The Free-Rider Problem in Intergroup Conflicts Over Step-Level and Continuous Public Goods

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Free riding is a paramount consideration in intergroup conflicts because the benefits associated with such conflicts are public goods with respect to the members of a competing group. To study the free-rider problem and its effects on conflict resolution, (a) intergroup conflicts are modeled as team games; (b) a new team game that models intergroup conflicts over continuous public goods is introduced and is contrasted with a recently developed game that simulates intergroup conflicts over step-level public goods; and (c) 2 experiments that compared the effects of communication in the 2 team games are reported. Experiment 1 shows that within-group discussion is highly effective in solving the intragroup dilemma in the step-level game but much less effective in the continuous game. In contrast, Experiment 2 shows that between-group communication is highly effective in solving the intergroup conflict in the continuous game but considerably less effective in the step-level game.

Realistic group conflict theory (Coser, 1956; Sherif, 1966) assumes that intergroup conflicts are rational in the sense that groups have incompatible goals or are in competition for scarce resources. This assumption, however, is restricted to the intergroup level of analysis. Although it stresses that groups are rational, the theory typically portrays individual group members as altruists who are ready to sacrifice their self-interest for group causes (Campbell, 1965).

Extending the assumption of rationality to individuals reveals a different, less harmonious account of intragroup relations in intergroup conflicts. The threat to ingroup harmony stems from the fact that the benefits associated with winning the intergroup conflict (territorial political influence, salary raises, and group pride) are public goods that are equally available to all group members regardless of their level of contribution to group success. Thus, whereas the group as a whole gains from winning the competition and acquiring the goods, rational and selfish group members, who take a free ride (by choosing not to fight, vote, or stand on a picket line), gain more. Of course, as a result of free riding the group may lose the competition, in which case none of its members will be able to enjoy the public goods.

The free-rider problem that arises when groups, as opposed to individuals, are involved in a controversy generates major structural and normative changes within the competing groups. Collective group goals are emphasized, more authoritative leadership often emerges, and norms of group-based (or ethnocentric) altruism are reinforced (Campbell, 1965; Pruitt & Rubin, 1986, Sherif, 1966; Stein, 1976). The primary function of these changes is to repress free riding among individual group members and allow them to realize their collective goal. However, by facilitating cooperation within the groups, these mechanisms necessarily contribute to the escalation of the conflict between them.

This point is nicely illustrated in a recent paper by Gilbert (1988). Gilbert observes that nuclear arms control activists in the United States are often accused of lack of support for American interests. He goes on to argue that the main reason why individuals do not oppose nuclear arms policies is that they would have to defend their commitment to the national interest and perhaps even their patriotism.

The situation is further complicated by the fact that the motivation underlying free riding is often ambiguous. Refusing to take part in a war may reflect one's genuine concern for the collective welfare. But, because it is also consistent with the individual's self-interest, a pacifist runs the risk of being labeled a coward, in addition to being called a traitor.

Intergroup Conflicts as Team Games

The problem of public goods provision in intergroup conflicts has received little theoretical or empirical attention. One explanation for this gap (in addition to the presumption of group-based altruism) may be the lack of pertinent research

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paradigms. Because the conflict of interests between the groups produces the intragroup dilemma and the groups' respective success in solving the internal dilemma determines the outcome of the intergroup competition, the intergroup and intragroup levels must be studied simultaneously.

Existing game paradigms are too restrictive for this purpose. An-person games, such as the Prisoner's Dilemma (PDG) and Chicken, which have been used for studying social dilemmas and problems of public goods provision, focus primarily on interpersonal (or intragroup) behavior (Dawes, 1980; Liebrand, 1983; Messick & Brewer, 1983; Messick & Mackie, 1989; M. Taylor & Ward, 1982). On the other hand, two-person games, which have often been used to study intergroup relations, necessarily ignore the conflicts of interest within the competing groups (Deutsch, 1973; Insko et al., 1987; D. Taylor & Moghadam, 1987).

To incorporate the competition between and within groups that characterizes intergroup conflicts, I propose to model such conflicts as team games. I hope to demonstrate that by expanding the payoff structure (or "given matrix") of intergroup conflicts, team games can illuminate the functional basis of many cognitive, motivational, and behavioral aspects of these complex social situations. Team games may also help formulate new hypotheses concerning the interface between intragroup and intergroup processes in intergroup conflicts. Finally, by confronting subjects with actual (but also highly controlled) dilemmas in which substantial amounts of money can be earned (Dawes, Orbell, Simmons, & van de Kragt, 1986), team games can serve as effective research paradigms for testing these hypotheses in the laboratory.

The notion of team games was originally formulated by Palfrey and Rosenthal (1983) in the context of voting behavior. A team game involves two (or more) groups of players called teams. Each player chooses how much to contribute toward his or her group effort. Contribution is assumed to be costly in terms of effort, time, money, or risk taking. Payoff to a player is an increasing function of the total contribution made by members of his or her own team and a decreasing function of the total contribution made by members of the opposing team. All players on the same team receive the same payoff. For simplicity, the discussion hereafter is restricted to a special case in which each player faces a binary choice between contributing and not contributing. These simplified team games are referred to by Palfrey and Rosenthal as participation games.

