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A CLASSIFICATION OF GAMES BY PLAYER TYPE

by

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A Classification of Games by Player Type

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Abstract

In this paper I classify situations of interdependent decision-making, or games based on the type of decision-makers, or players involved. The classification builds on a distinction between three basic types of decision-making agents: *individuals*, cooperative or *unitary groups* -- groups whose members can reach a binding (and costless) agreement on a joint strategy -- and *non-cooperative groups* -- groups whose members act independently without being able to make a binding agreement. Pitting individuals, unitary groups, and non-cooperative groups against one another, and adding Nature as a potential "opponent", generates a 3 (type of agent) X 4 (type of opponent) matrix of social situations. This framework is used to review the experimental decision-making literature and point out the gaps that still exist in it.

Introduction

In this chapter I lay out a classification of social situations -- situations of interdependent decision-making -- based on the type of decision-makers involved. Then, using this framework, I review the decision-making literature and point out the gaps that still exist in it. The classification of social situations, or games, builds on a distinction between three basic types of decision-making agents, or players: *individuals,* cooperative or *unitary groups* -- groups whose members can reach a binding (and costless) agreement on a joint strategy -- and *non-cooperative groups* -- groups whose members act independently without being able to make a binding agreement. Pitting individuals (I), unitary groups (U), and non-cooperative groups (G) against one another, and adding Nature as a potential “opponent”, generates the 3 (type of agent) X 4 (type of opponent) matrix depicted in Table 1.

<Insert Table 1 about here>

The I cell in the left-most column of Table 1 represents the vast literature on individual decision-making or one-person “games” against Nature (e.g., Camerer, 1995; Kahneman, Slovic, & Tversky, 1982). This cell is the only one in the matrix that does not involve interdependent or social decision-making per se (although social factors play a major role in shaping individual decision-making as well). The U cell represents the literature on decision-making by unitary ("common purpose") groups in games against Nature (e.g., Davis, 1992; Hastie & Kameda, 2005). There is also a substantial literature, particularly in social psychology (but recently also in economics, e.g., Blinder & Morgan, 2005), which compares group decision-making with that of individuals in these types of game (e.g., Kerr, MacCoun, & Kramer, 1996; Hill, 1982). The G cell in the bottom of column 1 represents the literature on non-cooperative n-person games, in particular the social-dilemma and public-good literature (e.g., Dawes & Messick, 2000; Hardin, 1982; Ledyard, 1995; Kollock, 1998) and the literature on coordination games (e.g., Van Huyck et al., 1990, Cooper, 1999). In the broader framework suggested here, these n-person games are seen as games of a non-cooperative group against Nature.

Another cell that has received much attention is the I-I cell, which represents the literature on two-person games (e.g., Komorita & Parks, 1995).[1] Two-person games have played a pivotal role in the study of cooperation and competition in inter-personal relations (e.g., Kelley & Thibaut, 1978). However, a good deal of the interest in the dyadic games has stemmed from issues of intergroup interactions, such as military confrontations, labor-management disputes, and competitions between organizations and interest groups, rather than interactions between two individuals (e.g., Axelrod, 1984, Brams, 1975, Deutsch, 1973). Two relatively recent lines of research have expanded the study of two-person games to the interaction between two groups. One has focused on competition between unitary groups, as in the U-U cell, while the other has investigated competition between non-cooperative groups, as in the G-G cell.

U-U vs. I-I: The "discontinuity effect"

In a series of experiments, Insko and his colleagues (Insko & Schopler, 1987; Schopler & Insko, 1992) compared the 2-person Prisoner's Dilemma game played between two unitary groups (whose members conducted face-to-face discussion to

[1] The I-I cell can be seen as a special case of the G cell with n=2. The difference between these two cells captures the common distinction between 2-person and n-person games (e.g., Colman, 1995) made in the literature.

decide, as a group, on whether to defect or cooperate) with the same game played between two individuals. They found that intergroup interaction is far more competitive than inter-individual interaction, and termed the observed difference between U-U and I-I interactions the *discontinuity* effect. Insko and Schopler (see, e.g., Wildschut, Pinter, Vevea, Insko, & Schopler, 2003) offer two explanations for the increased competitiveness of groups. The *social support for shared self-interest* hypothesis argues that groups are more competitive than individuals because group members provide one another with support for acting in a selfish, ingroup-oriented way. The *schema-based distrust* hypothesis postulates that group members compete because they expect the outgroup to act competitively and want to defend themselves against the possibility of being exploited. As a result of these processes, unitary groups are more selfish than individuals and also expect their opponents to behave more selfishly.

