1 3 4 1 1 1 3 4 1 3 4 1 2 4 1 3 4 1 2 4 1 2 4
1 3 4 1 2 4 1 2 4 1 3 4 1 1 1 1 1 1 1 3 4 1 3 4 1 2
4 1 2 5

CAMPBELL, A., MILLAR, S.E.M.

1 3 4 1 1 2 3 4 1 1 2 2 1 3 4 2 3 4 1 2 4 2 1 4 1 2
4 2 1 4 1 3 4 2 1 4 3 1 4 1 2 4 3 1 4 1 3 4 2 1 4 1
2 4 2 1 4 3 3 4 1 2 4 2 1 4 1 2 4 2 1 4 3 2 4 1 3 4
1 1 2 3 4 1 1 3 3 4 2 2 1 3 4 1 1 2 2 1 3 4 1 1 3 1
4 2 1 5

HUNTER, M.P., WEBSTER, F.M.

2 2 1 2 4 3 1 4 1 1 2 1 4 1 2 4 1 1 1 1 2 3 4 2 1 4
1 2 4 1 1 2 1 4 2 2 1 3 4 2 3 4 1 1 1 3 4 1 1 2 1 4
2 1 4 1 2 4 1 2 4 2 1 4 1 3 4 2 3 4 1 2 4 1 2 4 1 1
2 1 4 2 3 4 1 3 4 1 1 1 2 4 1 1 2 1 4 2 3 4 1 3 4 1
3 4 1 1 1 2 4 2 2 1 3 5

SIME, L., DOWNS, C.A.

2 1 4 1 2 4 1 2 4 2 3 4 2 1 4 3 1 4 2 1 4 1 3 4 1 1
3 3 4 1 1 1 3 4 2 1 4 2 1 4 1 3 4 2 2 2 2 1 3 4 1 1
2 2 1 1 1 3 4 3 1 4 3 1 4 2 2 1 1 2 1 4 2 1 4 1 3 4
1 3 4 3 2 4 3 1 4 1 2 4 1 1 2 1 4 2 2 1 2 4 3 3 4 2
1 4 2 3 4 1 2 5

WILSON, C.D., FORSYTH, D.

3 1 4 1 2 4 1 1 3 1 4 3 2 4 2 1 4 1 2 4 3 1 4 1 2 4
2 1 4 1 2 4 3 1 4 1 2 4 2 1 4 3 2 4 3 1 4 1 2 4 2 1
4 1 2 4 3 1 4 1 2 4 3 1 4 3 2 4 2 1 4 1 2 4 2 1 4 1
2 4 3 1 4 1 2 4 2 1 4 1 2 5

GALLAGHER, K.T., FRASER, H.W.

1 2 4 1 1 3 1 4 1 1 2 2 1 1 1 1 2 2 1 2 4 1 1 1 1 1
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2 4 1 1 2 1 4 1 2 4 1 1 1 1 1 1 1 2 4 2 1 4 1 2 4 1
2 4 1 1 1 1 2 2 1 2 4 2 1 4 1 2 4 2 2 1 1 1 2 4 2 2
2 1 4 1 1 1 1 1 1 1 1 1 1 1 2 4 2 1 4 2 1 4 2 2 1 2
4 1 1 1 1 1 2 4 2 1 4 1 1 2 2 2 2 1 2 4 1 1 2 2 1 1
1 2 4 2 1 4 1 1 1 1 1 2 4 2 1 5

HANDS, G., WATSON, P.

1 1 1 1 2 1 4 1 1 3 1 4 1 2 4 1 1 2 2 1 1 1 1 2 1 4
2 2 1 1 1 1 1 2 4 1 2 4 1 1 2 1 4 1 3 4 1 1 2 2 2 1
4 1 2 4 1 1 1 1 1 1 1 1 1 2 4 3 1 4 1 2 4 1 1 2 2 2
1 4 1 2 4 1 1 1 2 4 2 1 4 1 2 4 1 1 2 1 4 1 2 4 1 1
1 1 1 1 1 1 1 2 4 1 1 2 2 2 2 1 2 4 2 1 4 1 2 4 1 1
1 1 2 1 4 2 2 2 2 1 1 1 1 1 2 4 2 1 4 1 2 4 1 1 2 1
4 1 2 5

WHITE, B.E.E., VALLELY, C.M.

