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THE EFFECT OF BETWEEN-GROUP COMMUNICATION ON CONFLICT RESOLUTION IN THE ASSURANCE AND CHICKEN TEAM GAMES

by

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The Effect of Between-Group Communication on Conflict Resolution in the Assurance and Chicken Team Games

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Abstract

We studied conflict resolution in two types of intergroup conflicts modeled as team games, a game of Assurance where the groups' incentive to compete is purely fear, and a game of Chicken where the groups' incentive to compete is purely greed. The games were operationalized as competitions between two groups with three players in each group. The players discussed the game with other ingroup members, after which they met with the members of the outgroup for a between group discussion, and finally had a within-group discussion before deciding *individually* whether to participate in their group's collective effort vis-a-vis the other group. We found that all groups playing the Assurance game managed to achieve the collectively efficient outcome of zero participation, whereas groups playing the Chicken game maintained a highly inefficient participation rate of 78%. We conclude that communication between groups is very effective in bringing about a peaceful resolution if the conflict is motivated by mutual fear and practically useless if the conflict is motivated by mutual greed.

Introduction

Groups often communicate a great deal in time of conflict. "They talk, negotiate, signal, and make threats, commitments, and promises" (Majeski & Friks, 1995, p. 624). Much of this communication is costless and non-binding "cheap talk" that has no direct bearing on the participants' payoffs. The focus of the present investigation is the effect of such informal communication on the resolution of intergroup conflicts.

We compared the effects of communication in two different types of intergroup conflict, a game of Assurance, where the groups' incentive to compete is purely defensive (a rational group should compete only if it expects the outgroup to compete as well), and a game of Chicken, where the groups' incentive to compete is purely offensive (a rational group should compete only if it expects the outgroup not to compete or to compete to a lesser extent).

The games were operationalized as team games (Palfrey & Rosenthal, 1983; Rapoport & Bornstein, 1987; Bornstein & Horwitz, 1993) involving two groups with three members in each group. Each group member received an endowment of $\boldsymbol{e}$ and had to decide between keeping the money and contributing it towards the group's benefit. Contributions were not refunded.[1] The group with more contributors won the competition and each of its members received a bonus of $\boldsymbol{r}$ ($\boldsymbol{r} > \boldsymbol{e}$). The members of the group that lost the competition received no bonus. The difference between the Assurance and Chicken team games involved the case where the game was tied (i.e., when there was an equal number of contributors in both groups). In case of a tie in the Assurance game, each member of both groups was paid a bonus of $\boldsymbol{r}$. In case of a tie in the Chicken game, the members of both groups were paid nothing. Intergroup conflicts often end up in a stalemate, with neither side clearly winning nor losing the competition. The utility of such an outcome may, however, differ from one conflict to another. The intergroup Chicken game models a particularly fierce conflict where a tie is valued as a loss (Snidal, 1991). The intergroup Assurance game models a milder type of conflict where groups only aspire not to lose and therefore value a tie as a win.[2]

The players were allowed to discuss the game with other ingroup members, after which they met with the members of the outgroup for a between-group discussion, and finally had a within-group discussion before deciding individually whether to contribute their endowment. The decisions were made privately and anonymously and individual group members were not constrained to keep any agreement that may have been reached either between the two groups or within each group.[3] This procedure leaves open the possibility of free-riding. Since individual contribution is costly, a player who believes that her contribution will not affect the outcome of the competition (in the sense that her group will win or lose the competition regardless of what she does) is better off not contributing. It is typically the case in intergroup conflict that the payoffs associated with winning (e.g., national security, pride) are public goods that are available to contributors and non-contributors alike, and therefore group members are presented with the opportunity, indeed the temptation, to take a free ride on the effort of others (Rapoport & Bornstein, 1987; Bornstein, 1992; Gould, 1999).

The individual payoff matrices for the two games with the parameters used in the present study (e=IS 15 and r=IS 30) appear in Table 1. The entries in the various cells are the payoffs to Player i (a member of group A) as a function of her own decision to contribute or not and the number of ingroup (m_A) and outgroup (m_B) contributors. As can be seen in these matrices, a rational player should contribute if her contribution is critical for tying the Assurance game, or if it is critical for winning the Chicken game. In all other cases, a player is better off withholding contribution.

