Large Group Bargaining in a Characteristic Function Game

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This paper presents the results of an n-person characteristic function game played by between seven and and twelve players, one of whom was a monopolist. A factorial design allowed for analysis of the effects of group size, the availability of information, and communication opportunities for a series of seven trials. The data were compared to the game theoretic concepts of the core and Shapley value, (Shapley, 1953, Roth, 1977a), and to the predictions of the Weighted Probability model (Komorita, 1974). The findings indicated that the monopolist held a great deal of power, especially when communication among the players was not allowed. His payoffs increased over trials and approached the core in all of the conditions except when communicaion was available in seven and eight-person groups. The overall results were very close to the Shapley value and the predictions of the Weighted Probability model. The results were compared to an earlier study on a similar three-person game; increasing the group size seemed to be the primary case of the increase in the monopolist's payoffs.

N-person game theory offers several formal models that can be used to analyze a wide variety of conflict situations. In particular, game theory provides a framework within which games having different numbers of players can be compared. Unlike much of the social psychological literature (Chertkoff, 1970; Stryker, 1972), where research has focused primarily on the dynamics of three-person conflict situations, one advantage of game theory is its general applicability to situations where the number of players can vary.

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Several studies (e.g., Buckley and Westen, 1976; Michener and Sakurai, 1976; Rapoport and Kahan, 1976) have recently shown that game theoretic models are accurate predictors of coalition bargaining outcomes. The fact that these studies have taken decidely different approaches in testing the models is impressive support for the models' predictability. Another study (Murnighan and Roth, 1977) investigated the effects of communication and information availability in a three-person game,[1] and studied the relationship of the outcomes to the game theoretic concept of the core. The outcomes did not reach the core which, in the game studied, was an extreme point in the set of outcomes. However, the results suggested that the core might be reached under appropriate conditions. The present study, then, was conducted under similar communication and information conditions, with larger groups, to delineate the conditions where the core might be reached.

In any game the core is the set of outcomes which gives each coalition of players at least the payoff which they can command on their own. That is, a payoff vector is in the core if no coalition of players acting on their own can achieve higher payoffs for each coalition member. In a characteristic function game, v, with side payments, the core is thus the set of payoffs $(x_1, \ldots, x_n)$ such that, for each coalition S,

$$\sum_{i \in S} x_i \geqslant v(S).$$

In the game studied by Murnighan and Roth (1977), the players were denoted A, B, and C, and the characteristic function was: v(AB)= v(AC)= v(ABC)= 100; v(A)= v(B)= v(C)= v(BC)= 0. The core is the outcome which yields the payoff (100, 0, 0): i.e., 100 points for player A, and zero for the others. The payoffs in the Murninghan and Roth study (over all conditions, A received an average of 65 points per trial) did not reach the core (even though A's payoffs increased significantly over trials in the no communication conditions). In a sense, these results were not too surprising: the core of this game is an extreme point, and, thus, one might not expect it to be reached. The fact that other game theoretic models, including the bargaining set (Aumann and Maschler, 1964), and its subsets (Davis and Maschler, 1963; Horowitz, 1973; Schmeidler,

1. Under different experimental conditions, similar three-person games were studied by Maschler (1965).

1969) all coincide with the core for this game, however, might lead to stronger expectations. The question that the present study attempted to answer, then, concerned the conditions where the core might be reached (within the present paradigm). The possibility that increased group size would yield results close to the core was suggested by both social psychological (e.g., Komorita, 1974) and economic theory (e.g., Debreu and Scarf, 1963).

We predicted, then, that increasing the size of a relatively weak constituency would lead to increases in the monopolist's payoffs, and that they would approach the core. Group size, therefore, was manipulated to range from seven to twelve players. In particular, we studied games with player set N = A, . . . , L , with characteristic function v(S) = 100 for any coalition S containing player A and at least one other player, and v(S) = 0 for all other coalition S.

