Behavioral Differences between Collective and Individual Players in the Public Goods Game

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Abstract

Most experiments comparing individual and group behavior find that groups behave more egoistically than individuals. However, most of these studies do not control for the influence of the within-group decision making mechanism which might have an important impact on group behavior. In this paper, we report first results of laboratory experiments comparing individual and group behavior in a public goods game. Groups decide by majority rule. We find that cooperation levels do not differ between groups and individuals. The median player is the most influential group member. We can show that the institutional incentives set by majority rule dominate psychological traits which presumably lead to more selfish group behavior in other experimental settings.

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1. Introduction

In a vast variety of economic and political matters group actors bargain and decide over the provision of collective goods: trade-unions bargain over wages, qualification measures etc. with employer associations or firms, families and associations make joint decisions about the promotion of vocational and educational tasks, parties bargain over the formation of governments, just to name a few examples. In all of these cases, decisions have to survive two difficult stages of conflict in order to be accepted: first, there is an intra-group decision process which allows the group to offer a joint contribution, and second, there is an inter-group decision process which leads to a certain outcome that may or may not provide an adequate solution to the collective action problem. Of course, the outcome depends on how favorable or adverse the conditions for groups are to reach a consensus. From Mancur Olson (1965) we know for instance that group size has a large effect on the efficiency of collective goods provision. Among many other things it is also important what social or economic incentives a group can offer to promote cooperation.

In this paper we present first results from an experiment, in which we reduce this complexity of group decisions in order to answer two questions: First, we ask whether group actors behave differently from unitary actors when both of these types of actors approach a comparable collective goods problem. Second, we ask what impact the decision rule has which is applied in the intra-group decision process. Why are these questions relevant?

Mainstream economics and rational choice theory in political science examine the aggregation of individual preferences in social interactions. By employing the unitary actor assumption which states that group behavior mirrors individual behavior, standard models largely ignore the type of decision maker. However, it is not clear whether the aggregation of preferences in games with collective actors follows the same trajectories as the aggregation of individual preferences. Thus, our main research interest is to know more about the possible egoism or other-regarding behavior of groups vis-à-vis the behavior of unitary actors. If we find different patterns of cooperation between these types of actors, this will have important implications for the methodology of aggregating preferences in rational choice models. On the other hand, if we find similar patterns, this would serve as an interesting counter-example to findings in experimental research from which it has been followed that behavioral differences between collective and individual players must be assumed (see below). Thus, our study aims to enhance the understanding of the collective action problem with respect to the specific decision dynamics that occur in groups in contrast to the decision dynamics that occur among individuals. This should, for instance, be of general interest for those who are concerned with the tragedy of the commons dilemma (cf. Ostrom, 1990).

Of course, group behavior belongs to the classic fields of social science research. Below we will briefly deal with some theories which explain experimental evidence of group behavior. It appears from several studies, especially in social psychology, that groups act more egoistically than individuals. This finding is confirmed by experimental economists, who observed group behavior, for instance in the trust game (Cox, 2002) or the gift exchange game (Kocher and Sutter, 2007). Our central claim however, is that groups do not act more egoistically *eo ipso*. Whether they do behave more egoistically is dependent on a number of variables, first of all, the institutional rule under which the intra-group decision is made. If a group decides under majority rule it is most important how the median player behaves. If she chooses a more egoist solution, the group decides accordingly and vice versa. However, this means a group can also choose more cooperative solutions if the median player decides so. The power of the median player emerges from the institutional rule in the intra-group decision process.

Thus, we hypothesize that under certain constraints this otherwise apparent difference between group behavior and individual behavior may be weakened. Although we do not assume that group dynamics, as they are described in the literature, will completely vanish due to a certain decision mechanism, however, we do assume that the difference between aggregated group preferences and aggregated individual preferences may in fact be minimized, because under majority rule the median players' behavior may override other group-dynamics and is thus decisive for the behavior of a group. Since the distribution of preferences of the median player must not necessarily differ from the distribution of preferences among individuals, a more similar pattern of behavior of groups and individuals would well be explicable. Nevertheless, the literature cites numerous examples where differences between individual behavior and group behavior occur.

Thus, our paper first of all examines theories which aim to explain these differences (2). We then go on to illustrate our experimental design, procedures and hypotheses (3). In the next section of our paper (4) we will outline our first results. In the final section (5) we draw our conclusions.

