TEMPORARY COALITIONS IN THE PROCESS OF COALITION FORMATION

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THESIS

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ABSTRACT

TEMPORARY COALITIONS
IN THE
PROCESS OF COALITION FORMATION

by Ivan L. Preston

The purpose of this research was to investigate the implications for the coalition formation process of assuming that coalitions formed within groups may be temporary rather than permanent. Previous research, based on theoretical ideas by Theodore Caplow, assumed that coalitions cannot be broken once they are formed, whereas this study points out that coalitions formed in real-life situations are subject to dissolution and possible replacement by coalitions involving other persons. Theoretical ideas are presented in support of a suggestion that people given the opportunity will generally choose to break coalitions in time because the results produced by a coalition change the relationship of its members to each other, making the coalition unnecessary to one or more persons who earlier found it necessary.

Although a test of Caplow's theory, using permanent coalitions, found that people weak in power gain the advantage over the strong through the coalition formation process, it is argued here that the opportunity to form temporary coalitions will cause competitively-minded weak persons to misperceive their interests and fail to gain the advantage over the strong. This will happen because the prospect of coalescing on a temporary basis leads persons to favor coalitions with the strongest persons available, whereas the best advantage can be gained

by coalescing only with weak persons against the strong. Cooperatively-oriented persons will not make this mistake, it is argued, and thereby will gain more through forming coalitions. Competitive persons, after gaining experience with the problem, eventually will change their views so as to make proper decisions.

These and related hypotheses about the coalition-forming process were tested in an experiment in which a triad of persons competed in a game of moving tokens down a path toward a finish line. Tokens were given differing power values (4, 3, 2) and at the throw of a die each player moved a number of spaces found by multiplying the number on the die by his power value. Any two players might form a coalition in which they each used the sum of their two power values; this enabled them to advance faster. However, a winning coalition was required to divide the prize, whereas a player winning while playing alone received the entire prize himself.

Forty triads each played 30 games. Half were given instructions urging a highly competitive approach; the others received instructions suggesting that cooperation with opponents should be the principle of play. Triads also were separated into competitive and cooperative groups on the basis of a personality scale which measured players' tendencies toward masculine (competitive) or feminine (cooperative) interests. Data examined included power, competitive-cooperative set, coalitions formed and broken, and winnings made under various conditions.

Results showed that coalitions were broken in many games, though players found reasons to justify keeping coalitions intact in a majority of cases. Winnings data showed that players who coalesced with the weaker of two opponents scored higher than players who coalesced with the

stronger. But results also showed that neither competitive nor cooperative players learned to choose weak opponents to a significant degree. Both began by choosing strong opponents primarily; competitive players continued this preference; cooperative players eventually trended in the direction of choosing weak opponents. The data also showed that the player's relationship to the opening coalition overrode power as a determinant of winnings, although higher power did produce higher winnings when the relationship to opening coalition was not a factor.

TEMPORARY COALITIONS

IN THE

PROCESS OF COALITION FORMATION

by

Ivan L. Preston

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TABLE OF CONTENTS

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LIST OF TABLES

Tables Page

LIST OF ILLUSTRATIONS

INTRODUCTION

Contemporary theorists' views of the communication process have developed and widened with each new insight into the variables of human behavior which mediate the flow of messages from sources to receivers. One of these variables is group structure, considered important in communication under the assumption that a person's handling of messages is affected by his participation within an organization of people to whom the messages are relevant.

As the structure of a group changes, communication analysis predicts different effects resulting from the altering of message channels as people acquire different relationships to each other. Other things being equal, if group structure remains constant, communication channels will not vary. But if a group is changeable or unstable the handling of messages by its members may vary unpredictably. Perhaps, in this situation, some understanding can be acquired about a group's disposition to maintain itself under certain conditions and to break apart under others. If so, greater prediction of communication effects can be achieved.

This thesis examines a particular factor of group instability---the tendency for members to form coalitions within a group. A coalition is a sub-group whose members align themselves against the remaining member(s) of the original group. Coalition formation thus differentiates members within the group, whereas previously such structural differentiation did not exist. If a group contains no sub-structures, then the communication potential between any pair of members (other things being equal) is not

different from that between any other pair. But when coalitions exist, communication is facilitated within such a sub-structure and is disrupted between persons belonging to different sub-structures.

The writer is concerned with the flow of information in groups where coalitions may form; however, this thesis is not directly involved with examining the effects of messages. Instead, the experiment reported here is directed toward the related (and theoretically prior) problem of predicting whether coalitions will occur within groups, whether they will be stable or unstable, and whether those which break up will be replaced by alternate coalitions. A substantial literature on these problems exists, and various theories of coalition formation are reported therein. The present study is an attempt to expand this theoretical area.

CHAPTER I

This chapter contains the background for the study, the rationale, and a statement of the hypotheses.

BACKGROUND

The literature on coalitions triggered by Caplow's theoretical paper (4) involves the formation of permanent rather than temporary coalitions. Subsequent experimental work (3, 6, 9, 13, 20, 22, 23, 24, 26) has adhered to this assumption of permanence, whereas the consideration of coalitions as temporary phenomena suggests quite different results which have not yet been investigated.

For Caplow, the independent variable in coalition formation consists of the powers of the various individuals competing for a goal which only the most powerful can achieve. By power is meant the resources which a person commands which determine the extent of his achievement toward the goal. For example, heads of delegations to a political convention control given numbers of votes in a situation where some combination of delegates will eventually command a majority of votes and thereby achieve the goal of nomination for their candidate. In this case, Caplow would define each vote as a unit of power, and the independent variable leading to coalition formation would be the number of votes commanded by each delegate.

The dependent variable is the formation of a unit of individuals which commands more power than all other units and thereby achieves the

goal of nomination for their candidate. In this case, Caplow would define each vote as a unit of power, and the independent variable leading to coalition formation would be the number of votes commanded by each delegate.

The dependent variable is the formation of a unit of individuals which commands more power than all other units and thereby achieves the goal. In some cases, for example for 3 persons with a power distribution of 3-1-1, a single individual can establish himself as the most powerful unit. He does not need to combine with anyone else to become most powerful, because the combined powers of the others cannot match his strength. But there are other cases in which single individuals cannot establish themselves as most powerful units if other persons make a decision to coalesce. For example, for 3 persons with a power distribution of 4-3-2, 4 will not be the most powerful unit if 3 and 2 form a coalition.

Caplow (4) described six types of power distributions in triads, and made predictions concerning coalition formation in each. In a later paper (5) he added two more types. The eight types are described in Figure 1.

In their experimental test of Caplow's predictions, first six types only, Vinacke & Arkoff (24) confirmed these predictions. Thirty groups of three Ss played a game in which each S began with a counter placed at the start of a pathway of 67 spaces. Each triad played three games of each type. Caplow's theory assumes that a triad plays a single game, not a series of games; thus each game was considered to be a separate replication of the experimental situation. The players were randomly assigned

FIGURE 1.--Caplow's eight power distributions

Type	Power distribution among three players	Example of power distribution	Predicted outcome
1	A = B = C	1-1-1	Coalitions likely; all equally likely
2	B = C; A greater than either	3-2-2	Coalitions likely; BC most likely
3	B = C; A less than either	1-2-2	Coalitions likely; BC least likely
4	B = C; A greater than sum of B and C	3-1-1	Coalitions not likely
5	A greater than B; B greater than C; A less than sum of B and C	4-3-2	Coalitions likely; AB least likely
6	A greater than B; B greater than C; A greater than sum of B and C	4-2-1	Coalitions not likely
7	A greater than B; B greater than C; A equals sum of B and C	3-2-1	Coalitions likely; BC least likely
8	B = C; A equals sum of B and C	4-2-2	Coalitions likely; BC least likely

power values, and then with each throw of a die by E each player moved his counter a given number of spaces. The move was calculated by multiplying the number on the die by the power value. A prize of 100 points per game was to go to the player whose counter crossed the finish line first.

The game's outcome would be trivial were it not for the additional

rule that any two players might form a coalition at any time. Upon doing so, they were assigned a joint counter whose power value was the sum of their separate values. Once this was done, the outcome of the game once again was strictly determined, since all players moved simultaneously with each die throw. (In practice the die rarely was thrown.) The results favored Caplow's predictions, based on earlier observations by Simmel (18), that the weak would gain the advantage over the strong.

For Types 2, 3 and 5, the null hypothesis that all possible coalitions were equally likely was rejected, with the discrepancies in the predicted directions. For Types 1, 4 and 6 this hypothesis was not rejected. However, players in games of Types 4 and 6 formed significantly fewer coalitions than occurred for the others.

Upon forming a coalition, players were required to decide how they would share the prize of 100 points. Vinacke & Arkoff collected data on whether the division was 50-50, or from 51 to 70 points for one player, or else from 71 to 99 points for one player. The data showed that the most powerful member of the coalition was able to obtain the larger share of the prize. In an analysis of the number of times an offer was made to coalesce, the data showed that the least powerful players generally made the most offers.

In confirming Caplow's predictions, the Vinacke-Arkoff experiment disputed the expectations of game theory (25) that all possible coalitions would be equally likely to occur in Types 2, 3 and 5. Game theory points out that the players in these situations have equal amounts of power with respect to the goal, inasmuch as no player can win by himself but must have the help of someone else in order to win. In other words,

if power is defined as extent of resources enabling the player to reach the goal, then all players have equal power even though their tokens are given power values which differ. In a Type 5 game, for example, 4 is no more powerful than 3 or 2, according to game theory, because 4 can do no better than can 3 or 2 without a coalition. If 4 demands a majority share of winnings for coalescing with 3, 3 can turn to a coalition with 2. The result is that any player ought to be able to win a coalition partner two-thirds of the time on the average for a 50-50 share of prize on the average.

The fact that this expectation was not confirmed suggests a distinction between the game-theoretical definition of power and power as perceived by participants in the Vinacke-Arkoff game. For game theory, players with 4, 3, and 2 have equal power. For the perceived-power notion on which Caplow's predictions are based, players with higher values see themselves as having greater power, in proportions identical with those indicated by the power values. When we discuss power, then, we must be careful to note whether we mean game-theoretical power or perceived power.

Game-theoretical expectations were further compared with Caplow's perceived-power notions by Kelley & Arrowood (13) in a game similar to that of Vinacke & Arkoff except that Ss played 20 games using only the 4-3-2 (Type 5) distribution. The authors argued that game-theoretical predictions were the ones which should be confirmed because the game-theoretical definition of power correctly defines the extent of resources which a player actually commands. To play the game correctly, then, players <u>ought</u> to follow the game theory definition. However, the

authors continued by saying that game-theoretical reasoning is not obvious; rather, it is difficult to learn and understand, requiring time and experience. The player may begin the game with a perception of power not corresponding to the game-theory view, but his perception of power will gradually change until it coincides with the game-theory orientation. Therefore the study's hypothesis, which was supported, was that the results of later games would adhere more closely to game theory predictions than would the results of the first games played. The authors concluded that the tendency for perceived power to differ from game-theoretical power, which is assumed by Caplow's theory, was eliminated through learning.

Gamson (8, 9), disagreeing with game-theoretical predictions, formulated his own set of predictions based on "people's assumptions about the meaning of other people's power." His basic notion was that people will seek the "cheapest winning coalition." The rationale was similar to Caplow's, though differing in small details. For example, while Caplow said for Type 5 that a coalition including the player with 2 was most likely, because 2 was weakest, Gamson specified 3-2 in particular as the most likely coalition because 2 would react differentially to the values of 4 and 3.

Gamson also developed his ideas so as to be applicable to n persons, theoretically, with the possibility of coalitions of 3 or more persons and also the formation of counter-coalitions. In his experiment (9) he used 5-man groups to test the hypothesis that the cheapest winning coalition would be chosen. Ss, role-playing as committee chairmen who were wielding votes and patronage jobs at a political convention, responded

significantly often in the expected ways.

In another experiment based on Caplow's paper, Stryker & Psathas (20) varied the strength of the weak man in the Type 3 distribution. In a game like that of Vinacke & Arkoff, the weak players had power values of 1, 3 or 5, while the strong players always had values of 6. The authors hypothesized that as the weak man's strength increases he will be in a greater number of coalitions and will receive a greater share in the division of the prize. These expectations are opposed to the Simmel-Caplow belief that the weaker the player, the more he will be helped in a coalition. The results showed that there were no differences in the number of coalitions achieved by weak, weaker, and weakest players. However, there was some evidence, described as "not clear-cut," suggesting that the weak man tended to receive larger proportions of the prize as his weight increased.

The authors concluded that perceived power tended to differ from game-theoretical power for Ss when they divided up prizes but not when they formed coalitions. However, it is difficult to compare this experiment with that of Vinacke & Arkoff because Stryker & Psathas forced players to form coalitions in all games.

Willis (26), apparently independently of Gamson, developed an extension of Caplow's work to the tetrad. In a Vinacke-Arkoff-type game, he found his predictions supported weakly. He suggested that the same principles applied to the tetrad as to the triad, but felt that increased complexity limited the success of the predictions. The chance for coalitions of either 2 or 3 persons, and also the occurrence of counter-coalitions, makes possible a large number of outcomes in the tetrad.

Since Vinacke & Arkoff used only male Ss, Vinacke (22) decided to replicate the study using female Ss to check for possible sex differences. He found that women had a very different approach to the game problem. In their play they tried to help rather than oppose each other, and they treated the game as though the goal was to attain adequate social interaction rather than to compete. A number of measures of "feminine strategy" were noted, such as the tendencies to form triple coalitions, to divide prizes evenly, to coalesce when you can win without coalescing, and to make agreements that each of the three pairs will take turns coalescing.

Following this finding, Bond & Vinacke (3) examined triads pitting men against women, two against one, with each sex in the majority half the time. The expected differences occurred, with women displaying what the authors called "accommodative strategy" while the men practiced "exploitative strategy." The women accommodated their opponents by coalescing with the weaker opponent, while the men exploited the situation by securing coalitions with the stronger opponent. Interestingly, this led to higher winnings by female players, due to the habit discussed above of dividing coalition prizes according to perceived power differences. This occurred despite the fact, also noted earlier, that perceived differences in power values were inaccurate according to game theory.

In another experiment involving individual differences, Chaney & Vinacke (6) examined effects of two of the "manifest needs" of Henry A. Murray, achievement and nurturance. Ss high in achievement were more successful in improving their winnings over a series of 12 games. Also, they were high in proposing coalitions, whereas Ss high in nurturance

joined coalitions more often by accepting offers than by proposing them. The authors concluded that results were in general more closely associated with power differences than with personality differences.

To test for effects of alternate methods, Vinacke (23) compared the procedure of running games as separate events with the procedure of maintaining a cumulative score over a series of games. With a cumulative score, the two players who were trailing in points tended to ally regardless of initial strength, rather than to treat the experimental situation in the typical way found in the other studies.

No other experimental work is available which is directly involved with a test of Caplow's theory. However, the research of Hoffman, Festinger & Lawrence (12), published two years prior to Caplow (4), might be called the first empirical confirmation of the theory. The authors had three Ss (one a stooge) compete for points in an alleged intelligence test. The stooge was permitted to get far ahead in points and then the group was told that no further points could be scored except by a coalition of two persons. The stooge tried to get into the coalition, but was excluded to a significant degree. When he was included it was usually for the price of a minority share of the points which the pair might win. This was the earliest demonstration that all winning coalitions do not occur equally often; the one without the stooge occurred in a majority of cases. However, the researchers' principal purpose was not coalition formation, and the work did not directly pursue the factors which determine coalition outcomes. A number of other studies (2, 15, 16, 17, 19, 21, 27) may be cited as further examples to show the nature of this area prior to Caplow's paper; their content is relevant to the problem, but no

general theory is presented.