Several studies have employed the U-U vs. I-I design in the context of other two-person games. Bornstein and Yaniv (1998) compared group and individual behavior in the one-shot Ultimatum game. In this game Player 1 has to propose a division of a sum of money between herself and Player 2. If Player 2 accepts the proposed division, both are paid accordingly; if Player 2 rejects the proposal, both are paid nothing. In the U-U condition, the members of the allocating group conducted a face-to-face discussion to decide, as a group, on a proposed division, and the members of the recipient group held a discussion on whether to accept or reject the proposal. The game-theoretic solution for the Ultimatum game prescribes that Player 2, as a rational, self-interest maximizer, should accept any proposal greater than zero, and therefore Player 1, who is similarly motivated, should propose keeping all but a penny for herself. Bornstein and Yaniv (1998) found that, although neither individuals nor groups were fully rational in that sense, groups in the role of Player 1 offered less than individuals, and groups in the role of Player 2 were willing to accept less. Similar findings for the behavior of Player 1 were reported by Robert & Carnevale (1997).

Luhan, Kocher, & Sutter (in press) compared individual and group decisions in the Dictator game (Kahneman et al., 1986). The Dictator game is a one-sided ultimatum game where player 1 has to divide a sum of money between itself and player 2, and player 2 must accept the division. Their experiment used a within-subject design where decisions were first made individually, then in a (three-person) group setting, and then individually again. Individuals were assigned to groups based on their decision in the initial stage, so that each group consisted of a relatively selfish member, a relatively other-regarding member, and a moderate one. Luhan et al. found that groups were less generous than individuals -- the least generous group member exerts the most influence on the group's decision, and following a group decision individual allocations become more selfish as compared with the initial decisions.[2]

Kocher and Sutter (in press) studied individuals and groups in a one-shot Gift-Exchange game. This game models bargaining in the labor market, where the employer first determines the employee’s wage, and the employee then chooses her effort level. Rationally, the employee should exert minimum effort regardless of her wage and, anticipating that, the employer should pay the lowest wage possible. Kocher and Sutter (2002) found that groups in the role of employers and employees chose lower wages and effort levels, respectively, than individuals.

[2] However, an earlier study by Cason and Mui (1997) found that (two-person) groups made somewhat more generous, other-regarding allocations in the Dictator game than individuals.

Cox (2002) compared the Trust game played between two individuals with the same game played between two unitary groups (of three individuals each). In the Trust game (Berg, Dickhaut & McCabe, 1995) the *sender* receives an initial endowment, $X > 0$, and can transfer any part of it ($x \leq X$) to a *responder*. The latter receives $3x$ and can return any amount $y \leq 3x$ to the sender. The sender's choice of x is taken as a measure of trust -- one's willingness to make oneself vulnerable to the actions of another agent (Coleman, 1990) -- whereas the return y indicates the responder's trustworthiness. Cox's main findings were that individuals and groups did not differ in the amount sent, x, but groups in the role of responders return significantly smaller amounts, y.

Kugler, Bornstein, Kocher, & Sutter (in press) also compared the behavior of individuals and unitary groups in the trust game, but obtained different results. In their study, groups in the role of sender sent smaller amounts than individuals and expected lower returns. Groups and individuals in the role of responder return on average the same fraction of the amount sent. Hence, Kugler et al. concluded that groups are less trusting than individuals, but just as trustworthy. Obviously, more experimental work is needed to establish the difference between individual and group behavior in the trust game.

Bornstein, Kugler, & Ziegelmeyer (2004) compared the Centipede game (McKelvey & Palfrey, 1992) played by either two individuals or two unitary groups (see Figure 1). The two competitors in this game alternate in deciding whether to take the larger portion of an increasing pile of money, and as soon as one takes the money the game ends. The rational, game-theoretic solution is again based on the logic of backward induction. Assuming that Player 2 is selfish and therefore will choose Take at the last decision node, Player 1, who is similarly selfish, should choose Take at the next-to-last node. Applying the same logic to all moves up the game tree, Player 1, the first mover, should choose to exit the game at the first decision node. Bornstein et al. (2004) found that, although neither individuals nor groups fully complied with this theoretic solution, groups did exit the Centipede game significantly earlier than individuals.