<Insert Table 1 about here>

Let us now examine the Assurance and Chicken team games from the perspective of the competing groups. In the game between groups A and B, each group has four pure strategies, namely to designate 0, 1, 2, or 3 contributors. The group payoff matrices for the two games appear in Table 2. The entries in the various cells represent the total payoff for each group (rewards and endowments summed across all group members) as a function of the number of contributors in group A and group B.

<Insert Table 2 about here>

The maximin group strategy in the Assurance game is to designate all three group members as contributors. This strategy protects the group against the possibility of losing the competition and guarantees a reward of IS 30 for each group member. If both groups choose their maximin strategies, the outcome (represented by the lower right-hand cell) is a Nash equilibrium and no group has an interest to unilaterally deviate from it. This outcome is, however, collectively-deficient. The collectively optimal outcome, the one yielding the highest joint payoff in the game, results from mutual cooperation (represented by the upper left-hand cell). The mutually cooperative outcome is also a Nash equilibrium and therefore no group has an incentive to deviate from it unilaterally. Thus, if a group fears that the other group might compete (designate three contributors), its best response is to compete. But, if a group expects the opposing group to behave cooperatively (designate no contributors), its best response is to cooperate.[4] In other words, since the payoffs for winning and tying the Assurance game are identical, greed is not a rational reason for competition. The intergroup competition in this game is thus a generalization of the two-person Assurance or Stag-hunt (Jervis, 1978) game where it is rational for each player to compete if the other competes, and to cooperate if the other cooperates.

The strategic considerations in the Chicken participation game are quite different. If a team fears that the other team will behave competitively, its best response is to yield by designating no contributors (fear of the opponent, in other words, is not a rational reason for competition). Designating no contributors is the maximin team strategy which guarantees each team member a minimum of *e*. However, the intersection of the maximin strategies is not an equilibrium, and therefore each group can benefit from deviating from its maximin strategy if it assumes that the other team will stick to its own maximin. Of course, if both teams are greedy and try to win the game, the game might result in the outcome represented by the lower left-hand cell, which is the worst outcome in the game. As can be seen in Table 2, when all six players contribute their endowments no one gets paid. The intergroup conflict has the characteristics of a two-person Chicken game, as understood by Schelling (1960) and others. If one player "chickens out" the other can exploit its caution to win the game. But by trying to get the maximum payoff (i.e., by being greedy) both players are exposed to the risk of a mutually disastrous outcome (i.e., a "collision").

In a previous experiment, Bornstein, Mingelgrin, & Rutte (1996) compared the intergroup Assurance and Chicken games while allowing communication only within the groups. We found that when between-group communication was not permitted, the majority of the groups in both the Assurance and Chicken games (83% and 72%, respectively) chose the most competitive strategy of designating all group members as contributors, and practically all players abided by the group decision. As a result, 75% of the participants in both team games contributed their endowment (as compared with a participation rate of about 40% in both games in a no-communication control condition), and almost half (45%) of the intergroup competitions resulted in full-scale “war”– the outcome least efficient for both groups. Whereas the structural difference between the Assurance and Chicken games had little effect on (either group or individual) choice behavior, it did have profound effects on the intragroup processes leading to these decisions. In particular, the rationale for choosing the competitive strategy (as coded from group discussions) and the beliefs of individual group members following discussion (as reflected in the post-decision questionnaire) differed systematically as a function of game type.

The choice of the competitive group strategy in the Assurance game was based on distrust or fear of the opponent. Ingroup members expected the outgroup to compete by designating all of its members as contributors and decided to protect themselves against losing the game by making the same choice. This "playing it safe" strategy was reflected in the content of group discussions, which were characterized by risk-avoidance arguments (e.g., "If we all contribute we are assured at least a tie") and based on symmetric expectations concerning the ingroup and the outgroup (e.g., "They must be thinking in exactly the same way"). Following within-group discussion, group members assumed that ingroup and outgroup members would be about equally likely to contribute, and consequently expected the game to be tied. In contrast, the decision to compete in the Chicken game was motivated by risk-taking arguments (e.g., "If we all contribute, it's either all or nothing"), and was based on asymmetric ingroup/outgroup expectations. Specifically, participants expected the outgroup to be less likely to compete (designate all group members as contributors), and if such a decision was made they expected individual outgroup members to be less likely to keep it (e.g., "Let's all contribute, at least one of them is bound to defect"). Following within-group discussion participants estimated the contribution rate of the ingroup to be almost 20% higher than that of the outgroup and consequently estimated the ingroup's chances of winning the game as much higher than the outgroup's.