RATIONALE

Pertinent to the present study is the Caplow assumption that once a coalition is formed it will be permanent because its members cannot achieve their goal without it. All of the Caplow-inspired studies we have examined adhered to this assumption by requiring that Ss who formed coalitions could not later dissolve them.

What apparently is involved in this assumption is the belief that since amount of power is permanently established for each individual, a coalition desired at any given time in the game should remain equally desirable at later times. This point may be questioned by examining certain characteristics of Caplow's eight power distributions.

For four of these (Types 1, 2, 3 and 5) we feel that not one of the possible coalitions which may occur therein will continue to be desired by both members as a game progresses, even though it may have been desired by both at the time it was formed. The reason is that after any move the relationships of the players to each other under these conditions will necessarily be changed.

In Type 5, for example, if 3 and 2 form a coalition they will move more rapidly toward the goal than will 4. If players were permitted to break coalitions at any time, we should expect 3 to break this coalition just prior to reaching the goal. At such point, 3 will obviously precede 2 across the goal, and also can finish ahead of 4 because 4 fell behind during the existence of the coalition. In other words, 3 joined the coalition because he needed it, then broke it because he no longer needed it. He used 2 in order to reach a dominant position, then avoided the

necessity of sharing the prize with 2.

It is not permanently true, then, in the Type 5 situation, that members of a coalition cannot achieve their goal without it. Their need depends not only on the amount of power they have but also the amount they need. The need for a coalition, and in fact the need to be apart from a coalition, varies from move to move for every possible coalition in Types 1, 2, 3 and 5. These types might thus be described as containing only "unstable" coalitions, i.e., coalitions whose existence is unstable because they are needed at one time but not at another.

In contrast, each of the remaining types (Types 4, 6, 7 and 8) contains only stable coalitions. Types 4 (3-1-1) and 6 (4-2-1) contain coalitions which are unnecessary to one member at all times (coalitions of the dominant player with either opponent), and also coalitions which are useless to both members at all times (those of the weak players). Thus they contain only coalitions whose meaning to each player will remain constant under changing game conditions. Types 7 (3-2-1) and 8 (4-2-2) contain unstable coalitions (those of the dominant player with either opponent), but they also contain coalitions which are necessary and useful at all times (those of the weak players). Since these necessary coalitions presumably will be learned and adhered to after a few trials, we may assume that unstable coalitions will seldom occur in games using Types 7 and 8.

Unstable coalitions thus cannot exist for Types 4 and 6 and will seldom occur for 7 and 8. For these types, the assumption of permanence of coalitions is acceptable since no differences in behavior would be expected if the rules were changed to permit temporary coalitions. Coali-

tions formed at the beginning of a game probably would remain in effect throughout the game, and coalitions not desired at the beginning of a game probably would not be desired at any other time. For the other types of power distributions this is not so, and we now turn our attention exclusively to their particular characteristics.

Our thesis is that a rationale for the permanence of coalitions for Types 1, 2, 3 and 5 cannot be valid. If coalitions may be broken and alternate coalitions formed, these events surely will happen often. They will happen because the position of players with respect to the goal and to each other will change, and (except for Type 1) because there are game-theoretical differences (not just perceived differences) in power between players. Even when coalitions are not broken during a game, players will realize that they may be broken---and the possibility should influence their decisions.

Since the use of temporary coalitions should lead to operations which differ from those in games using permanent coalitions, it seems useful to determine whether they will also lead to different final outcomes. In particular we are interested in the Simmel-Caplow expectation that coalitions will give the weak an advantage over the strong. In the Vinacke-Arkoff experiment, the weak player's move was clear: he had to form a coalition with another player in order to share in the prize. And the weaker one's coalition partner, the greater one's share. With temporary coalitions we are looking at a situation in which the weak player may interact with the strongest player temporarily without necessarily being hurt. In fact, he may observe that a short-term coalition with the strongest opponent has the advantage of giving him, temporarily, the

greatest possible strength while at the same time not putting him at an obvious disadvantage. It doesn't matter that the strongest player demands a larger share of the prize than the other opponent would have wanted, because the coalition is temporary and the agreement may be dissolved at any time.

Probably it will not be clear to the weak man that this is an inaccurate assessment of the situation. If he opens the game by coalescing with the stronger of his two opponents, he moves along faster but he also is accompanied by the strongest opponent. For example, in the Type 5 situation, if 3 opens with 4 he moves with a power of 7 rather than the power of 5 he would have obtained by coalescing with 2. But 3 is now the weaker of the two coalition members, rather than the stronger. If the coalition is eventually dissolved, this difference will be significant.

At the start of the game, 3 was stronger than 2, weaker than 4. He might have gained advantage over both by opening with 2, but by opening with 4 he merely increased his advantage over 2 while 4 retained the advantage over him. The same strategy follows for 2 or 4: a player should form the first coalition in the game with the weaker rather than the stronger opponent. Each player should have the greatest average winnings when he opens the game by coalescing with the weaker of the other two. He should have smaller winnings when he coalesces with the stronger of the other two, and of course his average gain should be lowest when he is left out of the opening coalition.

However, this expectation may not be obvious in games involving temporary coalitions, because the possibility of a temporary alliance will make a player see the strongest opponent as an attractive partner in a

certain way. Accordingly, we expect that players with little experience will tend to choose the strongest opponent as the opening coalition partner.

As a result, we are not sure whether the Simmel-Caplow expectation will be confirmed when temporary coalitions are used. We expect that this altered condition will deter the weak from gaining the advantage over the strong. The critical condition would seem to be this:

Confirmation of the Simmel-Caplow belief that the weak has the advantage over the strong in coalition situations will depend on the weak's realization that his strength lies in associating with other weak players rather than with the strong.

In the Vinacke-Arkoff experiment, weak players had a beginning disadvantage, but they could create an advantage, and they did. Here we are saying that weak players are at a disadvantage and can create an advantage, but that they will not. They will not recognize the proper decision, at least not in the early games of a series. Eventually, as they see the outcome of a series of games they will realize that the stronger opponent is the one who should not be given any help. Only then will they switch their opening coalition choices toward the weaker opponent.

Once the opening coalition is formed, the differentiation which develops among the players should proceed rapidly. We expect that this differentiation with respect to the goal will lead to pressures which cause a break-up of the coalition and formation of an alternate arrangement. In a coalition of unequals (for instance, of 3 and 2 in the 4-3-2 group), the coalition's success will give both members reasons for abandoning each other eventually. When this happens in the case of three

different power values (Type 5), the possible subsequent events are these: (1) A second coalition composed of the weaker member of the opening coalition along with the player left out of the opening coalition, (2) a second coalition composed of the stronger member of the opening coalition along with the player left out of the opening coalition, or (3) no additional coalition formation during the remainder of the game.

We expect the first alternative to occur most often. The player left out of the opening coalition is the key to the next one. If he goes with the stronger member of the opening coalition, he is gaining no advantage over his strongest opponent. If he goes with the other, he is gaining advantage where it is needed most. So we predict he will choose to join the weaker of the other two. This is a similar situation to that of the opening coalition for which we predicted that the player often would go with the stronger opponent. It might seem that the same expectation would apply here, but in this case there has been considerable differentiation produced among players as a result of the opening coalition. Consequently, we feel in this case that the correct move will be more readily perceived.

After occurrence of a second coalition, the need for a third should develop. The same sort of rationale used above may be applied to predict that a subsequent event will occur and that it will be the coalition not yet formed. This should occur more often than the alternatives, which are the re-occurrence of the opening coalition, occurrence of no coalition, or no subsequent event.

Additional expectations can be stated. Power differences should produce differences in outcomes which can be shown wherever the independ-

ent variable of coalition formation is held constant. Knowledge of power without knowledge of coalition formation should not be useful in predicting results. For example, in the 4-3-2 distribution, the 4 may score the most points if the 4-3 coalition is most often used, but he may score the fewest if the 3-2 coalition is most often used. But given formation of a particular coalition, we expect that knowledge of power can be used to predict results. For example, given the 3-2 opening coalition, we expect 3 to score highest, with 2 next and 4 last. The difference between 3 and 2 is expected on the basis of power, with coalition formation held constant; that is, both 3 and 2 have formed the opening coalition with the weaker opponent. The difference between 2 and 4 is expected on the basis of coalition formation, even though the power difference is not held constant. The coalition difference should hold in spite of the power differences, whereas power differences will hold only in the absence of coalition differences.

Power differences seem to matter under conditions of temporary coalitions, whereas in the Vinacke-Arkoff situation the reader is tempted to agree that there were no game-theoretical power differences. The latter is not correct, however. The various powers could be judged equivalent, game-theoretically, in the Vinacke-Arkoff study only under the assumption that a game always had to involve the formation of a coalition. Indeed, coalition formation always occurred. But it did not have to; it involved a conscious choice. The alternatives being what they were, the choice always produced a coalition. Thus power values did not produce power differences, game-theoretically, with respect to which coalition was formed, but they did produce differences relevant to the question of

whether a coalition would be formed.

In addition to structural variables, the coalition-forming process is also subject to individual differences in the ways players regard their participation in it. The discussion thus far has implicitly assumed a competitive orientation toward the coalition-forming process, owing to the structural nature of the task as operationalized in the Vinacke-Arkoff experimental game. Our hypotheses assume that all players will attempt to win as many points as possible and to hold opponents to the fewest possible points. Some players, however, may regard their participation in a different light. Some might dilute their competitive purpose with an attempt to be cooperative or altruistic; in other words, they might prefer to win by a small margin or even to lose some games. Other players might be motivated even more by the cooperative urge, preferring never to take advantage of a powerful position which the opponents could not possibly have prevented them from achieving.

We have already seen (3) that males express a more competitive approach than females. In the experiment reported here, we use only male Ss and examine two other variables which we think are related to the tendency to perform cooperatively rather than competitively. The first variable is that of instructional set toward the task, with Ss instructed to approach the game in the spirit of either cooperation or competition. The second variable is that of masculinity-femininity of Ss, as measured by the appropriate scale of the Minnesota Multiphasic Personality Inventory (MMPI) (11). This scale indicates relative preference for male or female interest, and thus may be interpreted as showing a tendency toward competition (male interests) or cooperation (female interests).

Our expectations for the opening coalition must be varied for Ss likely to approach the task cooperatively, either by instructional set or by personality set. As stated above, we expect that competitively oriented Ss will tend to choose the stronger opponent as opening coalition partner in early games, then eventually switch toward choosing the weaker opponent. On the other hand, cooperatively oriented Ss should choose the weaker opponent even in the earliest games, and continue this tendency through the later games. This expectation is based largely on the findings of Bond & Vinacke (3) concerning differences between men and women; here we expect that similar differences within a group of males will produce parallel differences in behavior.

HYPOTHESES

The expectations stated above are summarized in the following set of hypotheses:

1-a. In early games, competitively-oriented players will form the opening coalition with the stronger opponent more often than with the weaker. In later games, they will form the opening coalition more often with the weaker. Over the series of games they will show a trend indicating increased tendency to coalesce with the weaker opponent.

1-b. Cooperatively-oriented players will not display such a trend, but in all games will form the opening coalition more often with the weaker than with the stronger.

2. After the opening coalition is formed, the most likely subsequent event is the formation of a coalition between the weaker member of the opening coalition and the player left out of the opening coalition.

3. After a second coalition is formed, the most likely subsequent

event is the formation of the only coalition not yet formed.

4. Winnings will be highest for the 4 under a competitive rather than a cooperative orientation, not different for the 3 under these orientations, and higher for the 2 under the cooperative rather than the competitive orientation.

5. Winnings will be highest for players coalescing with the weakest opponent in the opening coalition, next highest for players coalescing with the strongest opponent in the opening coalition, and lowest for players left out of the opening coalition.

6. Winnings will be highest for players with the strongest power when coalition formation is held constant.

CHAPTER II

This chapter describes the experimental method, including sections on the coalition game, independent variables, dependent variables, design, sample, and procedures.

Data were obtained to examine several hypotheses. These included expectations about the preferences of competitively and cooperatively oriented players for forming opening coalitions with various opponents (Hypotheses 1-a and 1-b), and for replacing opening coalitions with other arrangements (Hypotheses 2 and 3).

Also examined were the distributions of winnings among players having given powers under competitive vs. cooperative orientations (Hypothesis 4), winnings of players having different relationships to the opening coalition (Hypothesis 5), and winnings of players having different powers with other factors equal (Hypothesis 6).

This study examined these expectations in an experiment similar to that of Vinacke & Arkoff (24). For Hypotheses 1-a and 1-b, an analysis-of variance of mean strength of opening coalitions was performed, using the independent variables of competitive-cooperative set and number of games played. Hypothesis 2 involved t tests to compare the mean number of occurrences of various events of coalition formation against expected means. Hypothesis 3 called for a similar analysis. Hypotheses 4, 5, and 6 were examined by analysis-of-variance tests of mean winnings which used the independent variables of power, competitive-cooperative instructional set, competitive-cooperative interests (MMPI), and relationship to

opening coalition. The hypotheses were intended, wherever applicable, to apply to games of Types 2, 3 and 5. Type 5, however, permitted study of a wider variety of effects since it used three different power values; consequently, the study examined Type 5 games. The effects observed should be generalizable to Types 2 and 3. Finally, the experiment examined Type 1 games briefly, without formal testing of hypotheses, to determine whether they contained "unstable" coalitions.

THE COALITION GAME

The game was similar to that of Vinacke & Arkoff (24). The game board, placed on a table, consisted of a sheet of paper about three feet in length on which was drawn a series of spaces (or blocks or steps, as in common board games such as "Monopoly") numbered in a straight line from 1 to 90. Players were assigned small square tokens of similar design and color, with numbers (power values) printed on top, which were placed side by side in front of the first space. Players also were given identical sets of cards which they played to select coalition partners and form coalitions. On each move of the game, E threw an ordinary six-sided die and each player moved forward a number of spaces determined by multiplying the number on the die times his power value. The goal of the game was to have one's token reach the finish line (90th space) first. The winner of each game collected a prize of 100 points and the winning player was the one with the most points over a series of 30 games.

Under the rules of the game (which are stated fully in the "Procedures" section below), any two players might form a coalition, in which case each would play under a power value determined by summing their separate power values. Before the first move of each game, Ss had the

opportunity to select or reject either or both of their opponents as potential coalition partners. If reciprocal choices occurred, the two Ss were required to agree on a division of the 100-point prize should their coalition remain in force throughout the game and win the game. The rules provided that a winning player who was not participating in a coalition should get the entire 100-point prize, but that players winning while sharing a coalition should each get agreed-upon shares of the 100 points. The rules also provided that players might reconsider their coalition agreements after any move, which meant that coalitions formed on one move might be broken on another. If a coalition was broken, the agreement was dissolved and each member then had the opportunity to win the entire 100 points by finishing the game on his own. A coalition break-up, however, did not mean that additional coalitions could not be formed; rather, a second coalition could be formed any time after a first coalition was dissolved. Each player might participate in any number of coalitions during a game.

In summary, the resources which the player put into the game included the power value of his own token, plus the power value of any token with whose owner the player might be sharing a coalition. The output which the player obtained from each game consisted of a number of points, zero to 100.

At the start of a game, the numbers on the die, 1 to 6, were called by E at face value each time the die was thrown. But after at least one player advanced as far as space 45, E interpreted the 4 on the die as a throw of 1, the 5 as a throw of 2, and the 6 as a throw of 3, for the rest of the game. This meant that the die, in effect, had two sides

apiece with the values of 1, 2 and 3 during much of the game. The power of the die was reduced in this way in order to give players a chance to interact as often as possible as they approached the goal. Had die throws of 4, 5 and 6 been used, many games would have been completed in only a few moves, allowing less opportunity for E to observe Ss' maneuvers as the end of the game approached. Die throws of 1 through 6 were used in the first portion of each game, however, to keep the playing time per game restricted to a workable maximum. Played in this way, 30 games took Ss about one and one-half hours.