<Insert Figure 1>

Recent studies by Cooper & Kagel (2005) on signaling games, and by Kocher and Sutter (2005) on guessing ("beauty contest") games, where social (other-regarding) preferences play little role, show that unitary groups are better than individuals in reasoning from the point of view of the opposing player and, in particular, unitary groups learn much faster than individuals to play strategically.

Summary: The rapidly accumulating experimental literature on the I-I vs. U-U contrast shows quite clearly that groups and individuals make different decisions in two-person games. Groups, it seems, are more selfish and more sophisticated players than individuals, and, as a result, interactions between two unitary groups are closer to the rational, game-theoretic solution than interactions between two individuals.[3]

G-G vs. G: Intergroup vs. Single-Group Games

Competition between two non-cooperative groups (e.g., war, elections, rivalry between interest groups) is often associated with conflict of interest within each of the

[3] Unitary groups in the experiments reviewed in this chapter were operationalized as "natural" groups whose members can talk freely among themselves and share information and ideas. Unitary groups can, however, also be operationalized as nominal groups – groups whose members arrive at a group decision by some imposed public choice (i.e., voting) mechanism (e.g., majority rule, dictator choice) without an opportunity for face-to-face discussion (e.g., Bornstein, Schram, & Sonnemans, 2004; Allbitar, Gomberg, & Sour, 2004).

competing groups as well. The primary reason for the internal conflict is the fact that the benefits associated with the outcome of the external competition (e.g., territory, political power, status, pride) are public goods which are equally available to all the members of a group, regardless of their contribution to their group's effort (Bornstein, 2003; Palfrey & Rosenthal, 1983; Rapoport & Bornstein, 1987). When contribution entails personal cost (e.g., time, money, physical effort, or risk of injury or death), rational group members have an incentive to *free-ride* on the contributions of others. Of course, as a result of free-riding, the group might lose the competition, in which case the public good will not be provided, or, worse yet, a public bad will be provided for contributors and non-contributors alike.

This intragroup problem of public goods provision in the intergroup or G-G case is fundamentally different from that studied in the single-group or G case. In the case of a single group, the provision function (which relates the level of contribution to the amount of the public good provided) is determined by Nature. Nature, while sometimes uncertain (e.g., Messick, Allison, & Samuelson, 1988; Suleiman, 1997), never competes back. In contrast, the provision function in intergroup conflict is determined by comparing the levels of contribution made by the competing groups. The existence of another group whose choice also affects the outcome requires each group to make strategic considerations in selecting its own action. The group's choice of strategy and its success in carrying it out depends on its ability to mobilize contributions from its individual members, and its beliefs about the outgroup's ability to do the same. Several studies which contrasted a G-G game with a comparable G game illustrate the difference between the two social situations.

The Intergroup Prisoner's Dilemma (IPD) game: The IPD game (Bornstein, 1992, 2003) provides a particularly suitable setting for comparing G-G and G situations. This game, as exemplified here, involves competition between two groups of three members each. Each group member receives an endowment of 2 points, and has to decide whether or not to contribute her endowment. Each contribution increases the payoff to each ingroup member (including the contributor) by 1 point, and decreases the payoff to each outgroup member by 1 point. Since the individual loses 1 point by contributing, regardless of what the other (ingroup and outgroup) players do, a rational player should never contribute. However, since a 2-point endowment generates a total of three points for the group, all ingroup members are better off if they all contribute their endowments. Thus, the intragroup payoff structure in the IPD team game (or two-level game; e.g., Putnam, 1988) is an n-person Prisoner's Dilemma, regardless of what the other group does (Dawes, 1980).

Bornstein and Ben-Yossef (1994) used this property of the IPD game to test whether a social dilemma game is played differently when embedded in an intergroup conflict than when played in an isolated single-group setting. We simply contrasted the IPD game with an identical 3-person PD game. The only difference between the two games is that in the single-group PD contributing a 2-point endowment generates a point for each group member without affecting the outgroup in any way.[4] The payoff matrix for the IPD game appears in Table 2 (a flat bonus of 3 points is added to prevent negative payoffs).