2. Experimental evidence of group behavior

Research on group behavior has a long tradition in social psychology (see Levine and Moreland, 1998). Group behavior differs from individual behavior in several aspects. Groups were found to outperform individuals in problem-solving tasks (Davis, 1992). Another aspect concerns the evaluation of risks. Faced with a risky decision, individuals appear to support extremer choices as members of a group compared to deciding on their own (see Eliaz et al.,

2006). Two competing theories try to explain this *group polarization effect*. *Social comparison theory* states that people want to perceive and present themselves in a socially desirable light. In order to do this, an individual must continually process information about how other people present themselves and adjust her own self-presentation accordingly. *Persuasive argument theory* argues that an individual choice is a function of the number and the persuasiveness of remembered pro and con arguments. Within-group interaction can cause a choice shift when the interaction exposes an individual to new persuasive arguments favoring a different choice (Isenberg, 1986).

The mechanisms described in both theories could also explain choice shifts in the aggregation of social preferences. We define social preferences as other regarding behavior. Contrary to purely selfishly motivated individuals, individuals motivated by social preferences incur personal costs to affect the payoffs of other individuals. Over the past decades large series of experimental studies in social psychology have studied these kinds of choice shifts mainly in the context of the well-known prisoner's dilemma. Nearly all of them have found intergroup behavior being more competitive and less cooperative than interindividual play (Schopler and Insko, 1992). A choice shift in that direction, however, does not follow necessarily from social comparison theory and persuasive argument theory. A theoretical explanation for this *discontinuity effect* requires additional arguments.[1]

There are three prominent explanations for the discontinuity effect in social psychology (Wildschut et al., 2001). The first is *Identifiability.* In interindividual interactions, responsibility for actions can be addressed directly. Hence, people assume that they can be held accountable if a self-interested choice is made. Group membership, however, decreases identifiability of individual responsibility. Group members are thus able to avoid social sanctions for violations of norms of fairness and reciprocity by claiming that other group members were responsible for an egoistic group decision. The second explanation is *Social support for shared self-interest.* Intergroup interactions are more competitive than interindividual interactions because group members provide each other with social support to pursue their immediate shared self-interest. And finally, *Schema-based distrust* argues that intergroup interactions are more egoistic than interindividual interactions because the anticipation of the interaction with another group activates an out-group schema, consisting of learned beliefs or expectations that intergroup interactions are more competitive and unfriendly.

To sum up, greed is the underlying driving factor of the first two explanations of the discontinuity effect. Group membership offers ways to legitimate more egoistic behavior. The

[1] The terms 'group polarization' and 'discontinuity effect' are sometimes used synonymously. From our point of view, the usage of 'group polarization' is an intragroup phenomenon. The discontinuity effect describes choice shifts in interactions between groups and other actors. Hence we will use that term when talking about the more egoistic or more rational behavior of groups compared to individuals in social interactions.

third explanation stresses the importance of fear. People anticipate the greater egoism of groups and thus act more self-interested themselves (Wildschut et al., 2003).[2] Thus, according to the first explanation, being part of a group makes its members more self-interested while the second explanation argues that something about the strategic interaction with a collective actor provokes greater egoism (Winquist and Larson Jr., 2004).

Many of the experimental designs in social psychology involved deception of the subjects. In some experiments for example, participants were told that they interacted with other human players while they actually played against a programmed other. Many experiments were also conducted without monetary incentives. This threatens the internal validity of experimental findings. Experimental economists observe stricter standards on these accounts. In recent years, experimental economics has also shown a greater interest in team decision making studying group behavior in several kinds of games.

Overall, the experimental results largely confirmed the findings from social psychology that groups act more rationally and more self-interested compared to individuals. In games containing a pure problem-solving task, groups were found to make better decisions (Blinder and Morgan, 2005; Gillet et al., 2007; Rockenbach et al., 2007). However, in many games, players face a strategic setting in which more rational behavior cannot be unambiguously distinguished from more egoistic behavior. The beauty-contest game comes closer to a problem-solving task.[3] Groups made better decisions and outperformed individuals in this game in terms of payoffs when playing against each other (Kocher et al., 2006). This superior performance was mainly caused by the fact that groups learned faster than individuals in that game (Kocher and Sutter, 2005). Sutter (2005) also found that success in the beauty-contest game increased with group size. Groups with four members outperformed groups of two as well as individual players. Distributional conflict is more prominent in other games. Hence, these experiments reveal more about the role of social preferences in interactions with groups. Cox (2002) found that groups returned smaller amounts in the trust game.[4] Kugler et al. (2007) also tested the trust game, finding groups to send less, but return on average the same share. Hence, groups were less trusting, but just as trustworthy.

[2] Sometimes the reciprocity hypothesis is put forward as an alternative explanation of the discontinuity effect. It states that groups are not invariably more competitive than individuals, but are more likely to reciprocate the cooperative or competitive behavior of their opponent in an attempt to maximize their long-term gains and minimize their losses (Rabbie, 1998). However, it turned out that both perspectives on the discontinuity effect can be reconciled (Wildschut et al., 2001).