There exists, of course, an infinite number of team games, depending on the specific reward function or payoff rule. However, as a starting point for a taxonomy of games, I distinguish between intergroup conflicts involving step-level public goods and conflicts entailing competition over continuous public goods (Hovi, 1986; M. Taylor & Ward, 1982).

Common examples of intergroup conflicts over step-level goods are elections and sports competitions, for which a margin of one vote (or one point) is sufficient to decide the public good in its entirety. Wars, political struggles, and labor-management disputes, on the other hand, for which the rewards are divided between the parties on the basis of the margin (rather than merely the direction) of victory, are more appropriately modeled as intergroup conflicts over continuous public goods. Whereas the payoff rule in the former type of conflicts is "winner takes all," conflicts of the latter type are typically resolved by a compromise (in terms of territory, political concessions, and salary raises) that reflects the discrepancy in the amounts of relevant resources (effort, money, and bravery) expended by the competing groups.

The following section introduces a new team game paradigm, called the Intergroup Prisoner's Dilemma (IPD) game, for modeling intergroup conflicts over continuous public goods, and contrasts it with the Intergroup Public Good (IPG) paradigm devised by Rapoport and Bornstein (1987) for modeling intergroup conflicts over step-level goods. The games are illustrated below using the parameters of the present study. A general definition of the two team games appears in the Appendix.

The IPD and IPG Team Games

Both team games entail a competition between two groups with three members in each. Each of the six players receives an endowment of 5 Israeli Shekels (IS 5; approximately $2.50) and has to decide whether to keep the money or contribute it toward his or her group benefit.

In the IPD game, a reward of IS 18 is provided to each member of a group if all three members of that group contribute and none of the outgroup members contribute. Members of the losing group receive nothing. If there are two more contributors in one group than in the other group, each member of the winning group receives IS 15, and each member of the losing group receives IS 3. If a group has only one more contributor than the other group, each member of the winning group receives IS 12, whereas each member of the losing group receives IS 6. Finally, in case of a tie (an equal number of contributors in both groups) each player receives a reward of IS 9. In addition to the reward (public good) each player keeps his or her endowment if he or she does not contribute it.

In the IPG game, the reward of IS 18 is provided to all members of a team if the number of ingroup contributors exceeds the number of contributors in the outgroup. Members of the losing team receive nothing. In the case of an equal number of contributors in both groups, each player receives a reduced bonus of IS 9. As in the IPD game, players get to keep their IS 5 if they decide not to invest. The payoff to Player i (i is a member of Group A) in the IPD and IPG games as a function of Player i's decision to contribute (c) or not contribute (nc) and the difference between the number of ingroup contributors (m_A) and outgroup contributors (m_B) are shown in Table 1.1

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1 To facilitate the understanding of the payoff matrices in Table 1, assume that there are 2 contributors in Group A and a single contributor in Group B. In the IPD game, this results in a bonus payoff of IS 12 to each member of Group A and IS 6 to each member of Group B. In addition, each noncontributor gets to keep his or her endowment of IS 5, which brings the total payoff for the single noncontributor in Group A to IS 17 and the total payoff to the 2 noncontributors in Group B to IS 11. In the IPG game, each member of Group A receives a bonus payoff of IS 18, whereas members of Group B receive nothing. The total payoff for the noncontributing player in Group A is thus IS 23, whereas the payoff for the 2 noncontributors in Group B is IS 5.
Table 1
Individual Payoff Matrixes for the Intergroup Prisoner's Dilemma (IPD) and Intergroup Public Goods (IPG) Games

<table>
<thead>
<tr>
<th>$m_A - m_B$</th>
<th>IPD</th>
<th></th>
<th>IPG</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>$m_A = m_B$</td>
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<td>nc</td>
<td>18</td>
<td>nc</td>
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<td>15</td>
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<td>18</td>
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<td>14</td>
</tr>
<tr>
<td>-1</td>
<td>6</td>
<td>11</td>
<td>0</td>
<td>5</td>
</tr>
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<td>8</td>
<td>0</td>
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<tr>
<td>-3</td>
<td>—</td>
<td>5</td>
<td>—</td>
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</tr>
</tbody>
</table>

Note. $m_A$ = total number of contributors in Group A; $m_B$ = total number of contributors in Group B; $c$ = payoff to contributors; $nc$ = payoff to noncontributors.

Individual, Group, and Collective Rationality in the IPG and IPD Team Games

When discussing solutions to mixed motive games, one must distinguish between solutions that are individually rational and solutions that are collectively rational. In intergroup conflicts as modeled by team games, there are two levels of collective rationality that have to be taken into account. The first level involves group rationality, whereas the second involves the interest of the “superordinate” group consisting of all members of both groups.

Individual Rationality

From the point of view of the self-maximizing individual player, the primary difference between the IPD and IPG games is whether a dominant strategy exists. The IPD payoff matrix in Table 1 shows that Player i receives an additional payoff of IS 2 by not contributing, regardless of what other ingroup and outgroup members do. Withholding contribution, in other words, is the dominant individual strategy in this game. In the IPG game there is no dominant strategy. Whereas there is an incentive for free riding (as each individual player prefers that others supply the input necessary for the group’s success), there is also an incentive to contribute (because the private benefit from the public good exceeds the cost of contribution). Hence, as exemplified by the IPG payoff matrix in Table 1, Player i should contribute when his or her contribution is critical for tying or winning the game, but not otherwise.

