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Coalition Formation in Small Groups with Incomplete Communication Networks

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The question of how coalitions form within groups whose members cannot all communicate with each other was investigated with an experiment involving 41 adolescent West German subjects. In groups of six or seven members, subjects played a computer-based coalition game in which message channels were variably restricted to certain pairs of players. Subgroups with more communication channels became the winning coalition more often, and individual players voted more often to exclude from the coalition those with whom they could not communicate. Among those linked by communication channels, voting behavior was related to the frequency with which these channels were used and to the direction and content of the transmitted messages. For example, senders voted against receivers less than receivers voted against senders. The effects of the communication network remained undisturbed by two manipulations of the importance of communication.

Research on communication networks in task-oriented small groups has made it clear that these networks affect group behavior and that individuals at different positions in a network behave differently. In most instances, problem-solving efficiency, morale or satisfaction, and leadership or influence in reaching the solution have responded to manipulation of the network (Bavelas, 1951; Gilchrist, Shaw, & Walker, 1954; Leavitt, 1951; Macy, Christie, & Luce, 1953; Shaw, 1954, 1955, 1958; Shaw, Rothschild, & Strickland, 1957). The relationships are still far from completely known and appear to be complex. Although task performance tends to be more efficient in denser networks, that is, those with more channels, this may not be the case if the task is quite simple or highly dependent on central coordination (Heise & Miller, 1951; Shaw, 1958; Snadowski, 1972) or if the subjects have accumulated much experience working within the same network (Flament, 1963, pp. 82–84; Guetzkow & Simon, 1966; Mulder, 1960; Shaw, 1954). Typically, subjects located at more central positions of a network have tended to be more satisfied and to be seen as more influential in reaching the solution, but exceptions have been reported. Many of the experimental results have been reviewed by Hare (1962, chap. 10), Bössmann (1967, chap. 6), and Shaw (1971, pp. 137–145).

How do different networks and network positions affect intragroup conflict as opposed to cooperation? In particular, how does coalition formation proceed in groups characterized by incomplete communication networks, which do not allow every member to communicate directly with every other member? In a recent series of experiments on bargaining and coalition formation (Rapoport & Kahan, Note 1), the rules governing the secrecy and the timing of message transmission were manipulated, and the investigators looked for consequent differences in the coalitions that were formed, the ways they divided the reward, and several measures of bargaining behavior. "Throughout all these results," however, "there were no differences due to

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the various communication variables" (Rapoport & Kahan, Note 1, p. 13). Only the order of message transmission was found to have an effect: Subjects permitted to communicate first had an advantage. But this was the case only in four-person games and not in five-person ones.

If Rapoport and Kahan's (Note 1) largely negative findings were to be generalized to all manipulations of the communication network in coalition situations, the result would be most surprising. It would go against the belief among students of coalition behavior (Francis, 1970; Kelley, 1968) that communication opportunities affect the formation and composition of coalitions. It would also contrast with, even if not logically contradict, experimental findings that, at least under some conditions, bargaining outcomes are influenced by the type of communication permitted (Daniels, 1967; Westen & Buckley, 1974), cooperation is more likely when communication is facilitated (review by Santi & Wells, 1975), hostility and the willingness to hurt are reduced by closer communication (Cappello, 1972; Milgram, 1965), and satisfaction with other members of a group is greater when one can communicate with them (Snadowsky, 1974).[1]

The classical variable in communication network experiments—who may communicate with whom—is one that Rapoport and Kahan (Note 1) did not manipulate. It is to be expected that if this variable were manipulated in a coalition situation, it would have a strong effect on who enters the winning coalition and on the bargaining process leading to its formation. In coalition situations, participants exchange more than factual information and more, even, than offers of a given percentage of the reward. They also exchange offers of and bids for solidarity, or joint membership in an emerging group. Here it is to be expected that messages will lose much of their effectiveness when relayed through intermediaries, in addition to the loss of accuracy that is present for factual messages (Flament, 1963, p. 86; Verba, 1961, pp. 235–236). What should be important in coalition situations is not the indirect "reachability" of one group member by another but rather their "adjacency" (Harary, Norman, & Cartwright, 1965), that is, the presence or absence of a communication channel linking them directly. Subjects permitted to communicate with each other should be more likely to enter the winning coalition together, and subjects should be more likely to try to bring into the winning coalition those with whom they can communicate than those with whom they cannot.

