EFFECT OF KNOWLEDGE OF REWARD AND IMPOSED DIVISIBILITY OF REWARD UPON SOCIAL CONTACTS AND BARGAINING IN A THREE-PERSON COALITION GAME

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James L. Phillips
Major professor

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ABSTRACT

EFFECT OF KNOWLEDGE OF REWARD AND IMPOSED DIVISIBILITY
OF REWARD UPON SOCIAL CONTACTS AND BARGAINING
IN A THREE-PERSON COALITION GAME

By

Gerrit Earl De Young

In deterministic coalition formation games, initial contacts have been previously found to be directed most frequently to the less powerful of two potential coalition partners; successive contacts were directed more equally to each of the partners. The dominant hypothesis explaining this effect has been the elimination of confusion explanation, which suggested that subjects quickly concluded that, since a coalition of any two potential partners resulted in victory in a deterministic game, each partner could be considered to have equal resources. Alternative explanations included the cumulative score hypothesis, that players who were behind on the reward dimension discriminated against the leader on that dimension, and the utility of response variability hypothesis, that subjects in repeated contact attempts vary their responses through boredom or fatigue, or from considerations of equity. No previous attempt to obtain responses of subjects

in a series of probabilistic coalition formation games had been made, but the above hypotheses were adaptable to the probabilistic game also.

The present Experiment I permitted the elimination of confusion during a series of ten games, allowing extensive experience with the game while preventing any effect of accumulated reward. There was clearly no tendency for contacts or reward divisions to be divided more equally between the stronger and weaker candidates in contrast with the elimination of confusion explanation. The results of Experiment I appeared to be consistent with only the accumulative score explanation.

Experiment II was designed to test the accumulative score explanation by allowing one group of subjects to choose coalition partners with knowledge of their own and other potential partner's reward, while other subjects chose partners with knowledge of only their own reward. Subjects in both conditions apparently attended to only their own reward, since the effect predicted for the group which knew only their own reward occurred also in the group which had knowledge of each partner's reward. This may have been due to a memory factor introduced by a verbal announcement of the rewards, or may have been caused by a subtlety in the instructions.

Previous studies had found that subjects in a deterministic version of a coalition formation game tended to choose partners based on a criterion of "parity," such that they would maximize the amount they had contributed to a coalition, while subjects in a probabilistic version tended to make choices based on a criterion of "security," such that they would try to form the coalition with the maximum total resources. These findings were confirmed in the present study; the probability of choosing the weaker potential partners was consistently greater in the deterministic version. When a specific divisibility of reward was imposed in previous studies, it had been found that coalitions were formed such that the propositions of the resources contributed by each coalition partner approximated one or the other of the positions of the reward as it was required to be divided. No such trend was observed in this experiment; apparently even relatively small differences in the amount of resources contributed by each partner were sufficient to specify to the subjects which partner should receive the greater, and which the lesser, portion of the reward. Consistent with the above finding was the fact that when no specific reward division was imposed, the proportion of the reward obtained by the weaker candidate was consistently less than 50% but greater than the proportion of the resources which he contributed to coalition.

Mathematical models were constructed involving mathematical expressions for the parity, security, and cumulative reward factors; the results were intuitively reasonable. The model involving only the parity factor consistently fit the deterministic version data better than either the model involving only the security factor or the model involving a combination of the parity and security factors. Likewise, the model involving only the security factor consistently provided the best fit of the probabilistic version data. The cumulative reward factor consistently improved the prediction of data in which subjects were aware of their accumulated reward.

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Gerrit Earl De Young

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DEDICATION

To Peg, without whom this dissertation might have been possible but not worthwhile.

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TABLE OF CONTENTS

Chapter

LIST OF TABLES

LIST OF FIGURES

Figure | Page

CHAPTER I

INTRODUCTION

The Range of Triadic Coalition Situations

A triad can be viewed as an interrelated social system containing three elements, each element consisting of a person or an organization acting as a unit. The analysis of triadic situations has ranged from Simmel's (1950) discussion of the role of triadic conflict in the maintenance of social structure through more recent laboratory examinations of triadic situations and coalition formation (Vinacke and Arkoff, 1957; Caplow, 1959).

Caplow (1968) postulated that triads are the underlying building blocks of all social organizations. He identified triadic conflict and coalitions as being basic to primate dominance hierarchies (p. 41), family life (p. 62), industrial organizations (p. 128), civic politics (p. 142), international war (p. 150), and national government (p. 155).

Edwards (1927) compared the English, American, French, and Russian revolutions and presented an early theory of revolution based upon a triadic analysis. A society ready for revolution is typified by unrest and a sense of repression, and can be divided into groups of exploiters, intellectuals, and the exploited. The exploiters control the majority of the resources of such a society. The intellectuals, including the lawyers, teachers, and religious leaders, typically are paid by the exploiters and are expected to justify and transmit the system from one generation to another. The exploited are the group of productive laborers who are also paid by the exploiters. A major symptom of an approaching revolution according to Edwards is the defection of a majority of the intellectuals who begin to sympathize with the exploited class. As a result of this coalition, three main factions emerge: the conservatives, the moderate-reformers, and the radicals. The conservatives are composed of the exploiters who still control most nonsocial resources; some of the intellectuals and some of the exploited divide between the moderate-reform and radical factions according to their concept of the required institutional changes. When the conservatives become convinced that they can no longer govern alone, they attempt to preserve some of their former power by forming a coalition with the moderate-reformers, and by instituting a program of reform. In the case of an abortive revolution, this program could succeed. In the revolutions Edwards studied, the moderate-reformers quickly repudiated this coalition and formed a new coalition with the better organized radicals. The new coalition typically attempts to weaken the conservatives by harrassment including imprisonment, confiscation of property, and deprivation of political rights; the conservatives typically respond by emigrating and attempting to foment foreign intervention. The radicals then institute a reign of terror to eliminate the moderate-reformers and to further suppress the conservatives. Finally, the radicals gain full control, the reign of terror is terminated and an attempt is made to form a stable government.

Caplow (1968) suggested that an international balance of power could be defined as a stable power distribution in a triad without coalitions.

> The situation includes three or more organised collectivities contending for advantage in the same area, not subject to a common sovereign, and capable of making war. Over some appreciable interval of time peace prevails and no coalition is formed (p. 152).

Several factors familiar from triadic theory contribute to the maintenance of the balance of power and to the prevention of the formation of a coalition. (1) If a coalition were formed, the two coalition partners following a victory over the third power would still be independent powers with incompatible interests. If no two of the three original powers were originally equal in strength, no coalition should be formed since eventual defeat would be certain for the weaker of the two coalition partners after the elimination of the third power. (2) Ideological differences often prevent otherwise advantageous coalitions. (3) Stronger powers refrain from direct attacks against a weaker neighbor, since such an attack would compel the third power to join the weaker power to prevent his own eventual defeat. Caplow (1968) cited historical evidence that such a balance of power is typically unstable, and suggested several mechanisms to account for the establishment of a coalition and the resulting upset of the balance of power. (1) A weaker power may preemptively form a dangerous coalition with a stronger power if it believes a coalition between the other two powers is imminent. For example, Stalin believed that a coalition between the Allies and Germany was imminent in 1939; the Soviet Union therefore preemptively entered into a nonagression pact with Germany before that could occur. (2) A weaker power may miscalculate, offer to form a coalition with a stronger power, and therefore help to defeat the third power before being defeated itself. (3) One power may increase its relative strength until it alone can defeat the two other powers, eliminating the need for a balance of power. (4) Balance of power triads may be linked in such a manner that one element of a triad is an element in several other triads. Thus the relative strength of some elements may be indeterminable, and events in one triad can upset a balance of power in another triad.

These analyses are presented to suggest the range of application of triadic and coalition formation theory.

Factors which were used such as the reluctance of a weaker element to form a coalition with a stronger because of the control the stronger element can assert form a part of rigorous triadic theories. It will be necessary in the succeeding sections to further refine the concepts used in such analyses and to focus upon the issues of special relevance to laboratory research.

Alliances in Mixed Motive Games

Luce and Raiffa (1957) identify the existence of a "game" with the existence of a conflict of interest. Schelling (1958) divided two-person games into (1) pure coordination, (2) pure conflict, and (3) mixed-motive games. Gamson (1964) extended the classification for situations involving more than two participants.

Pure coordination games, exemplified by the interaction between a set of partners in a game of bridge, are characterized by the existence of a solution which maximizes the return for all players. In the classical sense, a pure coordination game should not be interpreted as a game at all, since no conflict of interest exists. Any relevance of this situation to game or bargaining theory typically derives from the introduction of some impediment to communication, creating problems in coordinating and mobilizing the resources required for the achievement of the goal (Schelling, 1958).

The pure conflict game is distinguished by the fact that no participant can gain more by joining with others than he can gain by himself. An example of a two person conflict game is chess, while the n-person situation, the pure n-uel, a generalization of the duel to the n-person case (Cole and Phillips, 1969), is an example of a pure conflict game, as are some n-person zero-sum games.

The mixed-motive game is characterized by the existence of both elements of cooperation and elements of conflict. The usual example of a mixed motive game is the two-person Prisoner's Dilemma Game, in which the participants can make either cooperative or uncooperative responses. In the n-person case, coalition games are examples since there is something to be gained by cooperation with some, but not all, participants. A distinguishing feature of the mixed-motive game is that a defection from a cooperative solution may conceivably increase the defector's payoff, while such a result would be impossible in the pure coordination game. This feature of mixed-motive games is responsible for the fact that so-called cooperative solutions to such games are highly unstable. Such solutions do, however, exist.

A general class of cooperative solutions for mixed-motive games is given by Phillips (1967). In general, a cooperative solution is referred to as an alliance, i.e., an ordered pair $<C_i, A_j>$ in which C_l is some sub-set of the n players and A_j is some agreement. The null agreement differs from other possible agreements simply in that the A_o interactive process, i.e., no negotiation, between the members of C_i is required to achieve it. It should be pointed out in this connnection, however, that the null agreement refers to a non-interactive cooperative solution in a genuine mixed-motive game and not to the mere successful cooperation in a game of pure coordination. In general, the usefulness of the concept of an alliance is limited to mixed-motive games since they are unnecessary in pure coordination games and impossible in pure conflict games.

In addition to the null agreement, Phillips notes other types of agreements which constitute the basis of more potentially cohesive alliances. For example, some subset of players may agree to abstain from certain behaviors as in some sort of tariff agreement or non-aggression pact, or to perform certain other behaviors as in some trade agreement or mutual defense treaty. The fact that these two types of agreements become indistinguishable when applied to a 2x2 matrix game is unimportant since this is due to the restriction of the range of behaviors to only two alternatives for each player.

DeYoung and Phillips (1970) suggested a possible parameterization of Alliance Theory in terms of the work of Browning (1969) which deals with that aspect of collective decision making generally known as log-rolling.

> In this example, consider some set S of decision makers and some set I of issues on which the decision makers will vote, that is, for any issue $i \in I$ there exists a partition of S, say $S_i = \{S_+, S_o, S\}$ such that if $n(S_+) > n(S_-)$, where $n(\cdot)$ is an enumerative measure of the set, the issue is said to have passed, and such that if $n(S_+) < n(S_-)$ the issue is said to have been defeated. Assume further that there exist two functions $f_{i+}(S)$ and $f_{i-}(S)$ that assign utilities to each member of S in either case. That is, $f_{i+}(S)$ maps the members of S onto a set r of utilities if, with respect to issue i, $n(S_+) > n(S_-)$ and $f_{i-}(S)$ maps the members of S into r if, with respect to i, $n(S_+) < n(S_-)$. Thus, the situation can be characterized by the set F of ordered pairs of functions $<f_i+, f_i->$ such that there is a one-to-one correspondence between the set F and the set I. Clearly there exist a wide range of F sets which make this a mixed-motive game.

Browning proposed two outcomes of political bargaining which can be interpreted as "cooperative solutions," (1) the minimization of variability of utility between players, and (2) the maximization of social welfare, i.e., the maximization of sums of utilities over players. Browning's model is formulated in terms of dyadic bargaining, so that it can be conceptualized in terms of agreement by two members of S to vote against certain subsets of the issues I, even if this is contrary to either of the player's individualistic interests. The number of issues involved in the agreement could be used as a measure of the intensity of the agreement, and DeYoung and Phillips (1970) suggested the hypothesis that the solidarity or cohesion of an alliance is directly proportional to the number of issues on which there is agreement.

Alternatively, a pair of players may want to agree to vote in favor of certain issues or, although not explicitly included in Browning's model, it is possible that a pair may want to agree not to log-roll on a set of issues upon which their interests coincide. In the terminology of Phillips (1967), it is possible in any of these instances to speak of a set of potential agreements, A_k, where A_k refers to an agreement on k issues. The null agreement, A_o, takes on the natural meaning of an agreement on exactly zero issues. DeYoung and Phillips (1970) concluded:

> If, in a game of the Browning type, it were possible for some subset C_j of players to agree on every $i \varepsilon I$, then this group would be recognized as a highly cohesive, maximally polarized sub-group of S. If, in addition to the explicit issues, this group were to invent or recognize some further transcendent issue such as some method of side payment which would guarantee to each member of C_j some fixed proportion of the payoff to the entire group, we would recognize the sub-group to be further strengthened. We might desire some special designation for this type of agreement and for the resulting type of alliance. Phillips (1967) provides these designations. The agreement, in virtue of the guarantee of fixed proportionality is termed a common-fate agreement, and the alliance is designated a coalition. While this usage of the term coalition is perhaps inconsistent with many of the ways that term has been used in the past, it is consistent with its meaning in a great many of the experimental studies of coalition formation (Vinacke and Arkoff, 1957; Kelley and Arrowood, 1960; Gamson, 1961 a, b; Chertkoff, 1966; Phillips and Nitz, 1968; Nitz and Phillips, 1969; Cole, in press), and is at least roughly compatible with the usage of Luce and Raiffa (1957).

A coalition is treated, therefore, as a very intense form of alliance which is one of a number of possible relatively cooperative solutions to some mixed-motive game. We will next be concerned with the interactive process that leads to such a coalition. This process and its outcomes as described in the succeeding sections will form the focus of this dissertation.

The Coalition Formation Process

The coalition formation process typically involves an attempt by each potential coalition member to combine with some other potential coalition member in order to share in certain payoffs or profits of the successful coalition. A review of previous coalition formation literature suggests that an analysis of the type of coalition formation process to be considered here can be made in terms of the following.

1. Each potential coalition member may attempt to contact another, yielding a set of initial contact probabilities from each individual to each of the other individuals.
2. If no reciprocal contact is made, another set of contact attempts may be initiated.
3. When a reciprocal contact is achieved, a period of bargaining between the contacters may ensue, in which matters pertaining to the functioning of the proposed coalition (division of profits of coalition, voting on certain issues, etc.) would be expected to be discussed.

4. If the bargaining is successful, i.e., if both members agree to the results of the bargaining, the coalition would be formed and could be expected to perform the function for which the coalition was proposed.
5. If the bargaining was not successful, the process could be expected to return to step 2.

A flow diagram of the proposed process is presented in Figure 1.

A wide variety of factors could be expected to affect the coalition formation process, either during the contact period or during the period of bargaining. The factors which would be expected to be primarily associated with the contact process itself would be such things as differential resources or differential status among potential coalition members (Caplow, 1959; Vinacke and Arkoff, 1957), the divisibility of the payoff (Phillips and Nitz, 1968; Nitz and Phillips, 1969), certainty of the payoff (Chertkoff, 1966), degree of control of resources (Cole, in press), ideological factors, and past experience with coalition formation (Kelley and Arrowood, 1960; Chertkoff, 1966). Those factors which would be expected to be primarily associated with the bargaining process could be subclassified along the lines suggested by Figure 1 into internal and external factors. Among the

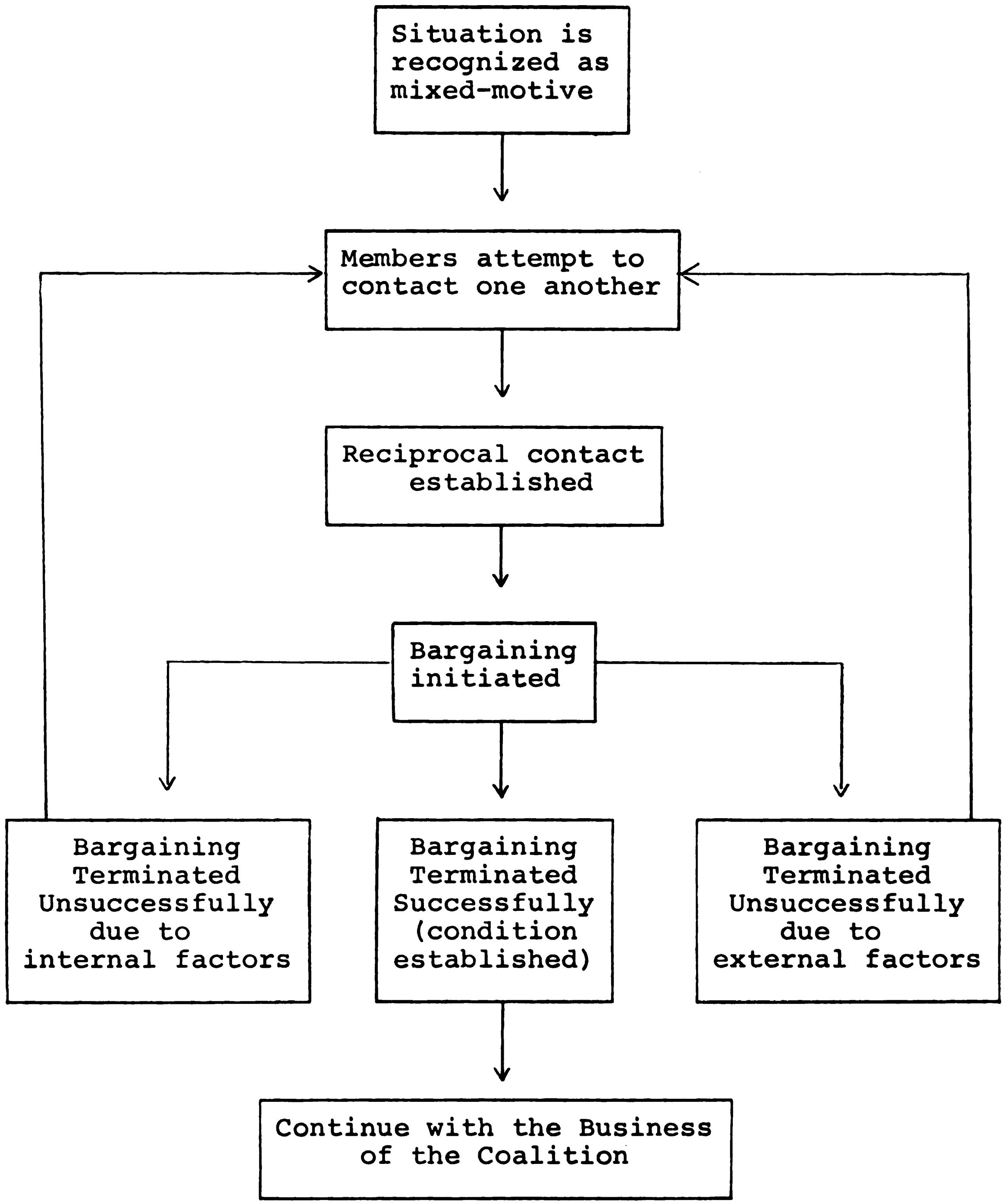


Figure 1.--Flow Chart of steps in the Coalition Formation Process.

external factors would be such things as threats and counteroffers by players not involved in the potential coalition (Kline, 1968), or external events which upset the present distribution of resources (Azar, 1969). Factors internal to the bargaining process include such things as bargaining style (Bond and Vinacke, 1961), personality characteristics of the bargainers (Vinacke, 1969; Nitz, 1969), or considerations of fairness or equity (Messe, 1969).

A. Coalition Formation Paradigms

One paradigm used to study coalition formation is the "parchesi game" (Vinacke and Arkoff, 1957; Kelley and Arrowood, 1960). In this game, several players have different weights such that when dice are rolled, the number rolled is multiplied by the player's initial weight to determine the number of moves each player can make toward the goal. Coalition formation enters into this situation since each player (having a weight of N_A) can attempt to join with either the weaker player (with a weight of N_W) or the stronger potential partner (with a weight of N_S) in order to ensure that the coalition members will reach the goal before the third player.

The pure truel, a special case of the n-uel in which each of three players is given varying resources and then is given the opportunity to remove part of either of the other two players' resources, has been described earlier as a pure conflict game. Cole (1969) devised a mixed-motive form of the truel by allowing the participants to form a coalition before the start of the game. The effect of the coalition was the formation of a non-aggression pact i.e., each coalition partner would attack only the player outside the coalition until that player was removed from the game by the total loss of his resources.

Recent research in the field of coalition formation (Chertkoff, 1966; Phillips and Nitz, 1968; Nitz and Phillips, 1969; Nitz, 1969) has involved the use of a Political Convention Situation, in which a subject is told that he represents one candidate for nomination. The subject's candidate purportedly has N_A votes, which is less than the majority of the votes represented at the convention and necessary to receive the nomination. The subject is also told that there are two other candidates for the nomination, a weaker candidate with N_W votes and a stronger candidate with N_S votes ($N_W < N_S$), neither of whom controls a majority of the votes at the convention. Since no candidate can win without joining with one of the other candidates, the subject is asked which of the other two candidates he will approach first to try to form a coalition.