1 3 4 1 2 4 1 1 1 1 1 1 2 2 1 1 1 2 4 1 1 1 1 1 1 1
1 1 1 1 1 4 1 1 3 1 4 1 3 4 1 1 2 1 4 1 2 4 2 1 4 1
1 1 2 4 2 1 4 1 1 1 2 4 1 1 1 1 1 2 4 2 1 4 1 2 4 2
1 4 1 2 4 2 1 4 1 2 4 2 1 4 1 1 2 1 4 1 1 1 1 1 2 4
2 2 1 1 1 1 1 2 4 2 1 4 1 1 1 2 4 2 1 4 1 2 4 2 1 4
1 2 4 2 1 5

LEWIS, C.J., MACKAY, E.T.

1 1 2 1 4 1 2 4 1 1 2 1 4 1 1 1 1 2 1 4 1 1 1 1 1 1
1 1 2 1 4 1 1 1 2 4 2 3 4 2 2 1 1 2 1 4 1 3 4 2 2 1
1 2 1 4 1 1 2 1 4 1 1 2 1 4 1 2 4 2 2 1 1 3 1 4 1 2
4 2 1 4 1 1 3 1 4 1 2 4 2 3 4 1 1 2 1 4 1 1 1 2 4 2
2 1 1 2 1 4 1 1 2 1 4 1 2 4 2 1 4 1 1 2 1 4 1 1 1 1
2 1 4 1 2 4 2 3 4 2 2 1 1 2 1 5

MATHER, R.M., BROWNLEE, M.M.

3 2 4 1 1 1 1 1 1 2 1 4 1 2 4 3 3 4 2 2 1 2 4 1 1 1
1 2 1 4 1 2 4 3 3 4 2 2 2 2 1 2 4 2 2 1 2 4 1 1 2 1
4 1 2 4 3 1 4 1 2 4 2 2 2 2 1 2 4 1 2 4 1 3 4 2 1 4
2 2 1 2 4 1 1 2 1 4 1 1 1 1 2 1 4 1 1 1 1 1 1 1 1 2
3 4 2 3 4 3 2 4 1 1 3 1 4 1 1 2 1 4 1 1 2 1 4 2 3 4
3 3 4 2 1 5

STARK, H.T., McGEE, F.A.M.

1 1 2 1 4 1 1 3 2 4 2 2 1 1 3 1 4 1 1 3 1 4 1 1 1 1
2 1 4 2 1 4 1 2 4 2 1 4 1 1 3 1 4 2 1 4 1 2 4 3 1 4
1 1 2 1 4 1 1 1 1 2 1 4 1 1 2 1 4 2 1 4 2 1 4 1 1 2
1 4 1 1 2 1 4 2 1 4 1 1 2 1 4 2 1 4 2 1 4 3 1 4 1 1
1 1 1 1 1 1 2 1 4 2 1 4 1 1 2 1 4 2 1 4 1 1 2 1 4 1
1 2 1 5

MACKAY, E.E., MARTIN, E.M.

2 1 4 1 1 1 1 1 3 4 1 1 1 1 1 1 1 1 1 1 1 4 1 2 4
1 2 4 1 1 1 2 4 1 1 1 3 4 1 2 4 1 2 4 1 2 4 1 2 4 1
2 4 1 1 1 1 1 2 4 1 2 4 1 2 4 1 2 4 1 2 4 1 2 4 1 2
4 1 2 4 1 2 4 1 2 4 1 2 4 1 2 4 1 2 4 1 2 4 1 2 4 2
2 1 1 1 1 1 2 4 1 2 4 2 2 1 1 1 1 1 2 5

JOAKIM, H., OLIZAR, A.U.I.

3 1 4 1 1 2 1 4 1 1 3 1 4 1 1 2 1 4 3 2 4 3 1 4 1 1
2 1 4 1 2 4 3 2 4 3 1 4 2 1 4 1 1 2 1 4 1 1 3 1 4 1
2 4 1 1 3 1 4 2 2 1 1 3 1 4 1 1 3 1 4 2 2 1 1 3 1 4
1 1 3 1 4 2 1 4 1 2 4 2 1 4 2 1 4 3 1 4 1 1 2 1 4 1
2 4 2 2 1 1 3 1 4 1 1 3 1 4 2 2 1 2 4 2 1 5

ROGERS, S., BROWN, J.H.