INDEPENDENT VARIABLES

Competitive-cooperative instructional set. Ss in half the triads playing the Type 5 game were given instructions which suggested that the game should be played by competing strongly against their opponents, taking full advantage when favored by the power differential. In the other triads, Ss were told that the game was most successfully played by cooperating to a high degree with opponents, and that it was not meritorious to win by taking advantage of a favorable power difference. These comments, intended to induce significantly different approaches to the game, were included in the rules which were presented to Ss at the start of the experiment.

Competitive-cooperative interests. This alternate means of defining competitive and cooperative approaches to the experiment was introduced not by varying the situation to which Ss were exposed, but by identifying Ss' personality characteristics along a competitive-cooperative continuum. The instrument used was the 60-item Mf scale of the MMPI, on which a high score indicates feminine interests, and a low score indicates

masculine interests. Feminine interest is interpreted here as implying a greater tendency to behave cooperatively rather than competitively, while masculine interest is equated with competitiveness. The Mf scale was used by summing scores of individuals within triads, enabling E to separate the most competitive triads (those with the lowest summed scores) from an equal number of most cooperative triads (those with highest summed scores).

Number of games played. Each triad played 30 games, and each game played was assumed to add to Ss' experience and learning and thus alter the style of play. In order to simplify this variable, the analysis examined data for each group of 6 games, 5 groups in all.

Power. This was the basic resource available to a player. It was assigned to each S by E before each game; the assignment was handled by the distribution of tokens which had numbers printed on them. Each number, or power value, indicated the number of times by which the player was to multiply the number on the die, the result indicating the number of spaces S moved on each throw. Ss who were members of coalitions each used the power value found by summing their separate values.

In Type 5 games, the values of 4, 3 and 2 were varied among Ss from game to game so that all possible combinations of power among the three Ss were used in turn. Players in each triad were randomly labeled A, B and C at the start of the game. E then assigned A, B and C the powers of 4, 3 and 2, respectively, in the first game, followed by these orders in the next five games: 4-2-3, 2-4-3, 2-3-4, 3-2-4, and 3-4-2. The order was repeated for each block of six games. In Type 1 games, all players had powers of 1; however, counters were labeled X, Y and Z so that sets

of data could be gathered separately for each.

Relationship to opening coalition. This variable reflected the success or failure of each S to obtain advantages offered by coalition formation. A player might get into the opening coalition or not. If he was successful, his partner might be the stronger or the weaker of the two opponents. The variable was not manipulated by E; each S's assignment to one of these three categories in each game was determined by his interaction within the triad. As a result, Ss might not necessarily fall into each category in equal numbers of games, and in fact might not fall into a given category in any games at all.

This independent variable was defined for each player, not for the triad collectively. To say that the opening coalition was the 4-2 coalition would serve to describe the situation for the triad as a whole. But to define the situation in terms of individuals it was necessary to point out that one player coalesced with the weakest opponent, one coalesced with the strongest, and one was left out of the opening coalition.

DEPENDENT VARIABLES

Mean strength of opening coalitions. The strength of an opening coalition was the sum of the power values of its two members in each game. Mean strength was computed for triads and for groups of triads across blocks of six games and across all 30 games.

This variable actually was the "relationship to opening coalition" variable conceived in terms of the entire triad rather than in terms of individual Ss. That is, it was a different way of quantifying the same events of coalition formation. The relationship between these two methods of measurement is as follows. When the 4-3 opening coalition was

used, each of the coalition partners coalesced with the strongest of his opponents and one player was left out. Another way of saying this is to state that the strength of the coalition was 7, the maximum. When the 3-2 coalition was used, each of the coalition partners coalesced with the weakest opponent. Here coalition strength was 5, the minimum. The 4-2 coalition indicated that coalition partners did not agree on the question of coalescing with the stronger or weaker opponent. Coalition strength was 6, midway between minimum and maximum.

Mean winnings. In each game, members of a triad (either one or two or all three) won a total of 100 points. In 30 games, they divided 3000 points. Mean winnings were computed for each S in each of various situations produced by using all combinations of all levels of the independent variables involved. Since a given S did not necessarily play under all combinations of conditions, winnings data were not necessarily available for each situation for each S. When an S played in a given type of situation only one time, his "mean" winnings for that situation consisted of his winnings figure for that one game.

DESIGN

The following discussion contains sub-sections describing the designs used for analyzing each hypothesis, and for analyzing the Type 1 games.

Thirty-six triads were assigned to Type 5 games, and four were assigned to Type 1 games. Half of those assigned to each type were given a competitive instructional set; the others were given the cooperative set.

Also, these 36 triads were separated on the basis of MMPI scores for triads: the 18 triads with highest scores were designated as

cooperative MMPI triads, and the 18 with lowest scores were called competitive MMPI triads. Within each of these two groupings, half of the triads received competitive instructions and half received cooperative instructions.[1] This meant that there were:

a. Nine triads competitive in both instructions and MMPI.

b. Nine triads cooperative in both instructions and MMPI.

c. Nine triads competitive in instructions, cooperative in MMPI.

d. Nine triads cooperative in instructions, competitive in MMPI.

Within triads, Ss were further distinguished by being randomly labeled A, B and C.

Hypotheses 1-a and 1-b. These hypotheses stated that:

1-a. In early games, competitively-oriented players will form the opening coalition with the stronger opponent more often than with the weaker. In later games, they will form the opening coalition more often with the weaker. Over the series of games, they will show a trend indicating increased tendency to coalesce with the weaker opponent.

1-b. Cooperatively-oriented players will not display such a trend, but in all games will form the opening coalition more often with the weaker than with the stronger.

To test these hypotheses, the two-by-two separation of 36 triads into four groups (by using both ways of operationalizing the competitive-cooperative distinction) was expanded into a two-by-two-by-five analysis-of-variance design. The additional variable was that of number of groups

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[1] This even division occurred by chance, since E was not able to administer the MMPI scales before the day of the experiment and did not think it advisable to administer them immediately prior to playing the game.

of games played; this variable took five values, since there were five groups of games (each group consisting of six games). The hypotheses indicated that the "games" variable should be analyzed by regression rather than by the usual analysis-of-variance test for differences.

The data were mean strengths of opening coalitions made in each game. These data were compiled for each of 30 games for each of 36 triads, with one response recorded for each game. In each game, the opening coalition was either the 4-3, 4-2, or 3-2 coalition. There was a coalition in every game. Occurrence of the 4-3 coalition indicated that Ss preferred to coalesce with the stronger opponent. Strength of this coalition was 7. The 3-2 coalition indicated that Ss preferred their weaker opponents; its strength was 5. The 4-2 coalition represented no clear choice by Ss between weaker and stronger opponents; the strength was 6.

The mean for each set of games under each combination of instructions and MMPI category was compiled from 9 scores representing the means of each triad for the six games within the set. For example, in the first set of six games a triad might form the 4-3 opening coalition three times, the 4-2 coalition twice, and the 3-2 coalition once. This would produce strengths of 7, 7, 7, 6, 6 and 5, which gives a mean of 6.33 for that triad in that set of six games. This figure was combined with a similar figure for eight other triads having the same combination of instructions and MMPI, to obtain the mean for that set of nine triads for the given group of games.

If coalitions were chosen by chance, we would expect an equal number of each kind and thus a mean strength of 6. If coalitions were chosen according to preference for strong or weak opponent, we would expect a

mean strength higher or lower than 6. Thus Hypotheses 1-a and 1-b might be re-stated as follows:

1-a. For competitively-oriented groups, in the first group of games the mean strength of the opening coalition will be greater than 6. In later groups of games it will be smaller than 6. Over the series of five groups of games there will be a trend toward decreasing strength.

1-b. For cooperatively-oriented players there will be no such trend; in all groups of games the mean strength of the opening coalition will be smaller than 6.

The hypotheses suggest the use of a 3-factor analysis (games, instructions, MMPI) patterned after Lindquist's (14) Type III design. One factor (games) involves repeated measurements on the same triads, while the other factors involve use of separate sets of triads. Nine triads were used for each of the four combinations of the instructions and MMPI factors. Each of the 36 triads was observed five times---that is, in five successive sets of games.

The 3-factor design permitted a number of statistical tests, including some not called for by the hypotheses. All tests were conducted; however, not all data and tests are reported in detail in the presentation of results (Chapter III) because of the lack of relevance. Appendix I reports all data and the results of all tests.

In particular, the hypotheses do not directly require examination of the two groups which were "competitive" in one way but "cooperative" in another. These two groups are eliminated in the detailed analyses, and the experimental design thus reduces to two variables, competitive-cooperative orientation (i.e., nine triads competitive in both ways and nine

triads cooperative in both ways) and number of games played. This design is patterned after Lindquist's Type I design, in which the games factor involves repeated measurements on the same triads while the orientation factor requires use of separate sets of triads.

The hypotheses, taken together, suggest interaction between games and orientation. This interaction is expected to result from the fact that competitive players show significant regression across the games factor, while cooperative players do not. Confirmation of the interaction thus would lead to analyses of simple effects of games to test for existence or absence of regression in competitive and cooperative groups. In addition, the hypotheses stated that among the ten (two-by-five) experimental cells, some cell means should be higher than the null value of 6, some should be lower, and some should not differ. Ten t tests were performed to test the obtained differences. For competitive players, the mean was expected to be higher for the first group of games and lower for the last group. For the three middle groups of games the hypothesis could be considered confirmed by any means which tended to support the hypothesized trend from high to low. For cooperative players, the means for all groups of games were expected to be lower than 6.

In the analysis-of-variance, the games factor was examined by tests for linear regression rather than by the usual tests for differences among the five means. This involved partitioning the sum of squares for games into two parts: a linear regression portion, which reflected the variance accounted for by comparing the five linear regression estimates with the overall mean, and a departure-from-linear-regression portion, which reflected the variance accounted for by comparing the five means

with the five regression estimates. Similar partitioning was done for all interaction sum of squares which involved the games factor. Finally, the error(w) sum of squares was partitioned in the same way. The error(w-regression) sum of squares represented variance of each triad's linear regression estimates from the overall mean, and the error(w-departure) sum of squares represented variance of each triad's five means from its five regression estimates. For each test involving games, the regression mean squares were tested against the error(w-regression) mean square and the departure mean squares were tested against the error(w-departure) mean square.

Basis for this adaptation of the Lindquist Type I and III designs was an article on trend analysis by Alexander (1). This material has been expanded and its handling made easier by Grant (10) and Edwards (7). According to the latter two discussions, the "games" factor could be partitioned into quadratic as well as linear components, and further into components representing regression founded on third- and higher-order polynomials. In doing so, Grant and Edwards expanded the test of Alexander, which merely involves separating the portion of variance representing linear regression from the portion representing a departure from linear regression. We have chosen to stop where Alexander stopped, since there seems to be no value in extending the analysis further.

The predictor variable in the regression analysis was the mean number of games played for each of the five sets of six games. In the first set, the predictor would be 3.5, since this is the mean of the numbers 1, 2, 3, 4, 5 and 6. The five values of the games variable in all of the regression analyses conducted were 3.5, 9.5, 15.5, 21.5, and 27.5, with

a mean of 15.5.

Hypothesis 2. The hypothesis stated that:

After the opening coalition is formed, the most likely subsequent event is the formation of a coalition between the weaker member of the opening coalition and the player not included in the opening coalition.

The data were the events occurring after formation of the opening coalition. Possible events were (1) formation of the hypothesized coalition; (2) formation of the third possible coalition; (3) occurrence of no coalition for one or more moves; (4) no subsequent event. These data were collected for each of 30 games for each of 36 triads, with one response recorded for each game. There was no game in the entire study in which an opening coalition was not formed.

Under the null hypothesis, each of the four events should have occurred in an equal number of games. Analysis of the data was hampered by the fact that responses for any triad were likely to fall into two or more of the four categories, thus producing a problem of response independence. The solution was to handle each category separately, comparing the obtained frequency of each event with the expected frequency. Thus the results of four separate analyses were examined---but they could not be statistically compared.

Each of the four possible events should have happened by chance 7.5 times for each triad, since one occurred in each of a triad's 30 games. Thus the mean of the frequencies for each event across 36 triads was obtained and a t test performed to examine whether the mean was significantly different from 7.5. A separate t test was done to test the mean frequency of each possible event against the expected frequency.

The hypothesis could be considered confirmed if the test for the hypothesized coalition showed that its mean frequency was higher than 7.5, and if the tests for the other three events did not show that their mean frequencies were higher than 7.5. If other results occurred, the hypothesis could not be considered confirmed. If the hypothesized coalition and also one or more other events showed greater-than-chance frequency, there would be no way to determine whether the hypothesized coalition was significantly more frequent than the other.

Hypothesis 3. The hypothesis stated that:

After a second coalition is formed, the most likely subsequent event is formation of the only coalition not yet formed.

The analysis was identical to that for Hypothesis 2.

Hypothesis 4. The hypothesis stated that:

Winnings will be highest for the 4 under a competitive rather than cooperative orientation, not different for the 3 under these orientations, and higher for the 2 under the cooperative.

Data were the scores made by players under the various combinations of power, instructions, and MMPI. As was done for Hypotheses 1-a and 1-b, competitive and cooperative orientations were defined in two ways. The hypothesis implies interaction between power and orientation, which means interaction between power and instructions and also between power and MMPI. Also hypothesized were particular simple effects of orientation (that is, of instructions and of MMPI) at various levels of power.

The 3-factor design (power, instructions, MMPI) is a Type III design with power being the repeated factor. Use of the design involves a problem of independence among observations. The responses of the three

triad members were not independent because their winnings in any game always totalled 100 points. Accordingly, it was necessary to analyze the data for all players who were randomly labeled A (one in each triad), and then to repeat the analysis separately for players B and C. Analyses, in other words, were carried out three times instead of once. There was no theoretical basis whatever to expect differences between A, B and C, yet random variations were expected to occur. Consequently we were faced with three different statistical tests of the hypothesis. When conclusions varied, there was no recourse to statistical methods to resolve the variation.

Hypothesis 5. The hypothesis stated that:

Winnings will be highest for players coalescing with the weakest opponent in the opening coalition, next highest for players coalescing with the strongest opponent, and lowest for players left out.

The data were the scores made by players under various conditions. The relevant independent variable was that of relationship to the opening coalition, but since a player might be holding different powers, the power factor was included in the analysis as a control variable. Also included was the "subjects" variable; this reduced experimental error because mean winnings varied from S to S. The instructions and MMPI factors might have been included as additional control variables, but were not used because they produced virtually no differences in the obtained data.

Testing Hypothesis 5 called for a 3-factor analysis-of-variance design (power, relationship to opening coalition, subjects). As for Hypothesis 4, it was again necessary to perform separate analyses for

players labeled A, B and C, in order to solve the problem of response independence.

Another problem concerned differences in patterns of response. Ss played 30 games under nine (three-by-three) combinations of conditions, and the number of times each S responded under each condition varied. Some Ss, for example, coalesced more often with the weaker than with the stronger; others exhibited other patterns. Thus the proportion of responses from cell to cell, row to row, and column to column varied for each S. To eliminate this, we have recorded only one response for each S for each cell, that being his mean winnings for the given combination of conditions.

Another problem, of course, was that under certain combinations of conditions there might be no response by a given S. This was possible because the relationship to opening coalition could not be controlled by E. An S might, for example, have been left out of the opening coalition only three times in 30 games and have held the power of 2 in none of these cases. Because of this, the appropriateness of the 3-factor design was curtailed by the necessary exclusion of many Ss. The solution was to supplement the 3-factor design with 2-factor analysis-of-variance tests which permitted maximum use of Ss. The need for this is explained as follows.