B. Initial Contact Probabilities

Effect of "Parity" and "Security"

Two factors, "parity" and "security," have been found to be especially relevant to the subject's initial choice of the weaker or stronger candidate. The concept of parity, as discussed by Gamson (1961), suggests that "any participant will expect others to demand from a coalition a share of the payoff proportional to the amount of resources which they contribute to a coalition." Clearly, a candidate would contribute a higher proportion of votes, therefore expecting to receive a greater payoff, if he formed a coalition with the weaker candidate. The postulate that subjects will tend to choose partners according to the parity norm, combined with the postulate that subjects attempt to maximize their share of the payoff, leads to the prediction that the coalition formed will be that winning coalition which has the fewest resources of the possible winning coalitions; this line of reasoning has been formalized as Minimum Resource Theory (Gamson, 1961). Such a tendency has been observed by Vinacke and Arkoff (1957) with respect to formation of coalitions, and by Chertkoff (1966) with respect to initial contacts. On the other hand, the coalition must be "secure" i.e., must have enough resources to afford as great a chance of winning as possible. Security could be expected to be a factor in the Political Convention

Situation since subjects would be aware that a certain amount of attrition in delegate strength is a possibility in real life political conventions. Clearly, although the subject's expected payoff would be maximized by choosing the weaker coalition partner, the security of the coalition would be maximized by choosing the stronger coalition partner (Cole, 1969).

Since these two factors are maximized by two incompatible choices, the salience of each factor can be manipulated. For example, in connection with his statement of the security principle, Cole (1969) introduced a probabilistic variation of the truel in which the removal of an attacked player's resources was determined with a probability less than one. Chertkoff (1966) made the attainment of a reward in the political convention paradigm dependent upon the results of a national election following the convention; in two conditions the likelihood of victory in the national election was stipulated to be greater if the strongest candidate were nominated.

DeYoung and Phillips (1970) discussed an Uncommitted Vote variation of the political convention paradigm. N_U uncommitted votes were introduced in addition to the N_A, N_W, and N_S votes. The requirement for a winning coalition was that the coalition includes a majority, i.e., at least $\frac{(N_A + N_W + N_S + N_U + 1)}{2}$ votes. In general, the formation of a coalition in the Uncommitted Vote situation did not guarantee a majority of votes, but simply improved the chances of obtaining a majority of votes after the uncommitted votes were split between the candidates. In this situation as in the probabilistic games described above, the emphasis placed upon the parity factor should be decreased since in order for there to be a payoff, the votes in the coalition must actually be sufficient to win the nomination.

In contrast with the deterministic situation in which the tendency to form the cheapest winning coalition typically results in the exclusion of the candidate with the greatest proportion of the resources (the "strength is weakness" effect), data from the probabilistic coalition formation situations suggest that players tend to choose the stronger partner (the "strength is strength" effect) in order to maximize their chances of winning; this result is clearly in accordance with the security principle.

Effect of Divisibility of Reward Upon Initial Contacts

Nitz and Phillips (1969) suggested that intra-coalition compatibility, which could depend upon the ease with which a reward for coalition formation could be divided between the members, could be a factor in initial coalition formation contacts. If the reward were only unequally divisible, a coalition between two candidates who differed in their amount of resources should be more likely since the difference in resources could suggest to the participants a norm for determining which participant should receive the greater share, and which should receive the smaller share of the reward. However, if the reward were to be shared equally, a coalition between equals should be relatively more likely. In confirmation of this hypothesis, Nitz and Phillips found that when the unequally divisible reward was the simulated nomination of a governor and lieutenant governor, Ss contacted the weaker candidate significantly less often when the weaker candidate was equal to the S in resources, compared with a condition in which the weaker candidate had fewer resources than the S. Equally important, Ss contacted the weaker candidate less often when the two were equal in resources in the unequal divisibility of reward condition compared with a condition in which the reward could be divided in any desired proportion.

An alternative effect is intuitively reasonable under conditions of imposed divisibility of reward, however. If the reward is of sufficient importance to the participants that it outweighs any potential difficulties in negotiation, the participants in an unequally divisible reward condition may choose that potential partner who would be more likely to accept the smaller share of the reward, i.e., the weaker potential partner, regardless of considerations of relative compatibility. When equality of reward is imposed however, no participant can increase his share of the reward by choosing the weaker potential partner; he can only increase his chances of acquiring the reward by increasing the security of the coalition. He can achieve this goal by choosing the stronger potential partner even if the candidate has considerably greater resources than his own.

C. Successive Contact Probabilities

Kelley and Arrowood (1960) and Chertkoff (1966), both using deterministic versions of coalition formation games, found that, while contacts in initial coalition attempts did occur between the weaker potential coalition partners with more than chance probability, contacts in later coalition attempts tended to be directed more equally to each of the two potential coalition partners.

Four hypotheses have been advanced to explain this change in response pattern:

1. Ss may have quickly learned that since a coalition with either of the other candidates in the Committed Vote version resulted in victory, each candidate could be considered to have equal resources (Kelley and Arrowood, 1960). Vinacke, Crowell, Dien, and Young (1966) have partially discredited this hypothesis by conducting an experiment in which they informed Ss directly that a coalition with either candidate resulted in

victory. They interpreted their data as demonstrating that the strength is weakness effect was not weakened;

2. Since bargaining resulted in an accumulation of reward over trials or games, a new resource dimension (i.e., the accumulated payoff) resulted. (a) The stronger candidate, after being left out of earlier coalitions, therefore quickly became the weaker candidate on the new, more salient resource dimension. Hoffman, Festinger, and Lawrence (1954) and Bond and Vinacke (1961) have found that players who were behind on the reward dimension tended to form a coalition against the player furthest ahead on that dimension. (b) The accumulated reward could affect each player even if he attended only to his own reward. If at one point, an S were relatively strong on the accumulated reward dimension for example, it is possible that he would attempt a "gambling" strategy, choosing the weaker vote resource player more frequently in an attempt to acquire an even more disproportionate proportion of the reward. Such an effect could occur independently of the high reward candidate's current status on the vote resource dimension. There has been no

previous examination of the effects of one's own reward in the coalition formation situation.

3. Aside from the previously discussed factors affecting the utility of each choice, there may also be a utility of response variability. Ofshe and Ofshe (1968) have developed and tested a mathematical model for "stable state" social choices involving this mechanism. Ofshe and Ofshe suggest that besides "boredom or fatigue," equity considerations enter into this utility of response variability.
4. In the case where successive choices are made because there was no mutual choice on the previous trial, the S's subjective expected probability of a reciprocated choice could be expected to decrease.

Differential predictions follow from these hypotheses. If hypothesis 1, that Ss reevaluate power relationships, is correct, the payoff should be divided as suggested by the parity norm after initial contacts, replicating Vinacke and Arkoff (1957). After successive contacts however, the Ss should tend to divide the reward evenly since at this point they would perceive each participant's relative power as equal. A second implication of this hypothesis, together with the suggestion that there is less emphasis on the payoff factor in the

Uncommitted Vote Variation, is that there should be less response change in successive contacts in the Uncommitted than in the Committed Vote Variation. That is, a re-evaluation of the payoff due a candidate should have less effect on choices in the Uncommitted Vote version since the security of the coalition is of greater importance in that version.

If the accumulated reward were responsible for the disappearance of the strength is weakness effect as suggested by hypothesis 2, that effect should occur only when (a) the Ss are aware of the amount of the reward acquired by the players at each point of the current vote resource distribution, and when (b) the amount of the reward acquired is inversely related to the number of votes, since Bond and Vinacke (1961) found a tendency for coalitions to form between those behind on the reward distribution. On the other hand, the response change over successive contacts should be negated by concealing from the Ss the amount of the payoff which had been acquired as the game progressed.

If there exists a utility of response variability as suggested by hypothesis 3, the model of Ofshe and Ofshe (1968) should be adaptable to describe the development of response variability over trials. One clear implication is that the utility of response variability should be greater when successive trials are employed rather than successive games. Also, in contrast with hypothesis 1, hypothesis 3 suggests that the degree of any response change in the Uncommitted Vote variation should be approximately equal to the degree of response change in the Committed Vote variation, since the effect of a utility of response variability would be approximately equal in both variations.

Mathematical Models of Coalition Formation

A. Shelly and Phillips (1966)

Shelly and Phillips (1966) suggested that each individual in a triad evaluated the other two members in terms of their value as a coalition partner. According to this theory, as in Luce (1959), $P_w = \frac{V_A(w)}{V_A(w) + V_A(s)}$ where P_w represents the probability that A chooses the weaker potential coalition candidate, and $V_A(w)$ and $V_A(s)$ respectively represents the "values" to player A of choosing the weaker and stronger candidate.

The model was derived for a deterministic coalition formation paradigm in which the person with greater perceived power is less likely to be included in a coalition, the "strength is weakness" effect. Therefore, $V_A(w)$ was defined in terms of perceived power M(A) and M(w) of player A and the weaker potential coalition partner respectively. In particular, $V_A(w) = \frac{M(A)}{M(A) + M(w)}$, and as a first approximation M(A) was taken to be equal to N_A. Therefore,

$$P_w = \frac{N_A + N_S}{2N_A + N_W + N_S} = \frac{N_A + N_S}{N_T + N_A}$$

The model was tested empirically by comparing its predictions with the observed data from studies by Chertkoff (1966), Vinacke, and Arkoff (1957), Vinacke (1959), Stryker and Psathas (1960), Shelly (1967), and Phillips and Nitz (1968). The predictions of the model were supported by data from the Chertkoff (1966) study but were not supported in the other studies. It should be noted however that the model has no parameters, and the assumption that $M(A) = N_A$ is an extremely strong assumption.

B. Chertkoff (1967)

Chertkoff (1967) mathematized a revision of a theory by Caplow (1956) for the deterministic condition and the power division $N_A > N_B > N_C$. Caplow's theory was based on the assumption that players will attempt to enter coalitions in which they have control, i.e., coalitions in which they have more resources than their coalition partners. Caplow predicted that there would occur an equal number of AC and BC coalitions, while predicting no AB coalitions. As implied by the phrase "strength is weakness" however, BC coalitions occur more frequently than AC coalitions. Chertkoff's revision was intended to correct this discrepancy.

Chertkoff (1967) revised Caplow's theory by emphasizing the choices confronting each of the players A, B, and C. Since player A can dominate either player B or player C, either player should be equally attractive to player A, and therefore he should contact either player B or player C 50% of the time. Likewise, player C can control neither player A nor B, and therefore C should contact either player A or player B 50% of the time. On the other hand, player B can only dominate C, and therefore C should be chosen by B 100% of the time. Assuming that the players make their choices independently of each other, these probabilities can be multiplied to obtain the probability of a mutual choice. The probability of an AB coalition is .5 x 0., therefore no AB coalitions are predicted; the probability of an AC coalition is .5 x .5, therefore the probability of an AC coalition is .25; and the probability of a BC coalition is .5 x 1.0, or .50. In the remaining 25% of the cases, no coalition would be expected on the first contact attempt. Therefore, Chertkoff's revision of Caplow's theory predicts twice as many BC as AC coalitions, which is more compatible with the frequently observed "strength is weakness" effect. In contradiction with this revision, AB coalitions do occur; since no AB coalitions are predicted, χ^2 tests cannot be conducted to determine the significance of this discrepancy.

C. Ofshe and Ofshe (1968)

Ofshe and Ofshe (1968) emphasized another factor other than the power division in a triad. After a series of social choices, a utility of response variability might develop, reinforced by boredom with a fixed response strategy and by a desire for an outcome equitable to all participants. Their model, based upon maximizing the subject's expected utility is applicable when some basis exists for presuming a stable subjective probability of response reciprocation and for presuming a knowledge of the participants' expected reward upon a reciprocated contact. The subject's expected utility of a given choice on each trial was defined as a function of his expected monetary reward and of his utility of response variability.

Differentiating their expression for utility of social choice with respect to P_w, Ofshe and Ofshe observed that that utility was maximized when $P_w = (1/4)(\alpha_w \pi_w + \alpha_s \pi_s) + 1/2$ where P_w represents the probability of choosing the weaker candidate, π_w and π_s represent the probability of a reciprocated choice by the weaker and stronger candidate respectively, and α_w and α_s are parameters to be estimated from the data. This model was designed to be applied to stable-state data, i.e., data obtained after the subjects have had extensive experience with the experimental situation.

D. DeYoung and Phillips (1970), Model One

The first mathematical model discussed by DeYoung and Phillips (1970) was developed for the prediction of initial contact probabilities and was of the form: $P_W = \alpha \cdot PAR_W + B \cdot SEC_W$ where P_W is the estimated probability of the subject initially contacting the weaker of the two coalition partners and α and B are parameters estimated from obtained data. α represents a "weight" or emphasis placed by subjects upon the parity factor, while B represents a quantification of the emphasis placed upon the security factor. PAR_W is an index of the advantage to the subject from the standpoint of payoff in choosing the weaker over the stronger coalition partner. SEC_W is an index of the relative advantageousness in choosing the weaker as compared with the stronger coalition partner from the standpoint of the security of the coalition.

The mathematical form of PAR_W was derived from the parity norm, according to which player A in a winning coalition with the weaker player would expect the weaker player to demand a proportion of the payoff equal to $\frac{N_W}{N_A + N_W}$, leaving a share of $\frac{N_A}{N_A + N_W}$ for player A. If player A formed a coalition with the stronger of the possible coalition partners, his expected share of the payoff would be $\frac{N_A}{N_A + N_S}$ which would be less than $\frac{N_A}{N_A + N_W}$. Therefore,

$$PAR_W = \frac{\dfrac{N_A}{N_A + N_W}}{\dfrac{N_A}{N_A+N_W} + \dfrac{N_A}{N_A+N_S}}$$

was taken as an index of the advantage, with respect to the payoff, to player A if he chose the weaker instead of the stronger potential coalition partner.

Similar reasoning was used in deriving the form of SEC_W. The strength of a coalition with the weaker partner can be represented by $\frac{N_A + N_W}{N_S}$, i.e., the amount of resources in the coalition divided by the amount outside the coalition. Similarly, with respect to a coalition with the stronger partner, the strength can be represented by $\frac{N_A + N_S}{N_W}$. Therefore, an index of the advantageousness of forming a coalition with the weaker partner, with respect to security is

$$SEC_W = \frac{\dfrac{N_A + N_W}{N_S}}{\dfrac{N_A + N_W}{N_S} + \dfrac{N_A + N_S}{N_W}}$$

Initial contact data has been collected by Dr. James Phillips and his students for both the Committed Vote and Uncommitted Vote variations by mean of a Political

Decision Questionnaire. Ten resource distributions were used; each resource distribution was constructed such that $N_A + N_W + N_S = 300$ and $N_A = \begin{cases} N_W \text{ if } N_A < 100 \\ N_S \text{ if } N_A > 100 \end{cases}$.

In order to test the applicability of Model One to the collected data, a separate α was estimated for each variation while a single B was estimated for both variations, such that the squared deviation between the estimated and observed probabilities was minimized. The initial probabilities of choosing the weaker candidate along with the Model One estimated probabilities are presented in Figure 2.

E. DeYoung and Phillips (1970), Model Two

The second model developed by DeYoung and Phillips (1970) for the Political Convention Situation was an extension of the Shelly and Phillips (1966) model. Again $P_w = \frac{V_A\ (w)}{V_A\ (w) + V_A\ (s)}$; where P_w represents the probability that A chooses the weaker potential coalition candidate, and $V_A(w)$ and $V_A\ (s)$ respectively represent the "values" to player A of choosing the weaker and stronger candidate.

This model hypothesized that $V_A\ (W)$ is proportional to

1. The amount of payoff - PAR'_w - to be expected from choosing the weaker candidate;
2. The security of the coalition - SEC'_w - i.e., the coalition's expected probability of

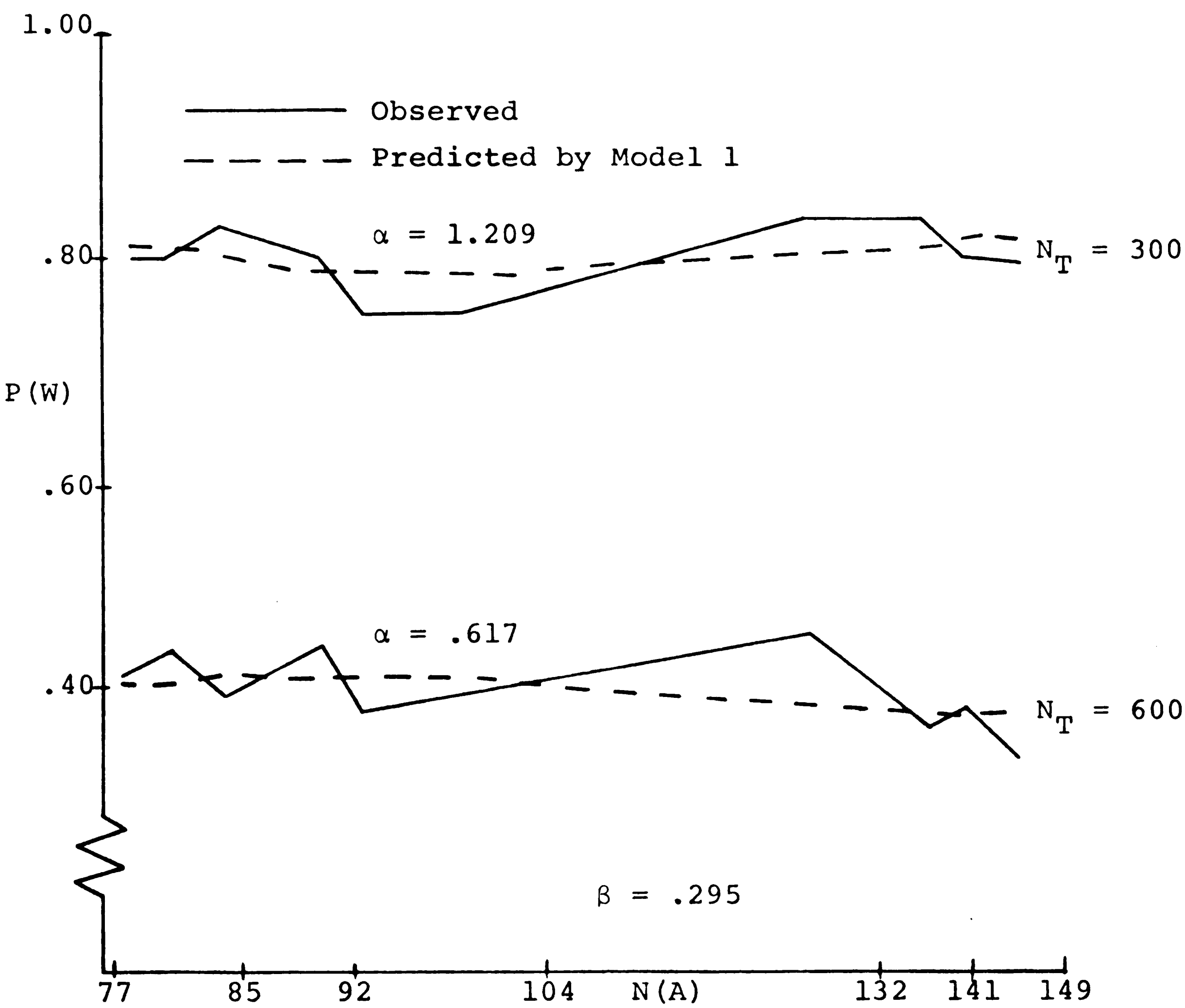


Figure 2.--Observed Probabilities of Choice of Weaker Candidate and Model 1 Predicted Probabilities

success in winning the nomination given the formation of a coalition with the weaker candidate;

3. The subjective likelihood of a reciprocal choice - π_w - by the weaker candidate; and
4. The expected ease of bargaining - B_w - with the weaker candidate, assuming a reciprocal choice.

The above hypothesis suggested an expression for V_A (w); $V_A (w) = K_w PAR'_w \cdot SEC'_w \cdot \pi_w \cdot B_w$, where K is a constant of proportionality. This expression was designed to be consistent with the intuitively reasonable supposition that if any of the above four factors is zero, the value to player A of choosing the weaker partner is zero.

The parity norm suggested an expression for the expected payoff factor - $PAR'_w = \frac{N_A}{N_A + N_W}$. The expression could not apply in the Uncommitted Vote Variation, since the maximum expected payoff could be

$$\frac{N_A}{\frac{N_T}{2} + 1}$$

no matter with which candidate player A forms a coalition. Although it would be difficult to suggest an expression for PAR_w and PAR_s in the Uncommitted Vote Variation, the above reasoning can be used to justify the assumption that $\frac{PAR's}{PAR'w} = 1$ in the Uncommitted Vote Variation.

Although data are lacking with respect to the subjective expected security of a coalition, the perceived security of a coalition was taken to be proportional to the quotient of the number of votes in the coalition and the number of votes outside the coalition, i.e., for computational purposes $SEC_w = \frac{N_A + N_W}{N_t - N_A - N_W}$.

Since no investigation had been made of π_w and B_w, these factors were combined with K_w' to yield K_w. Therefore,

$$P_w = \frac{V_A(w)}{V_A(w) + V_A(s)} = \frac{K_W \cdot PAR_W' \cdot SEC_W'}{K_w \cdot PAR_w' \cdot SEC_w' + K_s\ PAR_s'\ SEC_s'}.$$

This equation was simplified by dividing both the numerator and the denominator of the right hand side by $K_w \cdot PAR_w' \cdot SEC_w'$, yielding

$$P_w = \frac{1}{1 + \dfrac{K_s\ PAR_s' \cdot SEC_s'}{K_w\ PAR_w' \cdot SEC_w'}}$$

Replacing $\frac{K_S}{K_W}$ by α demonstrates that there is only the one parameter α to estimate using this model. For the Committed Vote Variation therefore,

$$P_w = \frac{1}{1 + \alpha \dfrac{\dfrac{N_A}{N_A + N_S} \cdot \dfrac{N_A + N_S}{N_W}}{\dfrac{N_A}{N_A + N_W} \cdot \dfrac{(N_A + N_W)}{(N_S)}}} = \frac{1}{1 + \alpha \dfrac{N_S}{N_W}}$$

For the Uncommitted Vote variation,

$$P_W = \cfrac{1}{1 + \alpha \, \cfrac{PAR'_S \quad \cfrac{(N_A + N_S)}{N_U + N_W}}{PAR'_W \quad N_U + N_S}}$$

$$= \frac{1}{1 + \alpha \, \frac{(N_A + N_S)\ (N_U + N_S)}{(N_A + N_W)\ (N_U + N_W)}}$$

For either variation, since an analytical solution is unavailable, α was estimated using a numerical least squares procedure.

The predictions of this model compared with the same data presented in the previous section are shown in Figure 3.