1 1 1 3 4 2 1 4 1 3 4 1 1 1 2 4 3 1 4 1 1 1 2 4 3 1
4 1 1 1 1 1 1 1 2 4 2 1 4 2 2 2 1 4 1 3 4 1 1 2 1 4
1 2 4 1 1 2 1 4 1 3 4 3 1 4 2 2 1 2 4 1 1 1 1 1 1 1
3 4 1 2 4 1 1 2 2 1 1 2 1 4 2 2 1 2 4 3 2 4 2 2 3 1
4 1 3 4 1 1 1 3 4 1 1 2 3 4 1 1 1 1 1 1 1 3 4 1 1 3
2 4 1 3 4 1 1 1 1 1 2 5

APPENDIX 8

The total joint payoff acquired by dyads in each of four experimental groups for TRIALS 1 - 30, and for each of six blocks of trials.

Total Joint Payoff to dyads in each of four experimental groups, for TRIALS 1 - 30.

MI	FI	MII	FII
790	980	790	730
665	880	805	840
310	830	840	1005
715	715	855	1010
680	810	155	860
790	770	725	825
890	725	970	685
600	765	840	710
590	720	770	830
905	585	750	825
665	435	955	695
720	440	635	795
585	895	535	890
695	825	905	725
870	895	-585	765
910	675	490	795
715	625	805	970
710	640	530	695
755	585	565	835
740	670	825	770
610	745	375	710
775	120	710	785
885	400	890	635
615	565	455	515

Total Joint Payoff to Male dyads in GAME I for each of six blocks of trials :

	TRIALS					
	1 - 5	6 - 10	11 - 15	16 - 20	21 - 25	26 - 30
	130	115	135	95	160	155
	120	70	105	115	80	175
	20	-15	85	85	40	95
	80	135	85	145	135	135
	120	25	125	135	125	150
	130	115	130	115	135	165
	155	115	160	175	160	125
	70	150	130	105	115	30
	120	85	125	100	40	120
	105	120	155	175	175	175
	105	75	130	130	165	60
	135	80	130	55	145	175
	85	35	170	120	75	100
	130	105	160	125	55	120
	120	140	125	145	165	175
	150	95	165	150	175	175
	115	110	130	155	100	105
	55	105	135	155	85	175
	115	150	75	140	150	125
	155	135	140	125	135	50
	80	60	115	125	145	85
	145	125	135	125	105	140
	165	85	160	150	165	160
	75	145	140	20	135	100
Mean =	111.667	98.333	131.042	123.542	123.542	127.917
Median =	119.375	107.50	132.00	126.875	135.625	130.00

Total Joint Payoff to Female dyads in GAME I for each of six blocks of trials :

	TRIALS					
	1 - 5	6 - 10	11 - 15	16 - 20	21 - 25	26 - 30
	160	160	175	175	160	150
	120	140	125	170	160	165
	135	135	150	135	145	130
	155	140	65	110	105	140
	135	130	130	160	145	110
	155	95	175	165	30	150
	145	120	110	110	115	125
	115	140	120	100	165	125
	110	155	120	110	60	165
	40	105	30	125	150	135
	130	115	35	5	100	50
	60	100	5	60	90	125
	155	120	165	105	175	175
	155	80	145	145	145	155
	140	155	160	145	155	140
	115	155	15	120	125	145
	155	40	135	115	60	120
	65	115	95	140	85	140
	75	50	-15	125	175	175
	130	130	145	125	80	60
	60	160	145	125	100	155
	140	30	-30	-25	10	-5
	95	125	105	-15	115	-25
	90	20	65	135	80	175
Mean =	118.125	113.125	98.75	111.042	113.75	124.167
Median =	131.25	122.50	121.25	124.375	116.25	140.00

Total Joint Payoff to Male dyads in GAME II for each of six blocks of trials :