<Insert Table 2 about here>

The results of the Bornstein and Ben-Yossef (1994) study show that individual group members are more likely to contribute in the intergroup IPD game than in the single-group PD game. Since the only difference between the two conditions is that

[4] Also, to exclude the possibility that the classification of players into groups rather than the conflict of interests between the groups (Rabbie, 1982; Tajfel & Turner, 1979) is responsible for any potential effects, we included two groups in the PD (G) control condition as well.

in the IPD game the two groups were in competition against each other, while in the PD game each group was engaged in a separate (independent) game, this increased cooperation must reflect changes in the individuals' utility function due to the "real" conflict of interests between the groups. Evidently, the intergroup conflict induced individual group members to substitute group regard for egoism as the principle guiding their choices (Brewer & Kramer, 1986; Kramer & Brewer, 1984; Dawes & Messick, 2000; Hardin, 1995). The participants' self-reported motivations are consistent with this interpretation. The participants in the IPD condition viewed themselves as motivated less by self-interest and more by the collective group interest than those in the PD control condition. They also reported a higher motivation to maximize the ingroup's relative advantage over the outgroup (Turner, Brown, & Tajfel, 1979).

Another experiment which employed the IPD vs. PD design was conducted by Baron (2001). Like Bornstein and Ben-Yossef (1994), Baron found that ingroup cooperation was higher in the IPD than the PD condition. Baron attributes this “two-groups vs. one group parochialism effect” to the “illusion of morality as self-interest” (Baron, 1997) -- the tendency of people to believe that self-sacrificial behavior on behalf of one’s group is in fact in one’s self-interest. Baron hypothesized that this illusion is greater when the ingroup is in competition with an outgroup. Indeed, he found that participants in the IPD condition were more likely than those in the PD condition to believe that contribution would earn them more money, and their contribution decisions were strongly correlated with this belief.

Probst, Carnevale, & Triandis (1999) also compared the IPD with the PD game. Probst et al. were interested in the relations between the players’ values and their decision to cooperate or defect in these games. They found that vertical individualists

-- competitive people who want to do better than others -- were less likely to cooperate in the single-group (PD) dilemma, where one's relative payoff is maximized by defection, and more likely to cooperate in the intergroup (IPD) dilemma, where winning is achieved by cooperating with one’s own group to defeat the other group. In contrast, vertical collectivists – cooperative people who tend to sacrifice their own interest for the interests of the group – were more cooperative in the single-group dilemma, where contribution serves the collective interest, and less cooperative in the intergroup dilemma, where universal defection is collectively optimal.[5]

Summary: The experiments described above suggest that individuals make different decisions in the G-G than in the G version of the PD game. Specifically, they show that people are more likely to cooperate in intergroup conflict, where the ingroup's gain comes at the expense of the outgroup, than in an isolated single-group game, as hypothesized by the intergroup conflict - intragroup cooperation hypothesis (Stein, 1976; Campbell, 1965, 1972). In the IPD game, as in the social reality that it models, this greater willingness to sacrifice on behalf of the group is destructive from the perspective of the larger society (which includes all members of both groups). As observed by Campbell (1965), altruistic behavior, while collectively beneficial in single-group dilemmas, is often detrimental in intergroup conflicts (Campbell, 1965).

Intergroup competitions are not always destructive, however. In some cases increasing individual contribution through competition between groups is beneficial for both the group and the society at large. Constructive competition regularly takes place between different organizations (e.g., firms, universities) as well as subgroups

[5] Baron (2001) suggested that vertical individualists, who value both pursuit of self-interest and competition against others, are especially vulnerable to the illusion of self-interest. These participants are willing to sacrifice their self-interest on behalf of their group when in competition against another group since in this context they do not see what they are doing as self-sacrifice.

within the same organization (e.g., R&D teams, academic departments). These competitions are won by the groups whose members are more cooperative and better coordinated with one another than the members of the competing groups. Several experiments (Erev, Bornstein, & Galili, 1993; Bornstein & Erev, 1994; Bornstein, Gneezy, & Nagel, 2002; Nalbantian, & Schotter, 1997, Rapoport & Amaldoss, 1999; Gunnthordottir, & Rapoport, in press) have demonstrated that, by decreasing free riding and enhancing coordination within the competing groups, intergroup competition can improve overall performance as compared with the single-group case.

G-G vs. I-I: Intergroup vs. inter-Individual Games

The use of two-person games to model conflicts between groups (e.g., Brams, 1975; Snidal, 1986) treats each group as a unitary, purposive player. However, as discussed above, the unitary player assumption collapses when the benefits associated with the outcome of the intergroup conflict are public goods, and group members cannot make a binding (and costless) agreement to overcome the ensuing free-rider problem. To test how sensitive bilateral interactions are to the violation of the unitary player assumption, this section reviews two experiments which contrasted I-I and G-G games. The first experiment involves the game of Chicken, while the second involves a price competition (Bertrand game).