In sum, when allowed only within-group communication, group members chose the most competitive strategy in both the Assurance and the Chicken games. However, in the Assurance game they competed because they perceived the outgroup to be competitive and dangerous and wanted to protect themselves against the possibility of losing the competition, whereas in the Chicken game they competed because they perceived the outgroup to be vulnerable and likely to "chicken out" and wanted to take advantage of its weakness to win the competition.

Would communication between the groups change the members' perception of the outgroup and consequently shift group behavior towards greater cooperation? In the Assurance game the answer is definitely yes. The cooperative solution in this game, namely for all members of both groups to withhold contribution, is symmetric and stable. The solution is symmetric as it allows both groups to 'not lose' the competition, and not losing in the Assurance game as defined above is as good as winning. It is stable, since no group (and no individual player) can benefit from unilaterally reneging on a no-contribution agreement.[5] Recall that the only rational reason to compete in the Assurance game is fear of an irrational or competitive opponent (or fear of the opponent's fear, etc). Communication between the groups can diffuse such fears by reassuring each group of the other group's rationality (its intention to maximize absolute, rather then relative, payoffs). Communication can also be used to verify a common understanding of the game's payoff structure, and enhance trust through an explicit agreement of mutual cooperation (Majeski & Fricks, 1995).

In the game of Chicken, however, since winning is all that matters, between-group communication is expected to be practically useless. The collectively optimal solution in this game is for one group to have a single contributor while the other group has none.[6] This solution, however, is asymmetric and inherently unstable. Assume that groups A and B have reached a 0:1 agreement, and that the members of group A believe that group B will keep the agreement and designate only one contributor; then they are tempted to win the game by designating two. Knowing that, group A should designated all three members as contributors, and anticipating this, group B should designate none. However, given the expectation that all members of B will defect, a single contributor is again sufficient to win the game for A, and so on. In other words, there is no Nash equilibrium in pure strategies in the Chicken game between groups A and B and therefore any non-enforceable agreement between them is expected to be rather futile.

Our hypothesis, then, is that the effect of between-group communication will interact with game type. Communication is predicted to be highly effective in bringing about the collectively optimal outcome in the Assurance game, where the competition is motivated by fear, but to have little or no effect in the Chicken game, where the competition is motivated by greed.

Method

Participants and Design: The participants were 120 undergraduate students at the Hebrew University of Jerusalem. They were recruited by campus advertisements promising a monetary reward for participation in a group decision-making task. Subjects were scheduled in sets of six. Ten such sets played the Assurance game and 10 the Chicken game. In addition to a flat show-up fee of IS 10, the participants were paid between IS 0 and IS 45, contingent on their decisions and the decisions of the other players in their set (IS 10 equaled approximately $2.50, when the experiment took place).

Procedure: As they arrived at the laboratory, the six participants were given instructions about the rules and payoffs of the game. The game instructions were phrased in terms of the individual player's payoff as a function of her own decision of whether or not to “invest” her endowment and the decisions made by the other players in her set, with no reference to cooperation or defection. The participants were given a short quiz to test their understanding, and the explanations were repeated until the experimenter was convinced that everyone understood the payoff matrix.

After the game instructions, the subjects were randomly divided into two three-person groups and were told that they would be allowed to discuss the situation with the other participants before making their individual decisions. Specifically, they were informed that the members of each group would first meet separately for a within-group discussion, then the two groups would meet together for a between-group discussion, and finally each group would conduct a second within-group discussion. The within-group discussions were held in two separate rooms and the between-group discussion in the central experiment room. Each discussion lasted up to 5 minutes. An experimenter was present in each room and audio-recorded the discussion with the explicit knowledge and consent of the participants.

