A TEST OF A STOCHASTIC MODEL OF COALITION FORMATION UNDER TWO CONDITIONS OF REWARD STRUCTURE

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ABSTRACT

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by Robert K. Shelly

The study of coalition formation in small, structured groups has received growing attention in recent research in social psychology. The work reported here was designed with a two-fold purpose: (1) to continue the development of a stochastic model of the process initiated by Shelly and Phillips (1966), and (2) to test for the operation of the parity norm using two payoff conditions. In developing the model a distinction was drawn between forced and non-forced coalition situations. A test of the model with data reported for a forced coalition situation (Chertkoff, 1966) showed no difference between the predictions of the model and the data. However, an attempt to apply the model in a non-forced coalition situation was unsuccessful because of insufficient information reported by the experimenter (Vinacke and Arkoff, 1957 and Vinacke, 1959). An experiment was designed to test the model in the non-forced situation. A secondary concern of the experiment was a test of reports in the research literature that the share of the reward gained by coalition partners in negotiation was correlated with the resource or power weights of the parties involved.

A reformulation of the model based on the evidence of dependence in the contact process was attempted. When mean trial to coalition was employed as the parameter of the model, in three of the four conditions the model's predictions were significantly different from the observed distribution of coalitions. When the parameter was adjusted so the predicted and observed occurrence of no-coalitions was nearly equal, in only one of the conditions did the model produce predictions significantly different from the observed results.

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INTRODUCTION

The purpose of the research which is reported here is the attainment of a greater understanding of the factors which influence alliances in small, structured groups. The study of such alliances or coalitions, as they are referred to in the literature, has proceeded in two conceptually distinct frames of reference. First, coalition formation was investigated as a process which developed among members of a small group. More recently the focus of the research has been on the final outcome of this process. The model developed here is an attempt to integrate the two methods of study by using the observations of the process to predict the final distribution of coalitions.

An understanding of what constitutes a coalition situation is crucial to any account of the process by which coalitions form. Gamson[1] defines coalition as ". . . the joint use of resources to determine the outcome of a decision in certain specified situations." Implied in this definition is a task orientation which is competitive in nature and a differential allocation of resources among the individuals in the situation. As an example, suppose

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[1]William A. Gamson, "Experimental Studies of Coalition Formation," Advances in Experimental Social Psychology, ed. L. Berkowitz (New York: Academic Press, 1964), I, 82.

three units are interested in controlling the rewarding of a prize. Each unit controls a share of the decision making power (less than) fifty-one per cent of the total. Were unanimity required, the task would be a cooperative one and the necessity for joint action by a subset of the group would be obviated as would the importance of the structural hierarchy. If unanimity is not required, then the task is competitive in that a subset of the group can control the decision by majority action, and the differential hierarchy becomes a salient feature of the situation.

Two experimental paradigms have been employed to study coalition behavior in small groups. The parchisi paradigm has involved the assignment of resource weights to the various individuals and the playing of a board game similar to parchisi. The subjects advance tokens differently along a board toward a goal by multiplying the value of a die, rolled by the experimenter, by their resource weights. The forming of coalitions allows two players to move together, adding their accumulated spaces and resource weights. This may be regarded as a non-forced situation, in that a winner is determined by the resource structure even if no coalition results during the play of the game. In the political convention paradigm the subjects are assigned a resource weight; e.g., a certain number of votes, told that a certain number of votes is necessary to win the nomination at stake, and encouraged to form a coalition to secure the necessary number. This latter paradigm is a forced coalition situation in that a coalition is necessary for a winner to be determined. Henceforth, the two different paradigms will be referred to as the forced coalition paradigm and the non-forced coalition paradigm.

Several distinct conclusions have emerged from the research conducted in both situations. Generally, division of the payoff for winning the game tends to be correlated with the assigned resource weight held at the beginning of the game. Noted by Gamson[2] as the parity norm, this finding is very close to Homans' description of distributive justice; ". . . if one is 'better' than another in his investments, he should also be 'better' than the other in the reward he gets for it . . ."[3] To pursue Homans' point further would lead us too far afield, for his development of reward and investment are too sketchy to allow application of the concept in coalition situations involving a small number of units. It is sufficient to note that individuals may expect that others will demand a share of the reward proportionate to their resource position. Although an individual may not feel that he is governed by such a norm, he may still feel that others will behave according to it.[4]

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[2] Ibid., pp. 87-88.

[3] George C. Homans, Social Behavior: Its Elementary Forms (New York: Harcourt, Brace and World), p. 245.

[4] Gamson, op. cit., p. 88.

One experimental exception to the parity norm noted above is that females in face-to-face contact tend to restructure the game. Dignified as anticompetitive theory, studies using females show that the subjects redefine the situation to be a cooperative task and play the game so as to preserve socially acceptable styles of behavior.[5] In addition to anticompetitive theory two other theories of coalition formation have been developed. The development of minimum resource theory was begun by Caplow[6] in an attempt to explain behavior in asymmetric power distributions, and carried further by Gamson[7] with the development of minimum winning coalition theory. The predictions of coalitions formed on the basis of the assigned resources have generally been upheld by the research literature. The alternative to minimum resource theory is the minimum power theory which is based on the work of Shapley.[8] The major prediction of this approach, that in a triad all coalitions are equally likely, has not been generally supported. A fuller development of the various theories and relevant research reports will be undertaken below.

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[5]See Appendix B for a detailed discussion of this phenomenon.

[6]Theodore Caplow, "A Theory of Coalitions in the Triad," American Sociological Review, 21 (1956), 489-493.

[7]William A. Gamson, "A Theory of Coalition Formation," American Sociological Review, 26 (1961), 373-382.

[8]L. S. Shapley, "A Value for N-Person Games," Annals of Mathematics Studies, 28 (1953) 307-317.

RELEVANT RESEARCH AND THEORY

Caplow's[9] theoretical formulation was the first attempt to delineate initial group structures and the occurrence of coalitions within them. The theory is based on the following four assumptions:

1. Members of a triad may differ in strength. A stronger member can control a weaker member, and will seek to do so.
2. Each member of the triad seeks control over the others. Control over two others is preferred to control over one other. Control over one other is preferred to control over none.
3. Strength is additive. The strength of a coalition is equal to the sum of the strength of its two members.
4. The formation of coalitions takes place in an existing triadic situation, so that there is a pre-coalition condition in every triad. Any attempt by a stronger member to coerce a weaker member into joining a non-advantageous coalition will provoke the formation of an advantageous coalition to oppose the coercion.

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[9] Caplow, op. cit.; and Theodore Caplow, "Further Developments of a Theory of Coalitions in the Triad," American Journal of Sociology, 64 (1959) 488-493.