Hypotheses

These and some related expectations can be formulated as a set of eight hypotheses. These hypotheses share a common pair of antecedent conditions: (a) There is a group in which some pairs of members are adjacent (i.e., the two members are linked by a direct, two-way communication channel) and other pairs are not (i.e., the two members cannot communicate directly). (b) If a coalition is formed by more than a certain number (the number being at least one half the size of the group) but less than the total number of the members of the group, the members of the coalition will be rewarded. Under these conditions, the following predictions can be made:

Hypothesis 1: A coalition that is actually formed will tend to contain more adjacent pairs of members than would be expected by chance. This hypothesis deals with the outcomes of the coalition-forming process. All of the remaining hypotheses deal with the process itself.

Hypothesis 2: A coalition that is proposed by any member of the group will tend to contain more members adjacent to the proposing member than would be expected by chance.

Hypothesis 3: At the individual level, the likelihood of a given member p_i proposing to include a given other member p_j in a coalition will be greater if they are adjacent than if they are not.

Hypothesis 4: Given that two members of the group, p_i and p_j, are adjacent (i.e., are

[1] The last finding emerges from an inspection of Snadowsky's (1974) data for satisfaction with leaders and nonleaders in complete and incomplete networks, although the significance of this interaction was not reported.

able to communicate), the likelihood of p_i proposing to include p_j in a coalition will vary with the frequency with which the communication channel between them has been used at the most recent opportunity. Specifically, the likelihood will be greatest if communications have traveled between them in both directions, next greatest if in only one direction, and least if no communication has traveled in either direction. The next hypothesis elaborates this one.

Hypothesis 5: If communication has traveled in one and only one direction between p_i and p_j at the latest opportunity, the sender will be more likely to propose the inclusion of the receiver in a coalition than the receiver to propose the inclusion of the sender. Deutsch (1958) found in a bargaining experiment that those who sent messages proposing cooperation were more likely to cooperate thereafter than those who received such messages. He offered the explanation that when he sends a message, the sender commits himself, but does not commit the receiver, as long as the situation is not so competitive as to make deception legitimate.

The hypotheses above have ignored the content of communications and the motivations of the group members, but these may be related to coalition-forming behavior and to each other. Deutsch and Krauss (1962) hypothesized that communication channels are more often used by cooperatively than by competitively motivated bargainers. If so, as group members develop cooperative orientations toward those with whom they perceive themselves to be coalescing, communication behavior should change. Those intending to propose each other's inclusion should communicate more than those intending to propose each other's exclusion. This would reinforce the relationship expected in Hypothesis 4.

But even if motivations affect communication volume so as to support Hypothesis 4, they may affect communication content in a way that counteracts that hypothesis. Extreme antagonism might lead p_i not to avoid communicating with p_j, but instead to send him offensive communications, such as a suggestion that p_j support a coalition that includes p_i (the sender) but excludes p_j (the receiver). In contrast, extreme benevolence might lead p_i to offer to sacrifice himself for p_j's benefit by suggesting that p_j support a coalition including p_j but excluding p_i. We should expect p_j to take offense at the first type of communication, which we term a hostile communication, and to take advantage of the second extreme type, which we term a "martyr" communication. This leads to the next prediction:

Hypothesis 6: Given that p_i and p_j are adjacent, the likelihood of p_j proposing to include p_i in a coalition will be less if, at the latest opportunity, p_i has sent p_j a hostile or a martyr communication than if p_i has sent p_j no communication at all, controlling for whether any communication has traveled in the other direction.

Hypothesis 7: The effects in Hypotheses 1, 2, and 3 will vary directly with the degree to which members of the group are sensitized to the importance of the communication channels and barriers in the group.

Hypothesis 8: The effects in Hypotheses 1–6 will vary inversely with the amount of information available to group members about the preferences of other members from sources other than member–member communication. These last two hypotheses assert that the various communication effects will be strengthened when the (subjective or objective) importance of the communication network (both hypotheses) or of actual communication (Hypothesis 8) is increased (Crott, 1972; Hartnett & Cummings, 1971).