Following the sequence of discussions, each participant was handed a promissory note for IS 15, a copy of the game's payoff matrix, and a decision form. The participants 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. Once all the decision forms were collected, the subjects were handed a questionnaire in which they were asked to estimate (i) the probability that exactly 0, 1, or 2 of the remaining ingroup members had contributed their endowment, (ii) the probability that exactly 0, 1, 2, or 3 outgroup members had contributed their endowments, and (iii) the probability that their team had won, tied, or lost the competition. The subjects were instructed that the probability estimates in each question should sum to 1. Following the completion of the questionnaire, the participants were debriefed on the rationale and purpose of the study. They were then paid and dismissed individually.

Results

Overall contribution rates: The mean number of contributors (per set of six subjects) was 4.7 (78%) in the Chicken game and 0 in the Assurance game. Clearly, this difference is statistically significant ($p < .001$ by Fisher exact test, using the set of six subjects as the unit of analysis).

Intergroup agreements, group decisions and individual choice: Table 3 reports the number of contributors agreed upon in the between-group discussion (B), the number of contributors designated in the following within-group discussions (W), and the actual number of contributors in each group (#), by game condition and session within condition. The (between and within-group) agreements were assessed independently by two judges, one of whom was present during the discussion, while the other listened to audio recordings of the discussions. The judges agreed on the outcome of 19 of the 20 B discussions, and 37 of the 40 W discussions (an agreement rate of 95% and 92.5%, respectively).[7] Table 3 reports the outcome of the between and within group decisions as indicated by both judges. Cases in which the discussion did not result in an explicit decision or in which the two judges did not agree on what the decision actually was appear as a minus sign.

Except for one session in which no agreement was reached, all between-group discussions in the Assurance game resulted in an explicit agreement of collective non-contribution.[8] Based on the strategic properties of this game, we hypothesized that these cooperative intergroup agreements would be highly stable. Indeed, Table 3 shows that all 9 agreements were fully kept at both the group and the individual levels. That is, following an intergroup agreement to designate no contributors, both groups decided to keep the agreement in their subsequent within-group discussions, and all individual players withheld their contribution in accordance with both the between and within group agreements.

In the Chicken game, the situation is dramatically different. Only four between-group discussions resulted in the collectively optimal agreement of 1:0, one discussion resulted in a 0:0 agreement, and the remaining five discussions did not result in an agreement. Of the five agreements reached, *none* were kept. For example, following a 0:1 between-group agreement in session 1, both groups violated the agreement by designating three contributors in the subsequent discussions, and all six individuals contributed their endowment (which resulted in a payoff of 0 for each player). In session 4, following a 0:1 agreement between groups A and B, group A reneged by designating three contributors and, since group B kept its side of the agreement and designated only one, group A ended up winning the game. Interestingly, the mean number of contributors per session following an agreement (in sessions 1, 2, 4, 6, & 8) was 4.6 (out of 6), which is hardly different from the mean of 4.8 contributors per session (in sessions 3, 5, 7, 9, & 10) when no agreement was reached. In other words, groups that reached a cooperative agreement were as competitive (and as inefficient) as groups that did not reach an agreement. Comparing the actual choices of the individual group members with the decision reached by their group shows that only one designated contributor (in session #3 of the Chicken game) did not contribute his/her endowment, in violation of the intragroup agreement.

<Insert Table 3 about here>

Questionnaire data: Table 4 reports the mean probability estimates made by the participants in response to the questionnaire. The probability estimates for question 1 were used to compute the expected contribution rate among the remaining ingroup members (denoted by p), while the probability estimates for question 2 were used to compute the expected contribution rate among the outgroup members (denoted by q).[9]

<Insert Table 4 about here>

Subjects expected both ingroup (p) and outgroup members (q) to be much more likely to contribute in the Chicken game than in the Assurance game [$t_{(9.1)} = 12.99$, $p<.001$ and $t_{(14.4)} = 10.74$, $p<.001$, respectively]. A more interesting result, however, involves the difference score p-q, the probability of contribution by an ingroup member minus that by an outgroup member. As can be seen in the table, p-q is 26.7% in the Chicken game as compared with –4.14% in the Assurance game. Both of these mean difference scores are significantly different from zero [$t_{(9)}$=6.01, p<.001, and $t_{(9)}$=-2.65, p <.05, respectively]. And, clearly, the p-q difference is significantly larger in the Chicken game than in the Assurance game [$t_{(11.2)}$=6.56, p<.001)].