Predictions for eight theoretical power distributions in the triad are developed as follows:

Type	Structure of Group	Predicted Coalitions
Type I	A = B = C	[AB] = [AC] = [BC]
Type II	A > B, B = C, A < (B+C)	[BC] > [AB] = [AC]
Type III	A < B, B = C	[AB] = [AC] > [BC]
Type IV	A > (B+C), B = C	[__]
Type V	A > B > C, A < (B+C)	[AB], [BC]
Type VI	A > B > C, A > (B+C)	[__]*
Type VII	A > B > C, A = (B+C)	[AB] or [AC]
Type VIII	A = (B+C), B = C	[AB] or [AC]

*The systems of brackets have been used to denote coalitions throughout this paper. Empty brackets designate no coalition. Only the continuous reward situation is considered here.

While each of these distributions, or types, is considered by Caplow and many subsequent experimenters to be a coalition situation, the Type IV and Type VI are not true coalition situations according to the definitions we have adopted from Gamson because in them no joint use of resources affects the structurally determined outcome. They are termed by Gamson "dictator situations" and we will ignore them, as he did.

Three types of experimental situations are also distinguished by Caplow. Based on the distribution of rewards in the situation these are: (1) the continuous, in which the object is to control the rewards for the entire situation; (2) the episodic, in which control is sought over episodic distributions; and (3) the terminal, in which a single redistribution is the object. The theory which Caplow developed was based primarily on structural influence patterns within the triad. The formulation presented in the present paper is based on expectancies derived from the structural pattern. While these theories differ on this point, the predictions from either are essentially the same.

Vinacke and Arkoff,[10] employed the parchisi paradigm and an episodic reward structure to test the theoretical formulations of Caplow. The evidence supports Caplow's predictions in all but the Type IV and Type VI situations. In these latter conditions of the game a significant number of subjects formed coalitions even though they derived little or no benefit from the coalition. An explanation of this finding may be based on the fact that subjects played under all six resource distributions, and hence, "learned" that coalitions had some intrinsic value, even though they derived no direct benefits in the situation. An analysis of the distribution of rewards indicated that subjects bargained on the basis of their initial resource weights, and rewards tended to be correlated with

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[10] W. Edgar Vinacke and Abe Arkoff, "An Experimental Study of Coalitions in the Triad," American Sociological Review, 22 (1957), 406-414.

the resource distribution. The conclusion was that subjects formed their agreements on the basis of their initial perceptions of the resource distribution. While low, the correlation lends support to the contention that a justice or parity norm is operating in the coalition situation. Chaney and Vinacke[11] report on some personality oriented variables and arrive at the conclusion that the probability of a coalition being formed is an inverse function of the power of the potential members, adding weight to the argument for a parity norm in a coalition situation.

Stryker and Psathas[12] investigated the behavior of subjects when the weak man in a Type II situation varied in perceived strength over plays of the game. Their results tend to support the contentions of Caplow, particularly in that divisions of reward increased in favor of the weak man as his perceived strength increased. Unfortunately, they would not allow some coalitions to form and replayed games to force the formations of those which were allowed. This complication of their design forces us to question the generalization of their findings beyond the given situation.

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[11] Marilyn V. Chaney and W. Edgar Vinacke, "Achievement and Nuturance in Triads Varying in Power Distribution," Journal of Abnormal and Social Psychology, 60 (1960), 175-181.

[12] Sheldon Stryker and George Psathas, "Research on Coalitions in the Triad: Findings, Problems, and Strategy," American Sociological Review, 26 (1961) 565-572.

Gamson[13] in a pair of articles describes a third theory of coalition formation based on the concept of perceived power relationships. From four explicit assumptions (an initial distribution of resources, a payoff for each condition, non-utilitarian strategy preferences, and an effective decision point) and an implicit payoff maximization principle, he deduces that people tend to favor the cheapest winning coalition. The distribution of the payoff is based on the initial resource distribution of the coalition, a point in favor of perceived power relationships. An empirical test of the theory using five-man groups in a political convention paradigm generally supported the theory. The formulation of the cheapest winning coalition theory appears to provide a method for analyzing groups of size greater than three, as well as lending support to the parity hypothesis.

Psathas and Stryker[14] in a replication of their earlier work, designed to overcome the major shortcomings of it, attempted to gain a fuller understanding of the process by which subjects arrive at their decisions regarding the coalition partner and the division of rewards. The subjects were screened from one another and required to

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[13] Gamson, op. cit.; and William A. Gamson, "An Experimental Test of a Theory of Coalition Formation," American Sociological Review, 26 (1961), 565-572.

[14] George Psathas and Sheldon Stryker, "Bargaining Behavior and Orientation in Coalition Formation," Sociometry, 28 (1965), 124-144.

communicate by means of paper and pencil offers of partner choice and the proposed distribution of rewards. The findings in the replication did not lead to any greater understanding of the mode of decision because the number of subjects was too small to analyze. In an attempt to rectify this problem they simulated the experimental situation in a questionnaire which was completed by a group of students similar to those in the actual experiment. The results of the experiment tend to support the perceived power theories and the parity norm, particularly in the case of those individuals who hold high resources. This perception by the strong man carries over in his style of play to influence the behavior of the weak man.

Chertkoff[15] performed an experiment in which the probability on the success of a coalition formed was varied. The political convention paradigm was used, and the probability of the final candidate's success was varied. The subjects were separated from one another and required to communicate by means of paper and pencil offers. By increasing the probability of success of the coalition partner, he was able to make the top man the desired coalition partner. An interesting finding noted in this report is that when subjects are first required to make reciprocal choices and subsequently bargain to solidify the relationship,

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[15]Jerome M. Chertkoff, "The Effects of Probability of Future Success on Coalition Formation," Journal of Experimental Social Psychology, 2 (1966), 265-277.

results show that no agreements resulted in only a small proportion of cases.

From the above discussion, it appears that minimum resource theory is the most viable in a coalition situation. However, minimum resource theory has been attacked on the grounds that it is an artifact of the experimental situation. The alternative, termed minimum power, was first explicitly stated by Shapley.[16] In his discussion, Shapely argues that power is a function of the number of times that an individual can join an existing coalition and, by his joining, make the coalition a winning one. In the triad, each of the players possesses one third of the power under this formulation, if the game is not one in which a dictator is involved. Under these conditions, any coalition is equally likely in a triadic game.

Evidence for minimum power theory has been slight. Kelley and Arrowood[17] argue that subjects in a coalition game tend to perceive power differences when in fact none exist, pointing to the Vinacke and Arkoff study as an example of the influence of irrelevant aspects on the experimental situation. Giving the subjects additional information tends to wash out the perceptions of power which are necessary to support Caplow's predictions.

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[16]Shapley, op. cit.

[17]Harold H. Kelley and A. J. Arrowood, "Coalitions in the Triad: Critique and Experiment," Sociometry, 23 (1960), 231-244.

Kelley and Arrowood suggest that giving each individual real power commensurate with what he appears to have induces the predicted effect on coalitions and that this effect increases with repeated plays of the game.