METHOD

Subjects

Subjects were 41 persons, aged 15 to 21, who lived in the area of Mannheim and Heidelberg, Federal Republic of Germany. They had previously taken part in a social-psychological experiment and indicated a desire to be subjects again. Some of those previously classified as highly introverted or extraverted had been withdrawn from the pool for another experiment. Most of the subjects were Gymnasium students. Subjects served in six groups, which were intended to have seven members each, but one group was reduced to six members by a subject who failed to appear and could not be replaced. A ratio of 25 males to 16 females was attained by accepting all female volunteers but not all male ones; the sex distribution was approximately equalized among the six groups.

Apparatus

The experiment took place in the computer-assisted instruction laboratory of a large training institution. Each subject was assigned to an IBM 2740 typewriter terminal, located inside a three-walled carrel. Terminals were connected to an IBM 370/155 computer, which executed the randomizations, instruction giving, training, message taking, message delivery, vote taking, result tabulation, feedback delivery, rule enforcement, timekeeping, event recording, and data analysis to be described below, via programs written in APL-PLUS. Subjects were already familiar with the use of the computer terminals, because they had participated in a 300-round Prisoner's Dilemma experiment the same morning using this equipment.[2]

Procedure

Subjects and the experimenter had lunch together before the experiment. Upon their return to the laboratory, the experimenter told them that they would now play a game against each other rather than against the computer as they had done during the morning. He then seated the subjects at their terminals, so that they were out of visual contact with each other. He next turned on the terminals. which proceeded to give each subject the rules and training for playing the game.

The game involved all six or seven persons in the group, had a coalition-forming task, and gave a monetary reward to those who succeeded in forming a winning coalition. The game was called *Tod auf See* (Death at Sea). According to the scenario, the subjects were passengers in a sinking lifeboat that could not hold them all and would continue to sink unless four of the passengers could reach an agreement as to which bare minority of the group (i.e., two in the six-person game or three in the seven-person game) should be thrown overboard. Passengers were informed at the beginning as to how long they had to reach this agreement before the boat would sink. If an agreement was reached in time, the four passengers who remained in the boat would reach an island, where they would find a buried treasure of 20 German marks, to be divided equally among them. In accordance with this scenario, the four winners of each game were paid five marks apiece (approximately $2), the losers were paid nothing, and, if the time limit passed without an agreement, no players were paid anything.

The mechanism that was provided for officially forming a coalition was voting. The game went on for as many rounds as were necessary to reach an agreement or to exhaust the time limit, and on each round each player could vote by naming the players he wanted to exclude from the winning coalition. If on any round four players cast identical votes, the four passengers left on board by their votes became the winning coalition, and the players were informed of the outcome of the game. Otherwise, if there was still time left before the deadline, the failure to reach agreement was announced, together with

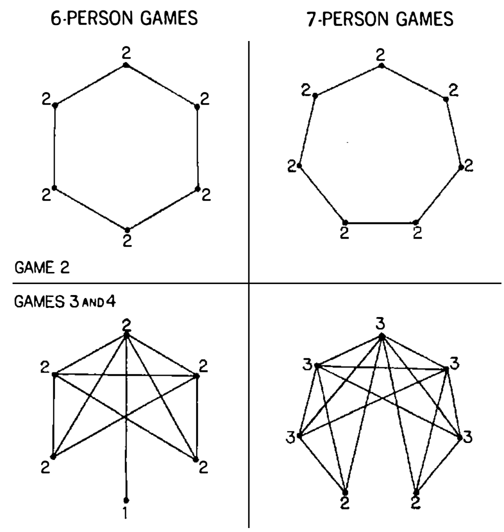

FIGURE 1. Communication networks in Games 2, 3, and 4.

the amount of time remaining, and the next round was begun. Nothing was stated in the instructions about the possibility of voting against oneself, but such a vote was accepted and processed if cast.[3]

Of the experimental conditions that were varied, the most important for the present study was communication. Each group played the game four times. In Game 1, no communication was permitted. This game, plus a training exercise, helped to acquaint the subjects with the rules and procedures and is excluded from the analysis below. In Games 2, 3, and 4, each player had the opportunity to send messages to other players before the votes were cast for each round. Each message went privately from one sender to one receiver. The number of messages that a given player could send in a round as well as the set of players he was allowed to send them to differed from player to player but remained in effect throughout a game. Figure 1 shows the communication networks that were provided in these games.