In Figure 2, one layer of the 3-factor design is shown; it involves nine cells which represent the responses of one S. The X's stand for cells in which a certain S has responded; we see that he has responded under every combination of conditions but one. The failure to respond in all nine cells means that the S must be discarded from the 3-factor

FIGURE 2.--One layer of the 3-factor design used for testing Hypothesis 5

	Power of 4	Power of 3	Power of 2
Coalesced with weakest opponent	X	X	X
Coalesced with strongest opponent	X	X	X
Left out of opening coalition	X	X	

analysis. However, the S could be included in an analysis-of-variance design which tested the hypothesis without using the power factor as a control variable. So we might decide first to test the hypothesis without using the power variable, thus using a maximum number of Ss. After doing this, we might use the reduced number of available Ss in the 3-factor design to test for interaction between power and relationship to opening coalition.

If interaction were confirmed, we would then want to test for simple effects of relationship to opening coalition at the various levels of power. For the simple effects tests, we see that our S in Figure 2 may again be of some use. We may include him in the tests for simple effects at the 4 level and the 3 level, though we cannot use him at the 2 level.

To sum up, the mythical S of Figure 2, who is typical of many Ss in this study, may be used to test the hypothesis across all levels of power combined, or across two of the three levels taken separately. But he cannot be used in the test of interaction. If there were only a few Ss who did not respond in certain cells, we might have followed the method

of filling in each empty cell with the mean of the available observations. The number of missing cases, though, seemed too large to justify this method. Alternately, we might have discarded such Ss entirely. If this were done, the number of Ss withdrawn from legitimate inclusion in certain tests would have been too large to make such a solution attractive. Consequently, we carried out the lengthier task of doing each test with all available Ss. The test of the hypothesis, done separately for players A, B and C, involved first the two-factor analysis (using Ss as a control variable) of mean winnings under various relationships to the opening coalition. Next it involved the 3-factor analysis to test for interaction. Finally, it would have included the tests for simple effects, if interaction had been found; actually, as the analyses turned out, no tests of simple effects were required.

The 3-factor test was not used to test for differences already examined by the 2-factor test using more Ss. Nor was the 3-factor test used to test for main effects of power. There was no basis for theoretical expectations concerning power, because winnings which accrued to players holding certain powers depended more on which coalitions were formed than on power differences (see Hypothesis 6).

Hypothesis 6. This hypothesis stated that:

When coalition formation is held constant, winnings will be highest for players with the strongest power.

In the tests of the other hypotheses it appeared meaningless to test for main effects of power because the relationship to opening coalition would be an interfering variable. For example, there was no reason to expect that 4 would always make more points than 3 or 2 when it was

possible that the 3-2 coalition might dominate the game. But if coalition formation is held constant, then the power factor can be assessed. In the 4-3 coalition both members are coalescing with the stronger opponent, and so the opening coalition factor is held constant for these players. In the 3-2 coalition the situation is similar because both have coalesced with the weaker player. No other pairs of players ever played while having the same relationship to the opening coalition. Consequently, the power hypothesis could be examined only in a limited way.

Data were the scores made by the 3 and 2 under the 3-2 opening coalition, and by the 4 and 3 under the 4-3 coalition. The design is called "treatments by subjects" by Lindquist (14), with the subjects variable used to reduce the variance attributed to error. With one observation in each cell, the interaction sum of squares is interpreted as the error sum of squares. Two separate analyses were required, one for the 4-3 coalition, one for the 3-2 coalition. Each was divided, in turn, into analyses for players A, B and C.

Type 1 games. Of the four triads which played the Type 1 game, two were given competitive instructions and two given cooperative instructions. MMPI scales were not administered. The data obtained were similar to those described for Type 5 games, but no attempt to analyze them formally nor to test the applicable hypotheses was intended. The only purpose was to observe whether or not there seemed to be a tendency among players of equal power for coalitions to break up rather than to be retained throughout a game.

SAMPLE

One hundred twenty male Ss were grouped into 40 triads. They were

selected from several classes meeting at Michigan State University during the summer, 1963. Triads were arranged to include only Ss who reported that they did not previously know the other two members. Otherwise, assignment to triads was made randomly.

PROCEDURES

Ss were seated at a table on which was placed the game board. E designated them by a random choice method as A, B and C. The experiment opened with the presentation of the game instructions, issued on paper and also read to them aloud by E, with accompanying demonstration of game features. The triads chosen to receive "competitive" instructions were given the following:

> We have asked you to come here to participate in a game called "Coalitions." Our purpose is to examine the way in which the game is played. Your purpose is to see how well you can play the game. We hope you will play the best you can against your two opponents, winning as much as you can and keeping your opponents from winning. This is a game of stiff competition.
>
> In the game each player begins with his counter at "Start." Each counter has a certain value or weight, such as 2 or 3. Before each game, players are assigned counters which they are to use in that game. Each player will have each counter in an equal number of games. On each move of the game, the instructor will throw the die and each player will advance his counter a number of spaces determined by multiplying the number on the die times his counter's value. The purpose of the game is to advance faster than the other players and reach the finish line (90th space) first.
>
> If there were nothing more to the game than this, each player's ability to win would be determined entirely by his counter's value, and the outcome would be obvious. However, there is an additional rule which says that any two players may form a coalition and operate as a team. If you form a coalition your counters both move according to the sum of your two values. For example, if one counter has a value of 6, and another a value of 5, then if the players holding these counters form a coalition, both counters will move a number of spaces found by multiplying the number on the die times eleven (six plus five). If one of the coalition's counters is ahead of the other, then the coalition crosses the goal on the play when the farthest advanced counter crosses; it is not necessary for the other one to reach the goal also. These are the advantages of

having a coalition.

A coalition has a disadvantage, too. If your coalition reaches the goal line, then you have to share the prize with your partner in the coalition. The two of you are required when you form the coalition to make an agreement about how you will split the prize. In each game a prize of 100 points goes to the individual or coalition which reaches the goal first. If you are playing alone and reach the goal first, you get the entire 100 points. If you are in a coalition and one or both of your counters reaches the goal first, then the coalition gets 100 points and the members each take the share agreed on.

If you play separately, without coalitions, and two players reach the goal on the same move, then each gets 50 points. If a coalition and the single player reach the goal on the same play, then the single player gets 50 points for himself and the coalition members get 50 points to divide. If all three of you, playing separately, reach goal on the same play, each wins 33 1/3 points.

Coalitions may be formed before any move and broken after any move. They are formed only when both players want to form them, and broken whenever one or both members want to break them. Coalition formation is handled according to the following rules.

Each player is designated A or B or C throughout the game. Each man holds 4 cards; for A the cards say "B," "C," "Both," and "Neither." Before the first move of a game, each player plays face down the card which indicates with whom he would like to form a coalition: one or the other of his opponents, both (i.e., either), or neither. You may make any of these choices, but you must make one of them. When all cards are played they are turned face up. If no reciprocal choices are made, then the first move of the game is played with no coalition. If one reciprocal choice turns up, the two players involved must negotiate the way they will split the 100 points if their coalition remains in force throughout the game. That is, they must try to decide how many of the 100 points will go to each player if they win (or how many of the 50 points if they tie). If they reach agreement the coalition is in effect and on the next move the two players each use a value obtained by summing their separate values. If they do not reach agreement, then the possibility of forming any coalitions on that move is voided. Negotiations are always conducted between two players only; the third man is not permitted to participate in any way.

If two reciprocal choices are made when the cards are played, the player involved with both must choose the one he prefers. The player then negotiates with his coalition choice. If an agreement is made, the coalition is in effect; if not, there is no further possibility for coalitions on that move.

If three reciprocal choices are made, players must play their cards again with instructions to choose only the one man with whom they

think it best to negotiate a coalition. If reciprocal choices then occur, the two players enter negotiation. If no reciprocal choices occur, the cards are re-played. If the cards turn up no reciprocal choices after 3 plays, the possibility of forming coalitions on that move is voided.

On subsequent moves, the following rules are used. If no coalition was in force during the previous move, players follow the procedures used for the opening move. If a coalition was in force during the previous move, the two members must state whether they will "stay in" the coalition, "renegotiate," or "break." If both choose to stay, the next move is made with the coalition still in force. If renegotiation is required, discussion follows and results either in a new agreement and retention of the coalition or in a break. If one or both members choose to break, or if renegotiation results in a break, then the coalition is dissolved and the procedures used on the opening move are used again.

These procedures are repeated before every move of the game. Don't worry about trying to learn them before the game starts. You may refer to this sheet at any time, or ask for help at any time. The instructor will keep you reminded of the rules which apply to the situation at hand.

You will play a series of 30 games in all, and your scores will be recorded for each game. First, second, and third place will be determined by the total score for the 30 games. The winner will receive a prize of $1.40, the second-place finisher will receive 70 cents, with 40 cents for third place.

SOME HINTS ON PLAYING COALITIONS

Keep in mind that your purpose in the game is to win as many points as you can in each game. Keep yourself oriented to this purpose, and don't get involved in agreements which give you fewer points than you think you can get. Use coalitions to improve your chances against your opponents.

In each game, each player has a different power value. This affects his chances of winning, but don't worry about this because all players will have each power value in an equal number of games. When your power or position gives you an advantage, try to make full use of it. When it does not, try to keep the other players from making use of it.

In some games you will find yourself in situations in which you cannot expect to win as many points as you'd like. This will happen to every player on occasion. In these cases, you will still be playing well if you are able to win as many points as possible under these conditions. Correct play in these games will help a lot in compiling a high point total.

The "cooperation" Ss were given instructions which differed in two places. The first paragraph was altered to read:

> We have asked you to come here to participate in a game called "Coalitions." Our purpose is to examine the way in which the game is played. Your purpose is to see how well your group can play the game. We hope that the three of you will play skillfully and fairly together, always making the plays which are of most benefit to the most players. This is a game which requires considerable cooperation and fair play among players.

In the second change, the material labeled "Some Hints on Playing Coalitions" was altered to read as follows for "cooperative" Ss:

> Keep in mind that the basic method in playing "Coalitions" consists of successful cooperation with the other players. Keep yourself oriented to this problem, and don't get involved in agreements which do not give the greatest possible benefit to both players. Use coalitions to achieve the best cooperation with other players.
>
> In each game, each player has a different power value. This affects his chances of winning, and so you will want to remember that the players are not equally matched. Often you will hold a position which the other players could not possibly have prevented you from achieving. When you hold such an advantage, remember that the other person is weaker and deserves fair treatment. When the game puts you at a disadvantage, play the best you can and keep your eyes open for skillful moves.
>
> In some games you will find yourself in situations in which you cannot expect to be very successful. This will happen to every player on occasion, and it is perfectly understandable because of the playing conditions. In these cases you will still be playing well if you are able to cooperate skillfully with other players. Correct play in these games will help a lot in subsequent games.

E interrupted his reading of the instructions to point out the tokens and cards, and to illustrate how cards were to be played and pieces moved. When the instructions were read in full, E asked if the procedures were understood. In some triads, questions were asked; almost all were answered by citing relevant portions of the instructions.

E then assigned tokens for the first game and called for cards to be played for the first move. The 30 games were played without pause in a

period of time ranging between 80 and 100 minutes. E recorded all choices, decisions, die throws, moves, and results in such a way that each game might later be fully reconstructed. As play progressed, Ss were not permitted to refer to scores made in previous games. This was done to keep them oriented toward scoring as much as possible in each game rather than playing conservatively when in the lead. Scores were revealed at the end of the experiment and Ss given their winnings.

After receiving prizes, Ss responded to the 60 Mf scales of the MMPI and answered some questions posed by E. The MMPI scales were presented on typed sheets in the same order in which they appear in the MMPI test booklet, but apart from the other MMPI test items.

These questions were posed to each S privately by E:

1. Did you use any particular strategy or method of play? If so, was it the same through the 30 games? Or did it change? How?

2. Did you make your plays on a strict competitive or strict cooperative basis? Neither? Some of each?

3. Did your opponents play in different ways? Were they different kinds of players?
   a. If so, were your responses toward them made according to these differences?
   b. Did you prefer to form coalitions with one opponent more than with the other?
   c. Did you want one of them to come out ahead of the other?

4. Did you think you had a good idea about the cumulative score? If so, did this affect the way you played? How?

5. Were you interested as you played? For what reasons?

Following the question sessions, E concluded the meeting by thanking Ss for participating, and by giving a brief explanation of the purposes of the experiment.

CHAPTER III

This chapter reports data and analyses; it includes sections on the masculinity-femininity data, the data and analyses pertaining to each hypothesis, the data collected from the examination of Type 1 games, and the answers given to E's questions posed to Ss playing the Type 5 games.

Masculinity-femininity. The 60-item Mf scale from the MMPI was administered to 108 Ss in the 36 triads playing the Type 5 game. Scores ranged from 13 to 34, with a mean of 25.76 and standard deviation of 4.325. A high score indicated high feminine interests, which implied a greater tendency to behave cooperatively rather than competitively. The established norm reported by Hathaway & McKinley (11) for the Mf scale is 30.5.

For players A, B and C (36 Ss each), the means should not have differed except by chance. Table 1 (a) presents the means along with an analysis-of-variance test showing that they did not differ significantly. When the scores were summed within triads, the results ranged from 64 to 92, with a mean of 77.28 and standard deviation of 6.601. For triads receiving competitive and cooperative instructions the respective means should have only chance variation. Table 1 (b) reports the means, and presents the test showing no evidence of variation.

Hypotheses 1-a and 1-b. The hypotheses stated that:

1-a. For competitively-oriented players, in the first group of games the mean strength of the opening coalition will be greater than 6. In later groups of games it will be smaller than 6. Over the series of

TABLE 1.--Masculinity-femininity across experimental cells

(a) Test of differences in mean masculinity-femininity scores for Players A, B, and C

Mean for Player A	Mean for Player B	Mean for Player C	Mean for All Players
24.67	26.89	25.72	25.76

Source	S.S.	df	M.S.	F	$F_{.95}$
Between	88.9629	2	44.4814	2.44	3.09
Within	1912.7779	105	18.2169		
Total	2001.7408	107			

(b) Test of differences in mean masculinity-femininity scores across triads given competitive and cooperative instructions

Mean for Competitive Triads	Mean for Cooperative Triads	Mean for All Triads
77.22	77.33	77.28

Source	S.S.	df	M.S.	F	$F_{.95}$
Between	.1088	1	.1088	.002	4.13
Within	1525.1112	34	44.8562		
Total	1525.2200	35			

five groups of games there will be a trend toward decreasing strength.

1-b. For cooperatively-oriented players there will be no such trend; in all groups of games the mean strength of the opening coalition will be smaller than 6.

The data came from 36 triads arranged into a 3-factor analysis-of-variance design (games, instructions, MMPI) which permitted numerous statistical tests. Since all tests did not pertain directly to the hypotheses, the entire set of data and tests is not presented here. Appendix 1, however, reports all data and all significant differences. The Appendix is included for completeness, but adds no findings of great consequence to the results reported in this chapter.

Two groups of nine triads apiece were examined, those which were competitive according to both ways of defining the term, and those which were cooperative in both ways. Table 2 reports means for these two groups for each of the five groups of games and for the entire experiment. Figure 3 presents a graph showing the change in means across groups of games.

The hypotheses suggest that the analysis should reveal an interaction between games and orientation, since a downward trend is expected for one orientation (competitive) and not for the other. The Type I analysis shown in Table 2 confirms this interaction, and makes irrelevant the tests of main effects of games and orientation. The hypotheses suggest that interaction stems from differences in simple effects of games for the two types of orientation. Accordingly, Table 3 reports an analysis of simple effects of games for competitive triads only. A "treatments by subjects" design is used, with the treatment sum of squares and interaction (error) sum of squares partitioned for regression analysis. The test shows that neither non-linear nor linear regression was present to a significant degree; the regression co-efficient was -.0031.