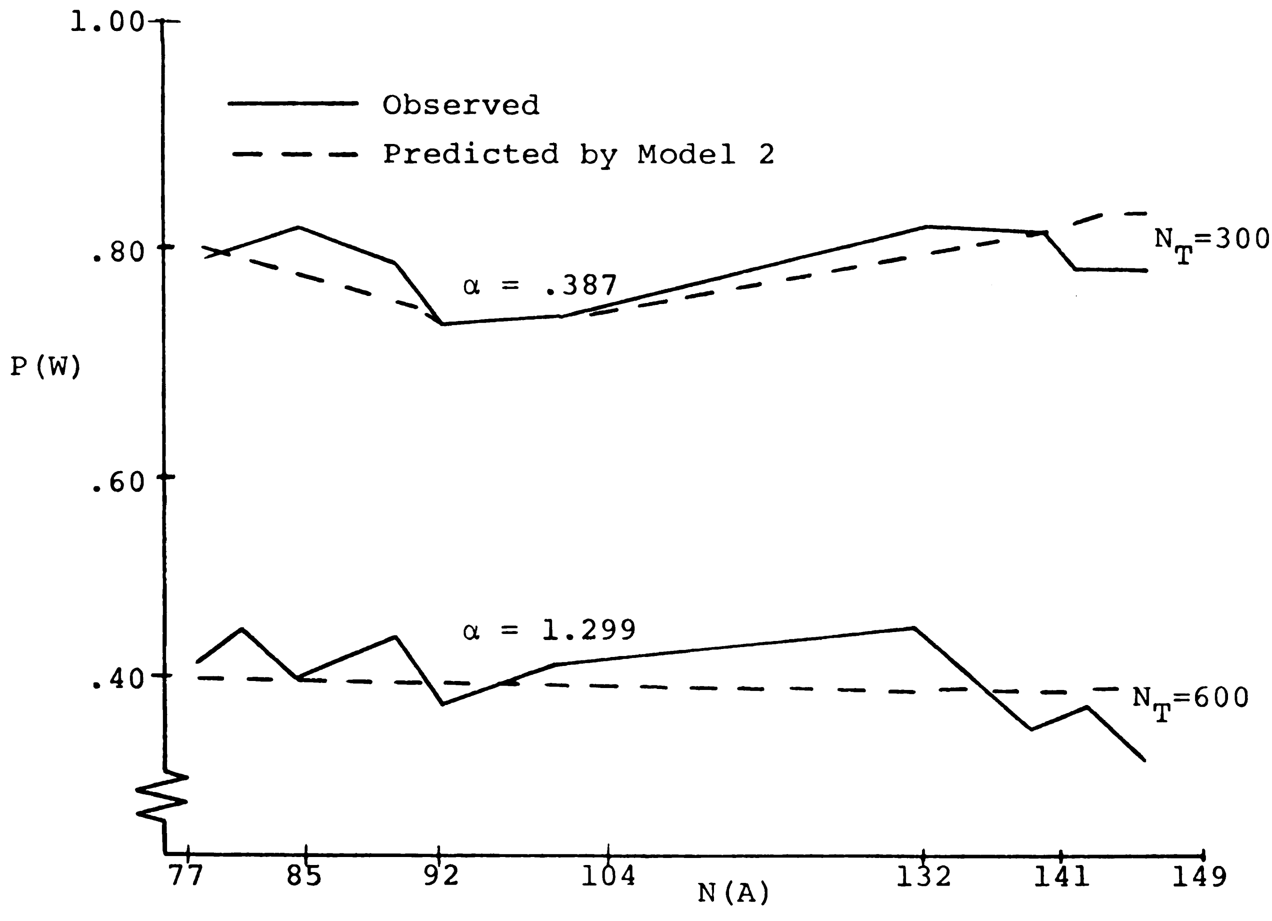


Figure 3.--Observed Probabilities of Choice of Weaker Candidate and Model 2 Predicted Probabilities

CHAPTER II

EXPERIMENT I

Statement of the Problem

Three major hypotheses were discussed in the previous chapter for the disappearance of the strength is weakness effect in successive Committed Vote version coalition formation games. The elimination of confusion explanation, that S's reevaluate power relationships after experience with the game, was advanced by Kelley and Arrowood (1960). The cumulative score explanation, that players who were behind on the reward dimension discriminated against the leader on that dimension, was supported by data obtained by Hoffman, Festinger, and Lawrence (1954) and Bond and Vinacke (1961). The utility of response variability notion was suggested by Chertkoff (1966), and a mathematical model based on this explanation was advanced by Ofshe and Ofshe (1968).

If an experiment were conducted such that Ss could have no knowledge of the accumulated winnings of themselves or of the other participants, the three explanations yield different predictions for the social contact and bargaining data obtained over successive games. (1) The elimination of confusion explanation predicts the disappearance of the strength is weakness effect in the Committed Vote version over time, but predicts stability of the strength is strength effect in the Uncommitted Vote version. With respect to the bargaining phase, the elimination of confusion notion predicts that, initially, coalitions will tend to divide the payoff in proportion to the resources of the coalition partners but that, over time, the payoff will tend to be divided equally between the two partners. (2) The cumulative score explanation predicts stability of the social contact and bargaining data over games in both the Committed Vote and Uncommitted Vote versions. (3) The utility of response variability explanation predicts a tendency to random responding, i.e., a probability of choosing the weaker candidate approaching .5, in the latter games of both the Committed Vote and Uncommitted Vote versions, but no departure from stationarity of reward division.

Experiment I was designed to test these three explanations. The necessary experimental control was obtained by (1) ensuring that choices were made without the Ss' knowledge of which individual represented each of the other candidates in each game, and by (2) preventing the accumulation of any reward over games; rather, one game was to be chosen at random for the division of the reward, making each game reward-independent and equally important to the Ss. If, as suggested by the interpretation of Vinacke et al. (1967), experience with the coalition formation paradigm did not lead to a change in response pattern over games, Experiment I was to provide sufficient data for the application of the mathematical models.

Method and Procedure

Subjects. Seventy-two males from introductory psychology courses at Michigan State University participated in this experiment, resulting in 24 groups of 3 Ss. Ss were unsystematically assigned to groups on the basis of their order of appearance at the laboratory.

Resource Distributions. Two criteria were used in choosing the resource distributions:

1. There should be consistency within versions, specifically all coalitions in the deterministic Committed Vote (CV) version should be winning coalitions and no coalitions in the probabilistic Uncommitted Vote (UV) version should be automatically winning coalitions; and
2. The resource distributions should cover a large range of resource points at approximately equal intervals.

In accordance with the two criteria, the resource distributions chosen were (80, 90, 130), (60, 100, 140), and (70, 110, 120); for brevity, these will be referred to as distributions 80, 60, and 70 respectively. In the CV version, the 300 votes represented by each distribution were the only votes in the convention. In the UV version, 600 total votes were represented at the convention, 300 of them uncommitted to any candidate.

Experimenters. Two male Es were used in this experiment. Each E was trained by participation as a subject in the experiment at least twice, and by participation as an E in at least ten practice sessions. In order to minimize demand characteristics and experimenter bias, one of the Es was kept uninformed as to the theory and purpose underlying the experiment.

Design. Each group of three Ss was run in ten games. The CV version was alternated with the UV version through the ten games; for half the groups of three Ss, the first game of the series was a CV version, while the first game was an UV version for the other half of the groups. Six different orders of distribution, i.e., distribution type 60, 70, or 80, were used. These orders are detailed in Appendix I. The six distribution presentation orders combined with the two possible CV - UV alternation orders resulted in twelve different game presentation orders. Of the 24 total groups, each E ran one group using each of the twelve game orders.

<u>Experimental Apparatus</u>. The Political Convention game was administered at a table divided into three sections which has been used in previous research on coalition formation (Kline, 1968). The experimenter was seated facing the *S*s on the other side of the table.

Each *S* was given a set of response sheets, on which he was to indicate which of the other potential coalition members he wished to contact on a given trial. Besides an area for a response to be made, each sheet had the current trial number, the number of votes the *S*'s candidate controlled, the total number of votes in the convention, the number of votes each of the other two candidates controlled, and the number of total votes in a coalition were the candidate to choose either of the other two coalition partners. The order of the two alternative coalition partners was randomized on the sheet, so that on one half of the sheets the stronger partner was listed first, and on the other half of the sheets the weaker partner was listed first. An example of one possible set of response sheets is contained in Appendix II.

Bargaining sheets were used so that coalition partners could successively offer each other part of the reward for forming a coalition. A bargaining sheet is contained in Appendix III.

<u>Procedure</u>. Upon their arrival at the experimental room, the *S*s were seated at the divided table and the

nature of the game was explained. The instructions were tape recorded to insure uniformity; a copy of the instructions is contained in Appendix IV. After a practice game, involving a distribution of 2, 3, and 4 votes, the Ss played ten games, assigned and conducted as described in the Design section.

Before each game, each S drew a packet of response sheets at random to indicate the number of votes which his candidate would control throughout that game. Each S also knew how many votes each of the other candidates controlled, but he did not know which of the other Ss represented which candidate. Each S made a choice on the response sheet independently of the other Ss, and returned the response sheet to the E through a slot in the partitioned table. If no mutual choice was made, the S marked the next response sheet and the game continued until there was a mutual choice. The bargaining took place on the bargaining sheets after two of the candidates chose each other as coalition partners. No communication other than the written offer was allowed during the bargaining phase of the experiment.

After ten games were concluded, the number of the one game which involved the actual $3.00 payoff was selected by a random drawing. Since no coalition in the UV version had a majority of the 600 possible votes, the determination of the winner(s) immediately followed the drawing if the game drawn was an UV game. The determination was made by splitting the 300 uncommitted votes among the three candidates. Thus, the Ss in the coalition received the votes that they controlled plus the sum of the previously uncommitted votes assigned to each of the two candidates whose representatives formed the coalition. The Ss were made aware of the above procedure before they played the game, and it had been pointed out that since there were 300 votes outstanding, it would be possible for the S left out of the coalition to receive all of the $3.00 in a version UV game.

Results

Table 1 contains the overall analysis of variance of the initial contact data in terms of the experimenter, version (CV versus UV), distribution, and resource point independent variables. All four effects are clearly fixed effects. The conservative "never pool" rule discussed by Winer (1962) was adopted, but in any case the large number of degrees of freedom in the error term would make negligible the effect of pooling nonsignificant interactions into the error term. While the design of the experiment suggests that a repeated measures analysis would be appropriate, the random drawing of response sheets resulted in the observation of some Ss at only 2 of the 3 possible resource points, the missing cells making a repeated measures analysis impossible.

TABLE 1.--Analysis of Variance for Probability of Choosing Weaker Candidate, Experiment I.

Source	SS	DF	MS	F	
Total	179.26	719			
Experimenter	4.58	1	4.58	20.96	<.0005
Version	17.71	1	17.71	81.11	<.005
Distribution	.53	2	.26	1.21	______
Resource Pt	1.18	2	.59	2.70	.07
E X V	.003	1	.003	.01	______
E X D	.40	2	.20	.91	______
E X R	.78	2	.39	1.78	______
V X D	.63	2	.31	1.44	______
V X R	1.21	2	.60	2.77	.07
D X R	1.32	4	.33	1.51	______
E X V X D	.63	2	.32	1.45	______
E X V X R	.11	2	.05	.24	______
E X D X R	.41	4	.10	.47	______
V X D X R	.05	4	.01	.05	______
E X V X D X R	.51	4	.13	.59	______
Error	149.30	684	.22		

Therefore, an unequal n's factorial analysis was conducted, forfeiting the power of the repeated measures design but using the multiple games per group simply as a device for the collection of more extensive data.

The analysis of variance in Table 1 indicates that the experimenter effect was highly significant. Whereas the overall probability of choosing the weaker candidate was .48, the mean for the informed E was .57 contrasted with a mean probability of choosing the weaker candidate of .38 for the E who was uninformed as to the purpose of the experiment. There was a highly significant different between the two versions of the Political Convention Game. The probability of a choice of the weaker candidate was .63 in version CV and .33 in version UV. No other effects were significant at the .05 level. The effect of comparative power of a candidate (resource point) approached significance ($F_{2,684} = 2.70$, $p < .07$). The weakest candidate chose the weaker potential coalition partner with a probability of .42, compared with a probability of .47 of the middle candidate choosing the weaker, and a probability of .54 for the strongest candidate choosing his weaker potential coalition partner. A test of trend showed that the linear trend with respect to resource point also approached significance with no quadratic trend. The version by resource point interaction also approached significance ($F_{2,684} = 2.77$, $p < .07$). Figure 4 shows the version by resource point

Figure 4.--Resource Point by Version Interaction Means, Experiment I.

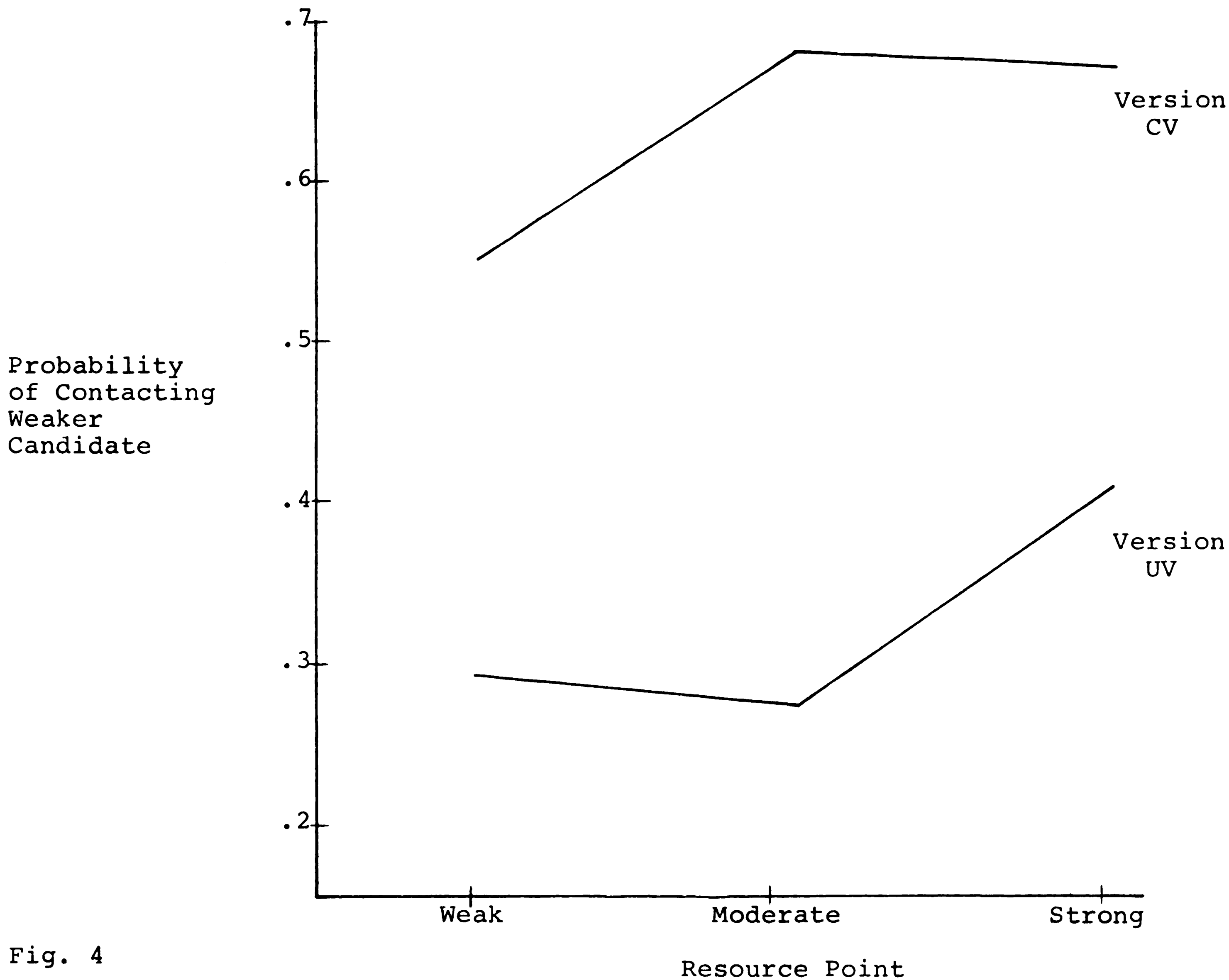

.7
.6
.5
.4
.3
.2
Probability
of Contacting
Weaker
Candidate
Version
CV
Version
UV
Weak
Moderate
Strong
Resource Point

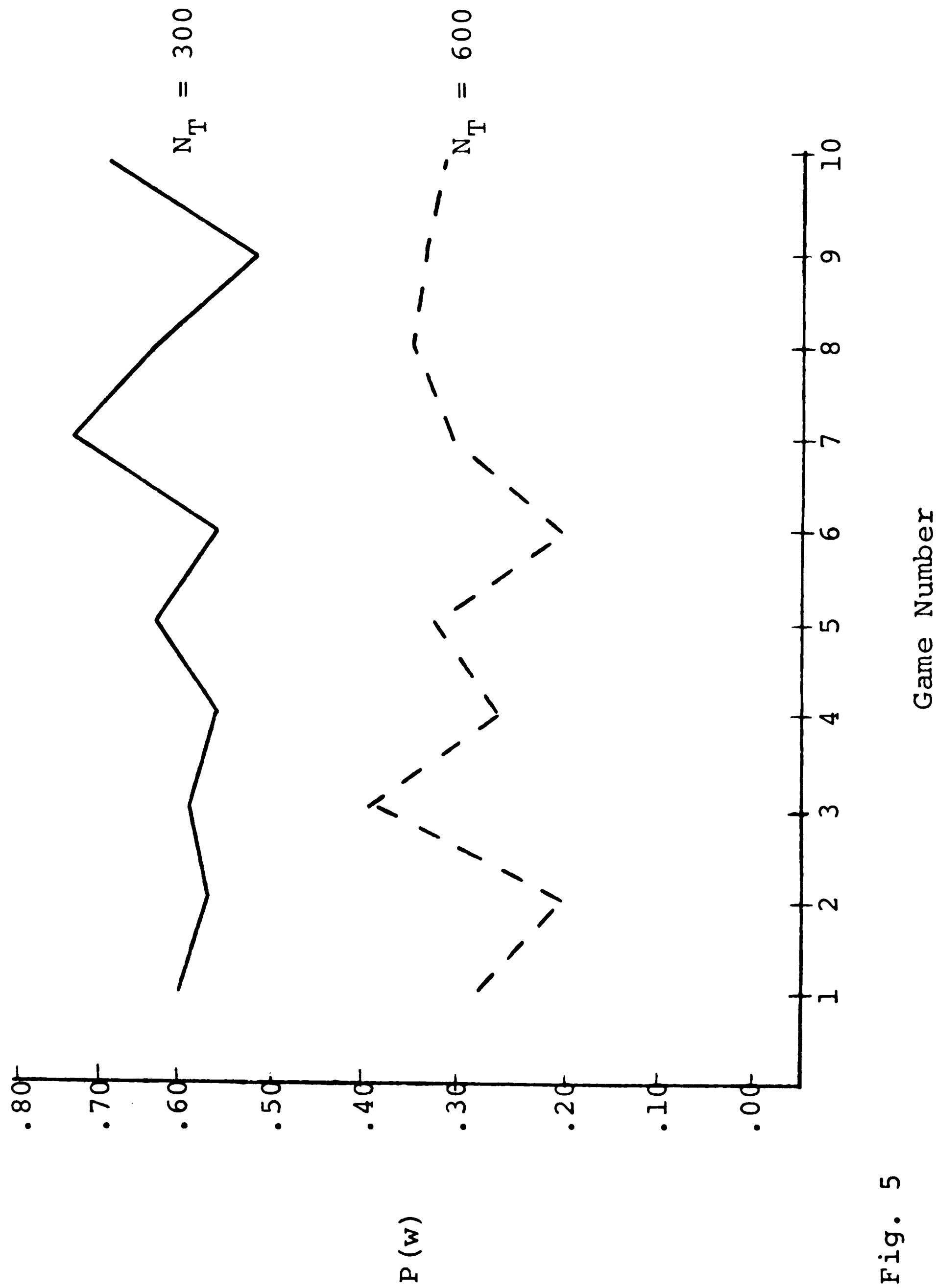
Fig. 4

interaction means. A t-test showed that the weaker candidate was more often chosen when that candidate's votes were listed first, i.e., on the left, ($t_{718df} = 2.5$, $p < .05$); that probability was .52, compared with .44 when the weaker candidate's votes were listed on the right.

Table 2 contains the frequency of each of the three possible coalitions in each version of the Political Convention game, summed over all ten games. Most coalitions in version CV were moderate-weak coalitions, and the fewest coalitions were strong-moderate coalitions; this finding is indicative of the strength is weakness effect. Comparing the observed coalition frequencies with an all-equal frequency null hypothesis yields $\chi^2_{2df} = 10.4$, $p < .01$. The table demonstrates an even stronger strengh is strength effect in version UV, $\chi^2_{2df} = 30.0$, $p < .001$.

In support of this finding, Figure 5 suggests that the probability of contacting the weaker candidate did not become more random in the later games of the series in either version CV or UV. In order to test this hypothesis statistically, the observed frequencies of contacting the weaker candidate were compared with the hypothesis of a constant frequency of contacting the weaker; for version CV, $\chi^2_{9df} = 2.05$, n.s., and for version UV, $\chi^2_{9df} = 5.58$, n.s. In addition, the correlations in version CV and version UV between the probability of choosing the weaker candidate and the game number were

Figure 5.--Probability of Choice of Weaker Candidate in Two Versions of the Political Convention Game as a Function of Game Number, Experiment I.



N_T = 300
N_T = 600
.80
.70
.60
.50
.40
.30
.20
.10
.00
P(w)
1
2
3
4
5
6
7
8
9
10
Game Number

Fig. 5

TABLE 2.--Frequency of Coalitions in Two Versions of Convention.

Version	Type of Coalition			
	Strong-Moderate	Strong-Weak	Moderate-Weak	χ^2
Committed Vote	24	44	52	10.4*
Uncommitted Vote	64	41	15	30.0**

Note: The expected value of each cell is 40, each chi-square has 2 df.