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[2] Support for the programming, program revision, and conduct of this experiment was provided by Stiftung Rehabilitation (Heidelberg), the Deutscher Akademischer Austauschdienst, the Council for European Studies, the Institut für Sozialwissenschaften der Universität Mannheim, the State University of New York, and Sonderforschungsbereich 24 der Universität Mannheim. Assistance of various kinds was rendered by Rudolf Wildenmann, Betty Weneser, Walter Wehrli, Wilfried K. Schreiber, Margit Oswald, Martin Irle, Jeannette Huber, Dietrich Franz, Wolfgang E. Fendt, Günter Dhom, Walter Augsburger, and others.

[3] Thus the winning and deciding coalitions need not be identical here. Since in practice they usually are, analysis is limited to winning coalitions.

Each point represents a player, each line represents a two-way communication channel, and each number represents the number of messages per round that the player in question was allowed to send. Since all channels are two-way and every player is "reachable from," although not necessarily adjacent to, every other player, the networks shown in Figure 1 are all incomplete, symmetric, strongly connected digraphs (Harary et al., 1965). Pairs of players differ in the distances between them and, in particular, in whether they are adjacent.

Messages were all of a fixed form and could only be voting suggestions or promises of side payments. A voting suggestion simply consisted of a recommendation as to which players should be excluded from the winning coalition. A promise of a side payment was a binding commitment to pay the receiver some chosen amount of money at the end of the game if both the sender and the receiver were members of the winning coalition. A voting suggestion could name no more and no fewer players than the number (two or three) to be excluded. Side-payment promises could be made in any amount of pfennigs, with the restriction that, in the course of any game, no player could promise a total of more than the reward out of which the promises were to be paid (i.e., 5 marks). Each message could take the form of a suggestion or a promise, but not both.

To prevent any single player from filibustering, a time limit of 30 sec was placed on each choice of message receiver, message type, message content, and actual vote. Players exceeding this limit were temporarily ignored so that the game could proceed. An option was provided for sending fewer than the permitted number of messages in a round but not for abstaining from a vote. In fact, however, a player could abstain from voting by exceeding the time limit. Since only four identical ballots were needed to end the game, a coalition could be formed even if all but four players exceeded the time limits.[4]

Two additional conditions, affecting the importance of communication, were also manipulated. One (Hypothesis 8) was information. In Games 2 and 3, the feedback after each round reported only the failure to reach an agreement. In Game 4, however, each player was given a complete tabulation of the votes cast that round, that is, who had voted against whom (and who had failed to vote). In effect, this condition removed ballot secrecy, permitted players to compare voting suggestions with actual votes, and provided perfect information about how the process of coalition formation was proceeding. The other condition varied (Hypothesis 7) was the meaning attributed to the communication barrier. In every odd-numbered group, those subjects who were not adjacent to everyone else were given an elaborated scenario, in which the passengers to whom they could send messages spoke German and the others spoke an "incomprehensible foreign tongue."

The players were identified only by number, and no one knew which player had which number, except for himself. At the start of each game, numbers were randomly reassigned to the subjects and also to the positions of the communication network for that game. Each player was then told his own number, the numbers of the players to whom he could send messages, and how many messages he could send each round, along with the other requirements of the game.[5]

Upon completion of the fourth game, subjects were paid whatever they had won in the four games, plus 10 marks for the day's participation, and were debriefed.

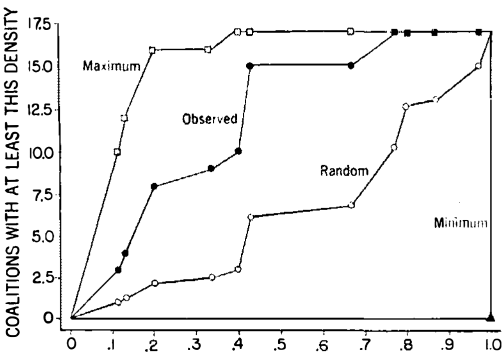

FIGURE 2. Communication channels within winning coalitions.