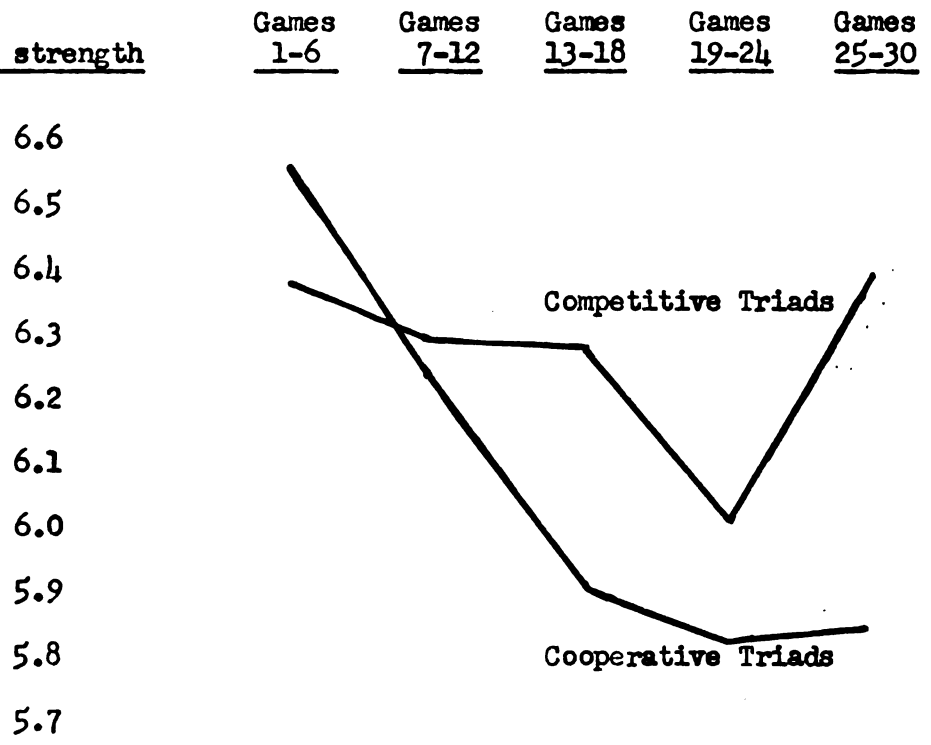
Table 4 reports a similar analysis of simple effects of games for

TABLE 2.--Analysis of mean strengths of opening coalitions for competitive and cooperative triads across groups of games

	Games 1-6	Games 7-12	Games 13-18	Games 19-24	Games 25-30	All Games
Competitive Triads	6.3703	6.2963	6.2778	6.0370	6.4074	6.2778
Cooperative Triads	6.5556	6.2408	5.9259	5.8148	5.8519	6.0778
All Triads	6.4629	6.2685	6.1018	5.9259	6.1296	6.1778

Source	S.S.	df	M.S.	F	$F_{.95}$	$F_{.995}$	$F_{.999}$
Between Ss	9.0787	17					
Orientation (O)	.9000	1	.9000	1.76	4.49		
error (b)	8.1787	16	.5112				
Within Ss	12.8021	72					
Games (G)	2.8991	4					
Regression	1.8398	1	1.8398	52.72			16.12
Departure	1.0593	3	.3531	4.13	2.80	4.85	
G x O	5.2360	4					
Regression	3.9649	1	3.9649	113.61			16.12
Departure	1.2711	3	.4237	4.95		4.85	6.30
Error	4.6670	64					
Regression	.5582	16	.0349				
Departure	4.1088	48	.0856				
Total	21.8808	89					

FIGURE 3.--Mean strength of opening coalition for competitive and cooperative triads across groups of games



cooperative triads. The test shows significant linear regression; the co-efficient of -.0306 shows that the regression was downward from the first group of games to the last.

The tests for simple effects of games do not support the hypotheses, though they disclose findings which are of hypothetical importance. The hypotheses suggested that competitive triads would show a decreasing trend, and cooperative ones would not. Instead, the reverse was true: a significant downward trend appeared for cooperative triads but not for competitive. Thus a difference, though not the hypothesized one, was evident between cooperation and competition.

Additional description of this difference is available through the

TABLE 3.--Analysis of mean strength of opening coalitions for competitive triads across groups of games

Source	S.S.	df	M.S.	F	$F_{.95}$
Between Ss	4.3556	8			
Games	.7538	4			
Regression	.0314	1	.0314	.34	5.32
Departure	.7224	3	.2408	1.65	3.01
Interaction (error)	4.2239	32			
Regression	.7302	8	.0916		
Departure	3.4937	24	.1456		
Total	9.3333	44			

TABLE 4.--Analysis of mean strength of opening coalitions for cooperative triads across groups of games

Source	S.S.	df	M.S.	F	$F_{.95}$	$F_{.99}$	$F_{.995}$
Between Ss	3.8231	8					
Games	3.8247	4					
Regression	3.0338	1	3.0338	13.74		11.26	14.69
Departure	.7909	3	.2636	2.83	3.01		
Interaction (error)	3.9997	32					
Regression	1.7661	8	.2208				
Departure	2.3336	24	.0931				
Total	11.6475	44					

tests of the other expectations included in the hypothesis. Hypothesis 1-a says that the expected downward trend of mean strength will occur because mean strength is greater than 6 for the first group of games, and smaller than 6 later. Hypothesis 1-b says that no downward trend for cooperative groups will occur because mean strength will always be less than 6. In Table 5 are reported the *t* tests used to test for significant differences between each obtained mean and the null value of 6. These results show that competitive triads preferred stronger-than-average coalitions at first, as expected, but that they continued this preference through all sets of games (with one exception: games 19-24). They also showed this preference in the overall mean for the 30 games.

Cooperative triads also preferred strong opening coalitions in the first set of games, the opposite of the expected result, but changed in subsequent games to prefer mean strengths which trended downward and were never again significantly different from 6. Their overall mean for the 30 games did not differ significantly from 6.

Indirectly, the hypotheses referred to the simple effects of orientation for different groups of games. The expectation was that competitive triads would show a higher mean strength than cooperative in the first group of games, since both groups were expected to be significantly different from 6, but in opposite directions. In later groups of games, mean strength for both groups was expected to be lower than 6. For those games, the hypotheses do not necessarily imply that no differences will occur between competitive and cooperative; the only expectation is that mean strength will be less than 6 for both.

TABLE 5.--Comparison of mean strengths of opening coalitions with the null value of 6 under varied experimental conditions

Games	Mean Strength	Error Term	t	$t_{.975}$ (32 df)	$t_{.99}$ (32 df)	$t_{.995}$ (32 df)	$t_{.999}$ (32 df)
	C O M P E T I T I V E		T R I A D S				
1-6	6.3703	.12110	3.06	2.04	2.46	2.75	3.65
7-12	6.2963		2.45				
13-18	6.2778		2.29				
19-24	6.0370		.31				
25-30	6.4074		3.36				
ALL	6.2778		2.29				
	C O O P E R A T I V E		T R I A D S				
1-6	6.5556	.11785	4.71				
7-12	6.2408		2.04				
13-18	5.9259		- .63				
19-24	5.8148		-1.57				
25-30	5.8519		-1.26				
ALL	6.0778		.66				

Table 6 reports the tests of simple effects of orientation; these consist, for the non-repeated factor in Type I designs, of individual t tests. There are t tests of differences in competitive and cooperative means for each group of games and for all 30 games. Significant differences were found only for the middle (13-18) and final (25-30) groups of games. This tends to confirm the reverse of what was expected; orientation did not make a difference at first, but did so later.

TABLE 6.--Analysis of differences between competitive and cooperative triads in mean strength of opening coalitions

Games	Mean Strength (Competitive minus Cooperative)	Error Term	t	$t_{.975}$ (16 df)	$t_{.99}$ (16 df)	$t_{.9995}$ (16 df)
1-6	-.1853	.12760	-1.45	2.12	2.58	4.02
7-12	.0555		.44			
13-18	.3519		2.76			
19-24	.2222		1.74			
25-30	.5555		4.37			
ALL	.2000		1.57			

In summary, the two groups of triads did differ in their preferences for coalition partners, as the hypotheses implied, although not in the expected way. Instead of the two groups beginning differently and finishing similarly, they began similar and finished differently. The competitive triads began as expected, but failed to change. The cooperative triads began in variance to expectations, but changed so as to tend toward the expected behavior.

To reduce complexity in the analyses of Hypotheses 1-a and 1-b, E separated triads into only two groups by MMPI score, yet actually this variable produced a variety of scores (summed for triads) ranging from 64 to 92. Accordingly, some additional evidence is available concerning relationship of MMPI score to the hypotheses. Correlations were obtained to compare each triad's MMPI score with the mean strength of its opening coalitions. The correlations were -.742 for the 18 triads given

competitive instructions, and -.440 for the 18 cooperative instructions triads. The first correlation was significant beyond the .0005 level and the other beyond .05. The negative correlation means that the greater the tendency to cooperativeness, the greater the tendency to form coalitions with the weaker opponent. This is in keeping with the evidence presented above.

Hypothesis 2. The hypothesis stated that:

After the opening coalition is formed, the most likely subsequent event is the formation of a coalition between the weaker member of the opening coalition and the player not included in the opening coalition.

Table 7 reports the mean frequency of occurrence of the hypothesized event and the three other events. The table also states the expected mean frequencies, the differences between expected and obtained means, and the values of t obtained in the tests of these differences.

To confirm the hypothesis, the analysis would first have to show that the hypothesized event occurred with greater than chance frequency. This was not shown; the obtained figure was less than the expected figure, to a degree almost reaching significance. The required level of significance was .05, and the test was two-tailed.

Reasons for this result may be explored by looking at the results for the other events. We see that mean occurrence of the not-expected coalition was significantly lower than chance; thus a preference for this event was not responsible for disconfirmation of the hypothesis. The same is true for the event of playing without a coalition. The fourth possibility, that of playing out the game without breaking or replacing the opening coalition, shows a different result. This possibility

TABLE 7.--Analysis for Hypothesis 2

Event	Obtained Mean	Expected Mean	Difference (Obtained minus Expected)	t
Hypothesized Coalition	6.278	7.500	-1.222	-1.95
Other Coalition	3.667	7.500	-3.833	-7.02
No Coalition	3.222	7.500	-4.278	-9.76
No Event	16.833	7.500	9.333	7.35
Hypothesized Coalition	6.278	4.389	1.889	3.01
Other Coalition	3.667	4.389	- .722	-1.15
No Coalition	3.222	4.389	-1.167	-1.87

$t_{.975}$ (35 df)	$t_{.995}$ (35 df)	$t_{.9995}$ (35 df)
2.03	2.72	3.60

occurred with far greater than chance frequency. It was the preference for this which led to disconfirmation of the hypothesis.

Although the hypothesis stands rejected, we might pursue further knowledge of theoretical importance, on an ad hoc basis, by examining the relative frequency of events in cases where some subsequent event occurred after the formation of the opening coalition. Since no event occurred in an average of 16.833 games out of 30, one or another of the remaining possibilities thus occurred in 13.167 games, on the average. By chance, then, each of these events would have occurred one-third of the

time, and thus be expected to occur by chance in 4.389 games apiece. Consequently, the obtained means were tested once more, against the expected value of 4.389, and the results of these tests are included in the lower portion of Table 7. This time the hypothesized coalition occurred more often than expected. The mean occurrence of the other two events did not differ from chance.

In summary, the hypothesized coalition was not preferred to a significant degree among all options available to players. But when the opening coalition was broken and followed by some subsequent event, the hypothesized coalition occurred with greater than chance frequency and the other events did not.

Hypothesis 3. The hypothesis stated that:

After a second coalition is formed, the most likely subsequent event is the formation of the only coalition not yet formed.

In order to obtain data relevant to this hypothesis, it was necessary for players to play a large number of games in which they formed an opening coalition, broke it, and formed a second coalition. We expected this to occur in a large majority of games; however, as the data for Hypothesis 2 show, a second coalition failed to appear in 20.055 games out of 30 for the average triad.

When third coalitions occurred in a game, we expected that this happened as the extension of a process which earlier produced a second coalition. Because of this, we feel that the games which did not provide data for testing Hypothesis 3 thereby tended to negate Hypothesis 3. Since there were many of these games, we consider Hypothesis 3 to stand rejected.

We have, however, done an analysis of the available data and included it in the study as Appendix 2. In brief, the results were similar to those for Hypothesis 2: it was most often the case that the second coalition failed to be broken. But among cases where some subsequent event followed, the hypothesized event had greater than chance frequency and the other events did not.

Hypothesis 4. The hypothesis stated that:

Winnings will be highest for the 4 under a competitive rather than cooperative orientation, not different for the 3 under these orientations, and higher for the 2 under the cooperative rather than competitive.

Data were mean responses for each S for each of the three power values. Each S responded ten times for each value. With nine triads (27 Ss) performing under each of the four combinations of instructions and MMPI, the data consisted of a total of 324 observations. It was necessary to separate the observations of players A, B and C, however, and perform three separate analyses which involved 108 observations each.

Table 8 reports mean responses for each combination of power, instructions, and MMPI for all players, and also for players A, B and C separately. The reported means for A, B and C are assumed not to vary from the means for "All" except by chance.

Table 9 reports the three analyses for players A, B and C. According to the hypothesis, significant interaction should be found between power and instructions and between power and MMPI. This cannot be confirmed, and the hypothesis is rejected.