Table 4 also reports the participants' subjective probability of winning (denoted by w), tying (denoted by t), or losing the game (denoted by l) in Chicken and Assurance games. The t-test performed on w revealed a significant main effect for game-type [$t_{(11)}$=13.63, p<.001]. Participants in the Chicken game estimated their group's chances of winning the game as 48%, whereas those in the Assurance game estimated their chances as only 2.4%. The participants estimated the probability that the game would be tied as about 30% in the Chicken game, and as 93% in the Assurance game. This difference is also statistically significant ($t_{(18)}$=-18.53, p<.001).

Another interesting comparison between the two games involves the difference score w-l (the estimated probability of winning minus that of losing]. As can be seen in the table, players in the Assurance game estimated their chance of losing as small but significantly ($t_{(9)}$ = -2.25, p< .05) higher than that of winning. Players in the Chicken game estimated their group's chances of winning as high, and twice as high as that of losing ($t_{(9)}$ = 4.04, p<.005). This pattern is consistent with the participants estimated contribution rates reported earlier. The participants in the Assurance game expected about 5% of the outgroup members to contribute (in violation of the cooperative agreement between the groups). And since the contribution (or violation) rate among ingroup members was expected to be lower (less than 1%), they reasonably estimated their chance of losing the game as higher than that of winning. The participants in the Chicken game expected a much higher contribution rate among ingroup members than among outgroup members (70% and 40%, respectively) and consequently estimated their chance of winning as much higher than that of losing. The w-l difference is of course significantly larger in the Chicken condition than in the Assurance condition ($t_{(9.7)}=4.39$, $p<.002$).

Discussion

Previous research has produced inconsistent results concerning the effect of intergroup communication on conflict resolution. Insko & Schopler (1987; Schopler & Insko, 1992) found that communication between groups is relatively ineffective as a means for resolving the conflict. Their research typically employed the two-person Prisoner's Dilemma (PD) game, and allowed group members (or group representatives) to discuss the game with their opponents before each group (as a whole) made its choice of a strategy. Insko & Schopler found that group decisions were highly competitive – much more so than individual decisions under the same conditions (see Schopler and Insko, 1992, for a review).

Insko & Schopler offer two explanations for the observed competitiveness of groups. The "schema-based distrust" hypothesis explains intergroup competitiveness in terms of *fear*. It postulates that group members compete because they expect the outgroup to behave competitively and want to defend themselves against the possibility of being exploited. The "social support for shared self-interest" hypothesis explains group competitiveness in terms of *greed*. It argues that groups are competitive because group members provide each other with support for acting in an exploitative, ingroup-oriented way.

In the Prisoner's Dilemma game either fear or greed is sufficient to motivate a competitive choice (Coombs, 1973; Dawes, 1980). Therefore, to help distinguish between these two motives for competition, Insko et al. (1990, 1993) devised a version of the PD game, called the PD-alt game, which includes a third option of withdrawal for both players. Withdrawal is a safe, risk-free option which guarantees each side a certain payoff regardless of what the other side does. This payoff is set to be higher than the payoff for mutual defection, so that a player who fears that the other player will defect should withdraw rather than defect. Defection, in other words, is rational only if a player believes that the opponent will cooperate, and is therefore indicative of greed.

Insko et al (1993) studied the effect of communication between players in the *one-shot* PD-alt game. They found that, while communication enhanced cooperation between two individuals, it did not improve cooperation between two groups (as compared with a no-communication control condition). Different results were reported by Majeski & Friks (1995), who compared the effect of communication on intergroup cooperation in the *repeated* PD and PD-alt games. These researchers found that communication in general enhanced intergroup cooperation; groups that were allowed to communicate cooperated more, defected less, and consequently earned more money than groups who were not. The option of withdrawing also had a positive effect. Groups who had that option (in the PD-alt game) defected less (whether they could communicate or not), but did not cooperate more or earn more money than groups which did not have the withdrawal option. Moreover, even groups that could communicate and had a withdrawal option chose to defect about 10% of the time, which led Majeski and Frickes (1995) to conclude that "some groups are apparently still motivated by greed."