If one assumes that individuals are strategically rational (that is, that each individual player takes the actions of the others into account when making his or her decision and also expects all other players to do the same), stronger hypotheses concerning individual choice behavior in the IPG and IPD can be made. The assumption of mutually expected rationality serves in game theory to derive solutions on the basis of the notion of equilibrium. An equilibrium is an outcome that allows none of the individual players to benefit from a unilateral change of strategy if all the remaining players adhere to the equilibrium strategy. When the competing groups are of equal size, the equilibrium solution of the IPG game is collective contribution (Palfrey & Rosenthal, 1983; Rapoport & Bornstein, 1987). Table 1 illustrates that when all players decide to contribute their endowments, no individual player can benefit from keeping his or her endowment. In contrast, the equilibrium solution of the IPD game is for all players to defect. As can be verified from Table 1, no player can benefit from unilateral cooperation when all other players defect.

Group Rationality

In examining the issue of group rationality in the IPG and IPD team games, it is useful to treat each group as if it were a single (or unitary) player. The intergroup conflict in this case may be framed as a two-person game between Groups A and B, in which a pure strategy corresponds to the number of contributors designated by the group. Each group has four such strategies, namely, to designate 0, 1, 2, or 3 contributors. The payoff matrices for the two-person IPD and IPG games appear in Table 2. The entries in the various cells represent the total group payoff (rewards and endowments summed across all group members) as a function of the number of contributors in Group A and Group B.

The group interest in the both the IPD and IPG games is clearly to designate all group members as contributors. Table 2 shows that designating three contributors is the equilibrium strategy in both games, because in neither game can a group benefit from designating less than three contributors when the three members of the rival group contribute their endowments. Designating all group members as contributors is also the maximin group strategy in both games, because only by designating three contributors can a group guarantee a tie and a reward of IS 9 for each of its members. (Note that in the IPD game, collective contribution is also the dominant group strategy, whereas there is no dominant strategy in the two-person IPG game.)

Collective Rationality

In intragroup dilemmas, contribution is consistent with the collective welfare (contribution and cooperation in this context are synonymous). In contrast, in intergroup conflicts as modeled by the IPG and IPD team games, contribution is good for the group but bad for the larger society. As is evident from the games’ payoff matrices, when all six players contribute their endowments, each gets IS 9, whereas if none contributes, each gets IS 14. Clearly, the Pareto optimal solution in the IPD and IPD team games, the one that maximizes the collective payoff in both games, is for all six players to withhold their contribution.

2 To exemplify the group payoff matrices, assume once again that there are 2 contributors in Group A and only 1 contributor in Group B. In the IPD game, Group A receives a total payoff of IS 41 (IS 12 for each of the 2 contributors plus IS 17 for the noncontributor) and Group B a total payoff of IS 28 (IS 6 for the single contributor and IS 11 to each noncontributor). In the IPG game, Group A receives a total payoff of IS 59 (IS 18 for each contributor and IS 23 for the noncontributor) and Group B a total of IS 10 (IS 0 for the single contributor and IS 5 for each noncontributor).
Table 2
Group Payoff Matrixes for the Intergroup Prisoner's Dilemma (IPD) and Intergroup Public Goods (IPG) Games

<table>
<thead>
<tr>
<th>m_a</th>
<th>m_b</th>
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<th>2</th>
<th>3</th>
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<td></td>
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<td></td>
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<tr>
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<td>54,10</td>
<td>54,5</td>
<td>27,27</td>
<td></td>
</tr>
</tbody>
</table>

Note: Values are payoffs for groups considered as a whole when 0, 1, 2, or 3 members contribute. m_a and m_b = total number of contributors in Group A and Group B, respectively.

Experiment 1: Group Decision and Individual Choice

In Experiment 1, I compared the IPG and IPD games under two conditions: a noncooperative control condition in which no communication among players was allowed and a within-group communication condition in which subjects were permitted to discuss the dilemma with other ingroup members. Communication was operationalized as an unstructured period of group discussion during which group decisions (if made) were neither binding nor enforceable (Dawes, McTavish, & Shaklee, 1977; Orbell, van de Kragt, & Dawes, 1988). This type of informal communication is often referred to as cheap talk (Farrell, 1987).

When deliberating the choice of a coordinated group strategy, all group members have a common interest in identifying and pursuing the collectively optimal strategy. It has already been shown that the optimal group strategy in both the IPD and IPG team games is for all group members to contribute their endowments. It is therefore predicted that in both games groups will use the opportunity for discussion to designate three contributors. However, the impact of the (nonbinding) group decision on subsequent individual choices is hypothesized to be different in the two games. In the continuous IPD game, a group decision to designate all group members as contributors does nothing to change the fact that contribution is the dominated individual strategy. Such an agreement, therefore, is vulnerable to defection by self-interested individuals. In contrast, a decision to designate all group members as contributors in the step-level IPG game constitutes a minimal contributing set (van de Kragt, Orbell, & Dawes, 1983). Designating a minimal contributing set removes the option to take a free ride by making each member's contribution necessary or critical for provision.3