Table 9 does not show tests for interaction between instructions and MMPI or for main effects of these factors. This is because such effects

TABLE 8.--Data pertaining to the tests of Hypothesis 4

			P O W E R			
INSTRUCTIONS	MMPI	PLAYERS	4	3	2	TOTAL
Competitive	Competitive	ALL	42.94	35.30	21.78	33.33
		A	42.94	35.02	19.83	32.60
		B	43.47	33.78	22.58	33.54
		C	42.31	36.19	23.00	33.87
	Cooperative	ALL	36.94	35.34	27.72	33.33
		A	38.82	37.27	28.78	34.96
		B	33.21	33.53	24.90	30.55
		C	38.80	35.23	29.47	34.50
	Sub-Total	ALL	39.94	35.32	24.75	33.33
		A	40.88	36.14	24.31	33.78
		B	38.34	33.65	23.74	32.04
		C	40.55	35.77	26.23	34.19
Cooperative	Competitive	ALL	35.48	35.66	28.86	33.33
		A	38.58	39.06	30.03	35.89
		B	30.86	32.67	26.97	30.20
		C	36.42	35.50	29.81	33.91
	Cooperative	ALL	41.26	33.52	25.22	33.33
		A	41.46	31.17	26.49	33.04
		B	42.02	33.27	27.66	34.31
		C	40.03	35.83	21.20	32.36
	Sub-Total	ALL	38.37	34.59	27.04	33.33
		A	40.02	35.11	28.26	34.46
		B	36.45	32.97	27.32	32.26
		C	38.23	35.67	25.50	33.13
	TOTAL	ALL	39.15	34.96	25.89	33.33
		A	40.45	35.63	26.28	34.12
		B	37.42	33.51	25.53	32.15
		C	39.39	35.72	25.87	33.66

MMPI	PLAYERS	4	3	2	TOTAL
Competitive	ALL	39.11	35.86	25.03	33.33
	A	40.76	37.04	24.93	34.24
	B	27.22	35.56	23.78	31.87
	C	39.36	35.90	26.40	33.89
Cooperative	ALL	39.19	34.06	26.75	33.33
	A	40.14	34.22	27.64	34.00
	B	37.62	33.40	26.28	32.43
	C	39.42	35.53	25.33	33.66
TOTAL	ALL	39.15	34.96	25.89	33.33
	A	40.45	35.63	26.28	34.12
	B	37.42	33.51	25.53	32.15
	C	39.39	35.72	25.87	33.66

TABLE 9.--Analyses for Hypothesis 4

(a) For Player A

Source	S.S.	df	M.S.	F	$F_{.95}$
Between Ss	2255.6739	35			
Instructions (I)	12.7789	1			
MMPI (M)	1.6256	1			
I x M	182.9101	1			
error (b)	2058.3593	32			
Within Ss	11261.8967	72			
Power (P)	3735.8360	2			
P x I	144.2625	2	72.1313	.68	3.15
P x M	139.1728	2	69.5864	.66	3.15
P x I x M	508.5186	2	254.2593	2.42	3.15
error (w)	6734.1068	64	105.2204		
Total	13517.5706	107			

(b) For Player B

Source	S.S.	df	M.S.	F	$F_{.95}$
Between Ss	2387.6499	35			
Instructions (I)	1.2675	1			
MMPI (M)	8.5008	1			
I x M	340.2675	1			
error (b)	2037.6141	32			
Within Ss	9277.4400	72			
Power (P)	2644.5024	2			
P x I	154.6517	2	77.3259	.84	3.15
P x M	13.5506	2	6.7753	.07	3.15
P x I x M	573.5238	2	286.7619	3.12	3.15
(error (w)	5891.2115	64	92.0502		
Total	11665.0899	107			

TABLE 9.--Analyses for Hypothesis 4 (continued)

(c) For Player C

Source	S.S.	df	M.S.	F	$F_{.95}$
Between Ss	2602.2775	35			
Instructions (I)	29.9779	1			
MMPI (M)	5.7408	1			
I x M	32.1223	1			
error (b)	2534.4365	32			
Within Ss	13317.5550	72			
Power (P)	3519.7254	2			
P x I	23.6875	2	11.8438	.08	3.15
P x M	5.8088	2	2.9044	.02	3.15
P x I x M	597.5931	2	298.7966	2.09	3.15
error (w)	9170.7402	64	143.2928		
Total	15919.8325	107			

could not occur except by chance. As shown in Table 8, the mean winnings for "All" under any combination of instructions and MMPI was 33.33 since total winnings per game per triad was always 100 points. The figures for players A, B and C vary from 33.33 only by chance.

Table 9 shows no tests for main effects of power for reasons discussed in Chapter II (see pp. 35-39).

Hypothesis 5. The hypothesis stated that:

Winnings will be highest for players coalescing with the weakest opponent in the opening coalition, next highest for players coalescing with the strongest opponent, and lowest for players left out of the opening coalition.

Data were the mean winnings of Ss under various conditions of power and relationship to opening coalition. The data were recorded in several ways. First, we have recorded the means under each combination of

conditions for all observations of all players. This was the basic data; however, it could not be used in the analyses because of interdependence of responses of players A, B and C. Therefore we have also recorded the means for each combination of conditions for players A, B and C separately. Each of these, in turn, required the recording of two different sets of means. For player A, for example, it was necessary to record mean responses of those players A who were included in the analysis which was done without using the variable of power. Next, we recorded mean responses of those players A who could be included in the analysis which used the power factor.

All of the means for players A are reported in Table 10. At the top of each cell is recorded the mean for the given combination of factors for all observations by all Ss in the experiment (see "All" under "Players"). The number in parentheses next to each mean is the number of observations on which the mean is based. Next is recorded the means for all players A who were included in the analysis which did not use the power factor (these means are labeled "A-R" under "Players"). The numbers in parentheses indicate the number of Ss out of 36 contributing to these means. The next set of means is that for the players A who were included in the analysis which used the power factor ("A-RP" under "Players"). Again the number of observations on which the mean is based is stated in parentheses. Empty spaces in the table occur in places where the given set of players A could not have contributed a mean.

Tables 11 and 12 report similar data for players B and C.

In these three tables, means recorded for various groups of Ss under a given combination of factors are assumed to differ only through chance

TABLE 10.--Data pertaining to Hypothesis 5
(Player A)

Relationship to Opening Coalition	Players	P O W E R 4	3	2	All Powers
Coalesced w/weakest opponent	All	58.13(285)	49.74(379)	40.28(379)	48.59(1043)
	A-R				48.20(36)
	A-RP	58.38(23)	56.40(23)	35.28(23)	50.02(69)
Coalesced w/strongest opponent	All	52.74(416)	39.00(416)	32.49(285)	42.56(1117)
	A-R				43.04(36)
	A-RP	53.78(23)	41.09(23)	30.80(23)	41.89(69)
Left out of opening coalition	All	9.97(379)	9.40(285)	8.26(416)	9.16(1080)
	A-R				-----
	A-RP	-----	-----	-----	-----
All Relationships	All	39.15(1080)	34.96(1080)	25.89(1080)	33.33(3240)
	A-R				-----
	A-RP	-----	-----	-----	-----
First two relationships (excluding "Left Out")	All	54.93(701)	44.12(795)	36.94(664)	45.45(2160)
	A-R				45.62(72)
	A-RP	56.08(46)	48.75(46)	33.04(46)	45.96(138)

variation.

In Tables 10, 11, and 12 there are a number of cells containing dashes in the sections which should present data for "left out of opening coalition" and "all relationships." Also, at the bottoms of these tables we have included a summary of data across two types of relationship to opening coalition, not including the "left out" relationship. These things have been done for the following reason. If main effects of relationship to opening coalition were found to be significant in the expected direction, we would be able to conclude only that a difference was

TABLE 11.--Data pertaining to Hypothesis 5
(Player B)

Relationship to Opening Coalition	Players	P O W E R 4	3	2	All Powers
Coalesced w/weakest opponent	All	58.13(285)	49.74(379)	40.28(379)	48.59(1043)
	B-R				48.08(35)
	B-RP	57.39(21)	48.43(21)	41.31(21)	49.04(63)
Coalesced w/strongest opponent	All	52.74(416)	39.00(416)	32.49(285)	42.56(1117)
	B-R				42.04(35)
	B-RP	53.06(21)	38.59(21)	28.78(21)	40.15(63)
Left out of opening coalition	All	9.97(379)	9.40(285)	8.26(416)	9.16(1080)
	B-R				-----
	B-RP	-----	-----	-----	-----
All Relationships	All	39.15(1080)	34.96(1080)	25.89(1080)	33.33(3240)
	B-R				-----
	B-RP	-----	-----	-----	-----
First two relationships (excluding "Left Out")	All	54.93(701)	44.12(795)	36.94(664)	45.45(2160)
	B-R				45.06(70)
	B-RP	55.23(42)	43.51(42)	35.05(42)	44.60(126)

evident somewhere among the three relationships involved. We would not be certain that a difference existed between coalescing with weaker opponent and coalescing with stronger opponent. But of all possible differences, it is this one which is of greatest importance. Fortunately, a look at the means for "All" shows that winnings were far smaller for the "left out" condition than for the others. So in the data and analyses we have simply assumed a difference between the "left out" condition and the other conditions, and have not included the "left out" data. Thus

TABLE 12.--Data pertaining to Hypothesis 5
(Player C)

Relationship to Opening Coalition	Players	P O W E R 4	3	2	All Powers
Coalesced w/weakest opponent	All	58.13(285)	49.74(379)	40.28(379)	48.59(1043)
	C-R				48.33(35)
	C-RP	59.01(26)	47.17(26)	36.10(26)	47.43(78)
Coalesced w/strongest opponent	All	52.74(416)	39.00(416)	32.49(285)	42.56(1117)
	C-R				42.28(35)
	C-RP	50.03(26)	39.90(26)	33.17(26)	41.03(78)
Left out of opening coalition	All	9.97(379)	9.40(285)	8.26(416)	9.16(1080)
	C-R				-----
	C-RP	-----	-----	-----	-----
All Relationships	All	39.15(1080)	34.96(1080)	25.89(1080)	33.33(3240)
	C-R				-----
	C-RP	-----	-----	-----	-----
First two relationships (excluding "Left Out")	All	54.93(701)	44.12(795)	36.94(664)	45.45(2160)
	C-R				45.31(70)
	C-RP	54.52(52)	43.53(52)	34.64(52)	44.23(156)

the use of a summary section titled "First two relationships." As a result, the significant findings which are reported below may be unequivocally traced to the difference between coalescing with strong or weak opponents.

In Table 13 are reported the analyses done for players A. The first analysis tests differences between the A-R means in Table 10. It involves a "treatments by subjects" design. The hypothesis is confirmed.

The second test in Table 13 tests differences among the A-RP means

TABLE 13.--Analyses for Hypothesis 5
(Player A)

(a) Analysis of A-R means

Source	S.S.	df	M.S.	F	$F_{.995}$
Relationship to opening coalition	479.0028	1	479.0028	13.13	9.18
Subjects	1768.9592	35			
Interaction (error)	1277.0102	35	36.4860		
Total	3524.9722	71			

(b) Analysis of A-RP means

Source	S.S.	df	M.S.	F	$F_{.95}$
Relationship to opening coalition (R)	2279.4487	1			
Power (P)	12750.2228	2			
Subjects (S)	2677.5200	22			
R x P	889.3116	2	444.6558	2.45	3.21
R x S	3278.3168	22			
P x S	3478.2137	44			
R x P x S (error)	7985.2674	44	181.4833		
Total	33338.3010	137			

of Table 10. This is a "treatments by treatments by subjects" design in which the second-order interaction mean square is treated as the error mean square, and first-order interactions involving "subjects" are not of theoretical significance. The test shows existence of no interaction between power and relationship to opening coalition. The test for main effects of relationship to opening coalition is not recorded, because this test was already carried out by the test of the A-R means which made use

TABLE 14.--Analyses for Hypothesis 5
(Player B)

(a) Analysis of B-R means

Source	S.S.	df	M.S.	F	$F_{.999}$
Relationship to opening coalition	636.9792	1	636.9792	15.89	13.35
Subjects	2842.0591	34			
Interaction (error)	1362.6564	34	40.0781		
Total	4841.6947	69			

(b) Analysis of B-RP means

Source	S.S.	df	M.S.	F	$F_{.95}$
Relationship to opening coalition (R)	2493.9581	1			
Power (P)	8624.1426	2			
Subjects (S)	6703.3329	20			
R x P	367.3826	2	183.6913	1.75	3.23
R x S	3166.3571	20			
P x S	5151.7827	40			
R x P x S (error)	4192.2654	40	104.8066		
Total	30699.2214	125			

of a larger number of Ss. A test of main effects of power is not of theoretical importance.

For players A, then, Hypothesis 5 is confirmed in both tests.

Tables 14 and 15 report similar analyses for players B and C. In the analyses of B-R and C-R means, the hypothesis was confirmed. In the analyses of B-RP and C-RP means, no significant interaction was found.

In summary, Hypothesis 5 was confirmed separately for players A,

TABLE 15.--Analyses for Hypothesis 5
(Player C)

(a) Analysis of C-R means

Source	S.S.	df	M.S.	F	$F_{.995}$
Relationship to opening coalition	639.1529	1	639.1529	10.11	9.18
Subjects	2103.0091	34			
Interaction (error)	2149.7075	34	63.2267		
Total	4891.8695	69			

(b) Analysis of C-RP means

Source	S.S.	df	M.S.	F	$F_{.95}$
Relationship to opening coalition (R)	1593.4745	1			
Power (P)	10316.8151	2			
Subjects (S)	5420.9390	25			
R x P	253.0901	2	126.5450	.63	3.18
R x S	5068.5897	25			
P x S	9895.4182	50			
R x P x S (error)	10127.8246	50	202.5565		
Total	42676.1512	155			

B and C, and therefore was confirmed for the entire experiment. The tendency for mean winnings to be greater for players coalescing with the weaker opponent seemed to be affected by the different power values, being greater for "All" when the power of 3 was used. But no significant interaction between power and the hypothesized effect was found.

Hypothesis 6. The hypothesis stated that:

When coalition formation is held constant, winnings will be highest

for players with the strongest power.

Data for one analysis were the scores made by the 3 and 2 under the 3-2 opening coalition; data for the other were scores made by the 4 and 3 under the 4-3 opening coalition.

The hypothesis states, in effect, that when the 3-2 or 4-3 opening coalition is used, the winnings of the members of the coalition will vary, with the stronger of the two making a higher mean score. The hypothesis does not concern the member who is left out of the coalition, and it has no relevance at all when the 4-2 opening coalition is used.

For the 4-3 coalition, Table 16 reports the mean winnings for the 4 and 3 for each of players A, B and C. Thirty-four Ss were available for the player A analysis, with 33 for B and 32 for C. A "treatments by subjects" design was used. In all tests, the hypothesis was confirmed.

For the 3-2 coalition, Table 17 reports mean winnings for the 3 and 2, again separately for players A (29 Ss), B (30 Ss), and C (31 Ss). The hypothesis is strongly confirmed by the three tests reported.

In summary, Hypothesis 6 is confirmed under all relevant conditions.

Type 1 games. Four triads, two each given competitive and cooperative instructions, were exposed to Type 1 games. With the players having equal power values, data were relevant only to Hypothesis 3 and to an altered form of Hypothesis 2. Because of this restriction, only a small sample of triads was used; the purpose was to determine whether coalitions among players of equal power would appear stable or unstable. No rigorous analysis was intended; the conclusions are not stated with statistical formality.

Hypothesis 2, altered to fit Type 1 games, states that after the

TABLE 16.--Analysis of mean points scored by 4 and 3 in 4-3 coalition

	4	3	Total
Player A	52.85	39.93	46.39
Player B	52.05	39.08	45.56
Player C	50.76	38.43	44.60

(a) For Players A

Source	S.S.	df	M.S.	F	$F_{.999}$
Subjects	3118.8252	33			
Power	2839.5579	1	2839.5579	50.38	13.29
Interaction (error)	1860.1989	33	56.3636		
Total	7818.5820	67			

(b) For Players B

Source	S.S.	df	M.S.	F	$F_{.999}$
Subjects	7114.0286	32			
Power	2775.9042	1	2775.9042	29.14	13.29
Interaction (error)	3157.5425	32	98.6732		
Total	13077.4753	65			

(c) For Players C

Source	S.S.	df	M.S.	F	$F_{.999}$
Subjects	5464.4969	31			
Power	2431.5997	1	2431.5997	19.41	13.29
Interaction (error)	3882.5882	31	125.2448		
Total	11778.6848	63			

TABLE 17.--Analysis of mean points scored by 3 and 2 in 3-2 coalition

	4	3	Total
Player A	54.97	37.33	46.15
Player B	48.51	41.72	45.11
Player C	48.42	37.10	42.76

(a) For Players A

Source	S.S.	df	M.S.	F	$F_{.999}$
Subjects	2670.8386	28			
Power	4509.8426	1	4509.8426	24.44	13.50
Interaction (error)	5168.2075	28	184.5074		
Total	12348.8887	57			

(b) For Players B

Source	S.S.	df	M.S.	F	$F_{.995}$
Subjects	3606.1394	29			
Power	690.4076	1	690.4076	11.19	9.23
Interaction (error)	1788.8735	29	61.6853		
Total	6085.4205	59			

(c) For Players C

Source	S.S.	df	M.S.	F	$F_{.99}$
Subjects	5752.9171	30			
Power	1983.6043	1	1983.6043	7.82	7.56
Interaction (error)	7606.5967	30	253.5866		
Total	15344.1181	61			

formation of the first coalition the most likely subsequent event will be formation of one of the other possible coalitions. Alternate possibilities are that the first coalition might dissolve and be replaced by no new coalition, and that the first coalition might remain in force throughout the game.