	TRIALS					
	1 - 5	6 - 10	11 - 15	16 - 20	21 - 25	26 - 30
	145	100	135	80	165	165
	135	150	90	160	140	130
	130	110	135	160	155	150
	135	155	140	140	155	130
	75	0	20	-80	70	70
	135	110	125	110	110	135
	155	140	170	175	165	165
	105	150	110	145	155	175
	150	100	145	130	130	115
	140	150	125	125	130	80
	155	165	160	160	160	155
	115	125	115	65	145	70
	80	55	80	60	175	85
	35	170	175	175	175	175
	-90	45	-250	-15	-25	-250
	145	65	135	25	45	75
	110	125	135	155	125	155
	110	80	60	75	50	155
	60	0	125	135	130	115
	155	80	150	150	140	150
	55	115	95	145	-110	75
	45	145	120	105	140	155
	145	165	160	135	150	135
	70	115	130	80	15	45
Mean =	103.958	108.958	107.708	108.125	112.083	108.750
Median =	122.50	116.25	127.50	132.50	140.0	132.50

Total Joint Payoff to Female dyads in GAME II for each of six blocks of trials :

	TRIALS					
	1 - 5	6 - 10	11 - 15	16 - 20	21 - 25	26 - 30
	75	145	90	150	155	115
	115	170	160	160	140	95
	155	165	170	165	175	175
	155	155	175	175	175	175
	120	140	150	150	150	150
	130	140	110	145	170	130
	70	140	110	155	85	125
	165	130	45	145	75	150
	120	140	150	160	130	130
	165	125	110	140	145	140
	55	75	125	135	140	165
	105	135	155	135	145	120
	135	125	135	165	175	155
	95	110	130	140	135	115
	80	145	135	135	145	125
	85	160	130	155	120	145
	145	170	155	170	160	170
	140	120	145	95	120	75
	65	150	155	175	175	115
	20	150	145	175	105	175
	110	110	140	150	70	130
	125	145	135	95	160	125
	70	115	115	95	145	95
	85	95	100	110	25	100
Mean =	107.708	135.625	132.083	144.792	134.167	133.125
Median =	112.5	140.625	136.667	150.0	144.375	130.0

APPENDIX 9

Median Scores per dyad over 30 trials for each of four experimental groups.

MI	FI	MII	FII
34.239	28.333	33.553	29.500
26.389	30.000	30.500	31.667
33.333	32.813	27.500	34.239
27.500	34.167	32.500	34.615
27.500	30.417	22.500	29.700
23.500	27.500	26.250	30.000
23.750	28.214	34.091	27.500
26.667	26.500	33.333	30.000
33.750	26.389	27.500	27.083
33.864	25.357	28.750	30.000
27.500	23.750	33.333	25.000
32.813	26.250	26.667	27.500
33.750	33.553	26.667	33.553
25.357	32.500	34.375	25.000
24.167	32.500	-48.167	26.136
25.833	25.833	23.929	26.944
23.214	27.500	32.500	33.553
26.591	25.500	23.500	25.625
27.500	26.500	25.357	34.239
33.088	25.625	32.813	33.088
15.277	30.000	25.000	24.773
26.250	32.500	23.125	26.250
32.813	22.500	33.L88	25.000
25.833	15.000	22.500	22.500

APPENDIX 10

The total number of steps to criterion as required by dyads in each of four experimental groups, for TRIALS 1 - 30, and for each of six blocks of trials.

Total Number of Steps to Criterion required by Male dyads in GAME I :

TRIALS						
1 - 5	6-10	11-15	16-20	21-25	26-30	1-30
8	10	7	12	5	7	49
10	15	11	11	11	5	63
20	17	14	14	15	13	93
13	9	14	8	8	9	61
9	15	9	8	9	7	57
8	11	8	11	9	6	53
6	9	6	5	6	9	41
12	6	8	10	10	15	61
10	14	10	12	15	10	71
9	10	7	5	5	5	41
11	11	9	9	6	16	62
9	11	9	16	8	5	58
12	14	5	10	14	12	67
7	9	5	6	12	8	47
10	8	10	8	6	5	47
7	12	6	7	5	5	42
9	10	9	7	9	9	53
13	12	9	7	14	5	60
10	7	11	8	7	10	53
6	8	7	9	9	13	52
13	16	11	9	8	14	71
6	9	9	10	12	8	54
5	13	5	6	5	6	40
13	6	7	17	8	11	62

Total Number of Steps to Criterion required by Female dyads in GAME I :