Although the core did not serve as an accurate prediction of Murnighan and Roth's (1977) results, the Shapley value (Shapley, 1953) did. In general, the Shapley value of a game v is the vector $\phi = (\phi_1, \ldots, \phi_n)$ given by

$$\phi_i(v) = \sum_{T \subset N} \frac{(t-1)!(n-t)!}{n!} \quad [v(T) - v(T-i)]$$

where t denotes the size of coalition T. This formula can be interpreted as the expected marginal contribution of a player when coalitions form in random order. The tradition theoretical justification for the Shapley value, however, lies in the fact that it is uniquely characterized by a certain set of simple axioms (Shapley, 1953). Recently, Roth (1977a, b) has shown that the Shapley value denotes the utility that a risk-neutral player might expect to receive from the play of a game. For the n-person game in the present study, $\phi_1(v) = 100 - 100/n$, and for i=2, . . . , n,

$$\phi_i(v) = \frac{100}{n(n-1)} .$$

For the game in the Murnighan and Roth study, the Shapley value gives the monopolist 66 2/3 points per trial, and each of the other players 16 2/3 points per trial; the results were very close to these values.

It is important to indicate that a social psychological theory, Komorita's (1974) Weighted Probability model, makes the same prediction

as the Shapley value. Of particular note is the fact that the Weighted Probability model is a descriptive model, based on accumulated data, that focuses on the distribution of resources among a set of players. The Shapley value, on the other hand, is a normative model. The fact that a descriptive and a normative model make identical predictions in this game strengthens confidence in the concurrent validity of both approaches.

Murnighan and Roth (1977) also found that the monopolist's payoff were highest and most sharply increasing in the conditions where communication opportunities were not given to the players. Thus, communication opportunities were manipulated in this study in an attempt to replicate the earlier results and extend them to larger groups.

In addition, we attempted to replicate the marginally significant effect for information availability which suggested that announcing the payoff division rather than keeping it secret would decrease the monopolist's payoffs, while announcing each players' offers, accepted offers, and rejected offers, would reestablish his relatively high payoffs. Thus, information availability was also manipulated in the present study.

This study, then, tested for the main effects of three variables (group size, communication opportunities, and information availability) on the payoffs obtained by a monopolist in a characteristic function game where he needed only a single partner to form a winning coalition. The study also tested the prediction of an interaction between communication opportunities and trials, where the monopolist's payoffs were expected to increase over trials when communication opportunities were not available. Other interactions (e.g., group size by communication opportunities) were also tested. In addition, other dependent variables, in particular the demands of the monopolist and the highest offers he received, were analyzed to determine their potential impact on the players' payoffs. Finally, attention was also paid to the messages that were sent and to the frequencies of the "all included" proposals made by the nonmonopolists to gauge their effects on the agreements that were reached.

METHOD

Subjects. Subjects were 526 undergraduate students who participated to fulfill requirements of a course in organizational behavior.

Subjects were told that the player in each position who obtained the most points among the players in their position would receive a $10 prize.

Design. This study manipulated four factors: (1) group size; (2) communication opportunities; (3) information availability; and (4) trials. Group size varied from seven to twelve players. For purposes of analysis, three levels of group size were considered: 7 and 8; 9 and 10; and 11 and 12. Communication opportunities were manipulated by allowing half of the groups to communicate with one another with secret, handwritten messages. The no communication groups were not allowed to communicate with each other. Information was made available in half of the groups by announcing every players' offers, acceptances, and rejections to all the players. The low information groups were only informed of the coalitions that had formed and the payoffs to the members of these coalitions. Each game was played for seven trials, where a trial was defined as an offer-acceptance sequence that resulted in the formation of a coalition. Thus, the number of trials was the only within-subjects variable in the design.

An additional information condition was also run for each group size. This condition was included as a control to check for the effects of announcing the payoffs to all the players. Thus, in this condition, only the positions of the coalition members were announced following each trial.

The final design, then, was a 3(group size) x 2(communication) x 2(information) x 7 (trials) factorial, with group size, communication, and information between factors and trials a within (repeated) factor. Ten groups participated in each communication/information combination, with three in each of the (7,8) and (9,10) group sizes and four in the (11,12) group size. Ten additional groups, in the same pattern of group sizes, were run as a control to test for the effects of announcing the payoff division.