Table 18 shows the way in which the 120 games were divided among these possibilities. The opening coalition was unstable in 61 games, stable in 59. The hypothesized event was not the most frequent event overall. Three of the groups did choose it most often, but the fourth group, given cooperative instructions, retained its opening coalitions in all 30 games.

Table 18 also gives similar data about events following the creation of a second coalition. This relates to Hypothesis 3, which states that formation of a third coalition is most likely to occur. Only 48 games from three triads are involved in this data. Among these games, the opening coalition was superceded by a second coalition which remained stable in 22 games, unstable in 26. The hypothesized event was not most frequent overall, but was most frequent in those games when <u>some</u> subsequent event occurred.

<u>Answers to E's questions</u>. The first question was:

1. Did you use any particular strategy or method of play? If so, was it the same through the 30 games? Or did it change? How?

The answers to this question may be placed under several categories. First, many answers merely confirmed the data reported under Hypotheses 1-a and 1-b. Ss, for example, stated that "I went with the strongest all the time" or "I tried for the 4 at first, but later I stayed away from him." Nearly all Ss made such statements; seven Ss reported that they

TABLE 18.--Data from Type 1 games

(a) Relevant to Hypothesis 2

New Coalition	No Coalition	No Event	Total
48	13	59	120

(b) Relevant to Hypothesis 3

Hypothesized Coalition	First Coalition	No Coalition	No Event	Total
18	2	6	22	48

had no such strategy and were moving either randomly or wholly according to determinants other than power. There was a virtually perfect correspondence between Ss' statements and the records kept by E of their play, indicating their awareness of the ways they were responding to power differences.

Second, in addition to the ways implied by Hypotheses 1-a and 1-b, 51 Ss stated that they learned to choose both opponents rather than one. This was done for the following reason. If the most-favored opponent failed to reciprocate, then the player still had a chance to coalesce with the other rather than be left out. Thus playing the "both" card was optimum strategy. It was foiled, however, when all three Ss chose "both" at the same time; the rules provided that each must then make a choice of one and only one opponent.

Third, about 40 Ss made comments indicating strategy based on the break-up of coalitions, as expected by Hypotheses 2 and 3. Many of these stated a willingness to break in order to improve their position. Some

chose to renegotiate rather than make a direct break, but were willing to break if the opponent held firm to the original agreement. Nearly all of the 40 Ss expressed either indifference toward the point split or else willingness to make a generous division of points upon formation of the opening coalition, on the assumption that this coalition would be broken before game's end.

In a fourth category of response were statements of a large number of Ss who expressed strategies of a different sort. They may be referred to as "non-power" strategies because they involved responding to opponents on bases other than their power values and positions on the board. Ss changed to these alternate strategies at various points in the series of 30 games, after first using the "power" strategies described above. The alternate strategies replaced the earlier ones completely for some Ss, but only qualified the use of earlier strategies for most Ss. The "non-power" strategies were of three kinds. First, Ss learned not to break the opening coalition, becoming aware of a threat of retaliation upon a player who proved to be an unfaithful partner. Eighty-one Ss, including at least one in nearly every triad, reported this tendency. It appeared to be an equally popular strategy under either instructional set. A typical report was "I learned not to break because you couldn't break and then get in coalitions later" or "I learned to stick with B because C liked to break." Most of these Ss reported that the possibility of gaining by breaking seemed overshadowed by the threat of being left out of coalitions in subsequent games.

Another kind of non-power strategy involved a willingness to finish the game in a coalition with a 50-50 split, even when more powerful than

the coalition partner. Thus Ss not only learned not to break the coalition, but also learned not to be dominant within it. Thirty-two Ss reported using this strategy. The third and final non-power method was that of forming coalitions with each opponent in turn, if they appeared to be even in points, or of forming coalitions exclusively with the lowest scorer if one's opponents were not equal in points. Seventy-seven Ss reported this strategy, though many admitted that they were slightly or considerably uncertain about actual scores, including their own. Some Ss described this strategy as "spreading the others" or "playing each of them against the other." Several explained that if a player coalesced on a 50-50 basis with each opponent in turn, he would easily win. Other Ss noted that they saw players who did this in early games but were subsequently "squeezed out" by the others. This kind of strategy seemed to be equally popular for the two instructional sets.

Question 2 asked:

2. Did you make your plays on a strict competitive or strict cooperative basis? Neither? Some of each?

The purpose of this question was to determine whether Ss recognized and applied the competitive-cooperative distinction. Up to this point there had been no suggestion by E that there might be two such points of view. For each instructional group almost equal numbers of Ss reported that they played each way. A difference between the two groups, however, was that 26 Ss receiving cooperative instructions reported some of each kind of approach, while only six Ss who received competitive instructions reported playing on this basis. In addition, a number of cooperative Ss reported confusion over the intent of their instructions, wondering whether the actual goal of the game was to cooperate or win points.

Several Ss who said they played cooperatively implied that their intent was competitive and that they cooperated only in order to compete more effectively.

No Ss said that they played neither cooperatively nor competitively.

Question 3 asked:

3. Did your opponents play in different ways? Were they different kinds of players?
   a. If so, were your responses toward them made according to these differences?
   b. Did you prefer to form coalitions with one opponent more than with the other?
   c. Did you want one of them to come out ahead of the other?

The purpose of this question was to find out if Ss viewed their opponents in ways not related to power. As it turned out, this kind of outlook was so prevalent that it was brought out clearly by Question 1. Most of the responses here merely confirmed information provided earlier. Ss were "different kinds of players" because of their attitudes toward keeping or breaking coalitions, toward making repeated renegotiations, and so on.

Actually, the kind of answers which E originally had in mind were those which might reveal tendencies to favor or disfavor opponents because of personal likes or dislikes held prior to the experiment. The question, in other words, was a check on the S's assertion that he did not know his opponents prior to the game. Although he thought there were signs of favoritism in three or four triads, E found that Ss always explained their behavior in other ways (e.g., "He was getting ahead so we had to stop him"). There was no admission of pre-game factors which led to preference for one opponent more than the other.

Question 4 asked:

4. Did you think you had a good idea about the cumulative score? If so, did this affect the way you played? How?

Earlier, in answering Question 1, 77 Ss implied that their choices were determined in part by the relative scores of the other players. This question confirmed this information, but also revealed that only about half of the 77 Ss thought they knew the running total score, whereas the rest were merely working on the basis of scores from a handful (roughly, two to six) of recent games. Thus the 120 Ss were divided into three nearly equal categories: (1) couldn't guess the running total or didn't try to guess it; (2) believed that one opponent was ahead of the other in recent games; (3) believed that one opponent was ahead of the other for all games played. Of players in the third category, about 70 per cent were right in their assumptions; the rest were wrong. Answers for players in the second category were nearly always accurate; however, in about 30 per cent of the cases the opponent who scored most in recent games was actually behind the other opponent in overall score.

Question 5 asked:

5. Were you interested as you played? For what reasons?

Table 19 reports the number of Ss who gave various reasons. Total number of responses exceeded 120, since some Ss explained their interest in more than one way. Only two Ss were not interested in the game; they described it as boring because repetitious. All others found it interesting, though 12 of these reported that it was interesting at first but boring near the end.

TABLE 19.--Reasons for interest in playing the game

Number of Ss	Reason for interest
89	Problem-solving. This was indicated by numerous phrases, including "skill," "insight," "matching wits," "thinking---like in bridge," "challenging," "figure out behavior behind it," "judgment," "looking for strategy." One S, reflecting his cooperative instructions, described the problem as "seeing how to make the scores as even as possible."
36	Liked competition. Wanted to out-play opponents.
27	The prize money.
15	Learning about opponents. One S said the game "brought out peculiar individual characteristics."
55	"General interest." Ss implied that the game was enjoyable, but did not specify why. This was typified by comments such as "fun," "novelty," "good game," "interesting," and "I like games." When pressed further, 41 of these Ss further responded in one of the other ways mentioned in this table.

CHAPTER IV

This chapter contains sections on conclusions of the study, discussion, and remarks on further theory and research in the study of coalition formation.

CONCLUSIONS

According to theory, any coalition occurring in the present experiment was "unstable" and its eventual break-up was expected. In the experiment, the opening coalition was broken in 13.167 out of 30 Type 5 games on the average. Further, out of an average 11.5 games out of 30 in which a second coalition was formed, this coalition was broken in 3.529 games. In addition, data for Type 1 games showed that the opening coalition was broken in 61 of 120 games, and that a second coalition was broken in 26 of 48 cases.

Moreover, we know that Ss played with the understanding that coalitions might be broken after any move, and so we may assume (though we lack a means to prove it) that coalitions were regarded as essentially temporary in many of the games in which they actually remained permanent. No coalition member could be certain that his partner would want to retain the coalition throughout the game.

Regarding formation of the opening coalition, the experiment showed that Ss who were given competitive instructions, and who also tended in their personal interests to prefer competitive activities, showed a

tendency to choose opening coalitions of greater than average strength. That is, they formed opening coalitions with the stronger opponent more often than with the weaker. They displayed this tendency across the entire set of 30 games, and also, with one exception, in each of the 6-game sets. They had been expected gradually to change their preferences so as to favor the weaker opponent after originally favoring the stronger, but no greater-than-chance change was found in the data.

Ss who were cooperative in both interests and instructions also began playing the game by forming opening coalitions more often with the stronger opponent. This result contradicted expectations, but in later games the choices of these Ss became more like what was expected. The preferences gradually changed in the direction of favoring the weaker opponent, and after the first set of six games they never again showed significantly high preference for the stronger opponent. However, they never changed enough to express significant preference for the weaker opponent, whereas the expectation had been that they would do so in all games.

After forming the opening coalition, Ss most typically retained it until the end of the game (in 16.833 games out of 30 for the average triad). This contradicted the expectation that Ss would tend more often than expected by chance to break the opening coalition and form a new coalition between the weaker member of the opening coalition and the player not included in that coalition. However, it was found that this hypothesized event did occur with greater-than-chance frequency in cases in which the opening coalition was broken.

Ss performed similarly after a second coalition was formed. Most

often they retained the coalition, although the expectation was that they would break it and form the only coalition not yet formed. Again, though, we found that the expected event occurred with greater-than-chance frequency in games where the coalition was broken.

In analyzing winnings of Ss under various conditions, we found first that winnings for players with different power values did not vary according to their competitive or cooperative tendencies. Variation had been expected. However, winnings did vary according to the player's relation to the opening coalition. Highest average winnings went to Ss who entered the opening coalition with the weaker of the two opponents. Next highest winnings were gained by Ss who coalesced with the stronger opponent, and lowest average winnings were made by Ss left out of the opening coalition. This result applied to players having any power value, though the difference in winnings for coalescing with weak rather than strong seemed especially great for players with a power value of 3.

Finally, the experiment showed that winnings were greatest for players having the highest power value, in cases where the relationship of players to the opening coalition was similar and therefore not a factor in determining winnings.

DISCUSSION

Of the experiment's several expectations, some were confirmed and some were not. These will be examined in turn in this section.

Expectations confirmed. The rules and assumptions of the Vinacke-Arkoff "coalitions" game were changed in the present study because the assumption of temporary coalitions seemed more in line with people's actual handling of coalitions. The writer's purpose, however, was not

merely to alter a model of behavior but also to suggest that the behavior produced experimentally by the new model would be significantly different from that found under the earlier model. Vinacke & Arkoff offered support for a belief suggested by Simmel and Caplow that coalitions would not only help weak players more than the strong, but would actually give weaker players an overall advantage over their stronger opponents. Vinacke & Arkoff found that the 3-2 coalition was the most popular coalition in Type 5 games, which meant that the 4 entered the fewest coalitions and scored the fewest points.

In the present study, the data (Hypothesis 5) similarly showed that players did better when the coalition they chose was with the weaker opponent. This meant that Ss should have chosen to coalesce with the weaker opponent, and thus the most popular coalition should have been the one between the 3 and 2.

But the data also showed (Hypotheses 1-a, 1-b) that players did not play as they should have played. The typical S began his play with a coalition with the stronger rather than weaker opponent. He did not understand that he could benefit most by hindering rather than helping the stronger opponent. Competitively-oriented Ss continued this preference throughout the series of 30 games. Cooperatively-oriented Ss gave up this preference and changed in the direction of favoring the weaker opponent, but even in later sets of games never adopted a clear-cut preference for the weaker opponent.

Neither cooperative nor competitive Ss played ideally in the present game, then, whereas the Ss of Vinacke & Arkoff did do so. Coalition formation here did not necessarily lead to the superiority of weak over

strong. The weak were able to take the advantage, but did not do so. There must be a difference, then, in treatment of coalitions which may be retained or broken by individual choice rather than considered permanent by necessity. These must be essentially different kinds of coalitions inasmuch as Ss' behavior toward them followed different patterns.

We believe that the difference lies in the perceived attractiveness of a coalition which may be formed with the stronger opponent at one point in time and abandoned at another. The coalition is attractive because the player will move faster and approach the goal sooner. This is a fallacious attractiveness because the game is won not by moving as fast as possible but by staying ahead of other players. The achievement of moving faster was not correlated with the achievement of keeping ahead; rather, the game was such that the former accomplishment tended to negate the latter.

In the Vinacke & Arkoff game the promise of fast gain was not attractive because the finish of the game was determined by the formed coalition. It was clear that the achievement of some secondary purpose would not change the result. In the present experiment, players were not so likely to see the fallacy because the game's finish was not determined by the opening decision. We conclude that weak players in the present type of game will defeat the strong only when they have thought through the problem accurately, and this task was not readily achieved. The rule which needed to be learned is that the weak player must associate only with other weak players in order to obtain the advantage.

Expectations not confirmed. An unexpected result was the low number of games in which the opening coalition was broken. Possibly the idea

that coalitions are unstable was inaccurate. Or else, as Ss' comments suggested, there was a feature of the experimental game which counteracted the tendency to instability. The expectation of instability assumed a situation consisting of one game, and E had accordingly intended that the experiment be perceived as a set of 30 replications of an event rather than a single event consisting of a 30-game series. Replications were necessary because we could not have collected sufficient data to make statistical tests feasible if only one game had been played per triad, nor could we have tested hypotheses concerning repeated experience with the experimental conditions.

It was important, however, to manipulate these conditions so that Ss would tend to play each game solely for its own sake. Unfortunately, Ss' comments indicated that they perceived themselves to be playing a 30-game series, and that they made many choices intended to cope with future games as well as with the immediate game. As reported in Chapter III, many Ss declined to break coalitions because opponents might tend to avoid them as partners in subsequent games. The chance of making greater winnings in a given game by breaking a coalition was recognized, but this was offset by the chance of being denied entry into coalitions in subsequent games. Players were willing to take smaller earnings in given games in order to maintain the chance for obtaining steady earnings in subsequent games. E observed that several Ss who failed to show this willingness were discriminated against eventually.

The phenomenon of "unstable" coalitions thus was counteracted when Ss had a series of games to play. The concept of "unstable" coalitions apparently is meaningful only when power is treated as important. The

perception of a series produced what we described in Chapter III as non-power strategies, whereas our theoretical expectations were based on an assumption that Ss would use power strategies. In a single game power is important; in a series of games power may be ignored when each player uses each power an equal number of times. If all Ss had seen all games as separate events, we believe that opening coalitions would nearly always have been broken. Since Ss tended to see the games as a unified series, they often did not break coalitions.

An experiment which intended to examine power as a determinant of coalition formation thus inadvertently has demonstrated the effect of non-power determinants. Ss regarded each other not only as 4's, 3's, and 2's, but also as persons with varying personality characteristics and differing motivations. These views of opponents as unique individuals may for some players have considerably diluted or even replaced the perception of opponents as holders of certain powers. The implications of this for the coalition formation process are pursued below in the section on further theory and research.