TRIALS						
1-5	6-10	11-15	16-20	21-25	26-30	1-30
6	6	5	5	6	7	35
7	6	7	5	5	5	35
7	7	7	8	8	7	44
6	7	12	9	12	8	54
7	8	7	6	7	9	44
6	11	5	6	16	7	51
6	8	9	10	9	9	51
8	7	7	8	5	9	44
11	7	10	10	13	6	57
14	11	13	7	6	8	59
9	10	15	15	10	17	76
12	13	18	13	10	10	75
6	9	6	10	5	5	41
7	15	7	8	8	7	52
7	5	5	6	6	7	36
9	5	16	9	10	8	57
6	17	8	11	13	10	65
12	9	10	7	10	6	54
15	17	17	10	5	5	69
9	8	8	10	14	13	62
15	6	7	9	11	7	55
8	16	21	18	18	22	103
11	9	11	19	11	18	79
12	17	15	9	11	5	69

Total Number of Steps to Criterion required by Male dyads in GAME II :

TRIALS						
1-5	6-10	11-15	16-20	21-25	26-30	1-30
7	12	9	11	6	6	51
9	7	13	5	8	9	51
9	8	8	6	6	6	43
8	7	8	8	5	8	44
15	19	17	20	12	12	95
8	11	10	11	11	8	59
5	6	5	5	6	6	33
12	6	9	6	6	5	44
6	10	6	8	7	9	46
7	7	10	10	8	11	53
5	5	5	5	6	6	32
11	10	10	16	8	13	68
14	15	14	13	5	14	75
13	5	5	5	5	5	38
21	18	30	17	18	30	134
5	12	9	16	18	15	75
11	9	9	7	10	7	53
10	14	13	15	14	7	73
16	19	10	9	7	11	72
7	10	7	7	7	5	43
13	11	13	8	23	11	79
13	8	10	12	8	7	58
8	6	6	9	7	9	45
14	10	9	14	17	18	82

Total Number of Steps to Criterion required by Female dyads in GAME II :

TRIALS						
1-5	6-10	11-15	16-20	21-25	26-30	1-30
12	7	13	6	7	10	55
8	5	5	5	6	10	39
5	5	5	5	5	5	30
5	5	5	5	5	5	30
8	5	5	5	5	5	33
6	6	8	6	5	8	39
15	8	11	7	14	10	65
5	9	18	8	15	7	62
9	7	7	5	8	7	43
5	7	10	7	6	6	41
13	11	7	6	5	5	47
10	8	6	8	8	10	50
8	10	9	6	5	7	45
13	10	9	7	9	10	58
10	7	8	8	7	9	49
12	6	9	7	10	8	52
6	5	5	5	5	5	31
7	10	7	12	8	12	56
12	7	7	5	5	11	47
16	7	8	5	12	5	53
9	10	8	7	12	7	53
8	6	8	11	6	9	48
15	11	11	13	8	13	71
12	13	11	11	14	12	73

APPENDIX 11

The total number of blockages on strategy-choice 1 made by dyads in each of four experimental groups for Trials 1 - 30, and for each of six blocks of trials.

The total number of blockages on strategy-choice 1 for Male dyads in GAME I :

TRIALS						
1-5	6-10	11-15	16-20	21-25	26-30	1-30
1	5	1	6	0	2	15
4	9	6	6	7	0	32
15	13	9	9	11	8	65
7	4	9	3	2	3	28
3	9	3	3	4	2	24
3	6	3	6	3	0	21
1	3	0	0	1	3	8
5	1	3	5	5	8	27
4	4	3	5	8	4	28
4	5	2	0	0	0	11
4	6	4	4	1	11	30
4	7	2	10	3	0	26
6	7	0	4	7	5	29
2	3	0	1	7	3	16
5	3	5	3	1	0	17
2	5	1	2	0	0	10
2	4	4	2	4	3	19
9	7	4	2	8	0	30
5	2	7	2	2	5	23
1	2	2	3	3	7	18
6	7	5	4	3	6	31
1	3	4	4	4	3	19
0	7	0	1	0	1	9
6	1	1	8	2	4	22

The total number of blockages on strategy-choice 1 for Female dyads in GAME I :

TRIALS						
1-5	6-10	11-15	16-20	21-25	26-30	1-30
1	1	0	0	0	1	3
2	1	2	0	0	0	5
2	2	1	3	2	2	12
0	1	6	3	6	2	18
2	2	2	1	2	3	12
0	5	0	1	9	2	17
1	3	3	5	3	4	19
3	1	0	2	0	2	8
5	2	5	5	9	1	27
8	5	6	2	1	3	25
4	5	11	12	5	11	48
7	7	14	8	6	5	47
0	4	1	5	0	0	10
2	8	2	2	3	1	18
2	0	0	1	1	1	5
4	0	12	4	5	3	28
1	10	1	6	9	4	31
7	2	4	2	4	1	20
10	12	13	5	0	0	40
3	2	3	5	7	9	29
8	1	2	3	4	2	20
3	12	16	14	13	17	75
5	4	5	14	6	15	49
6	12	8	3	7	0	36