*$p < .01$
**$p < .001$

each equal to .08. Therefore, the probability of choosing the weaker candidate did not vary systematically over time.

The utility of response variability concept suggested that, especially over successive trials within a single game, the conditional probability of choosing the weaker candidate given that the weaker candidate was chosen on the previous trial, i.e., the probability of perseveration, should decrease in both version UV and CV. In particular, the existence of a utility of response variability would be indicated after several trials of a game if that conditional probability were to decrease below the overall probability of a choice of the weaker candidate; at the same time the overall probability of choosing the weaker candidate should approach .5 in both version UV and CV. The data were summed into blocks in order to have enough observations at each data point; Block 1 was composed of trials 2 and 3, and Block 2 included trials 4 through 7. The overall probability of choosing the weaker candidate in version CV decreased from .63 at trial 1 to .47 in Block 1 and .47 in Block 2; the perseveration probability decreased from .75 in Block 1 to .56 in Block 2. In version UV, the overall probability was .33 on trial 1, .33 in Block 1, and .46 in Block 2; the perseveration probabilities were .55 in Block 1 and .56 in Block 2. The stability of the game to game overall probabilities of choosing the weaker candidate has already been discussed in connection with Figure 5. The associated game to game perseveration probabilities also showed no systematic increase or decrease.

Figure 6 contains the bargaining data over games for all distributions and both versions. There clearly was no increase in the amount of reward to the weaker candidate in the later games of the series; since the 99.9% confidence interval does not include a 50-50 division of the reward at any point, there is over 99.95% confidence that the true mean reward lies below a 50-50 division. A χ^2 analysis comparing the number of 50-50 splits over the ten games with the hypothesis of a constant number of 50-50 splits complements this finding, $\chi^2_{9df} = 2.44$, n.s.

The histograms in Figure 7 present the game by game bargaining data in more detail. The most striking

Figure 6.--The Amount of Money to Weaker Candidate and 99.9% Confidence Intervals as a Function of Game Number, Experiment I.

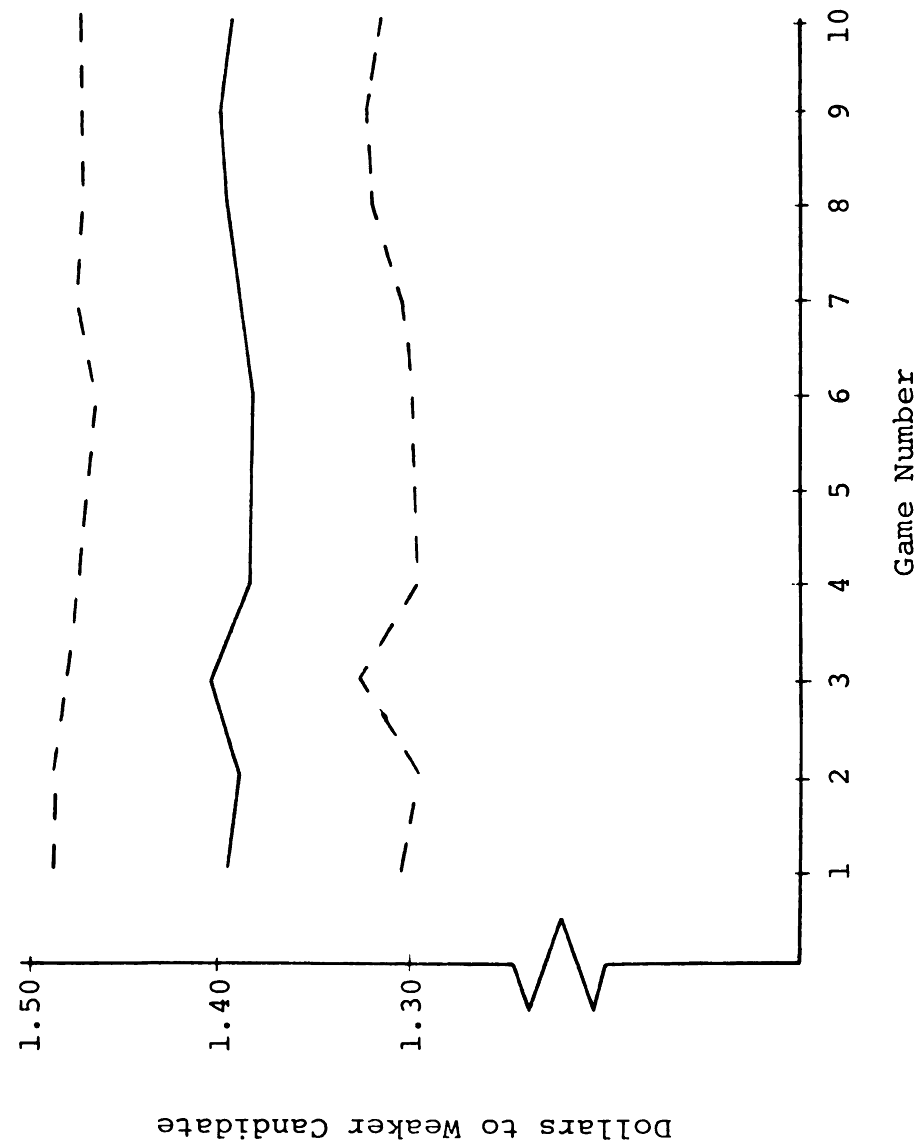

Dollars to Weaker Candidate
1.50
1.40
1.30
Game Number
1
2
3
4
5
6
7
8
9
10

Fig. 6

Figure 7.--Histograms of Reward to Weaker Candidate in Each of Ten Games, Experiment I.

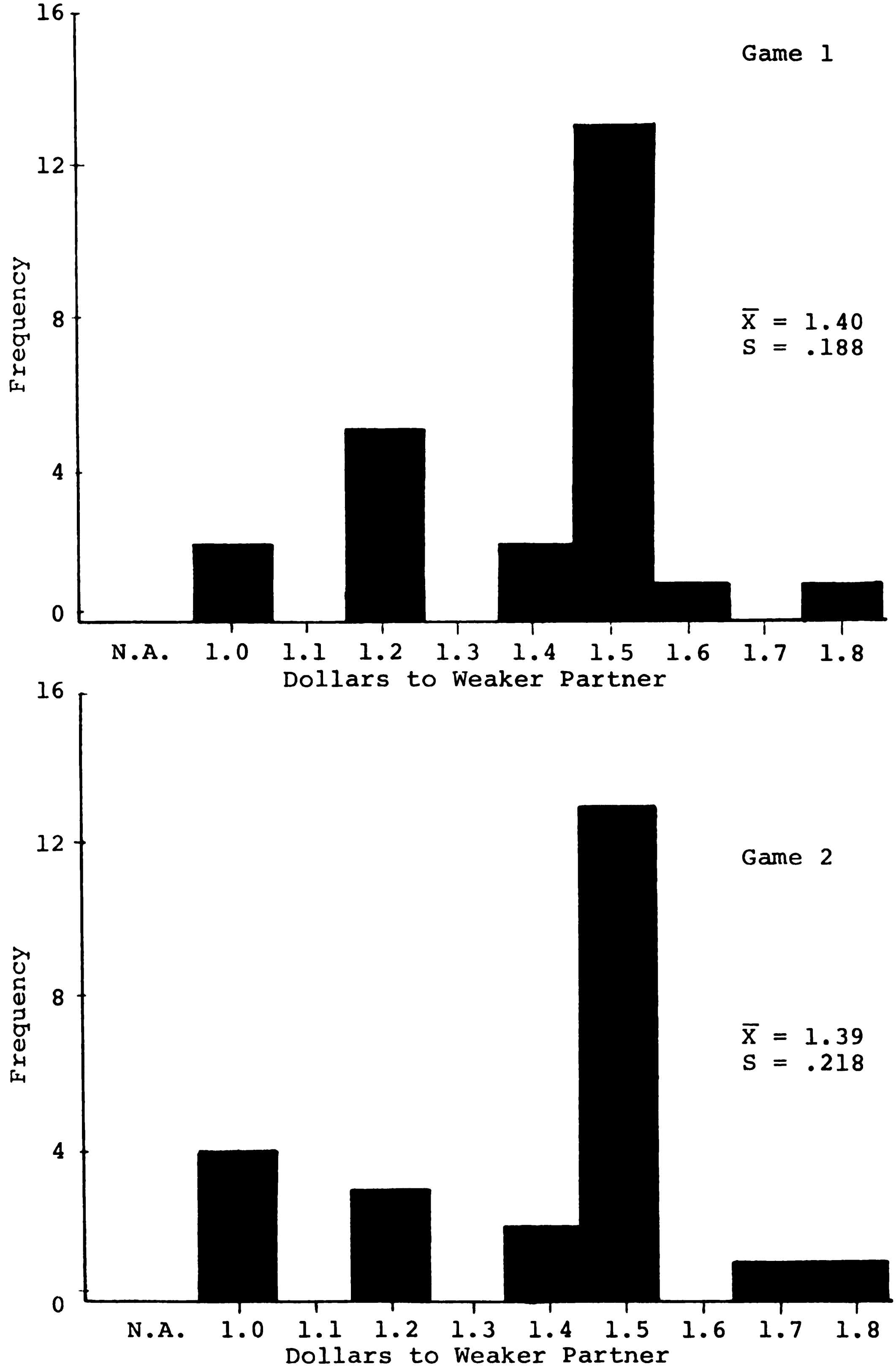

Game 1
16
12
8
4
0
Frequency
X̄ = 1.40
S = .188
N.A. 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8
Dollars to Weaker Partner
Game 2
16
12
8
4
0
Frequency
X̄ = 1.39
S = .218
N.A. 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8
Dollars to Weaker Partner

Fig. 7

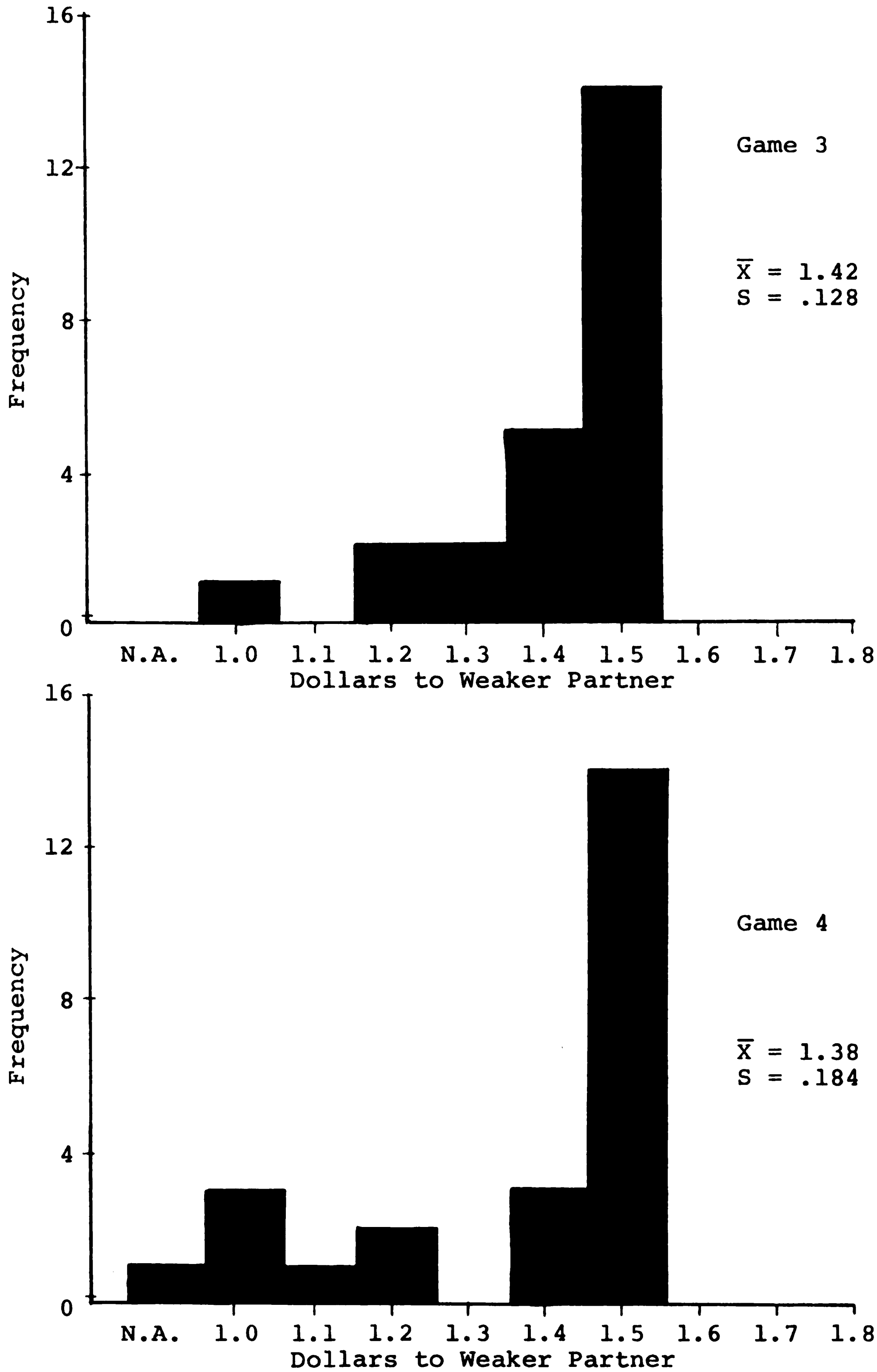
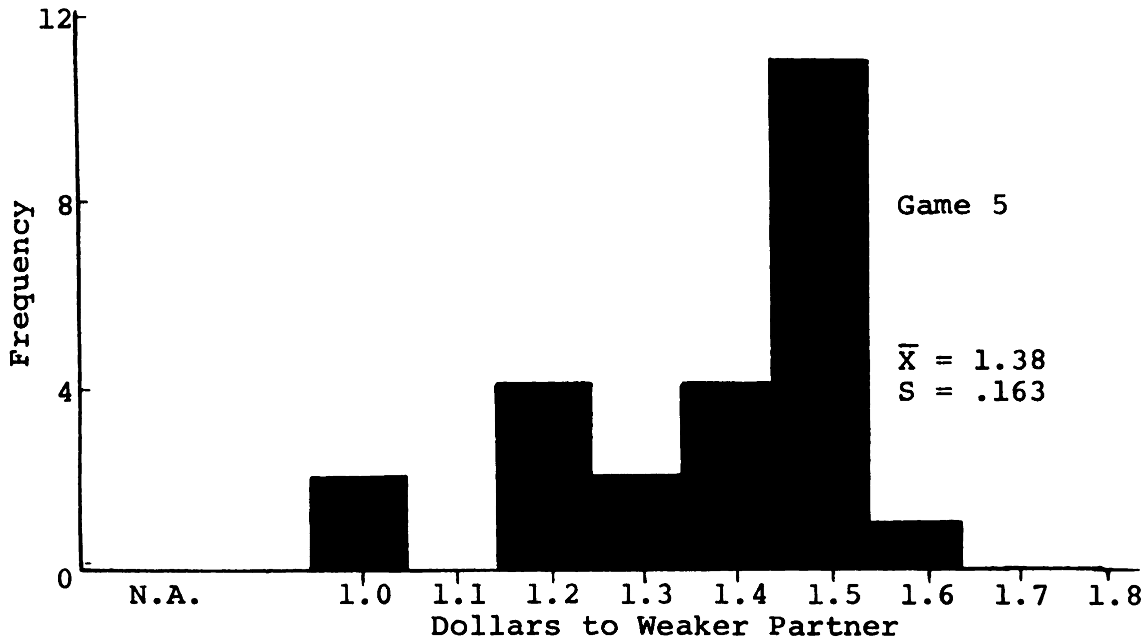

16
12
8
4
0
Frequency
Game 3
$\bar{X}$ = 1.42
S = .128
N.A. 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8
Dollars to Weaker Partner
16
12
8
4
0
Frequency
Game 4
$\bar{X}$ = 1.38
S = .184
N.A. 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8
Dollars to Weaker Partner

Fig. 7


12
8
4
0
Frequency
Game 5
$\bar{X}$ = 1.38
S = .163
N.A.
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
Dollars to Weaker Partner

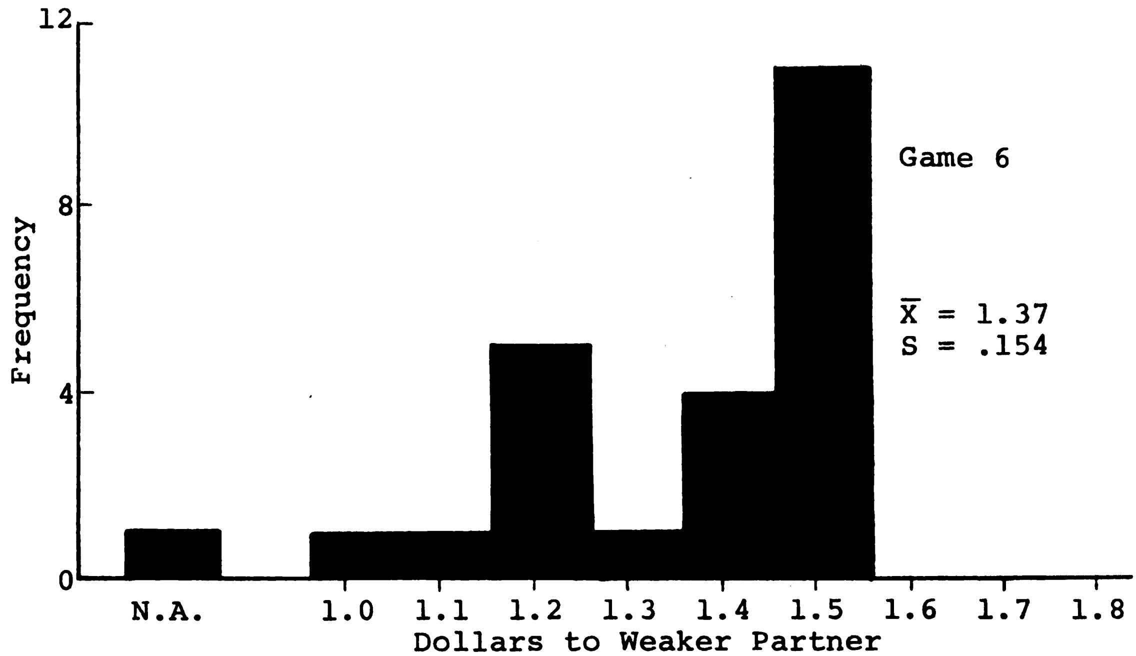
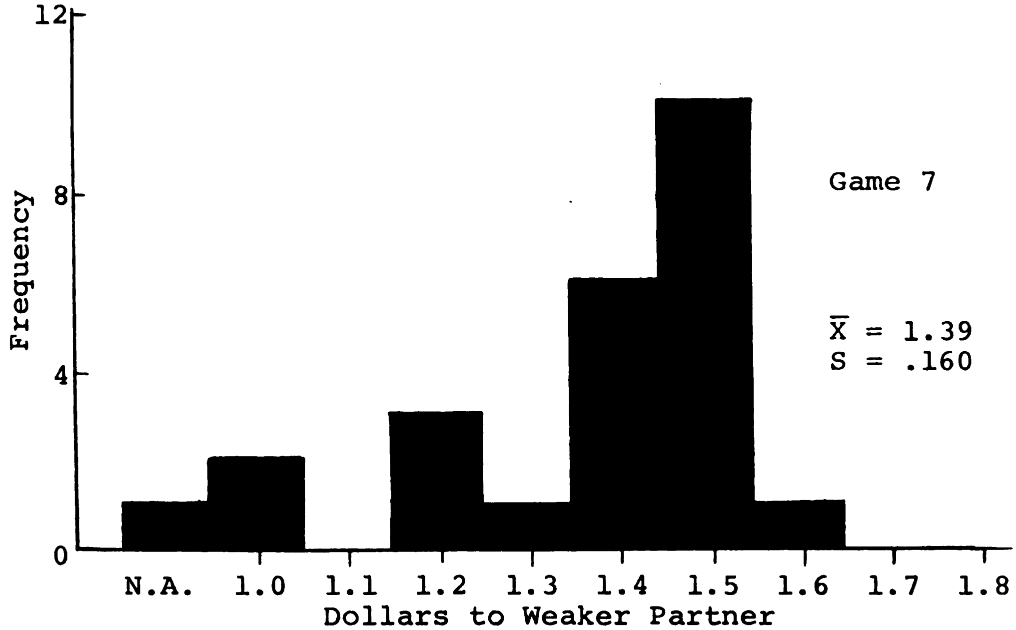

12
8
4
0
Frequency
Game 6
$\bar{X}$ = 1.37
S = .154
N.A.
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
Dollars to Weaker Partner

Fig. 7


12
8
4
0
Frequency
Game 7
$\overline{X}$ = 1.39
S = .160
N.A. 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8
Dollars to Weaker Partner