The Game. The participants were confronted by a situation very similar to the one utilized by Murnighan and Roth (1977). The game was presented as a market consisting of 7 to 12 players, depending on the group size for that session. For each trial in the game, player A (the monopolist) owned a right shoe while each of the other players owned a left shoe. Single shoes had no value, but a pair of shoes (consisting of one right shoe and one left shoe) or combinations of one

right shoe and several left shoes could be sold for 100 points. Thus, no player acting alone could earn any income from the market, but any coalition of players which could assemble a pair of shoes could earn 100 points. Player A thus controlled a monopoly on right shoes. The game can be modeled in characteristic function form where N= (A,B,C, . . . , L), v(A)= v(X)= v(XX)= . . . = 0, and v(AX)= v(AXX)= . . .= 100, where X indicates one of the players in positions B through L, XX indicates two players in the positions B through L, and so on, and v indicates the value or payoff that the coalition identified inside the parentheses could obtain.

Procedure. The participants were given written instructions that were also read aloud by the experimenter. The instructions presented the game (described above) and the following (summarized) information: "Your task is to bargain among yourselves to determine who will sell their shoes and how the sellers will divide their payoff. We will repeat this procedure several times, with each player assuming the same position each time." The players were then instructed in the mechanics of the experiment, including how offers could be sent, how offers were accepted or rejected, and how agreements were determined. In addition, specific instructions, particular to each condition, were also presented. After reading these instructions, the experimenter went over several examples to insure that each of the participants understood the rules and mechanics of the game. Only after all the players expressed understanding of the entire set of instructions did the procedure continue. This instruction phase typically consumed 30 minutes.

The monopolist was randomly selected and taken to a separate room after the other players had been taken to two other rooms. The players were separated from one another by opaque partitions so that they could not determine the identity of any of the players in any of the positions, and no verbal communication was permitted.

Each player filled out offer slips that consisted of the choice of a bargaining partner and a proposed payoff division totalling 100 points. For example, if Person X wished to form the A-X-Y coalition, he addressed offers to both Persons A and Y and specified a division of the rewards (e.g., 50-25-25 for Persons A, X, and Y, respectively). For two-person coalitions, a player was required to send a single offer slip. For n-person coalitions, a player was requird to send (n-1) offer slips. In the latter case, players were instructed that the (n – 1) offers must

be identical with regard to the proposed division of rewards; for example, they could not send an offer to one person to form one coalition and a second, different offer to the other persons to form another coalition. This procedure allowed all coalitions to form in a single step. Although larger coalitions may have been more difficult to form, the difficulty was not inherent in the procedure. After the players had completed their offer slips, the experimenter collected, examined, and distributed them to the proper persons. Upon receiving one or more offer slips, each player could accept at most one of the offers. An agreement was defined to be reached when an offer was accepted. However, when more than one offer was accepted, each player was bound to the offer he had made; this means that if a player made an offer that was accepted, he was held to that offer, even if he had accepted an offer for another agreement. The experimenter carefully explained to the players that if a left shoe player received an offer from A and accepted it, he would be included in the winning coalition. In addition, A could ensure that an agreement would be reached by accepting a two-person offer from any one of the left shoe players. If his own offer were rejected, his choice of the left shoe players' offers would determine the agreement. In cases where two players accepted each other's offers but the payoffs divisions were different, the average of the two payoff divisions was awarded. For offers that included more than one player, all players receiving the offer were required to accept it if that coalition were to form. This procedure (originally used by Komorita and Meek, 1973) was repeated for seven completed trials or until time ran out. The players, however, were not told how many trials would be run.

When the payoff division was not announced, only the positions of the players included in the agreements were announced. In all of the other conditions, the points won by each of the coalition members were also announced. When this division was announced, there were often vocal exclamations by some of the players. The experimenter's instruction to formulate one's next offer usually quieted any commotion. In addition, none of the players seemed to communicate anything other than surprise in these situations.