The total number of blockages on strategy-choice 1 for Male dyads in GAME II :

TRIALS						
1-5	6-10	11-15	16-20	21-25	26-30	1-30
2	7	3	7	1	1	21
4	2	7	0	2	2	17
1	1	2	0	0	0	4
2	1	2	2	0	2	9
9	15	13	18	8	7	70
3	5	4	3	5	3	23
0	0	0	0	1	1	2
6	1	3	1	1	0	12
1	4	1	3	1	4	14
2	2	5	4	3	7	23
0	0	0	0	1	1	2
6	5	4	10	3	8	36
7	10	9	9	0	9	44
5	0	0	0	0	0	5
19	13	30	14	15	30	121
0	7	4	12	10	7	40
5	4	4	2	5	2	22
4	8	9	10	10	2	43
11	14	5	3	2	5	40
2	6	1	2	2	0	13
9	4	8	3	21	7	52
9	2	5	6	3	2	27
1	1	1	3	1	3	10
6	5	2	7	13	12	45

The total number of blockages on strategy-choice 1 for Female dyads in GAME II :

TRIALS						
1-5	6-10	11-15	16-20	21-25	26-30	1-30
5	1	7	1	2	4	20
2	0	0	0	1	3	6
0	0	0	0	0	0	0
0	0	0	0	0	0	0
2	0	0	0	0	0	2
1	1	3	1	0	3	9
8	2	5	2	7	3	27
0	4	10	2	9	1	26
3	1	2	0	3	1	10
0	2	2	1	1	0	6
4	2	2	0	0	0	8
3	1	1	4	2	3	14
3	5	4	1	0	2	15
8	3	3	2	3	4	23
2	2	3	3	2	3	15
6	1	4	2	5	3	21
1	0	0	0	0	0	1
2	4	2	5	1	7	21
8	2	2	0	0	4	16
11	2	3	0	6	0	22
3	2	1	1	7	2	16
3	1	3	4	1	2	14
7	4	5	6	2	5	29
6	8	5	6	10	7	42

APPENDIX 12

The computation of partition of chi-square for TRIAL 1, and tables giving the frequency of occurance of each strategy choice on the first step of each of Trials 5, 10, 15, 20, 25, and 30, and the tables derived from the computation of the accompanying partitions of chi-square.

The Computation of Partition of Chi-Square

The partition of chi-square for the frequency of each strategy-choice on the first step of TRIAL 1 is calculated as below, using the data given in TABLE 9 of the text :-

$$x^2_{total} = \frac{(30 - 192/12)^2}{192/12} + \frac{(31 - 192/12)^2}{192/12} + \frac{(32 - 192/12)^2}{192/12} +$$

$$\frac{(26 - 192/12)^2}{192/12} + \frac{(13 - 192/12)^2}{192/12} + \frac{(13 - 192/12)^2}{192/12} +$$

$$\frac{(13 - 192/12)^2}{192/12} + \frac{(9 - 192/12)^2}{192/12} + \frac{(9 - 192/12)^2}{192/12} +$$

$$\frac{(5 - 192/12)^2}{192/12} + \frac{(3 - 192/12)^2}{192/12} + \frac{(8 - 192/12)^2}{192/12}$$

$$= \frac{14^2 + 15^2 + 16^2 + 10^2 + 3(-3)^2 + 2(-7)^2 + (-11)^2 + (-13)^2}{16}$$

$$+ \frac{(-8)^2}{16}$$

$$= \frac{1256}{16}$$

$$= 78.50$$

$$x^2_A = 0$$

$$x^2_B = 0$$

$$x^2_C = \frac{(119 - 192/3)^2}{192/3} + \frac{(44 - 192/3)^2}{192/3} + \frac{(29 - 192/3)^2}{192/3}$$