This structural difference between the two games is of much theoretical importance in the attempt to understand intragroup collective action in intergroup conflicts. It is particularly important for interpreting individual choice behavior in such conflicts. Earlier studies using the IPG game have shown that approximately half the subjects contribute their endowments when the game is played without communication, and nearly all contribute when cheap talk within groups is allowed. Whereas these findings are by now well replicated (Bornstein & Rapoport, 1988; Bornstein, Rapoport, Kerpel, & Katz, 1989; Rapoport & Bornstein, 1989), the motivation underlying individual contribution remains ambiguous. Contribution in the step-level IPG game may be an act of group allegiance, but to the extent that a player perceives his or her contribution as critical, it can also be motivated by self-interest. This ambiguity is removed in the present study by contrasting the IPG game with the IPD paradigm, in which contribution is distinctly and unambiguously an altruistic (or "patriotic") act.

Method

Subjects and design. One hundred eighty male undergraduate students at the Hebrew University of Jerusalem participated in the experiment. The subjects were recruited by campus advertisements promising monetary reward for participation in a group decision-making task. Subjects, in sets of six, participated in a single session that lasted approximately 45 min. Half the sets played the IPD game and half the IPG game. Five sets in each game condition were held without preplay communication, whereas in the 10 remaining sets subjects were allowed within-group communication. In summary, in Experiment 1 I used a two-factorial design with game type defining one dimension and presence or absence of within-group communication defining the other. Subjects were paid between IS 3 and IS 20 in the IPD condition and between IS 0 and IS 23 in the IPG condition, contingent on their decisions and the decisions of the other members of their set.

Procedure. On their arrival at the laboratory, subjects were seated in a single room with arrangements to ensure their privacy. Each subject was handed a promissory note for IS 5, a copy of the payoff matrix summarizing the different ways to earn money in the experiment, and a group membership card assigning him to either the green or the red group. Three subjects were assigned to each group. After they were assigned to groups, subjects were told that they could each choose between keeping the IS 5 and investing the money, and they were given verbal instructions concerning the rules and payoffs of the game. The game instructions were neutral and were phrased in terms of Individual i's payoff as a function of his own decision to invest or not and the decisions made by the other players in his set. Subjects were not instructed to maximize their earnings, and no reference to cooperation or defection was made. Subjects were given a short quiz to test their understanding, and explanations were repeated until the experimenter was convinced that all subjects understood the payoff matrix. Subjects were told that to ensure the confidentiality of their decision they would make their decision in writing by checking the appropriate box on the decision form, receive their payment in sealed envelopes, and leave the laboratory one at a time with no opportunity to meet the other participants. Subjects were also assured that the experiment involved no deception.

At this stage, subjects in the no-communication condition made

3 The distinction between the minimal contributing set explanation and the game-theoretic equilibrium solution should be emphasized. The game-theoretic analysis is based on the assumption of mutually expected rationality (Colman, 1982) and predicts that the IPG game will result in collective contribution regardless of whether communication is allowed. The mechanism of designating a minimal contributing set is based on the considerably weaker assumption of reasonableness (van de Kragt, Orbell, & Dawes, 1983). It assumes only that, after the group decision to designate all group members as contributors, each player will realize that he or she cannot benefit from unilateral defection and will believe that all other players also recognize that fact.
their decisions. Once all the decision forms were collected, subjects were handed a questionnaire in which they were asked to estimate (a) the probability that exactly 0, 1, or 2 of the remaining ingroup members contributed their endowment and (b) the probability that exactly 0, 1, 2, or 3 outgroup members contributed their endowments. (The subjects were instructed that the probability estimates in each question should sum to 1.) Following the completion of the questionnaire, subjects were debriefed on the rationale and purpose of the study. They were then paid and dismissed individually.

The procedure in the communication condition was identical, except that members of each group were allowed to discuss the situation for 5 min with the other ingroup members before making their decisions. Group discussions were held in two separate rooms; an experimenter was present in each room and tape-recorded the discussion with the explicit knowledge and consent of the subjects.

Results

Rates of contribution. When no communication among subjects was allowed, the mean number of contributors per set of six subjects was 3.60 (60.0%) in the IPG game and 1.60 (26.7%) in the IPD game. After within-group discussion, the mean number of contributors was 5.60 (93.3%) and 3.90 (65.0%) in the IPG and IPD games, respectively. An analysis of variance (ANOVA; using the set of six subjects as the unit of analysis) revealed significant main effects due to game type, $F(1, 26) = 15.9, p < .0001$, and communication, $F(1, 26) = 20.2, p < .0001$. The Game Type $\times$ Communication interaction effect was not significant.