Vinacke, Crowell, Dien, and Young[18] in an attempt to implement the suggestions of Kelley and Arrowood used learning sessions and information giving situations in the parchisi paradigm. The findings of this experiment were three in number and are particularly important for our problem. Initially, for subjects who were informed of the objective power distribution, there was no shift toward equal incidence of coalitions. This was qualified by the fact that those subjects who understood the information most did tend to form coalitions according to the predictions of minimum power theory. There was no evidence that differences in ability to form coalitions existed between the subjects in the various conditions. It was also shown that the chief effect of the information condition was to increase motivation to win. Coupled with the results from earlier experiments, the problem of information seems to be open to question.

The work of Chertkoff, coupled with earlier findings, leads to the view that subjects, when either face-to-face or non face-to-face contact is involved, pay attention to

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[18] W. Edgar Vinacke, Doris C. Crowell, Dora Dien, and Vera Young, "The Effects of Information about Strategy on a Three-Person Game," Behavioral Science, 11 (1966), 180-189.

the resource structure imposed on the group. Of the various theories of coalition formation advanced above, minimum resource theory, minimum power theory, and anticompetitive theory, minimum resource theory seems most applicable in situations involving small groups of males.

THE MODEL

In an attempt to further explicate the coalition process, Shelly and Phillips[19] developed a model which treats the process as being logically separable into two distinct, temporally disjoint phases: (1) the contact process, in which communications are established and initial offers of conditions of alliance made, and (2) the bargaining process in which agreement is reached on the final conditions of joint action. As presently developed, the model focuses only on the contact process in triads.

Definitions

1. In the case of experimentally imposed trials, an explicit trial is the unit within which each individual makes one choice, either to contact or not to contact one of the others.
2. In the case where trials are not imposed, the concept of implicit trial may be applied with the same criteria for trial as in the explicit trials situation.

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[19] Robert Shelly and James L. Phillips, "Social Contact Model for Coalition Formation," Human Learning Research Institute, Report #6, September 1966.

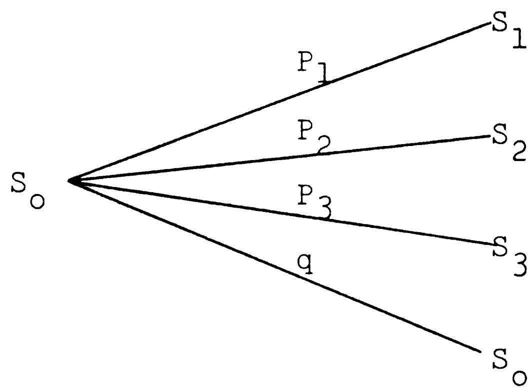
Assumption I

Reciprocal contact between individuals must be established for a coalition to occur. In an explicit trials situation, this occurs within the same trial unit. In an implicit trials situation, such contact may occur across trial units. In this case, trials may be assumed to be a continuous random variable for the purposes of evaluating the model.

Assumption II

The bargaining process, which determines the terms under which the coalition is formed, is considered to be deterministically completed if I is fulfilled.

Taking the conditions specified above, it is possible to express the probabilities of the contact process if we assume that each trial is independent of the others. We denote the probability that A contacts B as P (AB) and similarly for the other five possible one-way contacts. Since each of these probabilities is assumed to be independent of every other and the probability of a coalition is based on a reciprocal contact, the probability of a coalition between A and B is the product of A contacting B, and B contacting A; e.g., $P\{AB\} = P\ (AB) \cdot (BA)$. In like manner, the probabilities $P\ \{AC\}$ and $P\ \{BC\}$ may be derived. From the above, the probability of no coalition, $P\ \{\_\_\}$, is equal to $1 - (P\ \{AB\} + P\ \{AC\} + P\ \{BC\})$. Since the formation of a coalition determines the end of the game, it is possible to develop a "tree" of the probabilities for a finite number of trials. (For simplicity we shall be concerned only with one of the possible conditions and denote it as $P_1 = P\{AB\}$, where $P_2 = P\{AC\}$, $P_3 = P\{BC\}$, and $q = P\{\_\_\}$.) Since the game is deterministic after a coalition has been formed, S_1, S_2, and S_3 are absorbing states.



From the assumption of independent trials, we may express the probability of the i^{th} coalition forming by the r^{th} trial as:

$$P_{ri} = P_i + q\,P_i + q^2 P_i + \ldots\ \ldots + q^{r-1} P_i$$

This is just the sum of a geometric series which has the solution

$$P_{ri} = \frac{P_i\,(1 - q^r)}{1 - q}.$$

Although this may appear to be trivial, in that P_i, P_{ri}, q, and r are estimated from data, it should be noted that the predictive value of the model may be tested by allowing one of the parameters to vary and taking the others as fixed by the data estimates.

Although the model developed above was reported[20] before the publication by Chertkoff of his revision of Caplow's theory, it may be viewed as an extension of his revision. Chertkoff notes that for the triadic situation the Caplow theory is adequate for all of the conditions except the case where $A>B>C$ and $A<(B+C)$. Caplow predicts that AC and BC coalitions are equally likely while results have shown the following rank ordering in the formation of coalitions: BC, AC, AB. Chertkoff points out that Caplow assumes that coalitions are equally likely if choices are reciprocated. Carefully analyzing each position in the hierarchy, Chertkoff points out that for Caplow's control assumption to hold B would have no preference for A as a coalition partner. Chertkoff then arbitrarily assigns the following probabilities to the various contact probabilities: $P(AB) = P(AC) = P(CB) = P(CA) = .50$, $P(BA) = .00$, and $P(BC) = 1.00$. Using these probabilities and assuming that an infinite number of trials is possible, he arrives at the conclusion that BC coalitions will occur twice as frequently as AC and that the incidence of no coalition approaches zero.

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[20] Ibid.

Comparing his predictions with data from several articles, for the first game of a sequence only, Chertkoff reports no significant difference.

In considering Chertkoff's discussion, two points must be raised with respect to his assumptions. He assumes that the forced and non-forced coalition situations present only minor differences in strategy to the subjects. While this may seem a minor point, it should be remembered that a forced situation is indeed subject to an infinite trials interpretation, while a non-forced situation is subject to a restriction of finite trials in an experimental setting. The second point refers to his assignment of contact probabilities. When actual contact data from Chertkoff's earlier article are used to predict the distribution of coalitions, the model explicated in this paper is identical to Chertkoff's and a close fit to the data is achieved (see Table 1).

TABLE 1.--Fit of model for condition 1 of Chertkoff,* 1966.

	Predicted	Observed
AB	1.20	1
AC	6.96	9
BC	15.84	14
	$X^2 = .345$	d.f. = 2

*Since this is a forced coalition situation, $r \to \infty$ and $q^r \to 0$. Hence

$$P_{ri} = \frac{P_i}{1-q}.$$

EVIDENCE RELATED TO THE MODEL

Chertkoff[21] reports data from which it is possible to generate initial contact probabilities for use in a direct test of the model. When compared with the distribution of coalitions which he reports, the predictions of the model are not significantly different from the distribution of coalitions reported for his first condition of play.

The other conditions reported by Chertkoff were not included in the tests of the model because of the possible confounding effects of varying the probability of future success. While this is questionable, it should be pointed out that variables which are extraneous to the coalition formation process are not of concern in the present paper.