The present experiment uses a different approach to separate fear and greed. Rather than constructing the conflict as a PD-alt game where the groups have a safe withdrawal option (which is seldom available in real-life conflicts), we structured the conflict as either a game of Assurance, where there is no incentive to win (rather than tie) the competition, or a game of Chicken, where there is no incentive to tie (rather than lose) the competition. Thus, at least with respect to the monetary payoffs, greed is eliminated from the first game and fear from the second.

We found that this manipulation dramatically modified the effect of between-group communication on conflict resolution. In the Assurance game, where competition is motivated by fear, communication was highly effective in bringing about a peaceful resolution. In the Chicken game, where competition is motivated by greed, communication was practically useless. This latter result is particularly striking. Following between-group discussion, the participation rate in the Chicken game remained as high (and as inefficient) as that found in a previous experiment (Bornstein et al., 1996) where communication between the groups was altogether prohibited. Eleven (of the 20) groups in this game condition chose the most competitive strategy of designating three contributors, and all (except one) of the designated contributors adhered to their group's decision. Recall that choosing (and sticking with) this strategy makes sense only if the ingroup members believe that the outgroup members will *not* make the same choice. In other words, differential beliefs concerning the behavior of ingroup and outgroup members are necessary to sustain such a decision.[10]

The questionnaire data clearly affirm the existence of such biased beliefs. The participants in the Chicken game estimated the probability of contribution by outgroup members as much lower than that by ingroup members, and consequently estimated their chances of winning the intergroup contest as much higher. Since this optimism was shared by both groups, however, it proved unjustified, as three (out of 10) sessions resulted in full-scale "collision", and most other sessions resulted in a highly inefficient outcome for both groups. Apparently, intergroup contact did little to abate the tendency of group members to form and maintain (and eventually act on) biased outgroup perceptions.[11]

Conclusions: The game of Chicken models a variety of conflicts involving bilateral threat. Our experiment suggests that when, as in military confrontations or disputes between management and workers, the competing sides are groups, ingroup/outgroup bias can prevent either group from yielding, leading to an outcome, such as war or a strike, that is disastrous to both groups. The results concerning the intergroup Assurance game are much more optimistic. The Assurance game models a relatively benign version of the security dilemma where the temptation to defect for defensive reasons is balanced by the strong preference of both sides for mutual cooperation (Jervis, 1978). The present experiment suggests that intergroup communication (even when binding agreements are impossible) can facilitate the attainment of this desirable outcome.

Of course, in many real life conflicts the definition of the game is rather subjective, in the sense that changes in the utilities attached to the outcomes can transform the situation from one game into another (e.g., Jervis, 1978; Oye, 1986). The same objective situation can be perceived by both sides as a game of Assurance, where the crucial thing is not to lose, or as a game of Chicken, where winning is all that matters. Clearly, the way the conflict is perceived or framed by the competing groups is bound to affect their chances of resolving it peacefully.

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Table 1: Individual Payoff Matrices.

The Intergroup Chicken game

	m_A-m_B						
	3	2	1	0	-1	-2	-3
C	30	30	30	0	0	0	-
NC	-	45	45	15	15	15	15

The Intergroup Assurance game

	m_A-m_B						
	3	2	1	0	-1	-2	-3
C	30	30	30	30	0	0	-
NC	-	45	45	45	15	15	15

Note: The entries represent the net payoff in Israeli Shekels (bonus for contributors and bonus + endowment for non-contributors).

Table 2: Group Payoff Matrices.