In the high information condition, the offers, acceptances, and rejections of the monopolist were announced over an intercom system. The offers of the left shoe players, if directed only to the monopolist, were not announced individually; rather, the range of offers by the left shoe players to the monopolist were announced. All offers that included the monopolist and more than one of the other players were

announced as well. In addition, the individual responses of each of the players(i.e., their acceptances and rejections) were announced.

In the groups where messages were allowed, the players could send any communications they wished. The monopolist could send a message to any of the left shoe players individually. The left shoe players, however, could send messages either to the monopolist or to *all* of the other left shoe players. To simplify procedures, individual communications between left shoe players were not allowed. When a message was sent to all the left shoe players, it was read over the intercom to the two rooms that housed the left shoe players. In order to insure that the monopolist did not hear the messages of the left shoe players, low volume white noise was broadcast into his room. (All of the monopolists in this condition reported that they had not heard any of the announcements that the experimenter read over the intercom prior to the start of each bargaining session.) In the conditions where payoffs, offers, acceptances, and rejections were announced, the experimenter personally delivered this information to the monopolist.

RESULTS

Due to the large number of participants in the study, data was collected over two semesters. Analysis of the potential effects of semesters led to no results that even approached standard significance levels. Thus, the data reported below does not differentiate between semesters. Although 54 groups participated in the study, the data from four of the groups were not included in the statistical analysis because they did not complete 7 trials. In one of the groups, the monopolist often made proposals that included several left shoe players who did not accept his offer. Thus several proposal exchanges did not result in agreements. Two other groups can be characterized by the large number of messages they sent. In addition, the monopolist in one of these groups expressed confusion with the procedure and tended to be very slow in making his offers, while the members of the other group sent a large number of "all included" proposals. In both cases, time expired prior to the fourth trial.

The fourth group completed only four trials, due in large part to concerted efforts by the left shoe players to form a coalition that rewarded all the players equally (i.e., 10 points). Three attempts were made to form an agreement on the fifth trial: each time all of the left shoe players who received A's offer rejected it. Unfortunately time ran

out before this stalemate could be resolved. The postexperimental discussion with this group revealed that more than one of the left shoe players was seriously considering sending an offer to A which would have given him, as a defector, a sizeable payoff.

The data from these four groups were insufficient for normal statistical analysis. However, the agreements that were reached were quite similar to those obtained in the other sessions.

The remaining data were analyzed with the monopolist as the central focus. In particular, the major dependent variable in the analyses was the monopolist's payoffs. His demands and the highest offers he received were also analyzed to better characterize the bargaining. The only variables in the analyses that focused on the left shoe players were the number of times they proposed an agreement that included all of the players in the game (i.e., "all included" proposals) and the types of messages they sent.

Analysis of the effects of announcing the payoff division revealed no significant effects on the monopolist's payoffs, demands, highest offers, or "all included" proposals, either as a main effect or in an interaction with other variables. These results do not concur with earlier data (Murnighan and Roth, 1977), which found that announcement reduced the monopolist's payoffs.

Prior to the use of inferential statistical analysis on the remaining conditions, several descriptive analyses were conducted to insure that the appropriate statistical assumptions were met. In particular, tests for homogeneity of variance and the normality of the sample's distributions were conducted. These preliminary analyses revealed that the data were both negatively skewed and nonhomogeneous. Thus, the assumptions for analysis of variance could not be met without transformation of the data. Each score was subjected to a log transformation [i.e., $\log(101 - x)$], and additional tests for normality and homogeneity were conducted on the transformed data. Results indicated that the transformation led to an approximately normal distribution and one that was relatively homogeneous. Thus, the following analyses of variance findings are based on the transformed data. In addition, to better characterize the distributions, the entries in each of the tables include both the means and the medians within each condition.