$$= \frac{55^2 + (-20)^2 + (-35)^2}{64}$$

$$= \frac{4650}{64}$$

$$= 72.6563$$

$$x^2_{AB} = 0$$

$$x^2_{AC} = \left[\frac{(61 - 192/6)^2}{192/6} + \frac{(58 - 192/6)^2}{192/6} + \frac{(22 - 192/6)^2}{192/6} + \frac{(22 - 192/6)^2}{192/6} \right.$$
$$\left. \frac{(13 - 192/6)^2}{192/6} + \frac{(16 - 192/6)^2}{192/6}\right] - x^2_A - x^2_C$$

$$= \left[\frac{29^2 + 26^2 + 2(-10)^2 + (-19)^2 + (-16)^2}{32}\right] - x^2_A - x^2_C$$

$$= \frac{2334}{32} - 0.0 - 72.6563$$

$$= 0.2812$$

$$x^2_{BC} = \left[\frac{(62 - 192/6)^2}{192/6} + \frac{(57 - 192/6)^2}{192/6} + \frac{(26 - 192/6)^2}{192/6} + \frac{(18 - 192/6)^2}{192/6} + \frac{(8 - 192/6)^2}{192/6} + \frac{(21 - 192/6)^2}{192/6} \right] - x^2_B - x^2_C$$

$$= \left[\frac{30^2 + 25^2 + (-6)^2 + (-14)^2 + (-24)^2 + (-11)^2}{32} \right] - x^2_B - x^2_C$$

$$= \frac{2454}{32} - 0.0 - 72.6563$$

$$= 4.0312$$

$$x^2_{ABC} = x^2 \text{ total} - x^2_A - x^2_B - x^2_C - x^2_{AC} - x^2_{BC}$$

$$= 78.50 - 0.0 - 0.0 - 72.6563 - 0.0 - 0.2813 - 4.0312$$

$$= 1.5313$$

These calculations are summarized in TABLE 10 of the text. The frequency of occurance of each strategy-choice on the first step of TRIALS 5, 10, 15, 20, 25, and 30, and the summary tables of the accompanying partitions of chi-square are as follows :-

TRIAL 5

Choice	MI	MII	FI	FII
1	33	29	30	25
2	12	16	12	19
3	3	3	6	4

Frequencies

Source	Chi-Square	df	x^2 critical value at $\alpha = 0.05$
Total	84.875	11	19.680
A	0.0	1	3.84
B	0.0	1	3.84
C	80.2813	2	5.99
AB	0.0	1	3.84
AC	3.2187	2	5.99
BC	1.1562	2	5.99
ABC	0.2188	2	5.99

Partition of Chi-Square

TRIAL 10

Choice	MI	MII	FI	FII
1	31	31	33	21
2	13	14	9	23
3	4	3	6	4

Frequencies

Source	Chi-Square	df	x^2 critical value at $\alpha = 0.05$
Total	89.50	11	19.680
A	0.0	1	3.84
B	0.0	1	3.84
C	77.1563	2	5.99
AB	0.0	1	3.84
AC	5.9062	2	5.99
BC	1.5312	2	5.99
ABC	4.9063	2	5.99

Partition of Chi-Square

TRIAL 15

Choice	MI	MII	FI	FII
1	31	27	31	31
2	16	18	12	13
3	1	3	5	4

Frequencies

Source	Chi-Square	df	x^2 critical value at $\alpha = 0.05$
Total	92.750	11	19.680
A	0.0	1	3.84
B	0.0	1	3.84
C	90.0313	2	5.99
AB	0.0	1	3.84
AC	0.4062	2	5.99
BC	1.9062	2	5.99
ABC	0.4063	2	5.99

Partition of Chi-Square

TRIAL 20

Choice	MI	MII	FI	FII
1	29	32	33	32
2	16	14	12	12
3	3	2	3	4

Frequencies

Source	Chi-Square	df	x^2 critical value at $\alpha = 0.05$
Total	105.25	11	19.680
A	0.0	1	3.84
B	0.0	1	3.84
C	103.875	2	5.99
AB	0.0	1	3.84
AC	0.1250	2	5.99
BC	0.8750	2	5.99
ABC	0.3750	2	5.99