Intergroup Assurance Game

		m_A			
		0	1	2	3
m_B	0	135,135	45,120	45,105	45,90
	1	120,45	120,120	30,105	30,90
	2	105,45	105,30	105,105	15,90
	3	90,45	90,30	90,15	90,90

Intergroup Chicken Game

		m_A			
		0	1	2	3
m_B	0	45,45	45,120	45,105	45,90
	1	120,45	30,30	30,105	30,90
	2	105,45	105,30	15,15	15,90
	3	90,45	90,30	90,15	0,0

Note: The entries represent the total payoff for each group (rewards + endowments summed across all group members)

Table 3: Intergroup agreements, group decisions, and actual number of contributors by game.

Intergroup Assurance Game

session	*1*		*2*		*3*		*4*		*5*		*6*		*7*		*8*		*9*		*10*	
B	0:0		0:0		0:0		-		0:0		0:0		0:0		0:0		0:0		0:0	
W	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
#	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Intergroup Chicken Game

session	*1*		*2*		*3*		*4*		*5*		*6*		*7*		*8*		*9*		*10*	
B	0:1		0:0		-		0:1		-		1:0		-		1:0		-		-	
W	3	3	3	-	1	3	3	1	-	-	-	3	3	2	3	0	3	3	3	1
#	3	3	3	2	1	2	3	1	3	2	2	3	3	3	3	0	3	3	3	1

Note: B represents the intergroup agreements, W represents the subsequent within-group decision, and # is the actual number of participants in each group.

Table 4: Means and SD of subjective probabilities.

	CHICKEN N= 10	*ASSURANCE* N=10
	71.72 (17.17)	0.97 (1.45)
q	44.94 (10.17)	5.11 (5.85)
p-q	26.78 (14.07)	-4.14 (4.95)
w	47.66 (9.96)	2.38 (3.34)
t	29.36 (7.45)	92.6 (7.81)
l	23.43 (11.46)	4.86 (5.0)

Note: p indicates the probability of contribution by an ingroup member; q indicates the probability of contribution by an outgroup member; w indicates the probability of winning the game; t indicates the probability of tying the game; and l the probability of losing it.

Footnotes

[1] When, as in the present study, the individual decision is binary, a team game becomes a participation game where each player decides between participation (which is costly) and non-participation. We shall use the terms contribution and participation interchangeably.

[2] The parallel between these team games and the two-person Chicken and Assurance games will become clearer in the next section, when we discuss the payoff matrices from the groups' point of view.

[3] A similar communication protocol was employed by Bornstein, Rapoport, Kerpel and Katz (1989) in the Intergroup Public Good (IPG) game.

[4] In fact, all the cases in which the game is tied are Nash equilibria, meaning that the best response for each group is to match the number of contributors in the outgroup.

[5] The outcome, in other words, is a Nash equlibrium in the two-person Assurance game between groups A and B. Moreover, it is also an equlibrium in the non-cooperative game among the six individual players, since no player can benefit from contributing when all other players do not.

[6] When a single player contributes, the six players earn a total of 3(IS 30) + 5(IS 15) = IS 165, which is the highest joint payoff in the game.

[7] All the disagreements between the judges occurred in the Chicken game condition. In all of these cases one judge claimed that there had been a decision while the other did not. There were no cases in which the two judges claimed that different decisions had been made.

[8] In session 4, one group suggested the collectively-optimal solution, but the members of the other group decided to postpone their final decision until they met separatly. Judging by the outcome of the subsequent within-group decisions and the fact that none of the six players contributed their endowment, it seems that a tacit agreement had nevertheless been reached.

[9] 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 $p = [p(1)/2 + p(2)]$, and $q = [q(1)/3 + 2q(2)/3 + q(3)]$.

[10] Strictly speaking, each of the three designated ingroup contributors is critical for provision only if each assumes that there will be exactly two outgroup contributors (van de Kragt, Orbell, & Dawes, 1983).

[11] The biased representations of the outgroup are not necessarily formed consciously. It could very well be that, when discussing a group strategy, subjects first apply the mutual rationality principle.

However, since in the Chicken game this line of reasoning results in a dead end, subjects simplify the situation by creating their own image of the opponent. A study by Carroll, Bazerman, & Maury (1988) documented a similar tendency of individuals to ignore the cognition of others in competitive situations. People commonly reduce the complexity of strategic decision problems by making unilateral assumptions about the opponent while ignoring the opponent's contingent cognitive processing.