Another unexpected result of the experiment occurred in the data testing Hypotheses 1-a and 1-b. We have seen that the weak player, in order to win, needed to learn that he must associate only with other weak players. The hypothesized differences between competitive and cooperative Ss in following this rule were expected not because we believed that one group would see the rule more readily than the other but because cooperative play would just happen to be more similar than competitive play to what the rule required. The rule would be learned eventually, and so it was further hypothesized that cooperative play would continue

to fit it, while competitive play would change so as to fall in line with it. Consequently, we are forced to try to explain why competitive play never changed in the direction of the rule, and why cooperative play started differently than expected.

It is significant to note, although the absolute positions of both groups with respect to mean strength of opening coalitions were higher than expected, that the relative positioning of the two groups confirmed expectations. That is, Hypotheses 1-a and 1-b stated that competitive groups would prefer stronger opening coalitions than cooperative groups, in effect, and this was confirmed. The problem was that both groups preferred stronger opening coalitions than hypothesized. Less competitive play by the competitive groups might have led to the predicted regression of mean strength, and less competitive play by the cooperative groups might have led to the predicted tendency to choose weaker opponents in all games.

A possible explanation is that each S was free to interpret the game along a competitive-cooperative continuum according to his own previous experience with such situations. Competition and cooperation are relative terms, and Ss who were labeled "cooperative" may in fact have treated the game in quite a competitive way. One reason for expecting this is that the game, even for those persons receiving cooperative instructions, was a highly competitive exercise involving the possibilities of defeating opponents or being beaten by them, receiving a larger or smaller share of prize money, and solving or not solving certain challenging problems. It was a more competitive game than that used by Vinacke & Arkoff because it required more complex decisions and did not

allow Ss to perceive outcomes so readily. Another reason is that our Ss were all males, persons who have relatively strong competitive interests to begin with. We note, too, that the mean MMPI score for experimental Ss was about 5 points below the established norm for males, with a low score indicating high male interests. These scores were obtained just after the game was finished, and perhaps they differ from the norm as they do because the experience was a strongly competitive one.

Ss with cooperative instructions and cooperative interests, however, might still have had a greater relative tendency to play cooperatively, and this may explain why they changed their preferences while competitive groups did not.

Regarding Hypotheses 1-a and 1-b, we feel that the ability of the experimental procedure to detect differences between competitive and cooperative groups was not as strong as hoped for. The hypothesized differences were based on power considerations, but Ss tended to use non-power strategies because they perceived the experiment as a 30-game series. With non-power strategies so popular, it is perhaps remarkable that differences in the treatment of power by competitive and cooperative groups were found at all. Possibly the differences would have been clearer if Ss had used power strategies predominantly.

Another experimental outcome requiring comment is the failure of confirmation of Hypothesis 4. This can be explained as follows. In the tests of Hypotheses 1-a and 1-b we found no differences between competitive and cooperative instructions groups, nor between competitive and cooperative MMPI groups, in the mean strength of opening coalitions over all 30 games (see Table 20). Hypothesis 4 was based on the assumption

that specified differences would be found among these groups. In other words, Hypothesis 4 would follow directly from expected results which unfortunately were not obtained. We should have stated the hypothesis in such a way as to show that it was expected to apply only in conjunction with the occurrence of conditions which might fail to appear. If the differences in choices of opening coalition partners suggested by Hypotheses 1-a and 1-b had been greater, Hypothesis 4 would no doubt have been confirmed.

FURTHER THEORY AND RESEARCH

Coalitions will often be broken when the context (either rules of a game or a "real-life" situation) does not require that they be formed permanently. Therefore further theory and research in the field of coalition formation should not retain the permanent coalitions model but should assume that any coalition which is formed by agreement will probably last only as long as the basis for agreement lasts. Coalitions may be described as stable or unstable depending on whether the basis for agreement is likely to remain firm or to be dispelled. Even if stable coalitions are assumed to be involved, the behavioral model should not arbitrarily state that coalitions will remain permanent but should treat stability as a characteristic which needs to be confirmed empirically.

The problem of the nature of competition and cooperation is involved here. It appears that people who are oriented competitively don't easily see that the best competitive strategy may involve cooperative tactics. How are these two concepts to be distinguished in a game in which you compete best by cooperating best? The meaning of "cooperation" is subtly changed here; the player is cooperating superficially but his

purpose toward his coalition partner is actually non-cooperative. The disposition to compete leads to overt behaviors which have previously been explained as acts of cooperation.

Further research might also take up the fact that people dealing with temporary coalitions apparently cannot identify the best choice to make. In the present study E's questions obtained statements of strategy from Ss, but did not probe deeply enough to obtain explanations of strategies. In further study it would be valuable to learn Ss' own explanations of why they chose to coalesce with the 4. Could they defend their decisions, and if so, how? Their answers would contribute to research into the ways in which people perceive problems (e.g., research on subjective probability, game theory).

Additional research may also be done into many variations of the present experimental situation. For example, it would be useful to examine triads containing two Ss with one kind of instructions, competitive or cooperative, and one S with the other kind.

To test the hypotheses of the present study more validly, the present study might be repeated by using a procedure which forced Ss to treat each game as a separate event. One way of handling this would be to award prizes for each game. This would mean that each game would be worth winning for itself, whereas in the present study a player might have won 100 points in any single game yet still have finished in last place. The change in procedure could compel the S to treat the experiment as a set of replications of an event rather than as one event consisting of N connected games.

On the other hand, perhaps models of coalition formation should be

developed which account for a series of coalition events rather than a single event. The present model was developed because we felt it to be a better model of human activity, yet it still retained the assumption that coalition formation must be carried out within the context of a single game. As the results of this study have made clear, it is reasonable to assume that much coalition behavior assumes that the given situation will be followed by others in the future. Factions of a political party, for example, must consider coalitions at the 1964 convention, but must also consider what effect this will have on their power in future years. Caplow's theory of coalition formation does not account for this kind of activity.

If and when theory involving a series of coalition events is developed, it would be interesting to contrast the situation of equal power for all participants, which was the case in the present study, with a series of games in which players do not have each power value an equal number of times. How would the play of a person who is consistently stronger contrast with the play of someone who is usually weaker?

The discussion earlier of power and non-power determinants suggests a number of ideas for further research. On the one hand, it would be useful to study power determinants exclusively, forcing Ss to deal with each other only as 4's, 3's, and 2's. A way to do this would be to separate Ss behind partitions, with E mediating all of their interactions. There could be no playing against the leader or siding with one opponent against another if Ss never knew which opponent was which. They would not know which opponent held which power value, nor which had made given moves in previous games. These procedural changes would reduce the use

of non-power strategies and increase the opportunity for E to investigate a theory of power.

On the other hand, we might also take the opposite view and acknowledge that accurate models of coalition formation probably should incorporate non-power determinants. In fact, some readers may argue that it is the interaction among members of a triad which should be studied. Instead of separating Ss behind partitions, perhaps we should let them interact as in the present study and have methods available for examining this interaction critically.

Although the present experiment was designed to examine a theory of power, it is clear that human beings see each other as more than possessors of units of power. And it is true as well that the student of behavior should consider his subjects as possessors not only of power, but of personalities, of motivations. A reader of an early draft of this study stated, accurately, that the assumptions made here about behavior provide a "mechanistic conception" of the interaction within triads. Omitted are statements of expectations of coalition-forming behavior based on such things as Ss' tendencies to like or dislike their opponents in later games because of the nature of their interaction in earlier games.

Subsequent research might profitably examine these personality and motivational determinants of coalition formation. One appropriate method would be to perform an experiment similar to the present one, but with an extended question session which would thoroughly explore Ss' reasons for behavior. In addition, Ss might be encouraged to discuss their interactions with each other during their play, whereas in the present study we

discouraged statements or comments except those necessary according to the rules.

Not only should a study of personality determinants be carried out, but also there should be an examination of the way in which these determinants interact with power determinants. For example, when both kinds of determinants may possibly affect behavior, will one kind dominate the other or will both control behavior to some degree? Is the player's perception of power or of personality affected by his perception of the other?

For the communication researcher, the findings of this study permit inferences about the stability of groups to which a message is sent. Stable groups offer a greater chance for predicting the way in which information will be circulated among group members. But the results of this study suggest that some types of groups will change their internal structures repeatedly. This means that individuals may be thrown in and out of contact with each other, since those who join coalitions may no longer associate with persons in some other sub-group. Even if contact is retained, the forming and breaking of coalitions could mean variations in an individual's willingness to cooperate with another person. Group models developed for communication research have generally represented static, unchanging structures, but the present research suggests development of models in which structural variations are treated as independent variables in the communication process.

In summary, the present study has contributed new theory to the field of coalition formation, has suggested new directions for theory to follow, and has suggested further research projects to be pursued.

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APPENDIX 1

This appendix presents data and statistical findings relating to Hypotheses 1-a and 1-b. As discussed in Chapter III, data was collected from 36 triads arranged in a 3-factor analysis-of-variance design which permitted numerous statistical tests. Since not all of the data and tests pertained to the hypotheses, only portions of the findings were included in Chapter III. The means for all cells are reported in this appendix in Table 20, and the analysis-of-variance test for the entire set of data is reported in Table 21. The analysis in Table 21 is patterned after Lindquist's (14) Type III design, with the "games" factor involving repeated measurements. The analysis is similar to that for the Type I design reported in Table 2; details are discussed in Chapter II.

In Table 20 all statistically significant findings are noted; some of these findings are taken from tests reported in Tables 3, 4, and 21, while others are taken from additional analysis-of-variance tests of the data located in various sub-sections of the overall table. These additional tests are of peripheral interest and are not reported here.

Table 20 reports that regression for all triads was significant but was subject to interaction with MMPI and instructions. When separate analyses were done for competitive and cooperative MMPI groups, regression was significant only for cooperative MMPI groups. However, this regression interacted with instructions, and further tests indicated that it applied only for cooperative MMPI groups which also had cooperative instructions. A similar result occurred when separate analyses were

TABLE 20.--Additional data relating to Hypotheses 1-a and 1-b

	Games	Competitive Instructions	Cooperative Instructions	Total
Competitive MMPI	1-6	(i)6.3703	5.9444	6.1573
	7-12	(i)6.2963	5.8703	6.0833
	13-18	(i)6.2778	5.8148 (f)	6.0462 (c)
	19-24	6.0370	5.8889	5.9630
	25-30	(i)6.4074	5.8148	6.1111
	All	(i)6.2778(d)(g)(h)	5.8667(d)(g)	6.0722
		b: -.0031	b: -.0040	b: -.0036
Cooperative MMPI	1-6	6.0926	(i)6.5556	6.3240
	7-12	5.8889	6.2408	6.0648
	13-18	5.7963 (e)	5.9259 (e)(f)	5.8610 (c)
	19-24	5.8519	5.8148	5.8333
	25-30	5.9444	5.8519	5.8982
	All	5.9148(d)(h)	6.0778(d)	5.9963
		b: -.0056	b: -.0306 (a)	b: -.0181 (a)
Total	1-6	6.2315	6.2500	6.2408
	7-12	6.0926	6.0556	6.0741
	13-18	6.0370 (b)	5.8704 (b)	5.9537
	19-24	5.9440	5.8519	5.8981
	25-30	6.1759	5.8333	5.9954
	All	6.0963	5.9722	5.9657
		b: -.0044	b: -.0173 (a)	b: -.0108 (a)

(a) In each of these 4 sets of means there is significant regression across sets of 6 games. However, in 3 of them the regression effect is subject to interaction and cannot be generalized to all cases.
(b) These 2 groups of means are affected by significant interaction between instructions and games.
(c) These 2 groups of means are affected by significant interaction between MMPI and games.
(d) These 4 means are affected by significant interaction between instructions and MMPI.
(e) These two groups of means are affected by significant interaction between instructions and games (cooperative MMPI only).
(f) These two groups of means are affected by significant interaction between MMPI and games (cooperative instructions only).
(g) These two means differ significantly.
(h) These two means differ significantly.
(i) Each of these six means is significantly greater than 6.0000.

NOTE: In each of the 4 cells showing instructions x MMPI, each mean is computed from one response from each of 9 triads. Four sets of 9 triads each are used, giving 180 observations in all.

TABLE 21.--Analysis of data reported in Table 20

Source	S.S.	df	M.S.	F	$F_{.95}$	$F_{.975}$	$F_{.995}$
Between Ss	21.8061	35					
Instructions (I)	.6928	1	.6928	1.29	4.15		
MMPI (M)	.2593	1	.2593	.48	4.15		
I x M	3.7075	1	3.7075	6.92		5.53	9.10
error (b)	17.1465	32	.5358				
Within Ss	22.7828	144					
Games (G)	2.5244	4					
Regression	1.5163	1	1.5163	11.80			9.10
Departure	1.0081	3	.3360	2.34	2.70		
G x I	.7061	4					
Regression	.5460	1	.5460	4.25	4.15	5.57	
Departure	.1601	3	.0534	.37	2.70		
G x M	.8611	4					
Regression	.6882	1	.6882	5.36	4.15	5.57	
Departure	.1729	3	.0576	.40	2.70		
G x I x M	.8127	4					
Regression	.4682	1	.4682	3.64	4.15		
Departure	.3445	3	.1148	.80	2.70		
error (w)	17.8785	128	.1397				
Regression	4.1120	32	.1285				
Departure	13.7665	96	.1434				
Total	44.5889	179					

done for competitive and cooperative instructions groups. Significant regression was found only for cooperative instructions groups; further, within these groups significant regression was found only for those which were cooperative MMPI groups. Thus the significant regression reported in Tables 20 and 21 was found to be restricted to triads which were cooperative in both MMPI and instructions.

APPENDIX 2

This appendix presents data and statistical tests relating to Hypothesis 3. This material was not included in Chapter III because it was collected from so few games. It involved only 391 games played by 34 triads, out of 1080 games played by 36 triads.

Analysis was similar to that for Hypothesis 2, except that the expected values varied from triad to triad. Each event expected should have occurred in one-fourth of the games by chance, but the 34 triads contributed different numbers of games to the analysis. Accordingly, the appropriate data involved each triad's obtained and expected frequencies for given events. The difference between these figures was computed, and a *t* test then was used to examine whether the mean of these differences was significantly different from zero. The four possible events were examined separately, using four *t* tests.

Table 22 shows the results. The first three possibilities occurred with less than chance frequency, and the fourth occurred with greater than chance frequency. The tests were two-tailed, with an .05 confidence level. They reject the hypothesis.

As for Hypothesis 2, however, we may ask about the relative frequencies of events in cases where *some* subsequent event did happen after the formation of the second coalition. The above analyses do not suggest an answer, but additional tests can be done for the 120 cases (in 27 triads) where some subsequent event happened.

TABLE 22.--Analyses for Hypothesis 3

Event	Mean of Obtained Figures	Mean of Expected Figures	Mean of Differences (Obtained minus Expected)	t
Hypothesized coalition	2.147	2.875	- .728	-2.23
First coalition	.294	2.875	-2.581	-10.51
No coalition	1.088	2.875	-1.787	-7.91
No event	7.971	2.875	5.096	11.06

$t_{.975}$ (33 df)	$t_{.995}$ (33 df)	$t_{.9995}$ (33 df)
2.03	2.73	3.62

Hypothesized coalition	2.704	1.482	1.222	2.15
First coalition	.371	1.482	-1.111	-1.92
No coalition	1.371	1.482	- .111	- .23

$t_{.975}$ (26 df)	$t_{.995}$ (26 df)
2.06	2.78

This restricted analysis is also reported in Table 22. The hypothesized coalition occurred with greater than chance frequency. The other events did not. This result implies indirectly that the hypothesized coalition occurred more often than the other possibilities, in cases where some subsequent event occurred following formation of the second coalition.

VITA

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