A direct test of the model using initiation data reported by Vinacke and Arkoff[22] is impossible because they report data only for the initiator, but information on both the initiator and the recipient is necessary to generate contact probabilities. We used a numerical estimation procedure to generate the various contact probabilities for the data reported by Vinacke and Arkoff. The close approximations to the observed distribution of

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[21]Chertkoff, op. cit., p. 269.

[22]Vinacke and Arkoff, op. cit., p. 410.

coalitions yielded by this procedure indicated that these probabilities were reasonable estimates of the proportional breakdown of contacts. It should be noted that these are not estimates of actual contact probabilities, but estimates of the proportion of contacts which any initiator attempts with a recipient. All proportions were in the range of .20 to .80, and all contacts were assumed to be simultaneous. Table 2 presents the results of the test of the model using these estimated proportions.

TABLE 2.--Fit of the model with Vinacke and Arkoff, 1957.*

	Type I	Type II	Type III	Type IV	Type V	Type VI
AB	38.16	16.92	24.39	13.23	8.64	7.83
	33	13	24	11	9	9
AC	16.83	16.92	42.66	7.38	19.35	14.04
	17	12	40	7	20	13
BC	25.29	55.26	12.15	7.38	60.21	7.33
	30	64	15	7	59	8
--	9.72	.90	10.80	62.01	1.80	60.30
	10	1	11	62	2	60
X^2	1.584	3.779	.8442	.4148	.0833	.2568

*Predicted above, observed below.

An extension of a theoretical argument for the derivation of contact probabilities discussed by Shelly and Phillips[23] considers the experimental paradigm employed by Vinacke as a three-choice situation. This approach to the problem of deriving contact probabilities, however, leads to problems in assessing a constructed parameter.

The model, when applied to a forced coalition situation in which contacts were simultaneous, predicts very well the outcomes of the experiments. Shelly and Phillips in attempting to apply it to a non-forced coalition situation, treat it as a forced coalition situation with the estimated proportion of contacts directed to individual positions used as the contact probabilities. The experiment related below was specifically designed to test the model using empirical contact probabilities in a three choice situation (non-forced).

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[23]Shelly and Phillips, op. cit.

DESIGN OF THE EXPERIMENT

The primary concern of the experiment is a further test of the model, based on discrete trials data. The fit to the Chertkoff data, using the empirical contact probabilities which Chertkoff reported for his first trial was encouraging. However, the model was generally rejected when the data of Vinacke and Arkoff were used.[24] Several reasons for this may be advanced. The fact that the subjects in the Vinacke experiments played several games and hence may have been instrumentally conditioned to regard a coalition as desirable probably had an effect on the outcome of all games after the first. The methods of calculating the contact probabilities may be incorrect and contributing to the poor fit. The face-to-face nature of the Vinacke and Arkoff experiment might have influenced the style of play.

In an attempt to eliminate some of these factors and gain a fuller understanding of the actual contact process, two of the six standard power distributions were investigated. The Type III (3-2-2) and Type V (4-3-2) situations were selected by a process of elimination in which Types IV and VI were eliminated as dictator situations, Type I as of no concern because a differential in the payoff structure could not be achieved, and Type II as redundant of the

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[24]Shelly and Phillips, op. cit.

Type III situation. A non face-to-face situation was constructed so as to reduce the possibly extraneous effects resulting from personality and appearance differences between the subjects. Subjects played only two games, one under each resource structure with type of reward held constant, to allow a close examination of the effects of experience in the situation. Finally, a discrete trials record of all contacts was kept to allow a test of the model with empirical contact probabilities in a non-forced coalition situation.

Subjects communicated with one another in a non face-to-face situation by means of a series of lights and switches which acted as message devices. A trial was over when each subject elected to play alone for a trial, which was defined as no contact, or sent a message to another person in the group by pulling one of the switches on a display panel. At the end of each trial, subjects saw on their display panel, by means of the lights, the choices of the other subjects. If a light on their display was on, they had been contacted by that person; if it was not on, they had not been contacted by the person in that position. Trial by trial, who-to-whom matrices were recorded for each of the sessions giving information on the intermediate choices of the subjects (pre-coalition trials) and the trial on which the coalition was formed.

To adapt the parchisi game to the experiment, game boards were constructed which allowed the experimenter to control the moves of the various players in accordance with the distribution of resources. The game boards were designed so that the experimenter controlled three tokens, each one representing a player, by means of a master unit. The transformation from the experimenter's board to the subjects' was accomplished by means of servo-transformers. The number of spaces each subject's token moved on any trial was fixed by the power distribution. Subjects were thus able to observe their own position relative to the position of their "opponents." If a subject's weight was 3, his token moved 3 spaces on each move or trial (see Appendix A for instructions).

Since verbal or written communications were not allowed during the course of the experiment, reciprocal choices constitute coalition agreements when they occurred within the same trial. This fact was communicated to the subjects, along with a set of payoffs for each possible coalition in the particular resource distribution. A total of one hundred points was awarded to the winner(s) of each game and ten trials were allowed in each game. Each group of subjects played two games, one under each of the resource distributions. If no coalition had occurred by the end of ten trials, the subjects were told that the points would be distributed to the man who held the highest value in the original distribution.

Half of the triads were told in the instructions that the points were to be split equally between the coalition partners, no matter what coalition occurred. The other half of the triads were given a card that displayed a reward split based on the parity norm.

Subjects were recruited from introductory psychology classes and randomly assigned to one of the eight conditions of play. Each condition represents one cell of a 2 x 2 x 2 design generated from the two resource distributions, the two reward conditions, and the sequence of the game. After completing the first game, subjects played a second in which the reward condition was held constant and the resource distribution changed. A total of forty triads participated. No control for sex of player was introduced because research by Phillips, Nitz, and Shelly[25] showed no differences in style of play for males and females in a non face-to-face game situation similar to the present one.

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[25]James L. Phillips, Lawrence H. Nitz, and Robert Shelly, "A Note on Sex Differences in a Competitive Task," Human Learning Research Institute, 1966. (Mimeographed.)

HYPOTHESES

In addition to the questions raised by the formulation of the model, a set of fairly explicit hypotheses may be developed from the points raised above. From the results of applying the model to Chertkoff's data, the hypothesis that the model will give a good fit to the empirical distribution of coalitions if actual contact probabilities are available is a tenable one. If the parity norm, as explicated above, is indeed a major factor in the formation of coalitions, subjects in the parity condition will behave in accordance with previous results in forming their coalitions, and subjects in the even-split condition will behave in accordance with minimum-power theory, that is all coalitions will occur with equal frequency. From the point raised by Kelley and Arrowood regarding learning in coalition situations it is possible to formulate the hypothesis that subjects will learn early in the series of games that any coalition is a winning one and hence all coalitions will become equally likely.