[3] In the beauty-contest game, players choose simultaneously a number from the interval I= [0,100]. The player, whose number is closest to two thirds of the average of all chosen numbers, is the winner. Choosing zero is the only equilibrium of this game. However, typically play converges in the direction of the predicted equilibrium only after several rounds of the game (Nagel, 1995).

[4] In the trust game two players act sequentially. The first player gets an amount of money and has to decide how much to transfer to the other player. The amount transferred is tripled and the second player has to decide how much to send back to the first player. If player two acts rationally and is egoistically motivated she will send no money back to player one. She anticipates that and her utility maximizing strategy is to transfer nothing in the first stage of the game. Thus, the equilibrium predicts no transfers between players (Berg et al., 1995).

Kocher and Sutter (2007) studied the gift-exchange game played between groups.[5] Groups chose lower efforts as second movers than individuals. Overall, in an interaction with groups, trust in cooperative behavior seems to be reduced. Consistent with this finding, Bornstein et al. (2004) found that groups exited the centipede game earlier than individual players.[6] These results show that greater rationality and self-interest of groups can also decrease overall social welfare.

Ultimatum and dictator games allow the clearest conclusions about social preferences in group interactions.[7] Bornstein and Yaniv (1998) observed that groups send and accepted smaller amounts in the ultimatum game. Cason and Mui (1997) studied the dictator game. Their experiments produced the only results in which groups displayed more altruistic behavior compared to individuals leaving higher amounts to receivers.[8] In line with findings from all other experiments, teams in the dictator games conducted by Luhan et al. (2007) were more selfish than individuals.

Overall, results from team experiments in experimental economics corroborate the existence of the discontinuity effect. Groups make better decisions in problem-solving tasks and act more self-interested in social interactions. However, many important aspects are still unknown. For instance, we know very little about how various ways of intra-group decision making affect the interaction of groups with other actors. In most papers cited above, members of the same group interacted face to face deciding without a clearly predetermined decision rule. Such an experimental design, however, impedes clear conclusions concerning the effects of different decision rules. There are additional problems. Cason and Mui (1997), for instance, observed two-person groups. In such a setting, it is logically impossible to study the impact of majority rule, arguably the most important democratic decision mechanism.

Luhan et al.'s (2007) study of the team dictator game is an important exception. They ran computerized experiments enabling controlled within-group communication via a chat

[5] In the gift-exchange game of Fehr, Kirchsteiger, and Riedl (1993), several buyers announced price offers for a good. Once a seller accepted an offer, he decided about the good's quality with his costs increasing with the quality. Sellers' profits decreased with their costs while the payouts of buyers increased with the good's quality and decreased with its price. The number of sellers exceeded the number of buyers causing an excess supply. Applying backwards induction the game theoretic solution of the game can be found. Since profits of sellers decrease with the quality, they will choose the lowest possible quality. Rational buyers know that. Hence, they will offer the lowest possible price which just covers sellers' marginal costs.

[6] In this game, two players alternately get a chance to take the larger portion of a steadily growing amount of money. As soon as one person takes, the game ends with that player getting the larger portion of the pile, and the other player getting the smaller portion. Rational choice theory predicts the first mover should take the large pile on the first stage. However, usually the game reaches later stages (McKelvey and Palfrey, 1992).

[7] In a typical dictator game, subjects are paired with anonymous others. One of them, the proposer, divides a fixed amount of money between himself and the other subject, the responder. Since the responder has no say in the allocation, game theory predicts that the proposer will keep the entire amount. The ultimatum game mirrors a very simple bargaining situation. It is similar to the dictator game with the only exception that the responder has veto power over the proposed allocation (Güth et al., 1982). If he rejects the proposal both players will receive nothing. This modification hardly changes the Nash-equilibrium of the game. An egoistically motivated responder accepts any positive proposal. Hence, the proposer will allocate the smallest possible amount to the responder to maximize his own payout.