Partition of Chi-Square

TRIAL 25

Choice	MI	MII	FI	FII
1	29	29	29	36
2	15	17	15	9
3	4	2	4	3

Frequencies

Source	Chi-Square	df	x^2 critical value at $\alpha = 0.05$
Total	100.750	11	19.680
A	0.0	1	3.84
B	0.0	1	3.84
C	96.5938	2	5.99
AB	0.0	1	3.84
AC	0.5937	2	5.99
BC	1.2187	2	5.99
ABC	2.3438	2	5.99

Partition of Chi-Square

TRIAL 30

Choice	MI	MII	FI	FII
1	29	30	32	25
2	17	16	14	22
3	2	2	2	1

Frequencies

Source	Chi-Square	df	x^2 critical value at $\alpha = 0.05$
Total	97.250	11	19.680
A	0.0	1	3.84
B	0.0	1	3.84
C	93.4063	2	5.99
AB	0.0	1	3.84
AC	1.3437	2	5.99
BC	0.2187	2	5.99
ABC	2.2813	2	5.99

Partition of Chi-Square

APPENDIX 13

"Anova" - a computer programme designed to compute an analysis of variance for each personality trait (V) on each of 30 trials, where the traits are grouped according to first strategy-choice (TR), on the trial, and where N = 96.

```
ANOVA;
"BEGIN""INTEGER"I,J,K,TR,N,TRI,V,COUNT,Z;
TR:=3;TRI:=30;COUNT:=0;
V:=6;
N:=96;
"BEGIN"
"INTEGER""ARRAY"A{1:TR},D{1:N,1:TRI};
"REAL"SSA,SSW,SST,MSA,MSW,T,S2CT,C,F;
"REAL""ARRAY"S{1:TR,1:N},SCT{1:TR},P{1:N,1:V};
"FOR"I:=1"STEP"1"UNTIL"TR"DO"
"FOR"J:=1"STEP"1"UNTIL"N"DO"
S{I,J}:=0;
"FOR"I:=1"STEP"1"UNTIL"N"DO"
"FOR"J:=1"STEP"1"UNTIL"TRI"DO"
"READ"D{I,J};
"FOR"I:=1"STEP"1"UNTIL"N"DO"
"FOR"K:=1"STEP"1"UNTIL"V"DO"
"READ"P{I,K};
"FOR"J:=1"STEP"1"UNTIL"TRI"DO"
"FOR"K:=1"STEP"1"UNTIL"V"DO"
"BEGIN"
"FOR"I:=1"STEP"1"UNTIL"TR"DO"
"FOR"Z:=1"STEP"1"UNTIL"N"DO"S{I,Z}:=0;
"FOR"I:=1"STEP"1"UNTIL"TR"DO"A{I}:=1;
"FOR"I:=1"STEP"1"UNTIL"N"DO"
"BEGIN"
S{D{I,J},A{D{I,J}}}:=P{I,K};
A{D{I,J}}:=A{D{I,J}}+1;
"END";
"FOR"I:=1"STEP"1"UNTIL"TR"DO"
"BEGIN"
A{I}:=A{I}-1;
SCT{I}:=0;
"END";
SSA:=T:=S2CT:=0;
"FOR"I:=1"STEP"1"UNTIL"TR"DO"
"BEGIN"
"FOR"Z:=1"STEP"1"UNTIL"N"DO"
"BEGIN"
SCT{I}:=SCT{I}+S{I,Z};
S2CT:=S2CT+S{I,Z}↑2;
T:=T+S{I,Z};
"END";
"PRINT"SCT{I};
```

```
"END";
C:=T↑2/N;
"FOR"I:=1"STEP"1"UNTIL"TR"DO"
SSA:=(SCT{I})↑2/A{I}+SSA;
SSA:=SSA-C;
MSA:=SSA/(TR-1);
SST:=S2CT-C;
SSW:=SST-SSA;
MSW:=SSW/(N-TR);
F:=MSA/MSW;
COUNT:=COUNT+1;
"IF"F<3"THEN""GOTO"NXT;
"PRINT"COUNT,SAMELINE,´´S1``,J,´´S1``,K;
"PRINT"´´L``,´TREATMENTS`,SAMELINE,´´S8``,SSA,´´S3``,MSA;
"PRINT"´´L``,´WITHIN GROUPS`,SAMELINE,´´S6``,SSW,´´S3``,MSW;
"PRINT"´´L``,´TOTAL`,SAMELINE,´´S12``,SST;
"PRINT"´´L``,´F`,SAMELINE,F;
NXT:
"END";
"END";
"END";
```