RESULTS

The results of the experiment are contradictory with respect to the model. The parity condition gives support to the model in the 4-3-2 distribution, but not in the 3-2-2 distribution; support for the model is found in the equal condition in the 3-2-2 distribution, but not in the 4-3-2 distribution. Table 3 presents the model fit using contact probabilities based on all trials; r was set equal to ten, the number of specified possible trials. No distinction is made between games occurring in the first and second half of the experiment. This collapsing was carried out to increase the number of observations per cell and hence raise the expected frequencies to reasonable values for the purposes of analysis.

Table 4 presents the who-to-whom matrices across the first and second game for all trials. Visual inspection of the various positions reveals a definite position effect. In all but the 3-2-2 parity condition, the top man has a higher probability of no-contact than the other positions, and generally an interpretation based on Caplow's structural model, as opposed to an interpretation based on the parity norm, is in order. If the parity norm had been supported, the contacts in the equal reward condition would have been approximately equal. No other systematic differences are

TABLE 3.--Model fits disregarding sequence of game.

	Coalition	Predicted	Observed	Coalition	Predicted	Observed
	(4-3)	4.12	3	(3-2)	12.24	11
Parity	(3-2)	11.90	14	(2-2)	4.38	8
Condition	(4-2)	1.64	1	(---)	3.38	1
	(---)	3.86	2			
X^2		1.821			4.794	
	(4-3)	2.54	4	(3-2)	7.00	8
Equal	(3-2)	11.42	11	(2-2)	10.66	9
Condition	(4-2)	1.66	4	(---)	3.34	3
	(---)	4.38	1			
X^2		6.761			.437	

TABLE 4.--Who-to-Whom Matrices Across Games.

		Equal	Reward	Condition			Parity	Reward	Condition
		Recipient					Recipient		
		3	2	2'			2	2	2'
	3	.64	.16	.20		3	.44	.28	.28
Sender	2	.22	.48	.30	Sender	2	.13	.63	.24
	2'	.17	.35	.48		2'	.30	.18	.52
		Recipient					Recipient		
		4	3	2			4	3	2
	4	.68	.26	.06		4	.77	.15	.08
Sender	3	.09	.44	.47	Sender	3	.30	.34	.37
	2	.25	.22	.53		2	.22	.35	.43

revealed and a richer understanding of the contact process must be gleaned from the test for independence of contact across positions.

A test for independence of contact probabilities across trials, a basic assumption of the model, was conducted using a variation of a procedure suggested by Atkinson, Bower, and Crothers.[26] The various matrices of subtables A through D of Table 5 represent transitions from trial n to trial n + 1, of contact frequency, for the various resource positions. The expected frequencies were calculated from the marginals of the matrix, the hypothesis being that if the transitions were indepencent there would be no significant difference between the predicted and observed frequencies. Because of the low value of several of the predicted cell entries, it was not possible to conduct significance tests on this comparison. However, using the value of the X^2 in relation to the number of degrees of freedom as an index of goodness of fit, it is possible to reject the hypothesis of independence in all but one matrix. For these purposes a $X^2 \approx$d.f. indicates a good fit of the predicted to the observed data. Further consideration of this finding will be developed in the following section.

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[26]Richard C. Atkinson, Gordon H. Bower, and Edward J. Crothers, <u>An Introduction to Mathematical Learning Theory</u> (New York: John Wiley and Sons, 1965), pp. 45 f.f.

TABLE 5.--Test for independence of contact probabilities.

A 4-3-2 Parity

"4"		n+1 4	n+1 3	n+1 2
	4	44 39.47	5 7.40	2 4.11
n	3	3 5.42	3 1.02	1 .56
	2	1 3.10	1 .58	2 .32

$X^2 = 18.1977$
d.f. = 4

"3"		n+1 3	n+1 4	n+1 2
	3	14 7.40	3 9.58	10 10.01
n	4	1 6.03	17 7.81	4 8.16
	2	2 3.59	2 4.61	9 4.82

$X^2 = 33.33$
d.f. = 4

"2"		n+1 2	n+1 4	n+1 3
	2	19 13.11	2 6.82	11 12.06
n	4	2 6.55	7 3.42	7 6.03
	3	4 5.33	4 2.77	5 5.90

$X^2 = 14.12$
d.f. = 4

B 4-3-2 Equal

"4"		n+1 4	n+1 3	n+1 2
	4	30 25.04	3 8.61	3 2.35
n	3	2 6.95	8 2.39	0 .65
	2	0 .00	0 .00	0 .00

$X^2 = 22.16$
d.f. = 4

"3"		n+1 3	n+1 4	n+1 2
	3	16 13.67	3 1.88	9 12.37
n	4	00 .00	0 .00	0 .00
	2	5 7.32	0 .98	10 6.63

$X^2 = 5.49$
d.f. = 4

"2"		n+1 2	n+1 4	n+1 3
	2	25 19.37	3 5.74	5 7.89
n	4	2 5.86	4 1.74	4 2.39
	3	0 1.76	1 .52	2 .72

$X^2 = 15.04$
d.f. = 4

C		3-2-2 Parity												
"3"		3	2	2'	"2"		2	3	2'	"2"		2'	3	2
	3	23 15.62	7 10.41	8 11.97		2	38 30.49	4 8.71	11 13.79		2'	29 23.67	6 9.86	13 14.46
n	2	4 7.40	9 4.93	5 5.67	n	3	1 4.60	3 1.31	4 2.03	n	3	2 4.93	4 2.05	4 3.09
	2'	3 6.99	4 4.66	10 5.35		2'	3 6.90	6 1.97	3 3.12		2	5 7.40	5 3.08	5 4.52
		X^2 = 17.33					X^2 = 22.18					X^2 = 8.40		
		d.f. = 4					d.f. = 4					d.f. = 4		

D		3-2-2 Equal												
			n+1					n+1					n+1	
"3"		3	2	2'	"2"		2	3	2'	"2"		2'	3	2
	3	40 29.53	4 7.03	1 8.44		2	22 17.22	9 8.31	7 12.47		2'	30 22.02	1 3.79	8 13.21
n	2	0 3.94	3 .93	3 1.13	n	3	4 4.53	3 2.19	3 3.28	n	3	1 4.51	4 .78	3 2.71
	2'	2 8.53	3 2.03	8 2.44		2'	3 7.25	2 3.50	11 5.25		2	4 8.47	1 1.45	10 5.08
		X^2 = 41.35					X^2 = 13.60					X^2 = 30.32		
		d.f. = 4					d.f. = 4					d.f. = 4		

Table 6 presents the observed and estimated values of the mean and variance of the random variable trials to coalition. It is quite evident that in this respect the model does not fit the data well. This is a finding which can be better considered in a reformulation of the model, which will be undertaken below.

TABLE 6.--Parameter predictions of the model.

Distribution	Mean Coalition Trial #		Variance of Coalition Trial #	
	Predicted	Observed	Predicted	Observed
4-3-2 Equal	3.35	3.05	8.58	2.05
3-2-2 Equal	3.31	3.12	9.15	3.61
4-3-2 Parity	3.27	3.44	5.23	3.79
3-2-2 Parity	3.32	4.53	1.78	6.15

A test of the second hypothesis was conducted collapsing cells because of the small number of groups involved. No difference was found between the parity and equal conditions of reward in the data presented in Table 7. This appears to be a rejection of the concept of parity, or justice, as formulated above in that no differences were found to exist in the distribution of coalitions between the two conditions of play.