RESULTS

Two of the expected effects were absent. The tendency to vote against nonadjacent players was identical, whether the subjective importance of the communication network was high or low and whether the amount of extracommunicational information about player preferences was large or small. Thus neither Hypothesis 7 nor Hypothesis 8 was confirmed, and the data for both values of the two independent variables in these hypotheses are combined in the remaining analysis.

The data relevant to Hypothesis 1 are shown in Figure 2. In the 18 times Death at Sea was played in this experiment, the groups

[4] This procedure avoids the criticism of small-group experiments in which every member is, unrealistically, essential to the group's success (see Glanzer & Glaser, 1965).

[5] One of these other conditions was the time limit: 20, 20, and 14 minutes in the six-person game and 30, 30, and 22 minutes in the seven-person game, for Games 2, 3, and 4, respectively. These limits, based on the estimated difficulty of reaching agreement with different numbers of players and different feedback conditions, had been fixed a priori by the experimenter.

were successful in coming to an agreement on a winning coalition before the deadline in all but one case. If all of the 17 winning coalitions had contained the least dense communication networks allowed by their experimental conditions, then the (cumulative relative) coalition network density distribution would have followed the curve marked "minimum." If winning coalitions had been selected by chance, without regard to communication opportunities, the distribution of their network densities would have followed the "random" curve. And if the most communicatively endowed subgroup had become the winning coalition each time, the "maximum" curve would have indicated the distribution of their network densities. The actual distribution is the curve labeled "observed." At some points it coincides with the "maximum" curve; elsewhere it lies considerably toward the "maximum" side of the "random" curve. This means that the winning coalitions had considerably more adjacent pairs than would have been expected by chance ($p < .003$).[6] The four-person subgroups in each experimental condition with the largest number of adjacent pairs would have been expected by chance to become the winning coalition only 2.6 times, yet actually did become the coalition 9 times. The *least* densely linked subgroup(s) in each condition would have been randomly expected to form two of the coalitions but in fact formed none of them at all. This result confirms Hypothesis 1.

Hypothesis 2 deals with the votes cast in the process of reaching (or attempting to reach) a coalition. The only votes that are relevant to the hypothesis are those cast by players who were members of at least one adjacent and at least one nonadjacent pair. A total of 450 votes were cast by such players in the 18 games. Their distribution is shown in Figure 3. The pattern here is similar to that in Figure 2, although not so extreme. When each vote is rated as to its likelihood in the experimental condition where it was cast, it can be seen that the voting was definitely more favorable to adjacent players than random voting would have been ($p = e^{-60} \approx 0$).[7] In this case, the maximum curve shows the distribution that would have

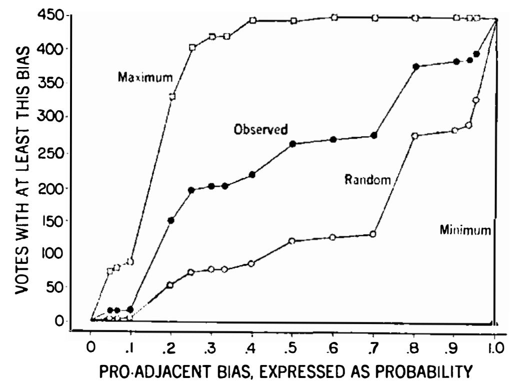

FIGURE 3. The tendency to vote against nonadjacent players.

resulted if everyone had always voted against the largest possible number of nonadjacent players. The result confirms Hypothesis 2.

Hypothesis 3 brings the level of analysis down from the vote to the vote element, that is, an instance of one player naming another player in a vote. There were a total of 1,409 vote elements, as shown in Table 1. Of these, 57% were against nonadjacent players, as compared with the 44% expected and the 75% theoretically possible. This result ($\chi^2 = 148$, $p < .001$) confirms Hypothesis 3.