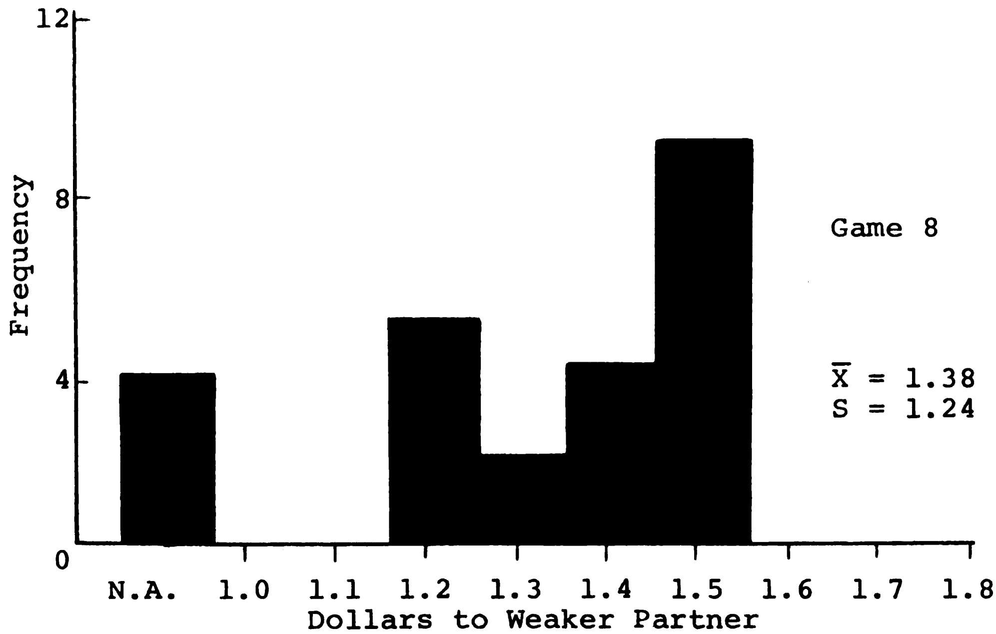
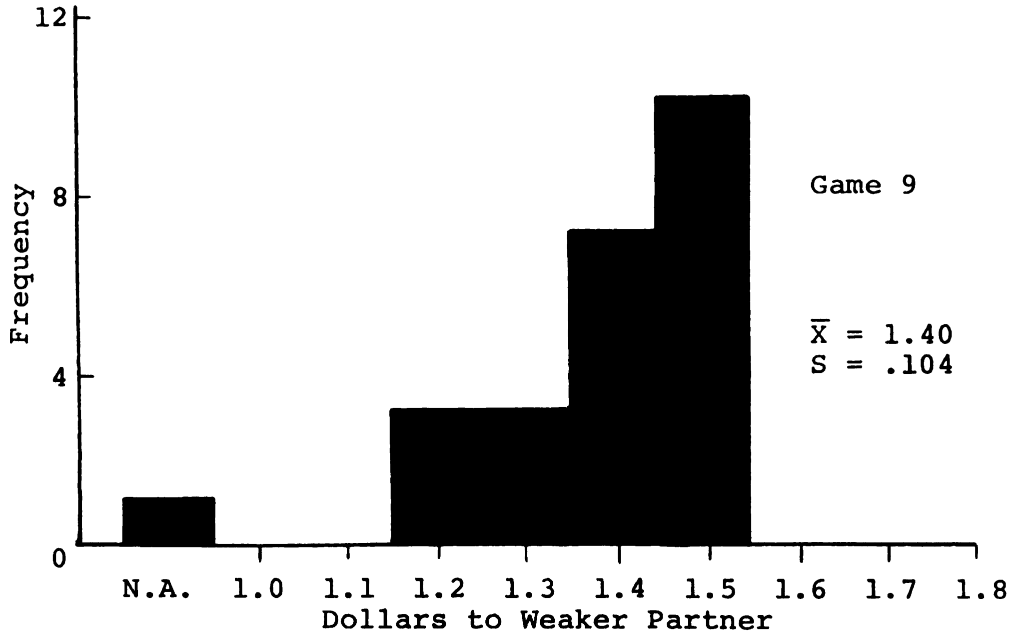

12
8
4
0
Frequency
Game 8
$\overline{X}$ = 1.38
S = 1.24
N.A. 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8
Dollars to Weaker Partner

Fig. 7


12
8
4
0
Frequency
N.A. 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8
Dollars to Weaker Partner
Game 9
$\overline{X}$ = 1.40
S = .104

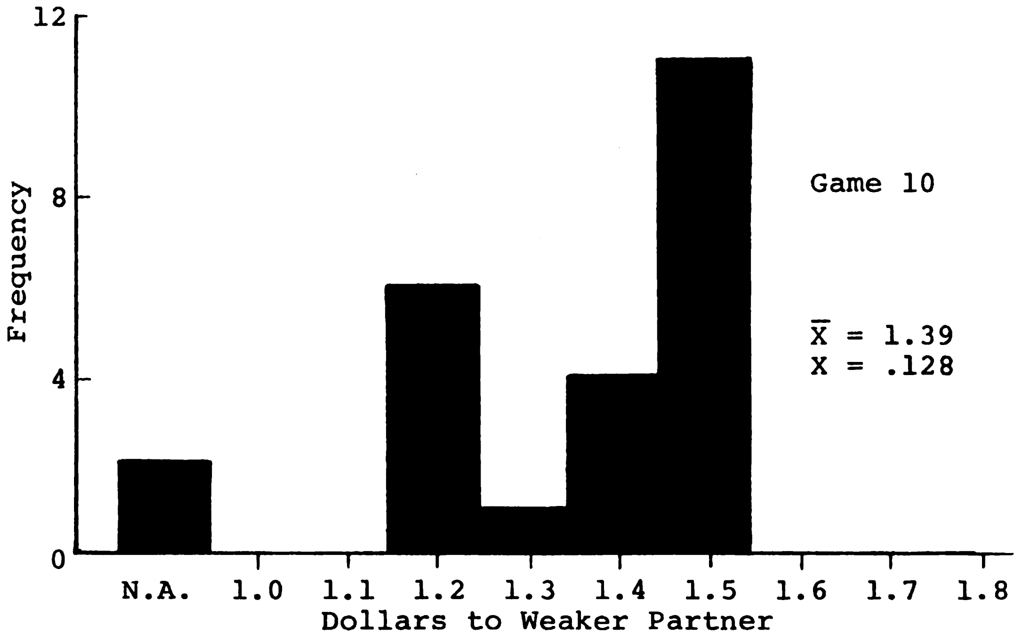
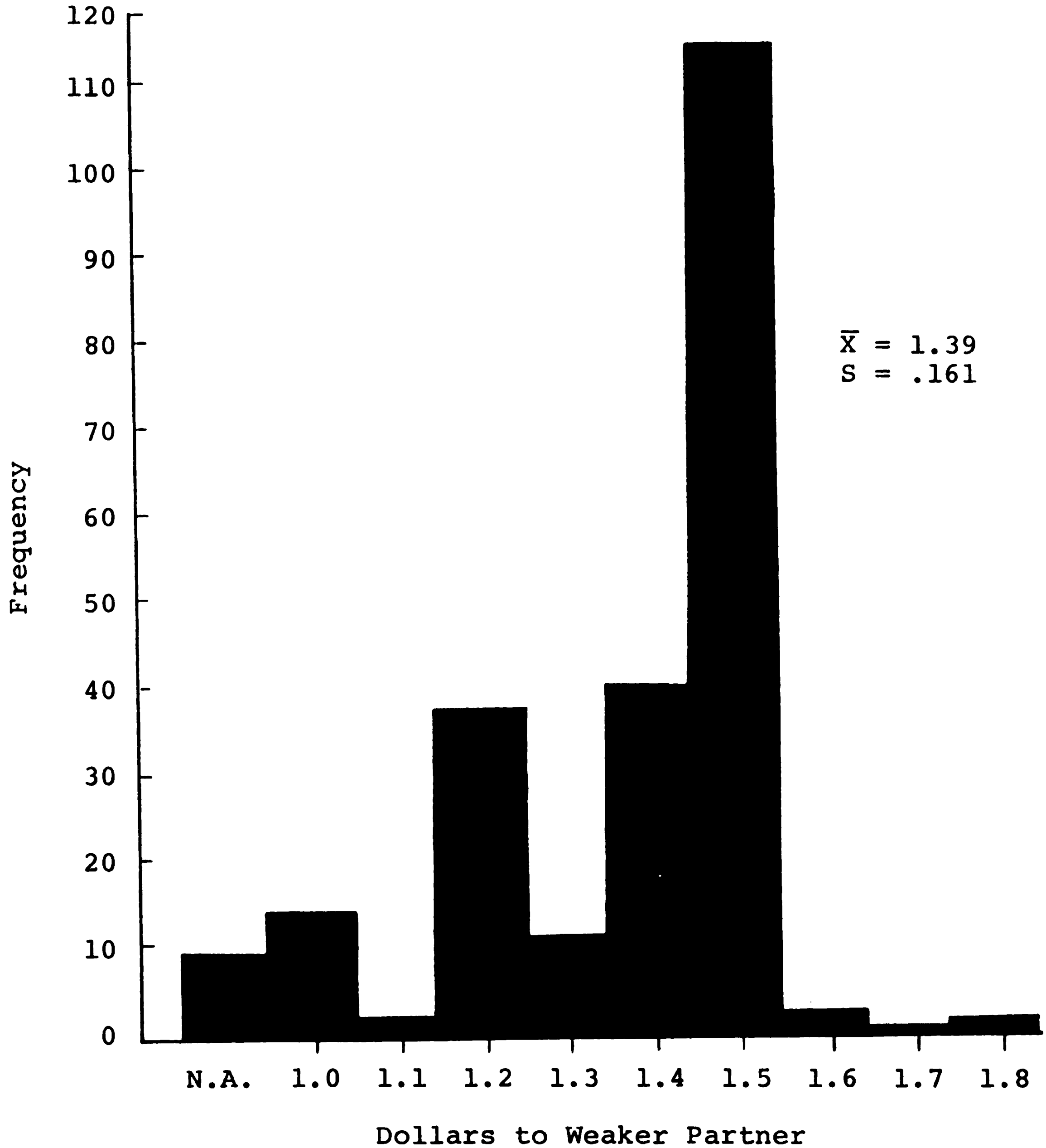

12
8
4
0
Frequency
N.A. 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8
Dollars to Weaker Partner
Game 10
$\overline{X}$ = 1.39
X = .128

Fig. 7

feature of the histograms is that the variances of the agreements reached appear to decrease over games; however the usual Bartlett's test is inappropriate for two reasons. Bartlett's test is seriously affected by non-normality and the data do not appear to be normally distributed; also, the variance of the third game is small so that Bartlett's test of homogeneity of variance would yield no assurance that a significant B indicated a decrease in variance over games. However, the average variance in the first four games was .033 compared with an average variance of .025 in the middle three games and an average of .014 in the last three games. The hypothesis that there is no difference between these mean variances can be examined by the more robust test suggested by Sheffe (1959, p. 83). The obtained $F(9,7) = 1.22$ does not permit rejectance of the null hypothesis. Figure 8 presents a summary histogram of the same bargaining data summed over all games.

While the above analyses suggest that bargaining is relatively stable over games and that Ss do not at any time fail to discriminate against the weaker coalition partner, the question remains as to whether Ss behave literally in accordance with the parity norm, i.e., whether Ss arrive at reward divisions proportionate to their relative contributions to the strength of the coalition. Figure 9 shows the parity division, the actual division of the reward, and 99% confidence intervals about the actual reward division in each coalition, averaged

Figure 8.--Summary Histogram of Reward to Weaker Candidate in All Ten Games, Experiment I.



120
110
100
90
80
70
60
50
40
30
20
10
0
Frequency
X̄ = 1.39
S = .161
N.A. 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8
Dollars to Weaker Partner

Fig. 8

Figure 9.--Parity Division and Actual Reward to Weaker Candidate in Each Coalition With 99% Confidence Intervals, Experiment I.

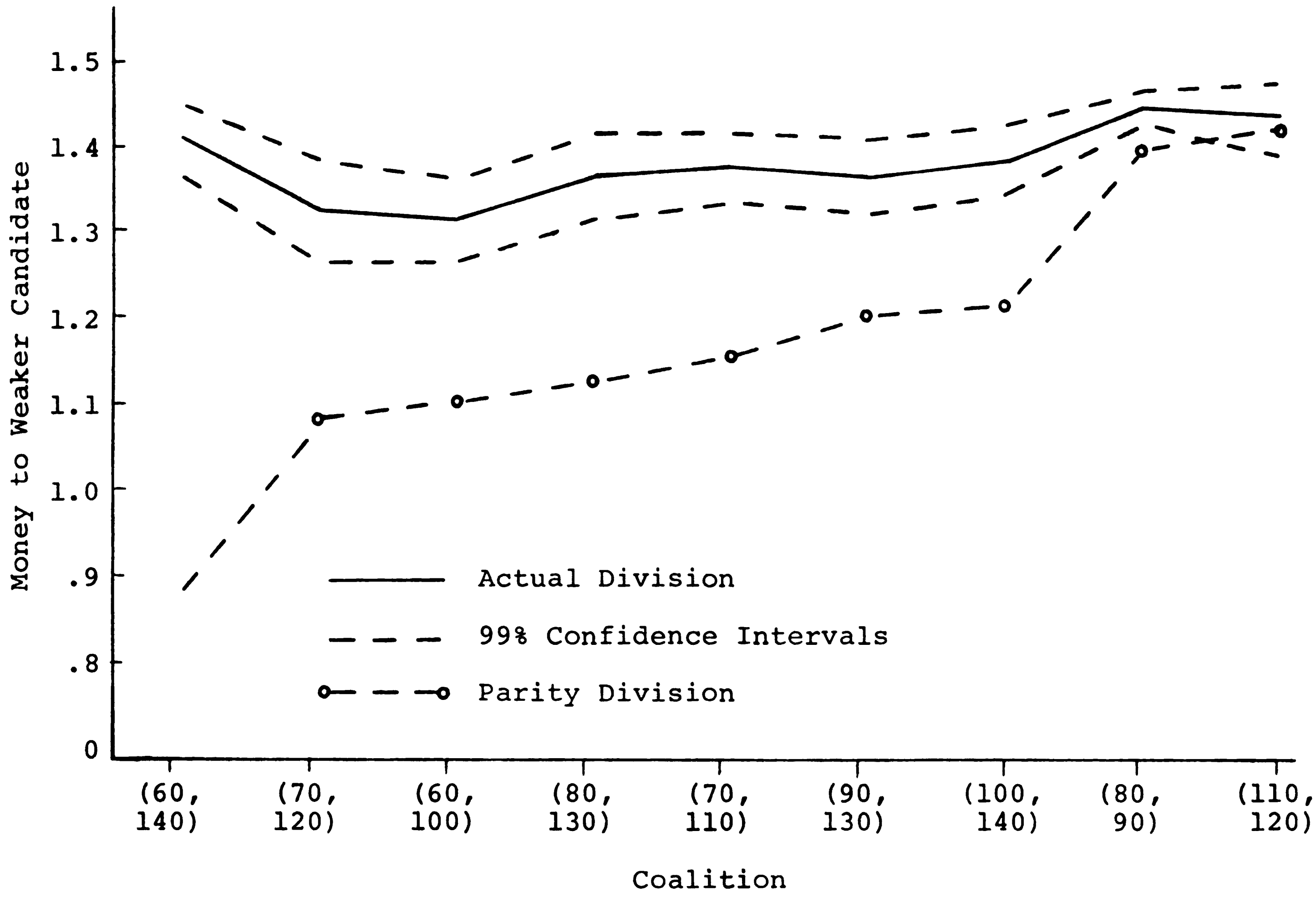

Money to Weaker Candidate
1.5
1.4
1.3
1.2
1.1
1.0
.9
.8
0
(60, 140)
(70, 120)
(60, 100)
(80, 130)
(70, 110)
(90, 130)
(100, 140)
(80, 90)
(110, 120)
Coalition
Actual Division
99% Confidence Intervals
Parity Division

Fig. 9

over all games and versions. At only one point does the 99% confidence interval include a parity division of the reward. (The 95% confidence intervals, not shown, also include a parity division of the reward at only this point.)

Table 3 contains the analysis of variance of the bargaining data in terms of the experimenter, version, distribution, and coalition (moderate-weak versus strong-weak versus strong-moderate) independent variables. No main effects or interactions were found to be significant, justifying the univariate breakdown of the data in the preceeding bargaining data analyses. The lack of a significant coalition effect or distribution by coalition interaction complements the data in Figure 9. Ss apparently not only achieved agreements significantly different from those suggested by the parity norm, but the trend of the agreements reached did not vary in accordance with the parity norm, i.e., the weaker candidate apparently received as much of the reward in a strong-weak coalition as he would have received from a coalition with the middle candidate.

Discussion

In the present experiment, in which an attempt was made to prevent any estimate of the previous winnings of any player, the strength is weakness effect was found to persist over a series of ten games in a deterministic

TABLE 3.--Analysis of Variance for Reward to Weaker Candidate, Experiment I.

Source	SS	DF	MS	F	SIG
Total	5.9160	239			
Experimenter	.0178	1	.0178	.7616	________
Version	.0007	1	.0007	.0289	________
Distribution	.0129	2	.0064	.2739	________
Coalition	.0683	2	.0342	1.4559	________
E X V	.0001	1	.0001	.0029	________
E X D	.0783	2	.0391	1.6679	________
E X C	.0075	2	.0038	.1606	________
V X D	.0332	2	.0166	.7073	________
V X C	.0229	2	.0114	.4876	________
D X C	.1672	4	.0418	1.7808	________
E X V X D	.0330	2	.0165	.7025	________
E X V X C	.0220	2	.0110	.4679	________
E X D X C	.1035	4	.0259	1.1023	________
V X D X C	.1155	4	.0289	1.230	________
E X V X D X C	.2154	4	.0538	2.2951	$.10 > p > .05$
Error	4.7885	204	.0235		

version of a coalition formation game, while the strength is strength effect was replicated in a probabilistic version (Table 2). The analysis of the data provided strong evidence that neither initial contacts (Figure 5), nor reward agreements (Figure 6) became more equal to each of two prospective coalition partners during the series of games. These results stand in direct contrast to the results reported in the Kelley and Arrowood (1960) and Chertkoff (1966) studies in which cumulative scorekeeping was allowed. The present study suggests that the results of Kelley and Arrowood (1960) and Chertkoff (1966) are therefore best accounted for by the cumulative reward explanation of the increasing randomness of initial contacts reported in those studies.

It is clear from the bargaining data that the weaker candidate received less than half of the shared reward (Figure 6), but that the degree to which this reward share was less than half did not depend upon the exact proportion of votes which the weaker candidate contributed to the coalition (Figure 9, Table 3) in contrast with the implications of Gamson's (1961) parity norm.

No systematic change in the variances of the bargaining agreements was found over games. Data consistent with the utility of response variability concept were reported for trial to trial (within games) contacts; such data are also consistent with an explanation in terms of a decreased subjective expected probability of contact reciprocation, however. That is, since more than one trial within a game was necessary when there had been no mutual choice, *S*s may have changed their choices when they no longer expected their preferred coalition partner to choose them in return.

CHAPTER III

EXPERIMENT II

Statement of the Problem

Experiment II was designed to investigate further the factors responsible for the disappearance of the strength is weakness effect. Since in Experiment I Ss did not ignore the power divisions of the potential coalition partners in the final games within a series of games in contrast with the Kelley and Arrowood (1960) hypothesis, the effects of accumulated reward remained to be investigated. As previously stated, Bond and Vinacke (1961) and Hoffman, Festinger, and Lawrence (1954) found that players who were behind on the reward dimension tended to ally against the leader in the reward division. The effect of the Ss knowledge of his own reward has not previously been separated from that effect however. The effects of accumulated reward would be a valuable addition to a quantitative theory of coalition formation.

An adequate quantitative formalization of the effect of accumulated reward would require the observation of a sufficient number of choices made under each of a limited number of accumulated divisions of the reward.

In Experiment II the necessary limitation of the numbers of types of reward division was ensured by announcing the amount of reward acquired by each candidate after each third game only, by employing imposed divisibility of reward, and by using several techniques which made it difficult for Ss to accurately assess their accumulated reward before the announcement was made.

Two experimental conditions were used in Experiment II. In the Complete Knowledge (CK) condition the accumulated reward was announced after every three games in terms of the amount previously earned by the player representing each power position in the next game; therefore, although each player would not know which individual represented each potential coalition partner in the succeeding game, each player would be able to choose a partner and bargain with him under knowledge of both the number of votes controlled by him and his previously accumulated reward. In the Incomplete Knowledge (IK) condition, the accumulated reward was announced in terms of the players who represented each power position in the previous game so that each player would only be aware of the division of the reward, his own accumulated reward, and the vote distributions in the succeeding game. Therefore, Condition IK would test for any effects caused by a player's own relative reward accumulation as opposed to interactive effects of one's own and other's accumulated reward.

Method and Procedure

Subjects. Two hundred and sixty-four male subjects from introductory psychology courses at Michigan State University volunteered for participation in this experiment, resulting in 88 groups of 3 Ss. Thirty of the groups were run in Condition IK, and 58 in Condition CK.

Resource Distributions. The same resource distributions were used in this experiment as were used in Experiment I.

Design. Each group of three Ss was run in twelve games. As in Experiment I, the CV version was alternated with the UV version of the Political Convention situation; for half the groups of three Ss, the first game of the series was a CV version, while the first game was an UV version for the other half of the groups.

The accumulated reward distributions announced after every third game was restricted to one of three predetermined reward distributions. Each game involved a reward of 25¢; the possible reward distributions, one of which was announced after every third game, were (25, 25, 25), (20, 25, 30), and (15, 25, 35). The number of reward distributions was able to be restricted without the awareness of the Ss for reasons outlined in the Procedure section.

Straightforward combinatorial techniques reveal that the above set of reward distributions can be combined with the three resource distributions to yield 39 unique combinations. Therefore only one resource distribution was used in the fourth, seventh, and tenth games where the effect of accumulated reward was measured, and a subset of only five of the possible thirteen combinations of the (vote) resource and reward distributions was selected to be the set of "payoff distributions" in order to obtain an adequate number of observations under each combination or "payoff distribution." Distribution 60 was the resource distribution chosen to be used at the first, fourth, seventh, and tenth games in order to test the effect of accumulated reward; that distribution is distinguished by the equal intervals of votes between the weakest, middle, and strongest player. The payoff distributions used are detailed in Table 4, which indicates that in payoff distribution 1, for example, the person who controlled 60 votes in the succeeding game had won 35¢ for the last three games, the person who controlled 100 votes had won 25¢, and the person who controlled 140 votes had won 15¢ in the last three games.

Games 2, 3, 5, 6, 8, and 9 which were presented between the games used to measure the effect of accumulated reward involved an imposed divisibility of reward. For each group, in half of the 6 games a 50%-50% division of the reward was imposed; in the other 3 games a 70%-30% division of the reward was imposed. Distributions 80 and 70 which were used in the 6 intervening games are resource

TABLE 4.--Combinations of Reward and Resource Point, i.e., Payoff Distributions, Used in Experiment II.