Questionnaire data. The probability estimates made by the subjects were used to compute the expected contribution proportion among the remaining ingroup members (denoted by $p$), and the expected contribution proportion among the outgroup members (denoted by $q$). Table 3 reports the means and standard deviations of these estimated proportions.\footnote{Denote by $p(1)$ and $p(2)$ the probability of exactly 1 and 2 ingroup contributors; and by $q(1)$, $q(2)$, and $q(3)$ the probability of exactly 1, 2, and 3 outgroup contributors. Then $p = [p(1) + p(2)]/2$, and $q = [q(1) + q(2) + q(3)]/3$.}

An ANOVA was performed separately on each of the dependent measures. The first ANOVA was conducted on $p$. It revealed significant main effects for game type, $F(1, 170) = 12.44, p < .001$, and communication, $F(1, 170) = 34.19, p < .0001$. The Game Type $\times$ Communication interaction effect was not significant. The ANOVA conducted on $q$ revealed a similar pattern of results with significant main effects for game type, $F(1, 166) = 15.59, p < .0001$, and communication, $F(1, 166) = 16.33, p < .0001$, and no interaction effect. The means in Table 3 show that subjects expected more (ingroup and outgroup) contributors in the IPG game than in the IPD game, and more contributors when within-group communication was allowed than when it was not. Although subjects underestimated the contribution rates in the IPG game (particularly in the communication condition) and overestimated the contribution rates in the IPD no-communication condition, their expectations corresponded quite well with the actual pattern of contribution reported earlier.

Finally, we compared the degree of ingroup–outgroup bias across the different experimental conditions. The measure of ingroup–outgroup bias was based on subjects' expectations concerning the behavior of other ingroup and outgroup players and involved the difference score, $p - q$. An ANOVA indicated that this performance bias was significantly higher when within-group communication was permitted than when it was not, $F(1, 164) = 8.96, p < .005$. The effect of game type and the interaction effect were not significant.

Group decisions and individual choice. In addition to comparing rates of individual contribution across games and communication conditions, I examined the relationship between the actual number of contributors in each group and the decision reached during the preceding intragroup discussion. This information appears in Table 4. Group decisions were assessed in two independent ways. One experimenter was present during the discussion and recorded the decision if one was made. Another experimenter coded decisions from the recordings of the discussions. Cases in which the discussion did not result in a clear decision or in which the two judges did not agree on what the final group decision actually was appear as missing data in the table.

The left-most column in Table 4 presents the group decisions in the IPG communication condition. It shows that, of the 20 groups in this condition, 18 groups reached a decision to designate 3 members as contributors. The second column, which reports the actual number of contributors in each group, shows that only 1 player (1.85%) defected from the group decision. In the IPD game, 14 of the 20 groups agreed to designate 3 contributors. Of the 42 designated contributors in this condition, 7 (16.7%) did not contribute their endowments.

Discussion

Experiment 1 shows that, regardless of whether communication among ingroup members is allowed, contribution rates in the step-level IPG game are approximately 30% higher than those in the continuous IPD paradigm. Whereas these findings do not fully support the assumption of "narrow rationality," they clearly demonstrate the importance of self-interest or criticalness in determining individual choice. The effect of the intragroup reward structure on contribution rates seems especially large in view of the fact that the team game manipulation is considerably more than minimal and involves, in addition to group categorization and labeling, common fate within groups and explicit intergroup competition (Rabbie, 1982; Rabbie & Horwitz, 1988; Rabbie, Schot, & Visser, 1989; Tajfel, 1982).

The effect of the intragroup reward structure is even more striking in the communication condition. Whereas subjects in this condition could not make binding agreements, the opportunity for discussion provided them with other effective means to advance the group's interest. Orbell, van de Kragt, and Dawes (1988) have suggested that discussion can promote cooperation by providing subjects with the opportunity to promise each other that they will act in accordance with the group decision. They also suggested that discussion may work by enhancing group identity, leading subjects to substitute "group-regardingness" for self-interest as a value guiding their choice. These extrarational mechanisms were equally available to the discussing groups in both game conditions. Nevertheless, our results show that only 9 groups (45%) in the IPD communication condition managed to carry out the optimal group strategy, as com-
pared with 17 groups (85%) that successfully eliminated free riding in the IPG game.

A group decision was operationalized in the present study as an explicit contract or understanding among all group members to contribute their endowments. It was argued that in the IPG team game such a decision renders the contribution of each group member critical for provision, whereas in the IPD game this is not the case. Therefore, to the extent that criticality determines individual choice, deflection rates among designated contributors in the IPD game were expected to be higher than those in the IPG paradigm.

The results show that, whereas most subjects kept their promise to the group, promises were considerably less likely to be kept in the IPD game than in the IPG paradigm. Nearly 17% of the designated contributors in the continuous team game did not contribute their endowments, as compared with a deflection rate of less than 2% in the step-level game. Moreover, promises in the IPD game were also less likely to be made. Table 4 shows that six groups in the IPD communication condition failed to agree on designating three contributors, as compared with only two such groups in the IPG game. Thus, whereas the data support the notion that promising enhances cooperation, they also demonstrate that the effectiveness of this mechanism as a solution to the intragroup dilemma largely depends on the situation's payoff structure.

To the extent that ingroup–outgroup bias can be taken as an indication of subjects' identification with their group (Brewer, 1979; D. Taylor & Moghaddam, 1987), the results also support the conclusion that within-group discussion enhances group identity (Orbell, van de Kragt, & Dawes, 1988). However, the index of ingroup bias was unaffected by game type (either directly or in interaction with communication), and therefore provides little help in explaining the differential rates of contribution observed in the two team games.

### Experiment 2: Intergroup Agreements and Individual Choice

While supporting the typical conclusion that discussion enhances cooperation, Experiment 1 demonstrated that, in the context of intergroup conflict, cooperation within groups may be detrimental to the collective welfare. To reiterate, the collectively optimal solution in the IPG and IPD team games, the one that maximizes the outcome of the “superordinate” group in both games, is for all six players to withhold their contribution. Can cheap talk between groups facilitate this cooperative solution?