The game of Chicken: The game derives its name from the practice of two drivers racing toward each other on a narrow road. Each driver has the choice of swerving to avoid a head-on collision or continuing on a collision course. While the original contest involved individual drivers, much of the interest in this game was motivated by questions about competition between groups. The two-person Chicken game has been commonly used to model intergroup situations such as military confrontations and disputes between workers and employers where, as in the driver scenario, a failure of either side to yield leads to an collision (war, strike) that is disastrous for both.

Bornstein, Budescu, and Zamir (1997) compared the intergroup Chicken game with the two-person game. The games were played repeatedly, as our interest was in assessing the ability of the participants in the two games to use the opportunities provided by repeated interaction to cooperate in realizing their mutual interests. The intergroup (G-G) game in our experiment was operationalized as a competition between two teams of two members each.[6] Each player received an endowment and had to decide between keeping it or investing it. A reward (defined to be larger than the initial endowment) was given to each member of a group if the number of ingroup investors exceeded that in the outgroup. Members of the losing team received nothing. If there was an equal number of investors in both groups, the players received no bonus. Regardless of the outcome of the game, players who did not invest their endowment kept it. In the two-person (I-I) game each player received an endowment and had to decide whether to keep it or invest it. A reward was provided to a player who invested the endowment when the other player did not. If both or neither player invested the endowment, neither received a reward.

As predicted, the level of cooperation in the two-person Chicken game was much higher than that in the intergroup game. In the I-I game, more than two-thirds of the rounds resulted in the collectively optimal outcome of one player contributing, and turn-taking between the two players (which generates a fair as well as an efficient

[6] Strictly speaking, the intergroup conflict in this experiment is an I-I vs. I-I game, but see footnote 2.

outcome) was rather common. Moreover, the level of efficiency, as reflected in the amounts of money earned, increased steadily as the game progressed,. These results stand in sharp contrast to those observed in the G-G competition. In the intergroup competition only about a quarter of the rounds resulted in the collectively optimal outcome of one player contributing; practically all the other rounds resulted in a higher, and therefore inefficient, rate of contribution, and, most notably, about 12% of the rounds ended up in a full-scale "collision" of all players contributing their endowments and all receiving a payoff of 0. There was also little indication of turn-taking within or between the groups, and no signs of improvement in collective efficiency over time.[7]

Price competition: The second experiment by Bornstein, Kugler, Budescu, and Selten (in press) employed the G-G vs. I-I design to study price competition in a duopolistic market. For simplicity, the competing agents in economic markets are typically modeled as unitary players, and are represented by individual subjects in experimental investigation of such markets. In reality, however, the agents operating in the market often consist of multiple players, and the possibility of conflicting interests within agents must be taken into account. This is obviously true when the competitors are alliances of firms (Amaldoss et al., 2000), but it is also true when the competitors are single firms.[8]

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[7] It can be argued that the differences between the two-person and the intergroup Chicken games is due to the fact that the intergroup game involves twice the number of players and thus entails a more intricate coordination problem. However, a comparison between the intergroup game and a four-person single-group (G) game of Chicken provides evidence against this possibility. The intergroup and the single-group games involve the same number of players and therefore present subjects with an identical coordination problem. Nonetheless, the coordination in the single-group game was much better than in the intergroup game.

[8] For example, principal-agent theory acknowledges the existence of conflicting interests within firms, but when firms are studied in strategic contexts of competition against other firms these internal conflicts are typically ignored.

The two competitors were operationalized as either individuals or non-cooperative groups (with either two or three players in each group). The game was played repeatedly for many rounds with the same set of players. In each round, the players stated their asking price (an integer between 2 and 25) independently and simultaneously. The team whose total asking price was lower won the competition and was paid its price, whereas the losing team was paid nothing. In case of a tie, the teams split the asking price. Each group member was paid his or her asking price if the team won, and half that if the game was tied. This internal payoff structure provides each group member with an opportunity, indeed a temptation, to free-ride. That is, if the other players in her group settle for a low price, a player can demand a higher price and might yet win.[9]

Theoretically, if the two competitors meet only once, the prices should equal the marginal cost (2 in our experiment) regardless of whether the players are individuals or groups. However, when the game is played repeatedly, as in our experiment, tacit collusion between the two competitors becomes both theoretically possible and practically viable (Tirole, 1988). This is because repeated interaction forces the players to take into account not only current profits but also the potential long-term losses of a price war. These long-term considerations decrease the temptation to cut prices and may encourage the competitors to collude in order to sustain higher (even monopoly) prices (Chamberlin, 1929).