Analysis of variance of the monopolist's payoffs (transformed) resulted in significant effects for communication opportunities and trials: $F = 7.06$, $df = 1/28$, $p < .02$ and $F = 12.98$, $df = 6/168$, $p < .00001$; and a significant communication by information by group size inter-

TABLE 1
Means for the Communication x Information x Group Size Interaction

Communication Conditions	*Information Conditions*	*Group Size*		
		7,8	*9,10*	*11,12*
no messages	secret offers	92.6(99)	83.3(95)	91.3(95)
	announced offers	84.9(90)	93.2(98)	97.3(99)
messages	secret offers	77.6(80)	80.3(80)	92.6(96)
	announced offers	87.7(90)	95.7(99)	84.6(87)
	Overall	85.7(90)	88.1(95)	91.4(95)

NOTE: Medians in parentheses.

action: $F = 6.93$, $df = 2/28$, $p < .01$. The main effects indicate that A's payoffs dropped when communication opportunities were available; they increased over trials. The interaction, on the other hand, is somewhat difficult to explain. Table 1 displays the means and medians for

TABLE 2
Means for the Communication x Trials Interaction and for Each Main Effect

Trials	*Conditions*		
	No Communication	*Communication*	*Over Both Conditions*
Trial 1	80.8(85)	79.4(80)	80.1(80)
Trial 2	87.7(95)	85.2(88)	86.4(90)
Trial 3	92.0(97)	83.2(85)	87.6(90.5)
Trial 4	89.7(99)	87.1(90)	88.4(95)
Trial 5	92.0(98)	90.7(93)	91.3(95)
Trial 6	95.7(99)	91.6(95)	93.7(98)
Trial 7	97.9(99)	89.2(92)	93.5(98)
Over all trials	90.8(97)	86.6(90)	88.7(90)

NOTE: Medians in parentheses.

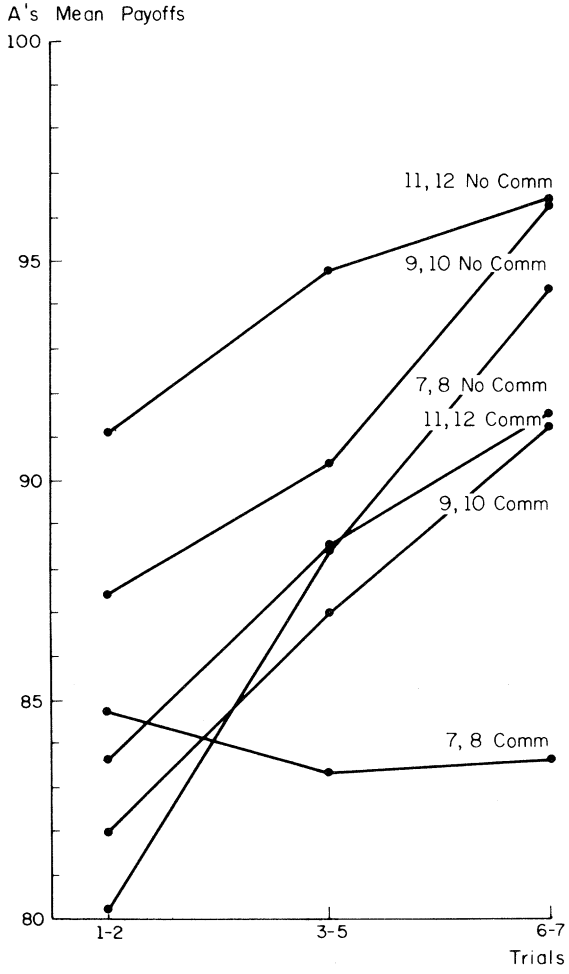

Figure 1: The Means of Each of the Group Size/Communication Conditions Across Trials

each of the cells in the interaction. The surprising results are those in the no messages/secret offers/7,8 person condition, where A's payoffs were relatively high, and those in the messages/announced offers/11,12 person condition, where A's payoffs were relatively low. The marginal means for group size also suggest that A's payoffs increased as the size of the group increased; this effect, however, was not significant.