Analysis of the reward structure suggests that an agreement to withhold contributions in the IPD game may hold even with-

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Note: IPG = Intergroup Prisoner's Dilemma game; IPG = Intergroup Public Goods game; p = expected proportion of contributors among ingroup members; q = expected proportion of contributors among outgroup members.

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<tr>
<th></th>
<th>Experiment 1</th>
<th>Experiment 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No communication</td>
<td>Within-group communication</td>
</tr>
<tr>
<td><strong>Group proportion</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>p</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>.50</td>
<td>.79</td>
</tr>
<tr>
<td>SD</td>
<td>.17</td>
<td>.24</td>
</tr>
<tr>
<td>q</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>.51</td>
<td>.70</td>
</tr>
<tr>
<td>SD</td>
<td>.19</td>
<td>.23</td>
</tr>
<tr>
<td>% contribution</td>
<td>.60</td>
<td>.93</td>
</tr>
</tbody>
</table>

**IPD**

|                |                |                      |                            |
| p               |                |                      |                            |
| M               | .41           | .62               | .18                        |
| SD              | .35           | .35               | .26                        |
| q               |                |                      |                            |
| M               | .43           | .53               | .13                        |
| SD              | .19           | .27               | .16                        |
| % contribution  | .27           | .65               | .08                        |
out enforcement because it does not violate the principle of individual rationality. In the IPG game, in which collective rationality dictates the use of a nonequilibrium strategy, this is not the case. Even if we assume that the opportunity for discussion was used to reach a cooperative agreement between groups rather than to coordinate ingroup strategies, a peace agreement in the IPG game is predicted to be unstable. Table 1 shows that when Player i expects all others not to contribute, Player i should in fact contribute his or her endowment. By doing so Player i can increase both own and group outcomes. Of course, as a rational player, Player i must assume that the other players are equally rational and therefore that they cannot be trusted to keep the intergroup agreement. Hence, in the absence of ingroup coordination, the IPG game reverts to a noncooperative n-person game.

**Method**

A total of 120 male undergraduate students at the Hebrew University of Jerusalem participated in the experiment in sets of 6. Half the subjects were assigned to the IPD game condition, whereas the other half played the IPG game. After receiving the game instructions and before making their decisions, subjects were allowed to discuss the situation with all other participants. Discussions were held in the central experimental room. Each discussion lasted exactly 5 min. In all other details the procedure was identical to that described above for Experiment 1.

**Results**

**Rates of contribution.** The mean number of contributors per set of 6 subjects was 1.80 (30.0%) in the IPG game and .50 (8.33%) in the IPD game. These means were compared using a 2 × 2 ANOVA with corresponding means in the no-communication control condition in Experiment 1 (using the set of 6 subjects as the unit of analysis). The ANOVA revealed significant main effects due to game type, F(1, 26) = 6.5, p < .02, and communication, F(1, 26) = 5.2, p < .05. The Game Type × Communication interaction effect was insignificant.

**Questionnaire data.** The means and standard deviations of p and q (the expected proportion of contributors among ingroup and outgroup members, respectively) appear in Table 3. A 2 × 2 ANOVA was performed separately on each of the dependent measures (using again the corresponding no-communication conditions of Experiment 1 as control groups). The ANOVA conducted on p revealed significant main effects for game type, F(1, 175) = 10.67, p < .001, and communication, F(1, 175) = 20.60, p < .0001. The Game Type × Communication interaction effect was not significant. The analysis of the q estimates revealed significant main effects for game type, F(1, 174) = 21.63, p < .0001, and communication, F(1, 174) = 34.32, p < .0001, and a marginally significant interaction effect, F(1, 174) = 3.34, p < .069.

The means in Table 3 show that subjects expected between-groups communication to reduce contribution rates (among ingroup and outgroup members) in both game conditions, and they expected more contribution in the IPG game than in the IPD paradigm. (The marginally significant interaction involving the q measure indicates that subjects expected between-groups communication to be somewhat less effective in reducing contribution among outgroup members in the IPG game than in the IPD paradigm.) Subjects slightly overestimated the contribution rates in the IPD game, but generally speaking they were quite accurate in predicting the actual pattern of results reported earlier.

A third ANOVA was performed on the ingroup–outgroup bias as reflected in subjects’ expectations concerning the behavior of other ingroup and outgroup players. It indicated that the performance bias p − q was unaffected by the opportunity for between-groups communication either directly or in interaction with game type.

**Intergroup agreements and individual choice.** Table 5 reports the number of contributors agreed on during the discussion and the actual number of contributors in each set. As in Experiment 1, the outcome of the discussions was assessed by two independent judges, one who was present during the discussion and another who coded decisions from the recordings of the discussions. Cases in which no between-groups agreement was reached, or the two judges did not agree on what the final agreement actually was, appear as missing data in the table.