TABLE 7.--Distribution of coalitions: parity vs. equal conditions.

	4-3-2 Resource Distribution			3-2-2 Resource Distribution	
	Parity	Equal		Parity	Equal
(3-2)	15	11		8	9
(All other)	5	7	(All other)	12	11
	$X^2 = .9484$	1 d.f.		$X^2 = .1022$	1 d.f.
	$.50<p<.25$			$.75<p<.50$	

The fourth hypothesis relating to learning in the situation receives support if average trial to coalition is used as a measure. Table 8 presents the average trial to coalition for each of the resource distributions and conditions of reward. Only in the case where the 4-3-2 distribution was played first in the parity condition is the mean trial to coalition in the second game greater than that of the first game. In testing the effects of sequence of game on coalition frequency, no differences were found between first and second game for either resource distribution. Again, in Table 9, cells were collapsed to provide greater expected values. Learning in this situation is apparently related only to speed of forming coalition and has no effect on the resource position involved in the coalition.

TABLE 8.--Mean trial to coalition.

Initial Game Distribution		Second Game Distribution	
4-3-2 Parity	4.3	3-2-2 Parity	4.8
4-3-2 Equal	3.4	3-2-2 Equal	3.0
3-2-2 Parity	4.4	4-3-2 Parity	2.8
3-2-2 Equal	3.6	4-3-2 Equal	2.7

TABLE 9.--First game vs. second game frequency of coalitions.

4-3-2 Distribution			3-2-2 Distribution		
	Game I	Game II		Game I	Game II
(3-2)	11	14	(2-2)	8	9
(All Other)	9	6	(All Other)	12	11
$X^2 = .9600$	1 d.f.		$X^2 = .051$	1 d.f.	
$.50<p<.25$			$.90<p<.75$		

DISCUSSION

The fact that the model failed to predict accurately the coalition structures within the groups in either the parity or equal reward condition, and the rejection of the hypothesis of differences in the frequency distribution of coalitions, suggests that the concept of parity may be so vague a normative constraint that a gross violation of it is necessary to produce the effects that are predicted. If this is so, a fifty-fifty split of the rewards may not be a sufficient test of the violation hypothesis; such a split is still within the bounds of what the middle man can expect in a bargaining situation with the weak man and also is a "fair" split if the subjects feel that the game is being played by three equal resource positions.

A feature of the contact process which deserves consideration is the high incidence $\overline{P\ (S-S)} > .34$ in all cases of no-contact, that is a choice not to contact another player. While this effect may be a result of the inclusion of this option in the non face-to-face interaction situation, the desire to closely approximate the parchisi paradigm developed by Vinacke was the reason for including it. Subjects in face-to-face interaction may choose to remain silent and, hence, effectively be making a no-contact. Exclusion of the no-contact alternative would have given a better approximation to the forced coalition paradigm but would have also increased the likelihood of chance, or accidental coalitions because of the nature of the message device. Such outcomes would very likely have yielded spurious results.

The failure of the model to predict the expected coalition trial indicates that the concept of implicit trials within the experimentally imposed trials may be in operation. Such a conceptualization may seem farfetched, but the subjects did not receive immediate feedback on the consequences of their action on any given trial, and hence were able to consider their choices for a relatively long period of time before having to respond again.

Before considering a reformulation of the model, it seems appropriate to discuss the learning phenomenon in the context of coalition experiments. From the results of this experiment it appears that subjects do not alter their perceptions of the most desirable coalition from one game to the next. While this finding seems to be a contradiction of what we might expect, it should be remembered that only one game was played under a given resource distribution by any one group. After the play of the first game, however, it should have been apparent, had the subjects been learning at the rate suggested by Kelley and Arrowood, that any coalition was a winning one, and that to maximize payoff every effort should be expended to enter a coalition. If this did indeed occur, no evidence of it appears in the data. From the trials to coalition analysis, it appears that all that the subjects gained in terms of knowledge was an increased facility in operating the apparatus, and a quicker solution of the problem, forming a coalition.

A second test of the model, based on dependent contact probabilities generated from the contact data of Table 5 was executed in light of the findings on independence of contact probabilities. For the purposes of this test, the probability of a contact by any member of the triad was construed as the sum two conditional probabilities: the probability that given a contact he contacted X_1, and the probability that given a contact he contacted X_2. Following the notation employed previously:

$$P(A) = P(A)\ P(AB) + P(A)\ P(AC),$$

$$P(B) = P(B)\ P(BA) + P(A)\ P(AC),$$

$$P(C) = P(C)\ P(CA) + P(C)\ P(CB).$$

Setting r, the parameter of the model, equal to the mean coalition trial resulted in a poor fit of the model (three of the four tests yielded X^2 values sufficiently large to produce significance at the .001 level). It should be noted that r does not retain significance in terms of the experimental trials; and if we assume it to be variable within the range of the total possible trials, a better fit of the model with the data may be obtained. If r is estimated such that the difference between the predicted and observed frequency of no coalitions is minimized, a good fit of the model to the data is obtained. Table 10 shows that only one of the conditions has predictions significantly different from the observed distribution. (Again, because of low N we invoke $X^2 \leq$ d.f. as a criterion for significance.)

TABLE 10.--Fit of the model employing conditional probabilities, with r variable.

4-3-2 Equal	Predicted	Observed	4-3-2 Parity	Predicted	Observed
(4-3)	3.98	4	(4-3)	6.86	3
(4-2)	3.02	4	(4-2)	3.16	1
(3-2)	11.96	11	(3-2)	7.98	14
(---)	1.04	1	(---)	2.0	2
	X^2 = .3965			X^2 = 8.1897	
	3 d.f., n.s.			3 d.f., sig.	
	$\hat{r}$ = 3.05			$\hat{r}$ = 1.59	

3-2-2 Equal	Predicted	Equal	3-2-2 Parity	Predicted	Equal
(3-2)	8.42	8	(3-2)	12.7	11
(2-2)	8.60	9	(2-2)	6.3	8
(---)	3.0	3	(---)	1.0	1
	X^2 = .0395			X^2 = .6862	
	2. d.f., n.s.			2 d.f., n.s	
	$\hat{r}$ = 1.30			$\hat{r}$ = 2.28	

The problem of explaining the inconsistency which results when the assumption of independence of contact probability is supported by the model when it is applied to the Chertkoff data, and rejected when applied to the data reported here may be at least partially resolved if we note some features of the experiments employed in both studies and in the work of Vinacke and his associates. The subjects in Chertkoff's experiment were playing a "game" which involved only two choices on their part and had to make a simultaneous reciprocal contact for a coalition to result. Each trial was also independent of all other trials in the sense that no cumulative effect on the outcome could result across trials. The subjects in the experiment reported here and in the Vinacke experiments were faced with a three-choice situation; and although simultaneous, reciprocal choices were required in this study, a cumulative effect on the outcome of the game was presented to the subjects on each trial. A feature of the Vinacke experiments which makes them difficult to interpret in terms of the model[27] is the fact that successive contacts could result in coalitions.