The interaction between communication opportunities and trials did not reach standard significance levels ($F = 1.69$, $df = 6/168$, $p < .13$); however, the means and medians for this effect are very suggestive (see Table 2). The marginal means and medians document the main effects for communication and trials; with no communication, the monopolist's payoffs were relatively high, and his payoffs increased over trials. The overall mean and median also indicate that the Shapley value was very close to the actual results. The interaction between communication and trials suggest that the monopolist's payoffs markedly increased over trials in the no communication condition, but increased only slightly after the first trial in the communication conditions. This result replicates the finding in the earlier three-person study (Murnighan and Roth, 1977).

A potential cause for this interaction is suggested by the means in the nonsignificant communication by group size by trials interaction, shown (with trials put into three blocks for increased clarity) in Figure 1. The payoffs for trials 6 and 7 are interesting because larger groups almost always resulted in (not significantly) higher payoffs for the monopolist than smaller groups, and communication opportunities tended to reduce his payoffs. More importantly, the data indicate that the monopolist's payoffs increased when communication opportunities were not available *or* when the group was large. The mean payoff in the 7,8/communication condition in trials 6 and 7 (i.e., 83.7) was significantly different ($t = 2.50$, $df = 12$, $p <$ two-tailed) from the mean of all the other conditions in trials 6 and 7 (95.3). Thus, it appears that, in this condition, the monopolist's payoffs were *not* substantially increasing over trials. In the other conditions, the increases in his payoffs are readily apparent.

The monopolist's payoffs were significantly correlated with his demands in each of the conditions. For the four communication/information conditions, the correlations ranged from .77 to .83 (all significant at $p < .001$). His payoffs were also highly correlated with the highest offers he received, ranging from .57 to .63 (except for $r = .81$ in the no messages/announced offers condition). Correlations between A's payoffs and the number of players indicated that increasing group size was positively related to payoffs in the no messages/announced offers ($r = .40$) and the secret offers/messages conditions ($r = .49$; $n = 70$, $p < .001$, *in each case*). The other conditions yielded no significant correlations. The inconsistency of these results was not anticipated, and a further analysis was conducted to determine a reason for them.

TABLE 3
Frequencies of Monopolist's Low Payoffs

	Condition	
	No Communication	*Communication*
Payoff $\geqslant$ Demand	14	15
Payoff = $\frac{\text{Demand + Hi Offer}}{2}$	0	7
Payoff = Hi Offer	0	9
Total[a]	14	31

NOTE: Low payoffs were operationally defined as less than 80 in trials 2, 3, or 4 and less than 90 in trials 5, 6, or 7; χ^2 (2) = 11.22, $p < .01$.
a. Two low payoffs in the no communication conditions were unrelated to either demands or high offers (the monopolist chose a relatively low offer) and were excluded from these figures.

Noteworthy among the entire set of correlations were the very high correlations between the monopolist's payoffs and his demands. They indicate a great deal of power. Indeed, the monopolist was very often able to obtain as high a payoff as he demanded. Situations where his demands and his payoffs were not related, then, would indicate some lack of power, especially if his payoffs were low. Thus, we focused on instances where the monopolist's payoffs were low, operationally defining "low payoffs" as less than 80 in trials 2, 3, or 4 and less than 90 in trials 5, 6, or 7. Out of 240 possibilities (excluding the control groups), there were 47 low payoffs. As might be expected from the significant main effect for communication opportunities, low payoffs were most prevalent in the communication conditions (accounting for 31 of 47). What is more important is the reason for these low payoffs. In some instances, the monopolist's demand was low; in these cases, even though his payoff was low, he was able to obtain his demands. In other instances, however, the monopolist's payoffs were low because he accepted a relatively low offer while his own demand was being rejected. Thus, when the offers he was receiving were low and his own offers were not being accepted, he was dependent on the other players to make him a good offer. We analyzed the frequencies of each of these possibilities, depending on whether communication opportunities were available. In addition to the two categories listed above (i.e., payoffs