Nevertheless, Bornstein et al. found that asking (and winning) prices were much higher when the competitors were individuals than when they were (two- or three-person) non-cooperative groups. Moreover, in competitions between two individuals

[9] For groups we also included a 'shared profit' treatment in which a group's profit for winning or tying the game was divided equally among its members. This division rule eliminates the internal conflict of interest. However, team members still face the problem of coordinating a joint strategy without communicating.

prices increased with practice and, as the game progressed, the collusive outcome (where both sides are paid the highest, monopoly price) was achieved in a substantial number of cases, whereas in competitions between two groups prices remained stable, and there was little evidence of learning to collude. Clearly, price competition is highly sensitive to violations of the unitary player assumption, and cooperation to keep prices high is much more likely when the competitors are individuals rather than multi-player groups.

Summary: The results of the two studies reviewed in this section accentuate the importance of distinguishing between I-I and G-G games. Clearly, games between two non-cooperative groups are not played out in the same way as games between two unitary players. Rather, the conflicts of interests within the players intensified the conflict between them. If nothing else, this finding suggests that extrapolation from experiments which study interaction between two individuals to interactions between two non-cooperative groups (nations, strategic alliances, firms) could be seriously misleading, as it provides a prediction for the prospects of cooperation that is far too optimistic.

Competition Between Different Types of Players

The experiments reviewed so far involved competition between two players of the same type. The discontinuity research has studied the U-U game, using the I-I game as a control. The team-game research has focused on the G-G game, using the G or the I-I game as a control. Little research has been done so far on asymmetric games, where the competition is between agents of different types (i.e., G-U, G-I, and U-I). Real-world examples of such asymmetric competition are abundant. A strike of an unorganized group of workers against an individual employer or a unitary board of directors, a standoff between a democratic state and a dictatorship, or a clash between a scattered group of demonstrators and a cohesive police force are only few of the examples that come to mind. How does the asymmetry between the conflicting sides affect the course and outcome of their interaction? Which type of player, if any, has the advantage?

A few recent experiments provide some preliminary answers to these questions. Kugler & Bornstein (2006) examined repeated interaction between a non-cooperative group (of three members) and an individual player.[10] The two sides in this G-I game were symmetrical in that they had equal resources at their disposal. However, while the individual player had complete control over her resources, the group's resources were divided among its members. If the group ended up winning the competition, the ensuing reward was divided equally amongst its members regardless of whether or not they contributed to the group's success.

The fact that the group has to overcome a collective action problem to fully realize its potential power, whereas the individual player is free of internal problems, gives the individual an advantage. Kugler & Bornstein (2006) found that the size of this advantage depends on the strategic structure of the game. The individual's advantage over the group, as reflected in relative payoffs, was more decisive in the Chicken and Prisoner's Dilemma games and less decisive in the Assurance game.

Kugler et al.'s (in press) study of the Trust game mentioned above included two asymmetric conditions, where a group sender played against an individual responder and vice versa. These conditions were included to examine whether either individuals

[10] The G-I game was compared with the two symmetrical control conditions, namely, competition between two individuals (I-I) and competition between two non-cooperative groups (G-G).

or groups behave differently towards other individuals and groups. Unfortunately, the results fall short of providing a definitive answer to this question. On the one hand, the average amount sent in the G-I condition was not significantly different from that in the G-G condition. On the other hand, groups sent nothing (x=0) significantly more often to group responders than to individual responders.

Sutter (2005) studied the "beauty contest" game played by either individuals or three-person unitary groups. In this game, N decision-makers simultaneously choose a real number between 0 and 100. The winner is the player whose number is closest to 2/3 of the mean of all the choices. The game is solved by a process of elimination of dominated strategies, and thus provides a good setting for estimating the players' depth of strategic reasoning. In the first, most naïve level, players assume that other will choose randomly, and therefore choose 33 (as 2/3 of a mean of 50). Assuming that others also think this way, the chosen number should be two-thirds of that (or 22), and this process continues until the equilibrium of 0 is reached. Sutter (2005) found that, while individuals and groups did not differ in their choices in the first round, from round 2 on, groups played much closer to the game's equilibrium than individuals, which indicates that they learn much faster to think strategically. Most relevant for this section is the finding that in a game involving both group and individual players, groups significantly outperformed individuals in term of payoffs.