Table 5 shows that of the 10 sets of subjects in the IPD condi-
Table 5  
Intergroup Agreements and Actual Number of Contributors by Game Type: Experiment 2

<table>
<thead>
<tr>
<th>Session</th>
<th>IA</th>
<th>m</th>
<th>IA</th>
<th>m</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0:0</td>
<td>3:0</td>
<td>0:0</td>
<td>1:0</td>
</tr>
<tr>
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<td>0:0</td>
<td>0:0</td>
</tr>
<tr>
<td>3</td>
<td>0:0</td>
<td>0:0</td>
<td>0:0</td>
<td>0:0</td>
</tr>
<tr>
<td>4</td>
<td>*</td>
<td>3:3</td>
<td>0:0</td>
<td>0:0</td>
</tr>
<tr>
<td>5</td>
<td>*</td>
<td>3:3</td>
<td>0:0</td>
<td>0:0</td>
</tr>
<tr>
<td>6</td>
<td>0:0</td>
<td>0:0</td>
<td>0:0</td>
<td>0:0</td>
</tr>
<tr>
<td>7</td>
<td>*</td>
<td>0:1</td>
<td>0:0</td>
<td>0:0</td>
</tr>
<tr>
<td>8</td>
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<td>0:0</td>
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</tr>
<tr>
<td>9</td>
<td>0:0</td>
<td>0:0</td>
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</tr>
<tr>
<td>10</td>
<td>0:0</td>
<td>0:0</td>
<td>0:0</td>
<td>0:0</td>
</tr>
</tbody>
</table>

Note: IPG = Intergroup Public Goods game; IPD = Intergroup Prisoner’s Dilemma game; IA = intergroup agreement (0:0 = two groups agreed to designate no contributors; * = no agreement has been reached); m = actual number of contributors.

Discussion

On the basis of the analysis of the IPG and IPD payoff structures, it was hypothesized that an agreement among all players to withhold contributions would be less stable in the step-level IPG game (in which the collective interest and individual rationality are in conflict) than in the continuous IPD paradigm (in which the collective interest and individual selfishness coincide).

The findings of Experiment 2 generally support this hypothesis. They show that although between-groups discussion is quite effective in reducing contribution in both team games (as compared with the no-communication control condition), its effectiveness as a solution to the intergroup conflict is significantly lower in the IPG game than in the IPD paradigm. A closer look at Table 5 indicates that when the two groups reached a cooperative (noncontribution) agreement, subjects were only slightly more likely to violate it in the IPG game than in the IPD paradigm. The difference between the two games results mainly from the fact that three sets of subjects in the IPG condition failed to negotiate a peace agreement in the first place, and the discussion session in two of these sets was used instead to coordinate ingroup strategies.

Similar results were reported by Bornstein, Rapoport, Kerpel, and Katz (1989), who found that discussion between groups is quite effective in solving the intergroup conflict in the IPG game as long as within-group communication is prohibited. When subjects conduct both between-groups and within-group discussions, their ability to achieve the collectively optimal solution is greatly diminished.6 This finding is consistent with the interpretation that individuals, like groups, attempt to maximize their security level. Whereas the maxim (maximizing minimal gain) group strategy in the IPG game is for all players to contribute, the maximin strategy for the individual player (in the absence of ingroup coordination) is to withhold contribution.

General Discussion

Like other game-theoretic models, the purpose of team games is not to reproduce reality, but to increase our understanding of fundamental processes by simplifying it (Snidal, 1986). The present study clearly demonstrates the potential of this new class of games, as both an analytical and an empirical tool, in advancing our understanding of social interaction in intergroup conflicts.

For example, the finding that groups are more effective in solving the free-rider problem in the step-level IPG game than in the continuous IPD paradigm provides valuable insights as to why zero-sum thinking ("It's either victory for them or victory for us") tends to develop in intergroup conflict (Pruitt & Rubin, 1986). Framing the conflict as an "all or nothing" matter has clear advantages from the perspective of the group. It changes the intragroup reward structure from a problem of continuous public goods provision, in which defection is the dominant individual strategy, into a step-level public goods problem, in which self-interested individuals should cooperate when this is critical for the group's success (Bornstein, Erev, & Rosen, 1990).

In contrast, the finding that groups are more likely to reach a cooperative solution to the intergroup conflict in the continuous IPD paradigm than in the step-level IPG game suggests that attempts to resolve the intergroup conflict to the advantage of the wider society should stress the continuous nature of the conflict and downplay the role of individual contributions. As observed by Campbell (1972), such peace initiatives have a better chance to succeed because they "have the temptations of [individual] selfishness on their side" (p. 34).

Perhaps most important, the findings of the present study support the notion that efforts to mobilize collective action within the groups are liable to interfere with the resolution of the conflict between them. This leads to the somewhat paradoxical conclusion that the free-rider problem that arises when groups, as opposed to individuals, are involved in a conflict could be responsible for the high level of competitiveness that often characterizes intergroup relations.