$\geqslant$ demands, and payoffs = highest offers), a third category was included to reflect those instances where the monopolist's payoffs resulted from the average of his demand and his highest offer (where both he and one of the nonmonopolists accepted each other's offers). The frequencies are shown in Table 3. A chi-square analysis of the frequencies in the table was significant: $\chi^2 = 11.22$, df = 2, $p < .01$. It is interesting to note that all of the low payoffs received by the monopolists in the no communication conditions (with the exception of two low payoffs that were unrelated to the monopolist's demands and highest offers) were a function of their demands. In the communication conditions, however, just over half of the monopolist's low payoffs were a function of his highest offer or a combination of his demand and his highest offer. Thus, it appears that the monopolist had substantially more power in the no communication conditions. These results emphasize the implications drawn earlier from the analysis of variance results: communication opportunities seem to have reduced the considerable power held by the monopolists in this study.

NONMONOPOLISTS' RESPONSES

The most important behaviors that the nonmonopolists could engage in, especially if they wished to limit the monopolist's payoffs and give themselves a chance for increased payoffs, were their "all included" proposals and the messages they sent to one another. (Their messages to the monopolist, on the other hand, could potentially have lead to a stable relationship with him.)

Analysis of variance of the "all included" proposals resulted in significant effects for communication: $F = 11.19$, df = 1/28, $p < .005$; for trials: $F = 16.22$, df = 6/168, $p < .0001$; and for communication by trials: $F = 2.42$, df = 6/168, $p < .03$. The means for each of these effects are shown in Table 4. It was somewhat surprising to find that group size did not yield significant effects, for larger groups certainly had more opportunities to send "all included" proposals. Although the results were in the right direction, they were not significant. The effects that were significant were not surprising: with the opportunity to communicate, "all included" proposals were more likely; they increased over trials; and they increased more sharply over trials when communication opportunities were available. The fact that these results are in the opposite direction from the results for the monopolist's payoffs might lead one to expect that the frequency of "all included" offers

TABLE 4
Mean Frequencies for the Communication x Trials Interaction for "All Included" Proposals

	Condition		
Trials	*No Communication*	*Communication*	*Mean*
Trial 1	.25	.25	.25
Trial 2	.10	1.05	.58
Trial 3	.50	1.60	1.05
Trial 4	.85	2.15	1.50
Trial 5	1.05	2.40	1.73
Trial 6	1.20	3.00	2.10
Trial 7	1.45	3.05	2.25
Mean	.77	1.93	1.35

might have been one of the causes of A's relatively low payoffs in the communication conditions. In fact, in almost every condition, there is a small positive correlation between the frequency of "all included" proposals and A's payoffs. Correcting for the number of players in the group does not alter the findings. Instead, some other factor may have led to the reduction in A's payoffs in the communication conditions.

An analysis of the messages sent by the players was conducted to determine their effects. The only significant effect was for messages that proposed "all included" proposals: they were correlated with the actual number of "all included" proposals. Messages to and from the monopolist were not significantly related to other variables. Indeed, it appears that messages may have led to relatively low payoffs for the monopolist by leading him to be cautious. Observations of the monopolists' reactions during the sessions indicated that, when communication opportunities were available, the monopolists were, in many cases, concerned about the potential for "mutiny." The monopolists' demands yielded the same results as the analysis of his payoffs; thus, the lower demands in the communication conditions may have been a result of a conscious attempt to be cautious.

DISCUSSION

The ability to communicate with the other players and the extremity of the outcomes in the no communication conditions resulted in ex-

tremely "rich" data. The players appeared to become enmeshed in their task, displaying strong motivation to do well. The monopolists, in many cases, adopted a rather cavalier attitude, chuckling to themselves when the offers they received were good, and enjoying their "exalted" position. This was not true as frequently in the communication conditions: as mentioned, monopolists in these conditions often became quite cautious, and reacted by displaying tension rather than amusement.

Several results from this study were quite straightforward. The monopolist received very high payoffs which approached the core quickly in the no communication conditions. Communication opportunities limited his payoffs. Over all conditions, his payoffs increased. Over all conditions and all trials, his payoffs approximately coincided with the Shapley value. Information availability had no noticeable effects on his payoffs.