Summary: In a competition with an individual player a non-cooperative group is at a disadvantage. This is because, unlike the individual, the group has to overcome a collective action problem in order to realize its potential power. Although we did not study competition between a non-cooperative group and a unitary one, it seems safe to assume that non-cooperative groups would fare badly in such asymmetric competitions as well. In a competition between unitary groups and individuals, unitary groups seem to have the upper hand.

Concluding comments

The taxonomy outlined here draws a clear-cut distinction between cooperative (i.e., unitary) and non-cooperative groups. This sharp distinction is obviously a simplification of the reality. In a more elaborated and realistic model, groups would be characterized by some continuous parameter to reflect their position on a dimension ranging from a fully cooperative or unitary group at one end to a fully non-cooperative one at the other. This parameter could take on many different but essentially equivalent meanings, such as group cohesion, group identification, group-based altruism, etc. The important thing is that the more cohesive the group, or the more patriotic its members, the lower the group's cost for mobilizing collective action. When group members identify with the group to the extent that its interest and the individual's interest become one, collective action is costless, and (not considering coordination costs) the group is a truly unitary one. When, on the other hand, group members are narrowly rational players who care only about their own interest, the group is a truly non-cooperative one. Real groups are always located somewhere in between these two hypothetical extremes. Moreover, as demonstrated by Bornstein and Ben-Yossef (1994), a group's location on this continuum is affected by the social context. Keeping the internal payoff structure constant, a group becomes more cooperative when facing another group than when playing against Nature.

This taxonomy covers interactions between just two agents (although each agent can comprise many decision makers). By adding more dimensions to the matrix, the taxonomy can be expanded to N-agent games. When modeling competition between several firms (i.e., oligopoly), multi-party elections, or multi-lateral negotiations among nations, such an expansion is necessary. The "beauty contest" experiment by Sutter (2005), described in the previous section, is the only one I know of which compared the behavior of U and I players in a multi-agent game.

There are many other differences between groups (both unitary and non-cooperative) that have not been considered in this chapter. For example, groups differ from one another in size (Isaac & Walker, 1994; Ledyard, 1995),[11] in their internal payoff structure or profit-sharing rule (Rapoport & Almadoss, 1999), in the ability of their members to communicate with and influence one another (e.g., Bornstein et al., 1989; Bornstein, 1992; Takacs, 2001), in the voting rule used for arriving at a group decision (e.g., Allbitar, Bomberg, & Sour, 2004), in the symmetry of the players within and between groups (e.g., Budescu, Rapoport, & Suleiman, 1990; Rapoport, Bornstein, & Erev, 1989), and the like. Nevertheless, the classification outlined here captures the most fundamental situations that humans (and non-humans as well, e.g., Conradt & Roper, 2003; Heinsohn, 1997; Velicer, 2003; Wilson, Hauser, & Wrangham, 2001) have encountered throughout their evolution. People, either alone or as part of a group, have to make decisions vis-a-vis Nature and vis-a-vis other individuals and groups.

[11] A recent study of the Beauty Contest game by Sutter (2005) showed that unitary groups of four members do not perform any better than two-member groups (although, as in Kocher & Sutter, 2005, both 2-person and 4-person groups outperformed individuals). Similar findings were reported by Pallais (2005) with regard to the Ultimatum game.

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Table 1: A Taxonomy of Games by Player Type

Opponent Player	Nature	Individual (I)	Unitary Team (U)	Non-cooperative Group (G)
Individual (I)	I	I-I	I-U	I-G
Unitary Team (U)	U	U-I	U-U	U-G
Non-cooperative Group (G)	G	G-I	G-U	G-G

Table 2: Individual Payoffs in the Intergroup Prisoner's Dilemma (IPD) game

	Number of ingroup contributors - Number of outgroup contributors						
	3	**2**	**1**	**0**	**-1**	**-2**	**-3**
Contribute	6	5	4	3	2	1	-
Not Cont.	-	7	6	5	4	3	2

Figure 1: The Centipede Game