Point Resource	Payoff Distribution				
	1	2	3	4	5
60	35¢	15¢	20¢	30¢	25¢
100	25¢	35¢	25¢	20¢	25¢
140	15¢	25¢	30¢	25¢	25¢

distributions in which intracoalition compatibility could be demonstrated by coalitions between the relatively equal players (80-90; 110-120) or the relatively disparate players (80-130; 70-120). Table 5 summarizes the design of this experiment with respect to accumulated reward, imposed divisibility of reward, and the resource distributions used in each of the 12 games.

Two conditions were employed to separate the usually confounded effect of an Ss knowledge of his own reward from the effect of the Ss knowledge of his own and the other players' reward. In Condition CK, the amount of money credited to each player for each set of three games was announced after distribution of the ballots for the succeeding game in terms of the number of votes controlled by each player in the succeeding game. In Condition IK, the accumulated reward was announced in terms of the number of votes controlled by each player in the previous

TABLE 5.--Order of Games Involving Accumulated Reward, Imposed Divisibility of Reward, and Each Resource Distribution Number, Experiment II.

Game Number	1	2	3	4	5	6	7	8	9	10	11	12
Distribution	60	70, 80	80, 70	60	70, 80	80, 70	60	70, 80	80, 70	60	70, 80	80, 70
Reward Announced				✓			✓			✓		
Imposed Divisibility of Reward		✓	✓		✓	✓		✓	✓			

game. The announcement was made twice to ensure accurate reception by the Ss. In both conditions therefore, the Ss were aware of the reward distribution for the previous three games, and were able to compute their own total reward from the first game. In Condition CK only, the Ss also knew the number of votes controlled in the next game by the player with each of the announced portions of the reward. Only one E was used throughout the experiment.

Experimental Apparatus. The table and the response sheets were identical to those used in Experiment I. The bargaining sheets indicated that offers should be made in terms of percentages, but were otherwise identical to those used in Experiment I.

Procedure. Upon their arrival at the experimental room, the Ss were seated at the divided table and the nature of the game was explained. The instructions were tape recorded to ensure uniformity; they were similar to the instructions for Experiment I, except that they explained that a 25¢ reward would be paid for each game, that an imposed percentage division of the reward would be announced before some games, and that the amount of reward won by each player in the previous three games would be announced after every third game "in order to keep Ss informed of their progress during the session." After a practice game, involving a distribution of 2, 3, and 4 votes, the Ss played twelve games, assigned and run as described in the Design section. The games were played similarly to those in Experiment I with the following exceptions:

1. A running total of each S's winnings was kept and each S's winnings for the previous three games was announced before games 4, 7, and 10. One of only five payoff distributions was announced before each of those games as detailed in Table 4 of the Design section.
2. The type of imposed divisibility of reward in games 2, 3, 5, 6, 8, and 9 was announced to the Ss before they made their initial choices of coalition partners. In the bargaining phase of the 70-30 division games, only offers consistent with that game's imposed divisibility of reward, either 70% or 30% were allowed to be made. No bargaining was necessary in 50-50 division games.
3. The reward bargained for in each game totaled 25¢ instead of $3.00.
4. Bargaining was conducted in terms of a percent of the 25¢ instead of a monetary amount. Offers and counteroffers were made in terms of multiples of 5%.
5. After all games were played, the Ss total recorded winnings were summed and paid, in

contrast with Experiment I in which the Ss' total earned depended upon the results of only one of the games.

It was stated in the Design section that the number of announced accumulated reward distributions was limited to three. The following degrees of freedom in the experimental procedure permitted this manipulation: (1) Agreements were made in terms of percentages, while announcement of the reward was made in terms of money earned, rounded to the nearest 5¢; (2) Ss were not informed as to whether they had won the 50%-50% imposed reward division games since no bargaining was necessary in those games; and (3) It was possible for the player left out of the coalition to be assigned all of the 25¢ reward for version UV games since the 300 uncommitted votes in that version could be divided such that any player could obtain a majority of the votes without being in a coalition.

In order to test the degree to which the Ss were aware of the deceptive devices used in the experiment, after all games were run, Ss were asked to challenge any of the announced reward distributions so that "any errors which the E made can be corrected before payment of the reward." Any challenge was met by the E with an explanation of the rewards in the three games leading to the announced reward distributions. If no satisfactory explanation were available, the necessary "corrections" were made and the Ss were given a questionnaire to fill out while the total rewards were being computed. The questionnaire asked each S the amount he expected to receive at the end of the session in order to test the S's attentiveness to his total accumulated reward; it also asked how likely he thought it was that deception was involved in the experiment; and if he thought there was deception, exactly what he thought the nature of the deception was. Each S was also asked to rate how hard he tried to win the games, using a scale ranging from 1 to 10.

The Ss were then informed that since the reward distributions were not determined completely by their own choices and bargaining, they would be given either the amount which they had earned or $1, whichever was greater, and in exchange were asked to refrain from discussing the experiment until they received a letter explaining the nature and purpose of the deception used and an overview of the results of the experiment. The payoff manipulation resulted in a mathematically possible reward range of $3 - $5 per group.

Results

The analysis of the initial contact data was divided into two parts. The effect of accumulated reward was tested using games in Distribution 60; therefore the data from these games were used in the first analysis of variance. The second analysis of variance was concerned with the effect of imposed divisibility of reward, and therefore was conducted on games in Distributions 70 and 80.

The analysis of variance for the probability of contacting the weaker candidate as a function of condition (CK versus IK), version, resource point, and payoff distribution is contained in Table 6. The first game in each series and all games in payoff distribution 5, the distribution which assigned 25¢ to each player, were played under conditions of reward equality to all Ss. Since there was no significant difference between choices in these games, their data were combined for comparison with the 4 payoff distributions involving reward inequality. The only significant main effect was for version; whereas the overall probability of choosing the weaker candidate was .50, that probability was .67 in version CV and .33 in version UV.

The cumulative reward prediction for payoff distribution 1 would be a disappearance of the strength is weakness effect in condition CK, while the "gambling strategy" hypothesis prediction would be an intensification of the strength is weakness effect in conditions IK. The predictions for other payoff distributions differ between conditions also. Therefore, the occurrence of both effects

TABLE 6.--Analysis of Variance for Choices of Weaker Candidate as a Function of Condition, Version, Resource Point, and Payoff Distribution, Experiment II.

Source	SS	DF	MS	F	SIG
Total	263.98	1055			
Condition	.005	1	.005	.02	
Version	23.17	1	23.17	107.62	<.0005
Resource Point	.75	2	.37	1.73	
Payoff Distribution	.80	4	.20	.93	
C X V	.62	1	.62	2.89	.10>p>.05
C X R	.91	2	.45	2.11	
C X P	.38	4	.10	.44	
V X R	.13	2	.06	.29	
V X P	.67	4	.17	.77	
R X P	4.25	8	.53	2.47	.01
C X V X R	1.51	2	.75	3.50	.03
C X V X P	.31	4	.08	.36	
V X R X P	1.92	8	.24	1.12	
C X R X P	1.79	8	.22	1.04	
C X V X R X P	1.13	8	.14	.66	
Error	214.46	996	.21		

in their respective conditions or only one effect in one condition would be indicated by a significant condition by payoff distribution by resource point interaction. That interaction was not significant; however the payoff distribution by resource point interaction was significant, suggesting that one of the predicted effects occurred in both conditions. Summing over payoff distributions, the probabilities of choosing the weaker candidate for the candidates with the most, intermediate, and least reward were .55, .53, and .40 respectively, consistent with the gambling strategy hypothesis. A Scheffe test indicates that the smallest of these probabilities is significantly different from the other two, which do not differ from each other. Since the condition by version by resource point interaction was significant, Table 7 contains the same data broken down by condition and version; 3 of the 4 sets of probabilities are in the predicted order. Since there are six possible arrangements of 3 items, and since there are 4 ways in which to select 3 from 4 sets, the probability that a result at least this discrepant from randomness is due to chance alone is less than .02. The one variation from the pattern predicted by the gambling strategy hypothesis involves a reversal of the probabilities for the highest and middle reward levels.

Table 8 contains the analysis of variance for the initial contact data as a function of reward divisibility

TABLE 7.--Probability of Contacting Weaker Candidate in Each Condition and Version of Experiment II, Summed Over All Payoff Distributions.

Condition - Version	Relative Amount of Money Possessed by Candidate Making Choice		
	Most (35¢ or 30¢)	Middle (25¢)	Least (15¢ or 20¢)
IK - CV	.80	.58	.48
IK - UV	.42	.39	.21
CK - CV	.67	.76	.58
CK - UV	.35	.29	.28
Average	.55	.53	.40

TABLE 8.--Analysis of Variance for Choice of Weaker Candidate as a Function of Reward Divisibility, Version, Distribution, and Resource Point, Experiment II.

Source	SS	DF	MS	F	SIG
Total	528.00	2111			
Reward Divisibility	.93	2	.46	2.10	____
Version	55.23	1	55.23	250.58	<.0005
Distribution	.69	1	.69	3.15	.10>p>.03
Resource Point	1.42	2	.71	3.23	.04
RD X V	.48	2	.24	1.09	____
RD X D	1.47	2	.73	3.33	.04
RD X RP	1.62	4	.41	1.84	____
V X D	.14	1	.14	.64	____
V X RP	1.36	2	.68	3.09	.05
D X R	.08	2	.04	.18	____
RD X V X D	.47	2	.23	1.07	____
RD X V X RP	.18	4	.04	.20	____
RD X D X RP	1.03	4	.26	1.16	____
V X D X RP	.49	2	.25	1.12	____
RD X V X D X RP	2.70	4	.68	3.07	.02
Error	457.61	2076	.22		

(no imposed division versus 50-50 imposed division versus 70-30 imposed division of reward), version, distribution (70 versus 80), and resource point. Two alternative predictions were advanced for the effect of imposed reward division. (1) The first prediction involved the concept of intracoalition compatibility. If the reward were to be shared equally, contacts between candidates more nearly equal in the number of votes controlled, i.e., mutual choices by candidates 80 and 90 in Distribution 80 and by 110 and 120 in Distribution 70, should be relatively more likely. However, if the reward divisibility were highly unequal, contacts between candidates who were more unequal in their amount of resources, i.e., between 70 and 110 or between 70 and 120 in distribution 70 and between 80 and 130 or between 90 and 130 in distribution 80, should be more likely since the difference in resources could suggest a norm for determining which participant should receive the greater share of the reward. This prediction would be supported by a significant reward divisibility by distribution by resource point interaction. (2) If the reward were of sufficient importance to the participants that it outweighed any potential difficulties in negotiation caused by intracoalition incompatibility, the participants in an unequally divisible reward condition should choose the weaker potential partner since he would be more likely to accept the smaller share of the reward. When equality of reward is imposed however, no participant can increase his share of the reward by choosing the weaker potential partner, he can only increase his chances of acquiring a share of the reward, particularly in version UV, by increasing the security of the coalition. This prediction would be supported by a significant reward divisibility effect or reward divisibility by version interaction.

Table 8 shows that neither of these predicted effects was significant. Also, the number of offers required before an agreement was reached in the 70-30 reward division condition did not support the intracoalition compatibility notion. If coalitions between relatively equal partners, i.e., coalitions (110, 120), and (80,90), were less compatible than coalitions between more disparate partners, longer bargaining sequences should be required in the relatively equal coalitions before an agreement was reached. The mean number of offers for the coalition (110, 120) to reach an agreement was 5.5 compared with 4.3 in the other two coalitions; the associated $t_{82\ df}$ equaled 1.05, n.s. In Distribution 80, the mean for coalition (80, 90) was 7.6 compared with 4.9 for the other two coalitions, yielding $t_{50\ df} = 1.08$, n.s. No similar comparison was possible for the 50-50 reward division condition since no bargaining was necessary in that condition to reach an agreement.

The data for successive trials within a single game were summed into blocks for comparison with the data from Experiment I; Block 1 was composed of trials 2 and 3, and Block 2 included trials 4 through 7. The probability of choosing the weaker candidate in version CV decreased from .67 on trial 1 to .56 in Block 1 and .57 in Block 2; the conditional probability of choosing the weaker candidate given that the weaker candidate had been chosen on the previous trial was .76 in Block 1 and .74 in Block 2. In version UV, the overall probability of choosing the weaker candidate increased from .33 on trial 1 to .48 in Block 1 and .46 in Block 2; the conditional probabilities increased from .72 in Block 1 to .77 in Block 2.

The analysis of variance for the reward to the weaker candidate for games not involving imposed divisibility of reward, in terms of version, distribution, and coalition formed is presented in Table 9. The overall average reward to the weaker candidate was 43%. The effect of distribution was significant at the .01 level; the weaker candidate in Distribution 60 received 42% of the reward, while the weaker candidate in each of the other two distributions received 44%. The effect of coalition formed was also significant at the .01 level. The weak candidate in a strong-weak coalition received 41% of the reward, while the weak candidate in a moderate-weak coalition received 42% and the moderate candidate in a

TABLE 9.--Analysis of Variance for Reward to Weaker Candidate, Experiment II.

Source	SS	df	MS	F	Sig
Total	3.4234	52.7			
Version	.0106	1	.0106	1.756	____
Distribution	.0571	2	.0286	4.716	<.01
Coalition	.0623	2	.0311	5.131	<.01
V X D	.0056	2	.0028	.462	____
V X C	.6282	2	.0141	2.323	.10>p>.05
D X C	.0339	4	.0085	1.399	.10>p>.05
V X D X C	.0167	4	.0004	.689	____
Error	3.0899	510	.0061		

strong-moderate coalition received 45% of the reward. A Scheffe test on these means demonstrated that the reward in the strong-moderate coalition was significantly different from that in the other two coalitions, which did not differ significantly from each other.

There was a high positive relationship between the first percentage demand of the weaker candidate and the number of offers necessary to reach an agreement, $r_{526\ df} = .45$, $p < .0005$, and negative relationship between the first percentage offer to the weaker candidate by the stronger candidate and the number of offers necessary to reach agreement, $r_{526\ df} = -.26$, $p < .0005$. However, there was no linear relationship between the number of offers made and the final agreement reached, $r_{526\ df} = -.03$.

Table 10 contains a summary of the game by game bargaining data for those games not involving imposed divisibility of rewards. There was no significant increase in the frequency of 50-50 divisions of the reward, $\chi^2_5\ df = 5.51$, n.s. The mean reward agreements varied only between 41% and 44% to the weaker candidate over games. Grouping the variances into blocks of two, i.e., games 1 and 4 in Block 1, games 7 and 10 in Block 2, and games 11 and 12 in Block 3, and applying the test developed by Scheffe (1959, p. 83) showed that the decrease in variance over games was not significant, $F(5,3) = 2.80$. A summary

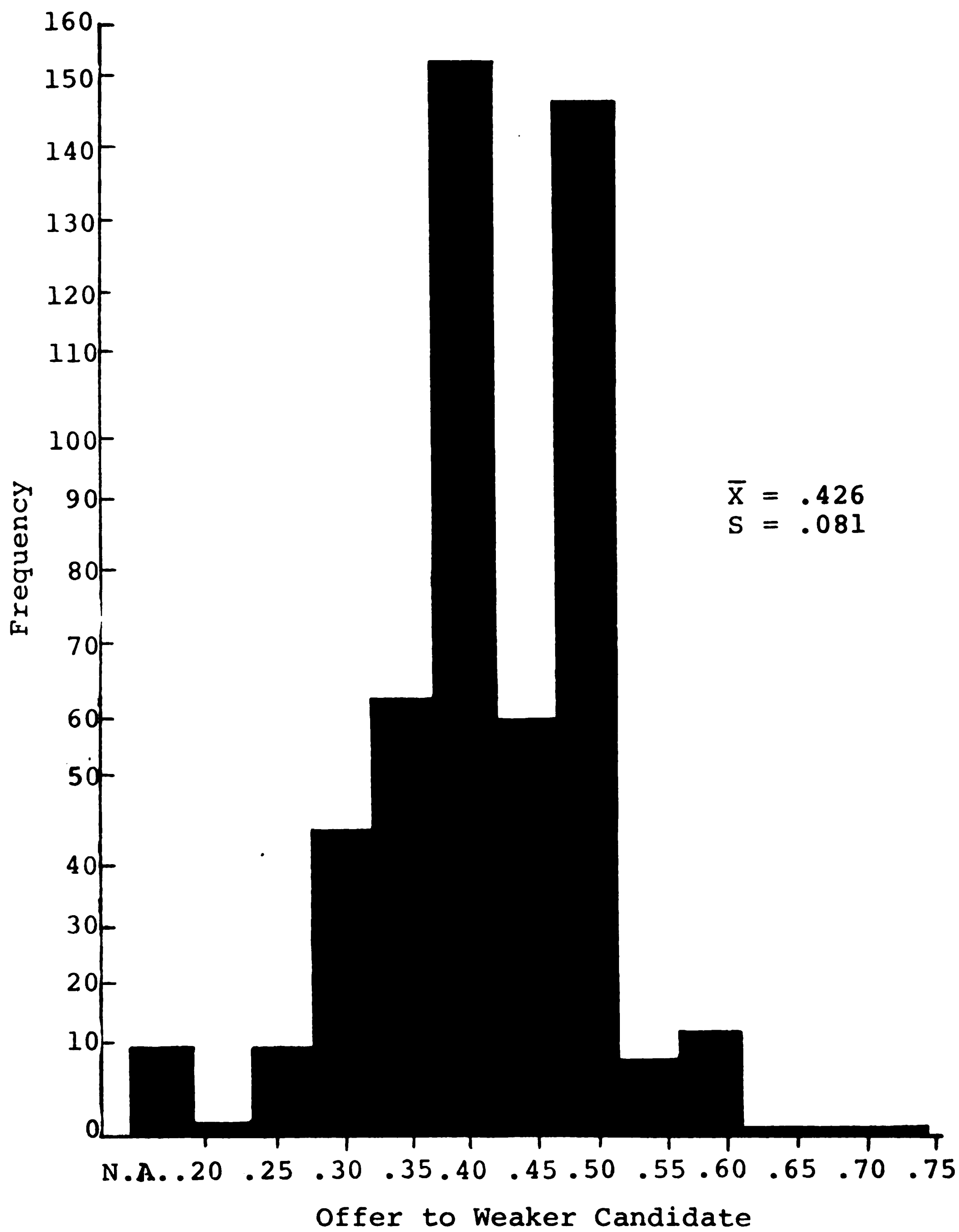
TABLE 10.--Number of 50-50 Splits, Mean Proportion of Reward to Weaker, and Standard Deviation of Reward to Weaker in Games Not Involving Imposed Divisibility of Reward, Experiment II.

	1	4	7	10	11	12
No. of 50-50 Splits	22	20	22	22	32	31 ($\chi^2_{5df} = 5.51$, n.s.)
Mean Proportion of Award to Weaker	.42	.43	.42	.41	.44	.44
Standard Deviation Reward to Weaker	.091	.092	.080	.082	.069	.064 ($F(5,3) = 2.80$, n.s.)

histogram of bargaining agreements reached is presented in Figure 10 for comparison with the same data from Experiment I.

The sequence of offers made by coalition partners in all games not involving imposed divisibility of reward is presented in Figure 11. The occasional decrease in the offers and increases in the demands in later trials could be caused by the termination of bargaining in groups which reached agreement in earlier trials leaving the data of groups whose offers and demands were more discrepant. Assuming that the same processes are involved in the bargaining sequence regardless of length, and that the process is simply proceeding at a faster rate in bargaining sessions with fewer trials, a more accurate view of the bargaining process can be obtained by dividing the bargaining sequence for each game into intervals. Figure 12 contains the bargaining data for the first offer, the offers made one quarter of the way through the sequence, at the midpoint of bargaining, at the three quarter point, at the trial preceeding the last, and at the trial where agreement was reached. The largest change in offers and demands occurred between the next to the last and last trial; the data would appear to be well described by a parabolic function. Similarly, the graph of the backward trial by trial bargaining data, where trial 0 represents the trial on which agreement was

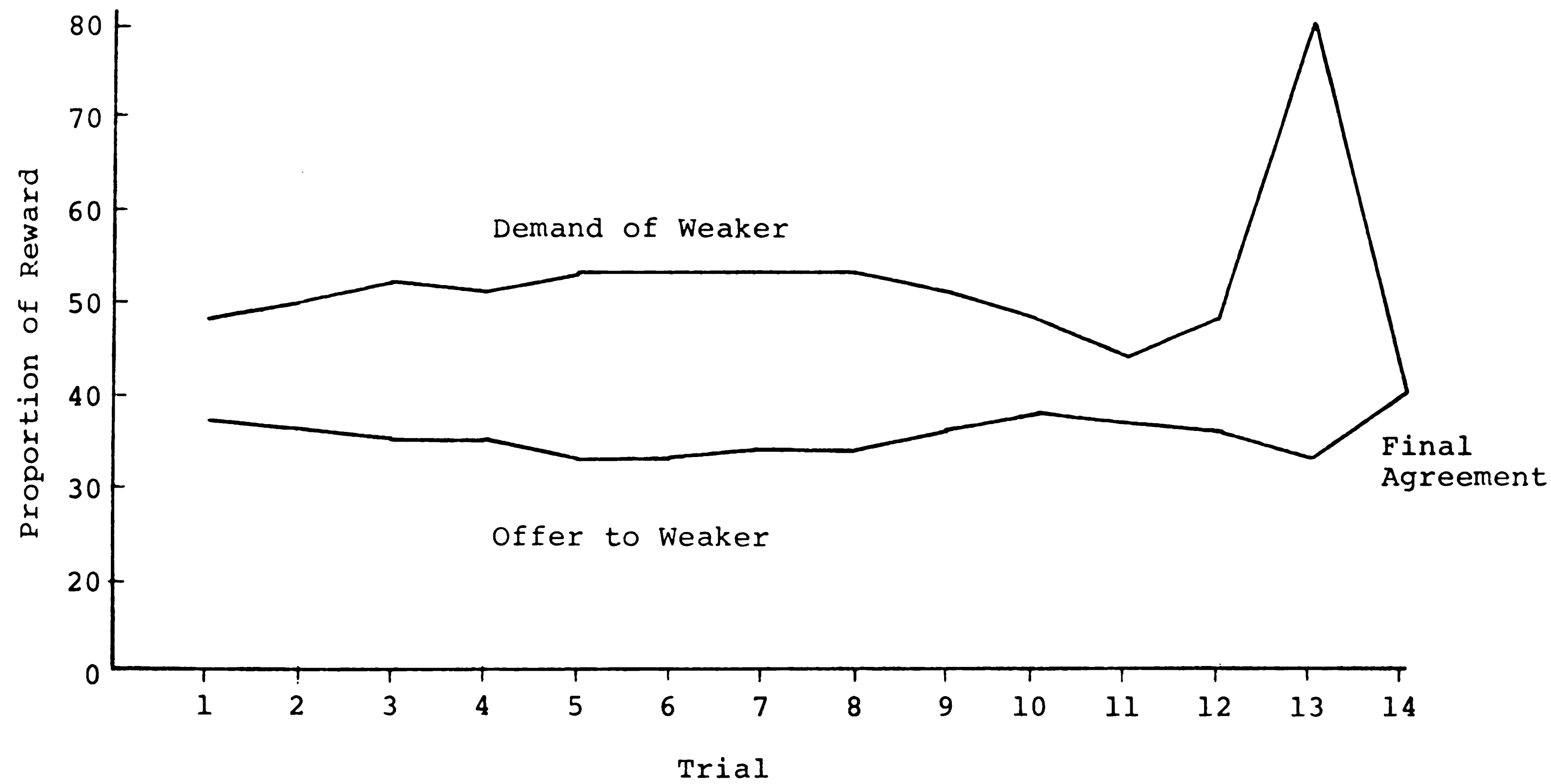
Figure 10.--Summary Histogram of Reward to Weaker Candidate in All Games Not Involving Imposed Divisibility of Reward, Experiment II.