We can see the result of the test of Hypothesis 4 in Table 2. As expected, the tendency to vote against a potential communica-

[6] Figure 2 was composed by rating each possible coalition in each of the four communication conditions (six-person vs. seven-person game, circle-shaped vs. webb-shaped network) as to the probability of a coalition being formed in that condition with an equally dense or denser network of channels among its members. Density was simply measured by the total number of lines, that is, adjacent pairs. But since a coalition with a given number of channels may be one of the densest possible coalitions in one condition and one of the least dense possible in another, all densities had to be translated into (within condition) probabilities for aggregation across conditions. The significance of the deviation of the observed distribution from the random one is measured here and in Figure 3 by the Smirnov test for maximum differences between cumulative distribution functions.

[7] By the likelihood of a vote is meant the likelihood that a vote cast by a person at that position in that communication network would, by chance, name as victims that many or more nonadjacent players, after having taken into account whether one of the players voted against was the voter himself.

TABLE 1

COMMUNICATION OPPORTUNITY AND COALITION CHOICE

Item	Vote elements against players not adjacent to voter		
	No. vote elements	As % of all cast	As % of those subject to choice
Theoretical maximum	1054	75	100
Observed	798	57	71
Chance expected	617.2	44	50
Theoretical minimum	173	12	0

Note. $N = 1409$.

tion partner varies greatly with the degree of actual communication that has just taken place between the two. Taking as the base the situation in which messages have flowed in both directions earlier during the round, we find a player more than twice as likely to vote against someone if messages have flowed in only one direction, and five times as likely to vote against him if they have not exchanged messages at all. This result ($\chi^2 = 223$, $p < .001$) confirms Hypothesis 4.[8]

The same table confirms Hypothesis 5 as well. Among those who have engaged in one-way communication with another player, receivers are more than twice as likely to vote against senders as senders are likely to vote against receivers ($\chi^2 = 49$, $p < .001$).

Looking at the table in another way, we can ask: Given whether p_i sent a message to p_j, does p_j's communication toward p_i help us to predict either p_i's or p_j's voting behavior? The answer is that each is significantly less likely to vote against the other if p_j has sent p_i a message during the round. But the messages a player sends tell us much more about his likely voting than do the messages he gets.

Hypothesis 6 is only partly confirmed by the data, which are shown in Table 3. When player p_i has sent a message to p_j, p_i is more likely to vote against p_j if p_j has sent him a martyr or hostile message (row 3) than if p_j has sent him no message at all (row 2) and least likely to vote against him if he has sent p_i an ordinary "friendly" message (row 1), as hypothesized ($\chi^2 = 22$, $p < .001$). But when p_i has sent no message to p_j, the only confirmed part of the hypothesis is that p_i is least likely to vote against p_j if the latter has sent him an ordinary message (row 6; $\chi^2 = 38$, $p < .001$); his likelihood of voting against p_j is greater—and about equally so—if p_j has sent him a martyr message, a hostile message, or no message at all (rows 7–10). The greater tendency to vote against the senders of martyr messages than against the senders of hostile ones, although consistent in both halves of Table 3, does not attain statistical significance. Finally, the table reveals a regularity further elaborating Hypothesis 5: Given p_j's message behavior, p_i is more likely to vote against him if p_i has not sent him a message during the round. This is shown by the fact that ratios in rows 6–10 are greater than respective ratios in rows 1–5 ($p < .001$, .001, .02, .02, and .25).

TABLE 2

COMMUNICATION CONDITIONS AND COALITION CHOICE

Communication between players	No. vote elements against other player		
	Observed	Expected	Observed: expected
Messages in both directions	86	256.2	.336
Message(s) in only one direction	266	378.8	.702
From voter	65	173.8	.374
To voter	201	205.0	.980
Communication channel but no messages	259	156.8	1.652

Note. $N = 1409$.