Before concluding this discussion, several issues concerning the generalizability of the present research paradigms should be addressed. The distinction between the step-level IPG game and the continuous IPD paradigm, as captured by the notion of criticality, is particularly relevant when the competing groups are of relatively small size. As the competing groups grow larger, the probability that a particular contribution will be the one that makes the difference becomes increasingly small and

6 The instructions in the present study were considerably more lenient than those used by Bornstein, Rapoport, Kerpel, & Katz (1989). Whereas subjects were allowed to communicate with all other participants, they were not explicitly prevented from conducting within-group discussions. This may explain the fact that the contribution rate in the IPG condition of Experiment 2 was 30% as compared with a contribution rate of only 7% in the between-groups communication condition of Bornstein et al. (1989).
the intragroup reward structure of the step-level game approximates a social dilemma with defection as the dominant individual strategy. This argument implies that the IPD team game is the more universal of the two models. In addition to adequately modeling (small or large) intragroup conflicts over continuous public goods, the IPD game may be used to simulate large-scale intergroup conflicts involving step-level goods. Up to this point, our treatment of intergroup conflicts has been entirely static. Needless to say, however, most intergroup conflicts outside the laboratory are repeated games in which the decision of whether (or how much) to contribute toward the group’s effort is a recurring one. The principal difference between one-shot and iterated games (often referred to as supergames) involves the possibility of conditional cooperation. Axelrod (1984) argued that, whereas defection is collectively stable in the one-shot PDG, contingent cooperation (tit for tat) may be stable in the PDG supergame. M. Taylor (1987) presented a similar argument with regard to the $n$-person PDG.

In intergroup conflicts as modeled by team games (in particular the IPD game), the notion of reciprocal cooperation is remarkably more complex. Contribution, which constitutes an act of cooperation toward one’s own group, is, at the same time, a competitive act toward the outgroup (and the society at large). Future research will involve team supergames in an attempt to identify the conditions under which reciprocal cooperation develops within and between groups.

References


(Appendix follows on next page)
Appendix

Games Used in This Study

Intergroup Prisoner’s Dilemma (IPD) Game

The IPD game is played between Teams A and B with \( n \) members in each team (\( n_A = n_B = n \)). Each player receives an endowment of \( C \) (\( C > 0 \)) units and has to decide between keeping the money (\( c \)) and contributing (\( c \)) it toward his or her group benefit. Denote by \( m_A \) the total number of contributors in Group A, by \( m_{A,i} \) the number of contributors in Group A excluding Player i, and by \( m_B \) the total number of contributors in Group B. Denote by \( r \) the maximal bonus payoff (in the present study, \( r = 18 \)).

The payoff to Player i (\( i \in A \)) for contributing is given by the following:

\[
P_{ci} = r/2[1 + (m_A - m_{A,i})/n].
\]

The payoff to Player i (\( i \in A \)) for not contributing is given by the following:

\[
P_{nci} = r/2[1 + (m_A - m_B)/n] + C.
\]

Defining \( D_i = P_{ci} - P_{nci} \) as the difference in payoff for Player i between contributing and not contributing, and omitting the subscript for convenience, we obtain

\[
D = r/2n - C.
\]

The IPD game is defined by the following properties:

\[
\frac{r}{2n} < C \quad \text{and} \quad \frac{r}{2} > C.
\]

The first inequality indicates that the cost of contribution for Player i (\( i \in A \)) is larger than his or her private benefit from contributing regardless of what other ingroup and outgroup members do. (The value of \( D \) in other words, is always negative.) The second inequality means that the net benefit to Player i’s group from his or her contribution is always positive (or, alternatively, that the payoff to i when all ingroup members contribute is larger than his or her payoff when none contribute). These two requirements taken together define the intragroup reward structure in the IPD game (for any number of outgroup contributors) as an \( n \)-person Prisoner’s Dilemma (Dawes & Thaler, 1988). Because Player i’s contribution reduces the benefits to Group B by \( r/2 \) while increasing the benefits to the ingroup by \( r/2 - C \), the net cost to the superordinate group is C. This last property means that the payoff to i when no one contributes is larger than his or her payoff when everyone contributes.

For simplicity, the IPD paradigm was described above for the limiting case in which the competing groups are of equal size. The game can be easily modified for the general case in which \( n_A > n_B \). The payoff for Player i (\( i \in A \)) for contributing in this case is given by the following:

\[
P_{ci} = r/2[1 + (m_A - m_{A,i})/n_A], \quad \text{where} \quad r/2n_A < C < r m_B/n_A.
\]

Intergroup Public Goods (IPG) Game

The payoff to Player i (\( i \in A \)) for contributing in the IPG team game is given by the following:

\[
P_{ci} = r, \quad \text{if} \quad m_A - m_B > 0
\]

\[
= s, \quad \text{if} \quad m_A - m_B = 0 \quad \text{(In the present study \( s = r/2 \)).}
\]

\[
= 0, \quad \text{if} \quad m_A - m_B < 0.
\]

The payoff to Player i (\( i \in A \)) for not contributing is given by the following:

\[
P_{nci} = r + C, \quad \text{if} \quad m_A - m_B > 0
\]

\[
= s + C, \quad \text{if} \quad m_A - m_B = 0
\]

\[
= C, \quad \text{if} \quad m_A - m_B < 0.
\]

The game is defined by two inequalities:

\[
s > C, \quad \text{and} \quad s + C < r.
\]

The first inequality means that the private benefit from contribution when Player i is critical for tying the game is larger than his or her cost of contribution. The second indicates that the same is true when i is critical for winning the game. (Other step-level team games in which Player i benefits from contribution only when critical for a win, or, alternatively, only when critical for a tie are possible and in fact are of much interest. Also possible are games in which Player i does not benefit from changing the game’s outcome while his or her group does.)

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