160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
Frequency
X̄ = .426
S = .081
N.A. .20 .25 .30 .35 .40 .45 .50 .55 .60 .65 .70 .75
Offer to Weaker Candidate

Fig. 10

Figure 11.--Offers and Demands Made in Each Trial of the Bargaining Phase in All Games Not Involving Imposed Divisibility of Reward, Experiment II.



80
70
60
50
40
30
20
0
Proportion of Reward
Demand of Weaker
Offer to Weaker
Final
Agreement
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Trial

Fig. 11

Figure 12.--Offers and Demands Made in Each Quarter of Bargaining Sequences in All Games Not Involving Imposed Divisibility of Reward, Experiment II.

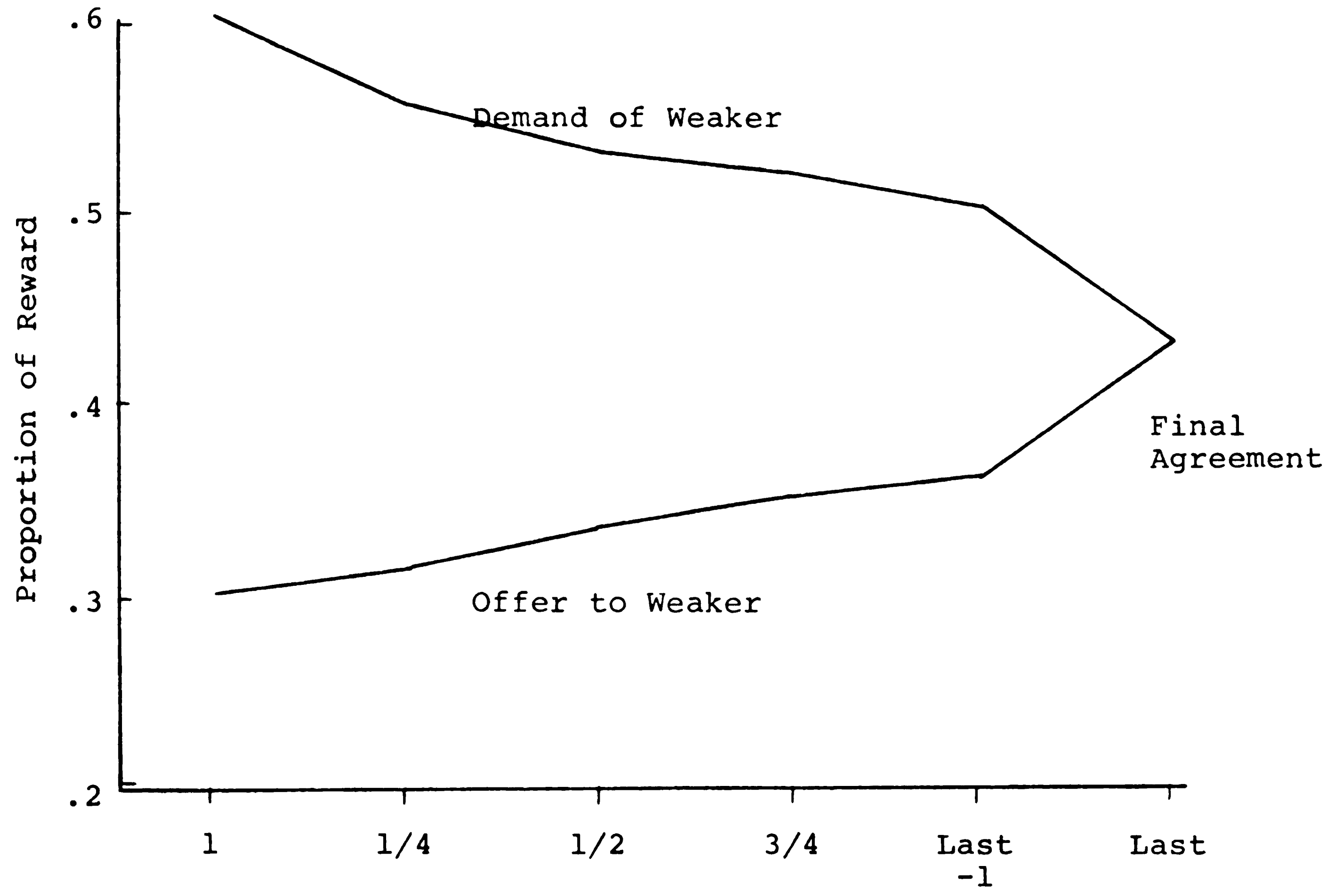

.6
.5
.4
.3
.2
Proportion of Reward
Demand of Weaker
Offer to Weaker
Final Agreement
1
1/4
1/2
3/4
Last -1
Last

Fig. 12

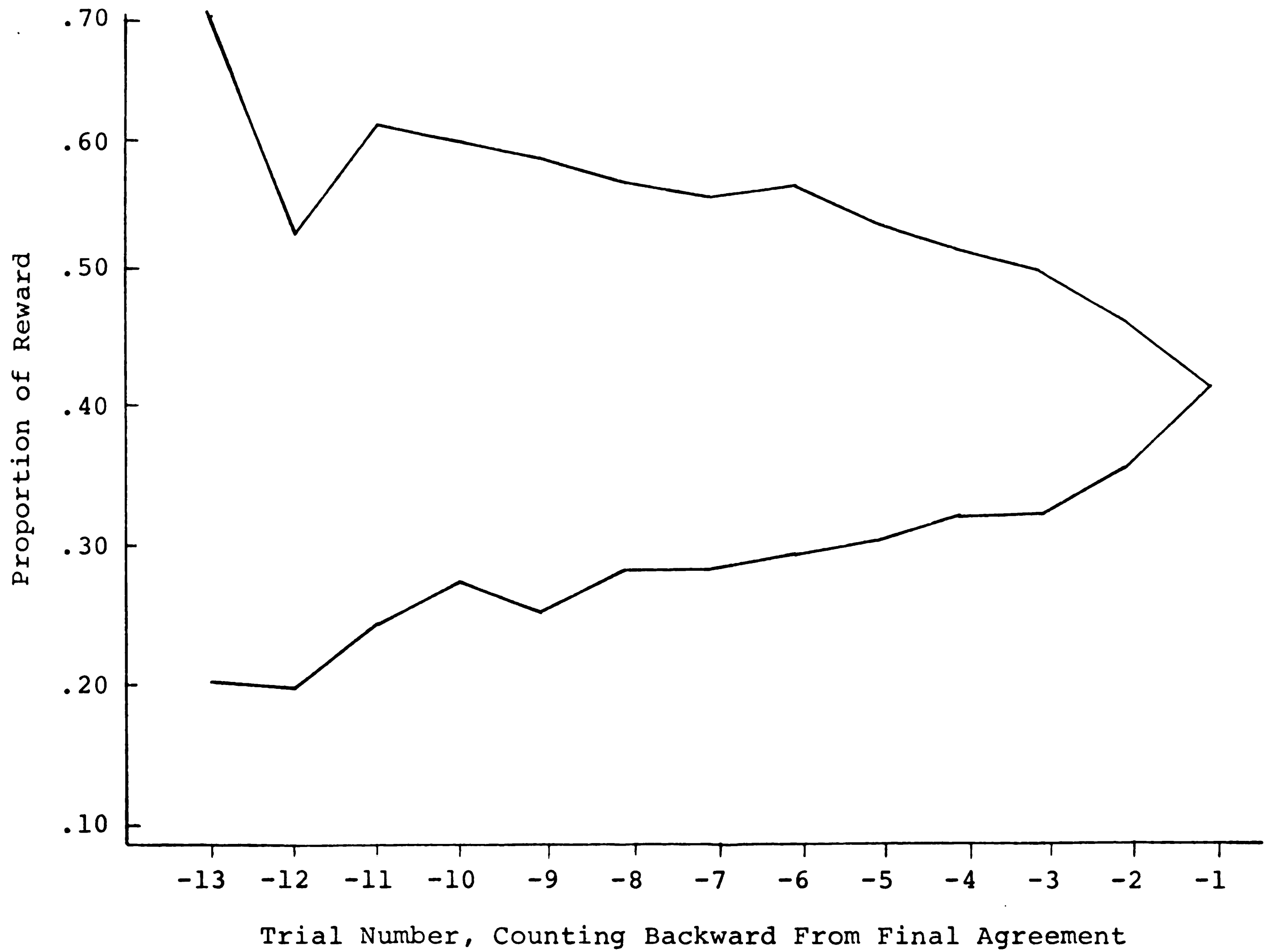
reached and trial -1 represents the trial immediately preceding the trial on which agreement was reached, appears to be parabolic in form (Figure 13).

The total amount of reward expected by the Ss was approximately normally distributed about a mean of \$.98 and a mode and median of \$1.00 with a standard deviation of .26, and was correlated .35 (262 df) with the total amount actually earned. The mean likelihood of deception score on a scale from 1 to 10 was 4.37, with a standard deviation of 2.50 and a median and mode of 5. With respect to the degree to which Ss tried to win, where a score of 1 meant that the S did not try at all to win as much as he could and 10 meant that he tried as much as possible, the mean report was 8.16 with a standard deviation of 1.93, a median of 9 and a mode of 10. There was little correlation between the degree to which Ss tried to win and the amount of money expected, amount earned, or their rating of the likelihood of deception, $r_{262\ df} = .07$, .07, and -.02 respectively. There was little correlation of the S's rating of the likelihood of deception with the amount of money expected, $r_{262\ df} = .04$, and a small but significant correlation of the deception-rating with the amount actually earned, $r_{262\ df} = .12$, $p < .05$.

Discussion

There was no evidence in this experiment that Ss in condition CK responded differently to their accumulated

Figure 13.--Backward Curve of Offers and Demands Made on Each Trial, Experiment II.



.70
.60
.50
.40
.30
.20
.10
Proportion of Reward
-13
-12
-11
-10
-9
-8
-7
-6
-5
-4
-3
-2
-1
Trial Number, Counting Backward From Final Agreement

Fig. 13

reward than did Ss in condition IK. Rather, Ss in both conditions adopted a gambling strategy, tending to choose the stronger vote resource candidate significantly more often when they had received the least reward than when they had received the most or intermediate amount in the previous three games. Ss in both conditions apparently attended to only their own reward, perhaps as a result of the verbal rather than written mode of announcement. If this restriction of attention occurred in condition CK, it is clear that it was not forced by the experimental procedure since the announcement was given twice to ensure accurate and complete reception; it was perhaps inadvertently encouraged by the instructions, however, since the Ss were told at the beginning of the experiment that the accumulated reward was announced so that they could keep track of their progress.

The degree of intracoalition compatibility did not affect the number of offers required to reach an agreement, nor, in contrast with the results of Nitz and Phillips (1969), did it affect the initial contacts. That experiment required a choice between one candidate exactly equal in power or another candidate somewhat disparate. Apparently, in this experiment even a small difference in power was sufficient to specify to the Ss the proportion of the reward which they should receive.

The game by game bargaining data (Table 9) revealed no systematic changes in mean reward to the weaker coalition partner, the number of even divisions of the reward, or the variance of agreements reached. The weaker candidate in strong-weak coalitions received significantly less reward than in a moderate-weak coalition which was consistent with the parity norm, but did not receive less than the moderate power candidate in a strong-moderate coalition, nor was the distribution by coalition interaction significant as required by the parity norm.

The correlational data involving the number of offers made are intuitively reasonable, demonstrating that more offers were required to reach an agreement if either the first offer to the weaker candidate was relatively low or the first demand of the weaker candidate was relatively high. However, the final offer, i.e., the agreement reached, did not depend upon the number of offers made.

The overall probability of contacting the weaker candidate over successive trials within games approached .5, which was consistent with a utility of response variability hypothesis. The associated conditional probabilities did not decrease as required by that hypothesis however.

As stated previously, no communication other than the written offer was allowed during the bargaining phase, and Ss only knew which coalition was formed as well as the information already gained from the contact phase. Therefore, any influence of previous agreements and explicit threats or promises with respect to future agreements between the same participants was prevented. It was also clearly impossible for external factors, such as threats or promises from the participant not in the coalition, to influence the sequence of offers made. Therefore, the bargaining sequence data (Figures 12 and 13) present an estimate of the shape of the pure bargaining process.

CHAPTER VI

MATHEMATICAL MODELS

It has been suggested that three factors have affected initial contact choices in the present experiment. The concept of parity (Gamson, 1961) has been advanced in connection with the "strengh is weakness" effect in deterministic coalition formation games. The security principle (Cole, 1969) has been advanced to explain the "strength is strength" effect in probabilistic coalition formation games. The above two factors have been combined in mathematical models developed by DeYoung and Phillips (1970). Finally, the "gambling strategy" has been related to initial contacts under knowledge of accumulated reward in Experiment II. The present chapter investigates the influence of the formulations of each of these factors upon the fit of the model to the data. Model II of DeYoung and Phillips (1970) has been selected as a vehicle for these comparisons since, unlike Model I, it is clear that differences in adequacy of various factors and combinations of factors in accounting for the experimental data can be ascribed to the formulations of the factors and not to differences in the number of free parameters estimated.

Games Not Involving Accumulated Reward or Imposed Divisibility of Reward

The effect of the parity and security factors are examined here in all games in which no accumulated reward or imposed divisibility of reward was announced, these games being most similar to those whose data have been previously presented in Figure 3. In order to obtain as much data as possible at each point, the data from games 1 through 10 of Experiment I was added to that from games 1, 11, and 12 of Experiment II.

The model involving both the parity and security factor is given in Chapter I. The model involving only the parity factor reduces to

$$P_W = \frac{1}{1 + \alpha\dfrac{(N_W + N_A)}{(N_S + N_A)}} \text{ while } P_W = \frac{1}{1 + \alpha\dfrac{(N_S + N_A)\cdot(N_T - N_A - N_W)}{(N_W + N_A)\cdot(N_T - N_A - N_S)}}$$

expresses the model involving only the security factor. The parameter α was estimated using a numerical minimum chi-square procedure. The obtained chi-squares for the models involving each factor are presented in Table 11. For comparison, the model of Shelly and Phillips (1966), identical to the above model involving only the parity factor with $\alpha = 1$, yielded chi-squares of 21.231, $p < .01$ in version CV, and 75.323, $p < .001$ in version UV. The

TABLE 11.--Minimum Chi-squares of Models Based on Parity and Security Factors in Version CV and UV Games Not Involving Accumulated Reward on Imposed Divisibility of Reward, Experiments I and II Combined.

Factors	Version	
	CV	UV
Parity	4.056*	11.409***
Security	14.516****	8.013**
Parity - Security	10.365***	10.983***

Each χ^2 had 8 df.

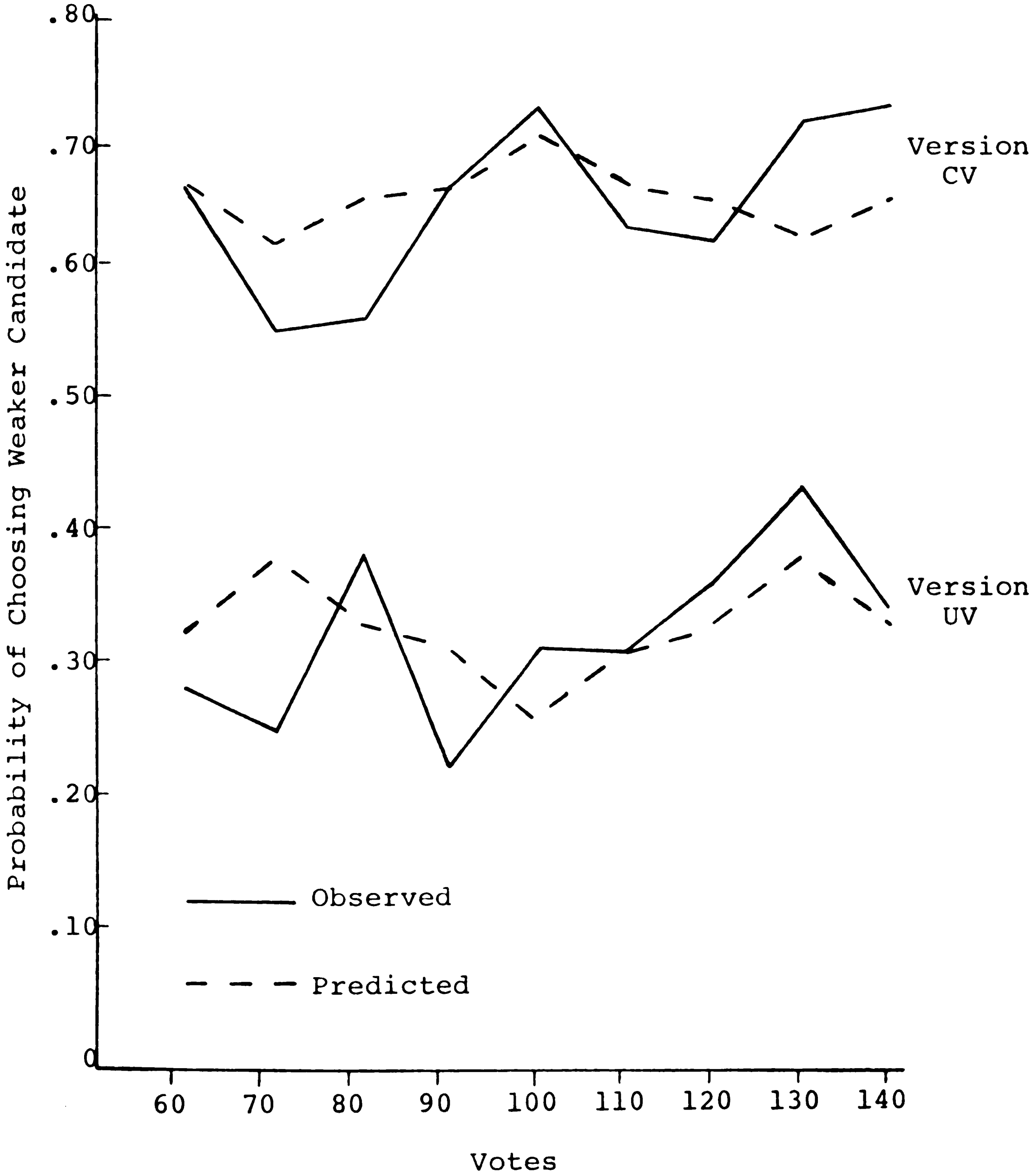
*.85>p>.75
**.45>p>.35
***.25>p>.15
****.10>p>.05

best fitting model for version CV involved only the parity factor, while the best fitting model for version UV involved only the security factor. The predictions of these two models and the observed probabilities are shown in Figure 14. The correlations between predicted and observed probabilities were .39 in version CV and .28 in version UV.

Games Involving Accumulated Reward

The games in which accumulated reward was announced were 4, 7, and 10 in Experiment II. The data from payoff distribution 5 and game 1 were combined since both were distribution 60 games involving equality of accumulated reward. The chi-squares for each possible model are

Figure 14.--Observed and Predicted Probabilities of Choice of Weaker Candidate, in Games Not Involving Imposed Divisibility of Reward or Accumulated Reward, Experiments I and II Combined, All Vote Distributions.



.80
.70
.60
.50
.40
.30
.20
.10
0
Probability of Choosing Weaker Candidate
Version
CV
Version
UV
Observed
Predicted
60
70
80
90
100
110
120
130
140
Votes

Fig. 14

presented in Table 12. The accumulated reward factor was formalized by multiplying $V_A(W)$ by the amount of reward which A had accrued divided by .25, the average reward.

TABLE 12.--Minimum Chi-squares of Models Based on Parity and Security Factors in Version CV and UV Games Involving Accumulated Reward, Experiment II.

Factors	Version			
	CV		UV	
	Without Accum. Rw.	With Accum. Rw.	Without Accum. Rw.	With Accum. Rw.
Parity	7.556*	5.372*	10.398***	8.959**
Security	11.192***	8.147**	9.079**	6.749*
Parity-Security	9.665***	6.788*	9.079**	10.961***

Each χ^2 has 14 d.f.

*.99>p>.90
**.90>p>.80
***.80>p>.65

For each model, the addition of the accumulated reward factor improved predictions in each version. The best fitting model involved the parity but not the security factor in version CV, and the security but not the parity factor in version UV. These predictions and the observed data are presented in Figure 15. The correlations between the predicted and observed probabilities were .55 in version CV and .67 in version UV.

Figure 15.--Observed and Predicted Probabilities of Choice of Weaker Candidate in Games Involving Accumulated Reward, Distribution 60, Experiment II.