While it is asthetically distasteful to cite procedural differences as the major reason for two distinct interpretations of the same phenomena it should be noted the differences discussed drastically alter the social context

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[27]See Shelly and Phillips, 1966, for a discussion of this problem.

within which the subjects in the various experiments make their choices and negotiate for rewards. Further investigation of the differences between the political convention and the parchisi paradigms will very probably yield a fuller understanding of the contact and bargaining process.

APPENDICES

APPENDIX A

INSTRUCTIONS--PARITY

We are interested in observing the ways in which people play competitive games. The two games you will play today involve the moving of tokens down a game board. Each of these games is part of a preliminary study which will be run later in the year. Although we cannot use money as a reward today we would like you to think of the points which each game is worth as a monetary reward. Each game will be worth 100 points to the winner. You may win by crossing the finish line alone, or you may join forces with another player to win. If two of you decide to join forces to win, each of you will receive a share of the 100 points. You will find a card in the room giving your share, if you join forces with either of the other players.

Each player will be in a small room with a game board like this. Each player will be represented by one of these three tokens. On each move of the game each token will move a certain number of spaces toward the finish line. Each player will be assigned a weight, a number that determines how many spaces his token is moved on each move. These weights are (4, 3, and 2) for one game, and (3, 2, 2) for the other game. The game boards in the room are controlled by this unit, which I will use to advance each player's token on each move of the game. If a player's weight is 3, then his token is advanced 3 spaces each move. The first player to cross the finish line is the winner. If two of you decide to join forces, the two of you automatically win. That is, if the player who has the weight of 2 decides to join forces with the player who has the weight of 3, their combined weights would be used to move both their tokens down the board, and hence, they would automatically win.

The object of the game is to get your button or token across the finish line before anyone else does--or at least as soon as anyone else does. There are two different situations in which you may find yourself. Either you will be <u>ahead</u> or you will be <u>behind</u>. That is, either your token will be closer to the finish line than anyone elses token, or someone elses token will be ahead of yours. If you are behind, the only way you can win is to join forces with someone else. If you are ahead, there are two ways you can win--you can either join forces with someone else, or you can just wait and hope neither of the other players will join forces.

O.K. So how do you go about joining forces with someone? The small gray box in your room allows you to communicate your desire to join forces with someone else. Each light and switch corresponds to another player. The top row of lights will not be used in this experiment, so just ignore them. Since there are only three of you who will be playing today, the unused lights and switches will be covered with plain white cards like this (show cover). The other switches will have the point value of some other player on them (show indicator). The colors of the lights correspond to the colors on the tokens on the game board. That is, the red light and the red token correspond to you, no matter which room you are in. The blue light and blue token represent the player in a particular room; similarly for the yellow light and token.

You will have two choices on each move: (1) you may contact one of the other players, which indicates a desire on your part to join forces with that player, or (2) you may choose not to contact anyone. To indicate your choices you will pull the lever towards you above the light which corresponds to your choice. If you wish to contact another player, you would pull the switch above his light. Please try to make your choice as quickly as possible because only a short time will be allowed for each move. A move will start when the large, red ready light on the front of your gray box comes on and will end with the beginning of the next move. As soon as each of you have pulled a lever, your choices will be recorded and after all of you have indicated a choice, all of the choices will be made known to the players who were chosen. This will be done by lighting the lights on the tops of your gray boxes. You may pull one and only one switch on a given move.

If two of you send messages to each other on the same move, we will consider that you have decided to join forces to win the game. If this happens, then the game is over because the two who joined forces automatically win. If this doesn't happen, then we will go on to the next move.

Please do not speak or make unnecessary noise during the experiment. The game boards and recording device make quite a bit of noise, but try to ignore it.

Are there any questions before we begin?

The instructions for the equal reward condition were the same as those for the parity condition, with the exception of the first paragraph. Subjects in the equal reward condition were told that they would receive fifty points regardless of the coalition which was formed during the game.

APPENDIX B

REVIEW OF RELATED LITERATURE

Although the studies discussed below are not directly relevant to the concerns developed in the body of the thesis, they are essential to a complete understanding of the variables pursued in the study of coalition formation. The reports discussed here may be categorized into several distinct units: (1) the first deals with studies conducted employing the Bales Interaction Process Analysis System, (2) the second with anticompetitive behavior, (3) the third with coalitions in tetrads, and (4) the fourth with a related theory of power relationships in social contexts. Any coherence which develops between the four distinct categories is accidental; this section is included for the sake of completeness and is not intended to be an integrated review of a body of research literature.

In the first research conducted involving coalitions, Mills,[28] using the Bales procedures, found that individuals tend to segregate into a pair and an other when median support rates were used as measures of coalition behavior.

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[28]Theodore M. Mills, "Power Relations in Three-Person Groups," American Sociological Review, 18 (1953), 351-357.

When this segregation was accentuated, a power structure developed which was stable across several trials of the experiment. The conclusion reached by Mills was that this result represented the "true coalition structure" in the group. In a later attempt to replicate and extend his findings, Mills[29] used several personality measures and found that emotional factors were involved in the formation of coalitions; coalitions were not structurally related to an interdependence between the partners.

Marie Borgatta,[30] in a review article which presents the various theoretical views of coalition formation in a complete discussion, points out that Mills did not necessarily investigate coalitions. She notes that task, role, and maximum possible interaction rate influence coalitions in addition to agreement between the two parties involved. The global inclusion of the work of Bales and his associates in this discussion aids in the understanding of coalitions based on interaction rates, but gives little insight into further problems. In discussing Caplow's theory of coalition formation, she notes that the necessity of status positions for the continuance of the group may influence coalition behavior.

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[29]Theodore M. Mills, "The Coalition Pattern in Three-Person Groups," American Sociological Review, 19 (1954), 658-677.

[30]Marie L. Borgatta, "Power Structure and Coalitions in Three-Person Groups," Journal of Social Psychology, 55 (1961), 287-300.

The discussion revolving around coalitions measured by interaction rates has been carried further by Borgatta and Borgatta[31] in an article which deals with the methodological aspects of Mills' studies. Questioning Mills' index of support and the matrices which are developed from it, they proposed another index which disregards the group response categories of the Bales system. The median rate of support is dropped from the analysis and the mean substituted for it. While their efforts in behalf of accounting for differential support and initiation rates in three-person groups are of heuristic value, the lack of cogent conclusions and clear discussion make it difficult to assess their research findings.

In a second article Borgatta and Borgatta[32] present a further analysis of the data discussed in their previous article. In developing the argument for consideration of their findings they note that the definition of coalition and the type of situation in which it is investigated have relevance for the theory and findings developed from research. While not a startling distinction, their cognizance that coalitions, to be meaningful, must occur in situations where persons act in accord toward a common

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[31]Edgar F. Borgatta and Marie L. Borgatta, "Coalitions and Interaction Concepts of Support in Three-Person Groups," <u>Social Forces</u>, 41 (1962), 68-77.