SUMMARY AND DISCUSSION

Some hypotheses about coalition formation in small groups having incomplete communication networks were tested by a computer-based experimental game played by West German adolescent subjects. As hypothesized, subgroups whose members had many channels of potential communication among themselves were far more likely to become the winning coalition than subgroups containing few channels. Subjects were considerably more likely to vote to exclude someone from the winning coalition if they were unable to communicate

[8] Chi-squares for Tables 2 and 3 have been computed without regard to the imposed limits on deviation from the expected frequencies and are thus conservative.

with him than if they were able to. Among those able to communicate with each other, there was a strong relationship between actual use of this opportunity and coalition partner choice: Those who had been communication partners on any round were more often selected as coalition partners. Two-way communication partners were preferred to one-way partners and among the one-way partners senders were more benevolent toward receivers than vice versa.

When messages were classified by content, it was found that recipients of hostile or self-sacrificial ("martyr") messages were more likely than recipients of ordinary (cooperative) messages to vote against the message sender. Although players rarely voted against the same people they sent messages to, the likelihood of such a vote appeared to be very responsive to the communication behavior of the message target. A negative vote was somewhat more likely if the target sent no message to the voter, and much more likely if the target sent him a hostile or martyr message. Why, then, was voting behavior less influenced by communications from those who were not among the voter's message targets? Why did it make no difference whether they sent the voter a hostile or martyr message or did not send him anything? One commonsense explanation is that people usually fail to send messages to a potential communication partner because they intend to vote against him. In such a case, it would not make much difference whether they received no message, a hostile message, or a martyr message from this person: Their intention to vote against him would not change. The intention might well be altered, however, by receipt of a friendly message; this pattern is present in the lower half of Table 3. In the upper portion of Table 3, voters have sent messages to their potential communication partner, presumably indicating an intention in most cases to vote for rather than against him. Although receiving a friendly message from him would reinforce that intention, receiving a hostile or martyr message would upset it, and receiving no message would subject it to reconsideration. The pattern of behavior observed is what this reasoning would suggest.

TABLE 3

MESSAGE TYPE AND COALITION CHOICE AMONG ADJACENT PLAYERS

Communication between players	No. vote elements against other player		
	Observed	Expected	Observed: expected
Voter has sent one or more messages to the other and has received:			
One or more ordinary messages	63	228.4	.276
No messages	65	173.8	.374
A hostile or martyr message	23	27.8	.827
A hostile message	10	17.1	.586
A martyr message	13	10.7	1.215
Voter has sent no messages to the other and has received:			
One or more ordinary messages	172	186.9	.920
No messages	259	156.8	1.652
A hostile or martyr message	29	18.1	1.602
A hostile message	16	10.6	1.505
A martyr message	13	7.5	1.733

The effects that were discovered did not vary when the barriers of the communication network were reinforced with fictional linguistic differences, nor did they vary when complete feedback about the voting results (i.e., who voted against whom) was provided at the end of each round. These negative findings disconfirmed the respective hypotheses. What might account for the stability of the communication effect when the importance of communication was manipulated? The differences in "linguistic" identity might have had no effect because they coincided exactly with the already announced communication barriers and thus introduced no new information. Identity differences failing to coincide with the communication barriers might make a difference; this is being investigated in current experiments.

As for the information contained in the voting feedback, two lines of reasoning are possible. On the one hand, more information should reduce the players' dependency on communication. But, on the other hand, feedback can make it harder to get away with misrepresentation of one's voting intentions through messages. If players are forced by complete voting feedback to send only sincere messages, then these messages may be trusted more by their recipients and thus may be more effective in reaching a consensus.[9] Perhaps what has been observed is a case of countervailing relationships canceling each other out.

A question for future analysis is the following: What experimental conditions and bargaining tactics are most conducive to success in becoming a member of the winning coalition? Beyond this, the patterns of coalition formation in various communication networks under different boundary conditions (group size, time pressure, reward structure, unidirectional vs. bidirectional channels, probabilistic vs. deterministic channels, etc.) remain to be investigated. Interactive computing systems should provide increasingly attractive sites for the relevant experiments (Pool & Grofman, 1975), and the combination of the communication-network and the coalition-formation traditions of experiments may provide a successful paradigm.

[9] Compare Burton (1969, p. 56). The comparison of Games 3 and 4 obviously falls short of a strict test of the effect of feedback, since players' experience and skill also increased from each game to the next.

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