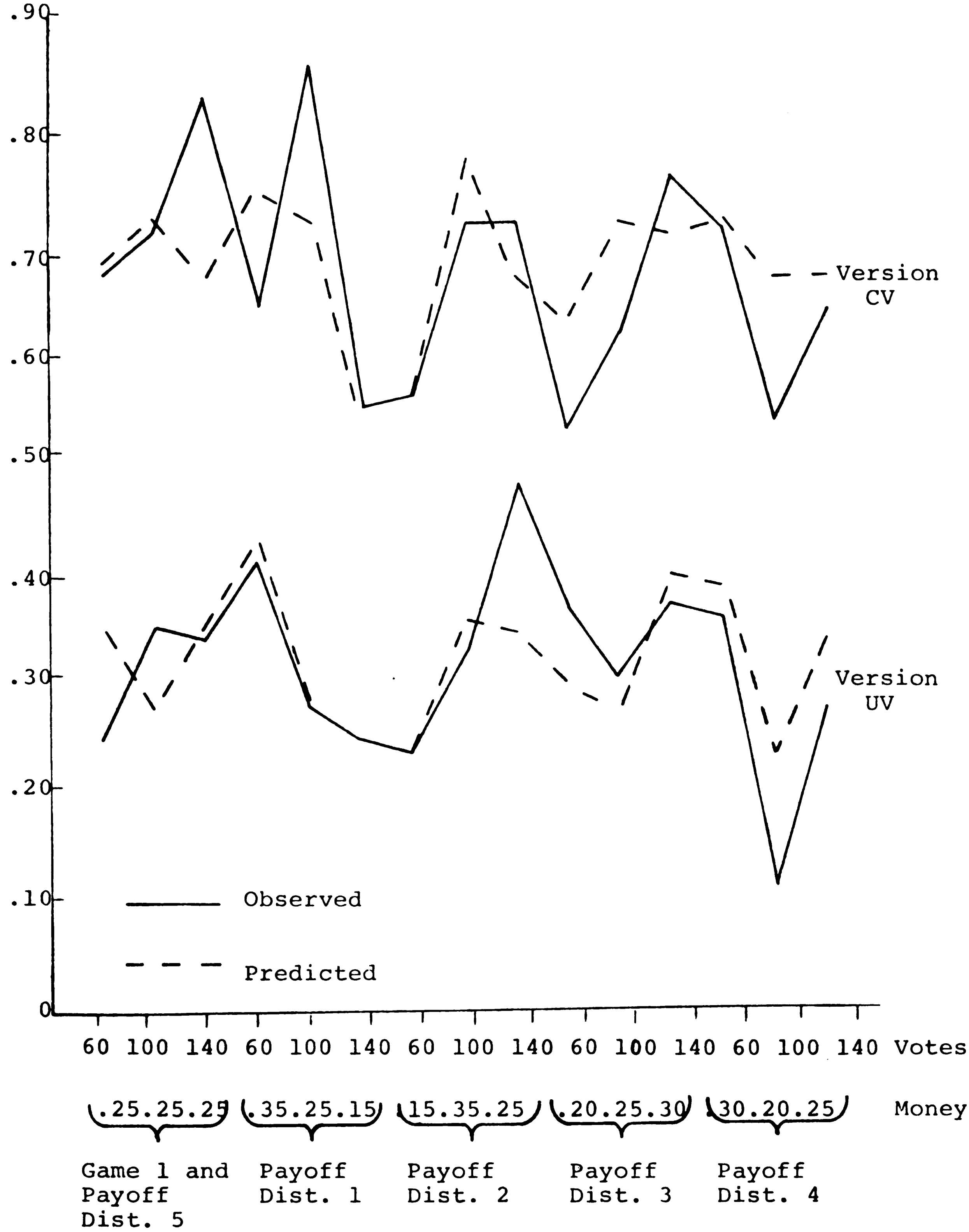

.90
.80
.70
.60
.50
.40
.30
.20
.10
0
Version CV
Version UV
Observed
Predicted
60 100 140 60 100 140 60 100 140 60 100 140 60 100 140 Votes
.25.25.25 .35.25.15 .15.35.25 .20.25.30 .30.20.25 Money
Game 1 and Payoff Dist. 5
Payoff Dist. 1
Payoff Dist. 2
Payoff Dist. 3
Payoff Dist. 4

Fig. 15

Discussion

The present investigation of the factors influencing social contacts support the contention of DeYoung and Phillips (1970) that the security factor was sufficient to account for the data from version UV; in both Table 11 and Table 12, the fit of the model based upon only the security factor, the relevant factor according to DeYoung and Phillips (1970), was superior to models based upon the parity factor or upon a combination of the parity and security factors. The present analysis also suggested that the parity factor was sufficient to account for the data from version CV, and the model based on parity was in fact superior to models based on the security factor or on a combination of the security and parity factors. Therefore, a simplified model involving only the parity factor in version CV and only the security factor in version UV would appear to be preferable to the model advanced by DeYoung and Phillips (1970).

Although methods exist (Atkinson, Bower, and Crothers, 1965) to test whether the simplified model is significantly superior to the alternative models, it is clear that the improvement was often small and the test was not applied. Rather, the simplified model is recommended by its more parsimonious explanation of the data, by the fact that each factor is used in the version for which it was originally advanced, and by the consistency of its superiority both in games involving accumulated reward and in games involving neither accumulated reward nor imposed divisibility of reward. Similarly, when models incorporating the accumulated reward factor were applied, small but consistent improvements in predictions were observed.

CHAPTER V

SUMMARY AND CONCLUSIONS

Successive Games

The major purpose of the dissertation was the examination of Kelley and Arrowood's elimination of confusion explanation for the disappearance of the strength is weakness effect in successive Political convention games. Vinacke, Crowell, Dien, and Young (1966) eliminated confusion by presenting Ss with information about possible strategies, including the strategy which viewed all participants as being equal in power since any two could win. They interpreted their data as demonstrating that the elimination of confusion explanation was not adequate.

The present Experiment I permitted the elimination of confusion during a series of ten games, allowing extensive experience with the game while eliminating any effect of accumulated reward. There was clearly no tendency for initial contacts or reward divisions to be divided more equally between the stronger and weaker candidates in contrast with the elimination of confusion explanation.

Although Experiment II was designed to allow Ss to choose coalition partners based upon both their own and other candidate's reward, Ss apparently attended to their own reward only. This conclusion is supported by the analysis of variance of the initial contact data (Table 6), which showed that the level of accumulated reward had a significant effect upon initial contact choices. However, this effect did not differ between a condition in which Ss knew only their own reward and another condition in which Ss knew every player's accumulated reward.

It is probable that two factors are largely responsible for the Ss' restriction of attention to their own reward. The announcement of the accumulated reward was verbal, introducing a memory factor into the experiment even though the announcement was repeated. Secondly, the instructions stated: "The amount that you have won will be announced every few games so that you can keep track of your progress." Many Ss may have interpreted this statement as referring to the second person singular, even in the condition in which they were given information about more than one candidate's winnings.

These data therefore do not allow inferences to be made about the effect of knowledge of the other candidates' previous reward upon initial contacts. The "gambling" effect that was observed as a function of an S's own reward was conceptually similar to the effect of resource point in

Experiment I. In each case, the weakest candidate, whether the weakness was in terms of previous reward (Experiment II) or in terms of votes (Experiment I), chose the weaker vote resource candidate less often than did the strongest candidate. Therefore, it appears that the money resource dimension can have effects similar to the vote resource dimension as suggested in the introduction.

Imposed Divisibility of Reward

When the possible reward division was limited to either an extremely unequal (70%-30%) division or an exactly equal division (50%-50%) previous research (Nitz and Phillips, 1969) would suggest that initial contacts would be made such that intracoalition compatibility would be maximized. Specifically, there should be a tendency toward the formation of the coalition whose parity division of the reward most closely approximated the imposed reward division. The intracoalition compatibility effect was not observed in this experiment, nor did relative incompatibility of the coalition lead to difficulties in the bargaining process in terms of the number of offers necessary to reach an agreement. These results suggest that intracoalition compatibility will affect initial contacts only when the number of votes of one of the potential coalition partners is exactly equal and that of the other is not equal to the number of votes of the candidate making the choice. Thus, *relative* intracoalition compatibility, as in this experiment, does not appear to affect initial contact choices.

Division of Reward

Gamson's (1961) parity norm suggested that the reward for coalition formation should tend to be divided in proportion to the resources contributed by each partner. Kelley and Arrowood's (1960) elimination of confusion explanation implied that the reward should tend to be divided equally between the coalition partners after they have had an opportunity to understand the game. The present experiments support neither of these predictions. The reward to the weaker candidate was everywhere less than 50% and was significantly different from a parity division for 8 of the 9 possible coalitions in Experiment I. Rather, the observed reward to the weaker candidate was consistently intermediate to the parity and even reward division. In neither experiment did the reward to the weaker candidate even vary from coalition to coalition as specified by the parity norm (Tables 3 and 9).

The sequence of offers and demands made in this experiment was relatively free of contaminating variables. No communication other than the written offer was allowed during the bargaining phase, and it was impossible for external factors to influence the bargaining process. The bargaining sequence under these conditions would appear to be well described by a parabolic function (Figures 12 and 13).

Miscellaneous

The utility of response variability concept for successive trials within games received little support from these experiments. The probability of contacting the weaker candidate did approach .5 in later trials within a game in both versions of both experiments as required by this hypothesis; however, this result would also be observed if there was a decrease in the S's expectation of response reciprocation by his preferred coalition partner. However, response variability would be maximized if the probability of perseveration decreased in later trials within a game. Such a decrease was observed in only version CV of Experiment I.

The present data did not support a utility of response variability hypothesis for changes in game to game initial contacts. However, the Ss in the Kelley and Arrowood (1960) and Chertkoff (1966) studies maintained the same power positions in the same game from one game to the next, making their experiment more similar to a series of trials in the present experiment with bargaining following each trial. The Ss in the present experiments played at different power positions in successive games which had different resource distributions.

The results of comparing the mathematical models were intuitively reasonable. The model involving only the parity factor consistently fit the version CV data better than either the model involving a combination of the parity and security factors or the model involving only the security factor. Likewise, the model involving only the security factor consistently provided the best fit of the version UV data. For each such model, the fit was very good by a minimum chi-square criterion. The probability of failing to reject the null hypothesis of no difference between the predicted and observed data ranged from $.45>p>.35$ to $.99>p>.90$ for the best fitting model.

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BIBLIOGRAPHY

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APPENDICES

APPENDIX I

DISTRIBUTION PRESENTATION ORDERS

APPENDIX II

SAMPLE SET OF RESPONSE SHEETS

122 A

APPENDIX II

SAMPLE SET OF RESPONSE SHEETS

BALLOT 1

THERE ARE 600 TOTAL VOTES IN THE CONVENTION, 300 VOTES UNCOMMITTED.

YOUR CANDIDATE HAS 100 VOTES.

301 VOTES ARE NEEDED FOR A MAJORITY.

```
THE OTHER CANDIDATES HAVE   / 140 VOTES/       /  60 VOTES/
INCLUDING YOUR              / 100 VOTES/       / 100 VOTES/
THE PARTNERSHIP WOULD HAVE  / 240 VOTES/       / 160 VOTES/
```

CIRCLE THE NUMBER OF VOTES OF THE CANDIDATE YOU CHOOSE ON THIS BALLOT

NO PARTNERSHIP WAS FORMED AND NO CANDIDATE WAS NOMINATED.
A OTHER BALLOT WILL HAVE TO BE TAKEN.

BALLOT 2

THERE ARE 600 TOTAL VOTES IN THE CONVENTION, 300 VOTES UNCOMMITTED.

YOUR CANDIDATE HAS 100 VOTES.

301 VOTES ARE NEEDED FOR A MAJORITY.

THE OTHER CANDIDATES HAVE	/ 60 VOTES/	/ 140 VOTES/
INCLUDING YOUR	/ 100 VOTES/	/ 100 VOTES/
THE PARTNERSHIP WOULD HAVE	/ 160 VOTES/	/ 240 VOTES/

CIRCLE THE NUMBER OF VOTES OF THE CANDIDATE YOU CHOOSE ON THIS BALLOT

NO PARTNERSHIP WAS FORMED AND NO CANDIDATE WAS NOMINATED.
ANOTHER BALLOT WILL HAVE TO BE TAKEN.

BALLOT 3

THERE ARE 600 TOTAL VOTES IN THE CONVENTION, 300 VOTES UNCOMMITTED.

YOUR CANDIDATE HAS 100 VOTES.

301 VOTES ARE NEEDED FOR A MAJORITY.

THE OTHER CANDIDATES HAVE	/ 140 VOTES/	/ 60 VOTES/
INCLUDING YOUR	/ 100 VOTES/	/ 100 VOTES/
THE PARTNERSHIP WOULD HAVE	/ 240 VOTES/	/ 160 VOTES/

CIRCLE THE NUMBER OF VOTES OF THE CANDIDATE YOU CHOOSE ON THIS BALLOT

NO PARTNERSHIP WAS FORMED AND NO CANDIDATE WAS NOMINATED.
A OTHER BALLOT WILL HAVE TO BE TAKEN.

BALLOT 4

THERE ARE 600 TOTAL VOTES IN THE CONVENTION, 300 VOTES UNCOMMITTED.

YOUR CANDIDATE HAS 100 VOTES.

301 VOTES ARE NEEDED FOR A MAJORITY.

THE OTHER CANDIDATES HAVE	/ 60 VOTES/	/ 140 VOTES/
INCLUDING YOUR	/ 100 VOTES/	/ 100 VOTES/
THE PARTNERSHIP WOULD HAVE	/ 160 VOTES/	/ 240 VOTES/

CIRCLE THE NUMBER OF VOTES OF THE CANDIDATE YOU CHOOSE ON THIS BALLOT

NO PARTNERSHIP WAS FORMED AND NO CANDIDATE WAS NOMINATED.
ANOTHER BALLOT WILL HAVE TO BE TAKEN.

BALLOT 5

THERE ARE 600 TOTAL VOTES IN THE CONVENTION, 300 VOTES UNCOMMITTED.

YOUR CANDIDATE HAS 100 VOTES.

301 VOTES ARE NEEDED FOR A MAJORITY.

THE OTHER CANDIDATES HAVE	/ 140 VOTES/	/ 60 VOTES/
INCLUDING YOUR	/ 100 VOTES/	/ 100 VOTES/
THE PARTNERSHIP WOULD HAVE	/ 240 VOTES/	/ 160 VOTES/

CIRCLE THE NUMBER OF VOTES OF THE CANDIDATE YOU CHOOSE ON THIS BALLOT

NO PARTNERSHIP WAS FORMED AND NO CANDIDATE WAS NOMINATED.
A OTHER BALLOT WILL HAVE TO BE TAKEN.

BALLOT 6

THERE ARE 600 TOTAL VOTES IN THE CONVENTION. 300 VOTES UNCOMMITTED.

YOUR CANDIDATE HAS 100 VOTES.

301 VOTES ARE NEEDED FOR A MAJORITY.

THE OTHER CANDIDATES HAVE	/ 60 VOTES/	/ 140 VOTES/
INCLUDING YOUR	/ 100 VOTES/	/ 100 VOTES/
THE PARTNERSHIP WOULD HAVE	/ 160 VOTES/	/ 240 VOTES/

CIRCLE THE NUMBER OF VOTES OF THE CANDIDATE YOU CHOOSE ON THIS BALLOT

NO PARTNERSHIP WAS FORMED AND NO CANDIDATE WAS NOMINATED.
ANOTHER BALLOT WILL HAVE TO BE TAKEN.

BALLOT 7

THERE ARE 600 TOTAL VOTES IN THE CONVENTION, 300 VOTES UNCOMMITTED.

YOUR CANDIDATE HAS 100 VOTES.

301 VOTES ARE NEEDED FOR A MAJORITY.

THE OTHER CANDIDATES HAVE	/ 140 VOTES/	/ 60 VOTES/
INCLUDING YOUR	/ 100 VOTES/	/ 100 VOTES/
THE PARTNERSHIP WOULD HAVE	/ 240 VOTES/	/ 160 VOTES/

CIRCLE THE NUMBER OF VOTES OF THE CANDIDATE YOU CHOOSE ON THIS BALLOT

NO PARTNERSHIP WAS FORMED AND NO CANDIDATE WAS NOMINATED.
ANOTHER BALLOT WILL HAVE TO BE TAKEN.

BALLOT 8

THERE ARE 600 TOTAL VOTES IN THE CONVENTION, 300 VOTES UNCOMMITTED.

YOUR CANDIDATE HAS 100 VOTES.

301 VOTES ARE NEEDED FOR A MAJORITY.

THE OTHER CANDIDATES HAVE	/ 60 VOTES/	/ 140 VOTES/
INCLUDING YOUR	/ 100 VOTES/	/ 100 VOTES/
THE PARTNERSHIP WOULD HAVE	/ 160 VOTES/	/ 240 VOTES/

CIRCLE THE NUMBER OF VOTES OF THE CANDIDATE YOU CHOOSE ON THIS BALLOT

NO PARTNERSHIP WAS FORMED AND NO CANDIDATE WAS NOMINATED.
ANOTHER BALLOT WILL HAVE TO BE TAKEN.

BALLOT 9

THERE ARE 600 TOTAL VOTES IN THE CONVENTION, 300 VOTES UNCOMMITTED.

YOUR CANDIDATE HAS 100 VOTES.

301 VOTES ARE NEEDED FOR A MAJORITY.

THE OTHER CANDIDATES HAVE	/ 140 VOTES/	/ 60 VOTES/
INCLUDING YOUR	/ 100 VOTES/	/ 100 VOTES/
THE PARTNERSHIP WOULD HAVE	/ 240 VOTES/	/ 160 VOTES/

CIRCLE THE NUMBER OF VOTES OF THE CANDIDATE YOU CHOOSE ON THIS BALLOT

NO PARTNERSHIP WAS FORMED AND NO CANDIDATE WAS NOMINATED.
ANOTHER BALLOT WILL HAVE TO BE TAKEN.

BALLOT 10

THERE ARE 600 TOTAL VOTES IN THE CONVENTION, 300 VOTES UNCOMMITTED.

YOUR CANDIDATE HAS 100 VOTES.

301 VOTES ARE NEEDED FOR A MAJORITY.

THE OTHER CANDIDATES HAVE	/ 60 VOTES/	/ 140 VOTES/
INCLUDING YOUR	/ 100 VOTES/	/ 100 VOTES/
THE PARTNERSHIP WOULD HAVE	/ 160 VOTES/	/ 240 VOTES/

CIRCLE THE NUMBER OF VOTES OF THE CANDIDATE YOU CHOOSE ON THIS BALLOT

APPENDIX III

SAMPLE BARGAINING SHEET

APPENDIX III

SAMPLE BARGAINING SHEET

__________ votes | __________ votes

I want	Leaving you	I want	Leaving you
$	$	$	$

APPENDIX IV

INSTRUCTIONS

APPENDIX IV

INSTRUCTIONS

Assume you are the manager for a candidate in a political party convention. No candidate has a majority of the votes in the convention, but no candidate can be elected unless he can control a majority of votes. It will therefore be necessary for you to approach other candidates to attempt to join together in order to have a better chance of winning the nomination. It is assumed that these contact attempts take place before each convention ballot. When on any ballot two candidates decide to approach each other, their managers are expected to discuss such matters as the proportion of the payoff which each shall receive in case the partnership is successful in winning the nomination. We are interested in how people choose partners in this situation when they are trying to earn as much for themselves as possible.

(BEGIN PASSING OUT BALLOTS FOR PRACTICE GAME)

The details of this particular political convention are given on the ballots which are being passed out to you now. Look closely at the ballots you have been given. The first line tells you that there are 9 votes in the convention, with no votes uncommitted. Some conventions which you will participate in will have uncommitted votes in them. The next line tells you your candidate has a certain number of votes. One of you represents a candidate with 2 votes, another of you represents a candidate with 4 votes, and the third candidate has 3 votes. The next line shows that 5 votes are required for a majority in this convention. A majority, or at least this number of votes, is required to win.

The next line, the line that says, "The other candidates have" contains the number of votes held by each of the other two candidates besides yourself. When the game is played, you are to circle one of these two numbers to indicate the candidate with whom you would like to try to form a partnership on each ballot.

The next line simply repeats your number of votes, and the bottom line tells you how many total votes the partnership would have if you formed a partnership with the candidate whose votes are above it in that column. On the first ballot choose one of the two candidates listed. If there is no mutual choice on the first ballot, we will continue through successive ballots until there is a mutual choice. Before the game starts, do you have any questions about the way the game is played?

(PAUSE)

This will be a practice game. You will have ten seconds to make your choice. Please do not try to communicate with each other, but simply make your choices on the ballot and pass it through the slot in front of you.

(AFTER COMPLETION OF PRACTICE GAME)

There was a mutual choice on this ballot; the person representing the candidate with _X_ votes chose the candidate with _Y_ votes, and the candidate with _Y_ votes chose the candidate with _X_ votes. If no two of you had chosen each other, we would have gone on through ballots __, __ and so on until there was a mutual choice. The next game will be played similarly to the first game, except different numbers of votes will be used and some games will have uncommitted votes in them. Make your choices carefully since one of these games will be chosen at random for the division of $3.00. The winner of the game will have an opportunity to bargain over the division of the money. After all games have been played, one of the games will be chosen at random; and if a partnership has won that game, the bargain made after that game will be binding.

(LET _S_s CHOOSE BALLOTS AT RANDOM. ADMINISTER EACH GAME AS BEFORE. GIVE _S_s AT LEAST 10 SECONDS TO EXAMINE THE GAME BEFORE THE FIRST BALLOT.)

(ANNOUNCE BEFORE EACH GAME INVOLVING UNCOMMITTED VOTES)

Notice that this game has 300 uncommitted votes in it. If this game is chosen for the division of the $3.00, the 300 uncommitted votes will be split between the partnership and the third candidate to determine who will receive the money. If the person left out of the partnership gets enough of the uncommitted votes to have a majority, he would win the $3.00 all by himself. Otherwise, the money will be divided between the partners according to the agreement they have made.