[32]Marie L Borgatta and Edgar F. Borgatta, "Coalitions in Three-Person Groups," <u>Journal of Social Psychology</u>, 60 (1963), 319-326.

goal. If a subset of the members of the group are involved, a coalition has developed; if all the members of the group are involved, a unanimous situation obviates the relevance of a coalition. Using a modified Bales scoring system and the distinction between types of group situations, the Borgattas present profiles for 38 triads. No consistent results are apparent from the table which they present although nine of the eighteen measures show trends favoring one of the group forms over the other, across three sessions of the experiment. As with other reports which have employed the Bales scheme of analysis, it is difficult to determine exactly what the findings indicate. To try to generalize beyond the finding of differential preferences for interaction partners in three-person groups seems to be a path littered with pitfalls.

Vinacke[33] introduced females into the parchisi paradigm described above (page 2) and found that they were more interested in arriving at fair and equitable solutions than were the males. Introduction of cumulative score keeping (Caplow's continuous situation reported above) washed out the sex differences, which, according to Vinacke, suggests a higher interest for the females under this condition of play.

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[33]W. Edgar Vinacke, "Sex Roles in a Three-Person Game," Sociometry, 22 (1959), 343-360.

In further investigations of the sex differences reported above, Vinacke and Bond[34] found essentially no difference in the amount of bargaining which took place when either males or females were in the majority in mixed sex triads. The striking points in the report of the experiment were that the female members who were in the minority did better than their male counterparts. The female concern for parity in rewards carried over into this situation, and the females lost their interest in the cumulative score situation. The findings lead to the conclusion by the authors that male strategy is "self-defeating" when it encounters female strategy. Uesugi and Vinacke[35] used a game involving statements about inter-personal behavior, designed to overcome the masculine bias of the previous experiments and report a significant increase in female strategy, but found no difference for the males in the situation. The results of these experiments led Vinacke and his collaborators to label male strategies as exploitative and female strategies as accomodative.

Vincake[36] reports in yet another variation of his earlier work in which the task was not competitive within

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[34] W. Edgar Vinacke and John R. Bond, "Coalitions in Mixed-Sex Triads," Sociometry, 24 (1961), 61-75.

[35] Thomas K. Uesugi and W. Edgar Vinacke, "Strategy in a Feminine Game," Sociometry, 26 (1963), 75-88.

[36] W. Edgar Vinacke, "Intra-Group Power Relations, Strategy and Decision in Inter-Triad Competition," Sociometry, 27 (1964), 406-414.

the group, but was directed at competition with another group that consensus was arrived at with greater frequency without regard to power differences. This is not a startling result when one considers the nature of the task. The subjects were asked to present a united front to an outside source and did so with a minimum of conflict; the task was not perceived as a competitive one by the subjects, but was correctly perceived as a cooperative task.

From the above studies it is possible to find support for anticompetitive theory in groups which involve females in a face-to-face competitive task. Several explanations have been advanced for this result, but no systematic investigation has been carried out to determine the reasons for the phenomena reported. The explanation that the anticompetitive norm develops as a result of normative prescriptions on the female role appears to be the most viable explanation advanced to date.[37]

Willis[38] attempted to extend the Caplow theory to four-person groups, using a game similar to Vinacke's to test the extension. Unfortunately, his results fail to support the theoretical extension except in the case of

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[37]James L. Phillips, Lawrence H. Nitz, and Robert Shelly, "A Note on Sex Differences in a Competitive Task," Human Learning Research Institute, 1966. (Mimeographed.)

[38]Richard H. Willis, "Coalitions in the Tetrad," Sociometry, 25 (1962), 358-376.

the three-person coalitions. Several reasons were advanced by Willis to explain the failure, but the most plausible explanation seems to lie in the greater complexity of his experimental situation.

Shears[39] employed the parchisi paradigm discussed above to study tetrads. The subjects employed were males, a face-to-face situation was involved, and each group played ten games. Unfortunately, several of the groups formed permanent alliances at the outset of the session reducing the number of groups available for full analysis. One of the two power distributions employed allowed a weak, winning, triple alliance, the other a weak, tying, triple alliance. From the results obtained in studies dealing with triads, the expectation of such alliances occurring frequently is a tenable one. However, this result was not obtained; the weak, tying, triple alliance occurred above chance, but in less than half of the groups studied. The weak, winning, triple alliance occurred with less than chance frequency. When one considers the payoffs, this is not a startling result. In the case of the weak, tying, triple alliance, the payoff share, assuming a parity norm, is only .17 as opposed to .25 for the winning dual alliance in this situation. In the case of the weak, winning, triple, the payoff share, assuming

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[39]Loyda M. Shears, "Patterns of Coalition Formation in Two Games Played by Male Tetrads," <u>Behavioral Science</u>, 12 (1967), 130-137.

a parity norm, is greater for two members of the group if the winning triple is employed (.40 as opposed to .30 , and the same for the other member with either the dual or triple alliance. In this case it is appropriate to invoke ease of forming the coalition and assurance of payoff to explain the results.

In attempting to assess the contributions of the two articles on coalitions in tetrads the conclusion reached is that neither contribute significantly to the understanding of coalition formation. The latter article does, however, point out several variables which are of interest for further research in both triads and tetrads.

The position that power in a social sense resides not as an attribute of the actor but as a property of the social relationship between two actors is maintained by Emerson.[40] The power which one individual holds over another, according to this theory, resides implicitly in A_2's dependence on A_1. This dependence is manifested by proportional relationships involving the extent of A_2's motivation in goals mediated by A_1 and the availability of these goals outside the social relationship. The direct measure of power employed in this theory is the amount of resistance manifested by one actor which can be overcome by the other. Emerson goes on to discuss a

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[40]Richard M. Emerson, "Power-Dependence Relations," American Sociological Review, 27 (1962), 31-41.

series of balancing operations which influence power relationships. The only operation relevant to our discussion is the last, which denies the most powerful access to alternatives for achieving his goals. This results in increased strength for the weaker actors through a collectivization of their resources.

Two experiments were conducted by Emerson[41] to test his theory. The first involved conformity to a coercive source of authority. The results of the experiment supported the contentions developed by Emerson regarding dependence in power relations. The second experiment was a three-person game which allowed a payoff on each of the twenty trials. Coalitions were formed by the subjects in this experiment so as to equalize the cumulative outcomes between the various power positions. Emerson notes that in both experiments the availability of alternative rewards is a crucial variable. While of heuristic interest in pointing to variables which may operate in coalition formation situations, the concept of power dependence has little value in analyzing the complex behaviors evidenced in studies of coalition behavior.

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[41]Richard M. Emerson, "Power-Dependence Relations: Two Experiments," <u>Sociometry</u>, 27 (1964), 282-298.

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