Other results, including those that did not reach standard significance levels, were no less important. In particular, the results suggest that the monopolist in the no communication conditions was able to obtain almost any payoff he wished. In the conditions where communication opportunities were available, the monopolist was not always able to completely control his outcomes. Also, the results pictured in Figure 1 lead to the suggestion that the monopolist's payoffs will increase if the groups are moderately large (i.e., 9 or 10 players) or larger, even if communication opportunities are available.

Also intriguing are the results for group size. In the range from seven to twelve players, group size did not have a significant effect on the monopolist's payoffs. Although some increase was noted in his payoffs as group size increased, it was not substantial. Comparing his payoffs in this study to payoffs in Murnighan and Roth's (1977) study, where there were only three-person groups, however, leads to the proposition that increasing group size had a marked effect on a monopolist's payoffs. Murnighan and Roth (1977) found an overall average payoff of 65; this study found an average payoff of 89. One might suspect that this disparity is attributable to the differences between the procedures. Further research is necessary, then, to substantiate the hypothesis that increased group size will increase a monopolist's payoffs.

Unlike the previous study, "all included" offers in this experiment seemed to act as messages when messages were not allowed. As soon as one individual sent an "all included" offer, many players realized that they had the opportunity to possibly reduce A's payoffs. Thus, while

"all included" offers were often disregarded by the other weak players in the earlier study, the likelihood of additional "all included" offers by the other left shoe players on the next trial increased (if only because there were more players) in this study.

In addition, in the three groups where the monopolist initiated "all included" proposals, "all included" coalitions were not successful. Instead, the monopolists in these three groups might be characterized as "frustrated benevolents." Of the 22 left shoe players who received these offers, only seven accepted. It seems that the left shoe players were either unwilling to pursue a "cooperative" strategy or were unwilling to trust that the othe players would also agree. Given that all but four of the nonmonopolists responded with proposals including only A and themselves on the subsequent trials, the first alternative seems to be correct. A norm may be prevalent, at least in the early trials, to attempt to establish two-person agreements including yourself and the strong player and no one else. This hypothesis, however, should be tested in future research.

The messages in this study also seemed to fulfill additional functions compared to the messages in the three-person study. Whereas the players in the three-person groups sent messages that were almost exclusively task-related (for instance, "Let's both offer and accept only 50-50 agreements"), the messages in the present study also appeared to serve as frustration-release mechanisms. While they often urged the other players to adopt a unified front, after several attempts to block the monopolist had failed, many of the messages seemed to be sent simply to relieve tension. Messages like "I'm getting out of the shoe business; It's apparent that I don't have but one foot to stand on," were quite common in the later stages of the game.

In addition, messages were often used to threaten or to doublecross the other left shoe players. Two players (in separate groups) threatened the others with a message that read, "If everyone does not send an offer of 10 points for each of us, I will offer A all 100 points on the next trial." (They both carried out their threat.) Also, on occasions where there seemed to be a concerted effort to hold to "all included" proposals, at least one of the left shoe players would send a message to A to inform him of this development, while at the same time proposing an agreement that would be quite rewarding to himself. (This observation is reinforced by the significant positive correlation between the number of "all included" proposals and A's payoffs in the messages condition.)

The core was essentially reached by many of the groups in this study. Of 350 agreements, 140 (40%) gave player A 99 points or more. Of 210 agreements in the no communication conditions, 106 (50%) gve him 99 or more. What is more important, however, is the proportion of times player A received 99 or more points *when he demanded it.* On 131 occasions, the monopolist demanded 99 points or more; 117 (90%) of the payoffs that resulted were within one point of the core. This is true in both the no communication *and* the communication conditions. Thus, when the monopolist had the insight, the courage, the determination, or whatever characteristic might be attributed to him, to demand nearly the entire payoff, he almost always received it.

The Shapley value is also supported by the results of this study. It indicates quite well what a player might expect to receive from the play of this game. Recent results (Murnighan, 1977) also indicate that it makes excellent predictions in several other games as well. Thus, it seems to be a noteworthy a priori predictor of the ultimate results of coalition bargaining.

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