[8] Bosman et al. (2006) found no significant behavioral differences between groups and individuals in the power-to-take game which mirrors the dictator game in several aspects.

program. The three members of a group had to agree on a joint decision within ten minutes. In case of differing inputs all group members would have earned nothing in that period. So formally, unanimity rule was the decision rule in this experimental setting. However, without a specified way how to arrive at a unanimous decision, many groups agreed to use other decision rules. Luhan et al. analyzed the stored chat protocols to identify ex post whether groups actually applied unanimity rule, majority rule, or compromise as decision rule. Their findings indicate that the applied decision rule did not cause significant behavioral differences between groups. Instead, they found that the most selfish team member had the greatest impact on group behavior.[9]

In this paper we focus on the impact of majority rule on group behavior. We doubt Luhan et al.'s finding that the applied decision rule does not play a role. Luhan et al. studied various decision rules in the shadow of unanimity rule. Even if a group agreed in within-group discussions to apply another rule, there was nevertheless no means to enforce such an agreement. Take for example the case in which a group agreed to apply majority rule. In case of strong disagreement with a majority decision, an overruled subject could still threat to vote for another amount, thus destroying the payoffs of all group members. The fact that this threat was never executed in the experiments does not imply that it did not have an influence on the results. There is still the possibility that subjects anticipated that threat and strategically adapted their behavior.

We have good reason to belief that majority rule does not necessarily lead to more selfish behavior of groups compared to individuals. Let us assume that all players can be ordered according to the strength of their social preferences. Under majority rule the median player should be decisive in a group decision. If this individual is more other-regarding than the average individual in the group, this should result in more other-regarding decisions compared to a situation in which all group members decide on their own. If the median player is less other-regarding than the average player, we should observe more selfish outcomes in interactions between collective actors compared to interactions among individual actors. We thus argue that the influence of majority rule on group behavior is conditional on the distribution of other-regarding preferences in a group. If the majority of group members have non-selfish preferences, they will be able to exclude the influence of purely selfishly motivated individuals. On the other hand, if the majority consists of egoists, the preferences of non-selfish individuals will not matter. In this case the mean outcome will be more self-interested than the mean outcome of individual decisions where the few other-regarding individuals still matter. Thus, if the applied decision rule has an impact on the aggregation of

[9] Groups were composed systematically. Before the group treatment, the same subjects played a standard dictator game individually. Subjects were classified into terciles according to their amount given in that treatment and ranked within the terciles in ascending order. Teams consist of the subjects with the same rank in the three terciles.

social preferences, majority rule should amplify egoistic or other-regarding tendencies in a group, depending on the relative strengths of these motivational forces in a group.

We will test our argument in a public goods environment. The public goods game has been studied extensively by experimental economists, but we are aware of no publication focusing on interactions of collective actors in that game. Earlier studies have shown that the existence of a small fraction of egoistically motivated players is sufficient to crowd out most initially existing cooperative behavior (Fehr and Fischbacher, 2002; Fischbacher et al., 2001). If majority rule has an effect on group behavior, its effect should be very prominent in the public goods game because majority rule could be a means to reduce the damaging influence of a few egoists, thus stabilizing high levels of cooperation.

Compared to other games, the public goods game offers additional advantages for studying the aggregation of preferences of collective actors. It allows for example studying more facets of cooperation than a simple prisoner's dilemma game. The public goods game can be played with more than two players and it offers more options of action to the players. While players can only choose whether to cooperate or to defect in the prisoner's dilemma, the public goods game allows cooperation of varying degrees and thus offers a more precise measure for cooperative behavior. Compared to other games like the commons dilemma game, the game structure of the public goods game is rather simple, because decisions in one round have no effect on the distributional amounts in following rounds. Thus, it is more suitable to study the influence of social preferences in a social dilemma setting because a possible influence of bounded rationality should be less prominent here. In the following section, we will outline our experimental design.

3. Experimental design, procedures and hypotheses

Our experimental setting was a standard linear public goods game (see Ledyard, 1995). In our experiment, a *community* consisted of four *actors*. We compared two treatments. In the group treatment (GT), each actor was a group of three individuals which is the minimum number to study differences in intra-group decision making rules. In the individual treatment (IT), each actor consisted of a single individual. Hence, communities consisted either exclusively of groups or individual actors. We used a between-subject design. Subjects either participated in GT or IT, but not in both treatments. The game was repeated for 15 periods. We applied partner matching. Hence, the composition of communities and actors did not change between periods and therefore each community is a statistically independent observation. In both treatments, each actor had an endowment of 20 points in each period. The task was to decide how to spend the points. An actor could either keep the points to

itself or contribute some or all of the points to a public good called "project". The number of points contributed by player i is n_i $(0 \leq n \leq 20)$ with n_i being an integer. Actor i's income y_i in a round is given by the following equation:

(1) $$y_i = 20 - n_i + 0{,}5\sum_{j=1}^{4} n_j$$

The marginal return from the public good was 50%. Hence, if all four actors contributed their complete endowment to the project, group welfare would have been doubled compared to a situation in which nobody cooperates. Each actor earned the points it kept to itself and half of the sum of all points contributed to the project. All group members constituting actor i earned y_i. Thus, participants faced the same monetary incentives in GT and IT. Figure 1 shows a schematic illustration of a community in GT.

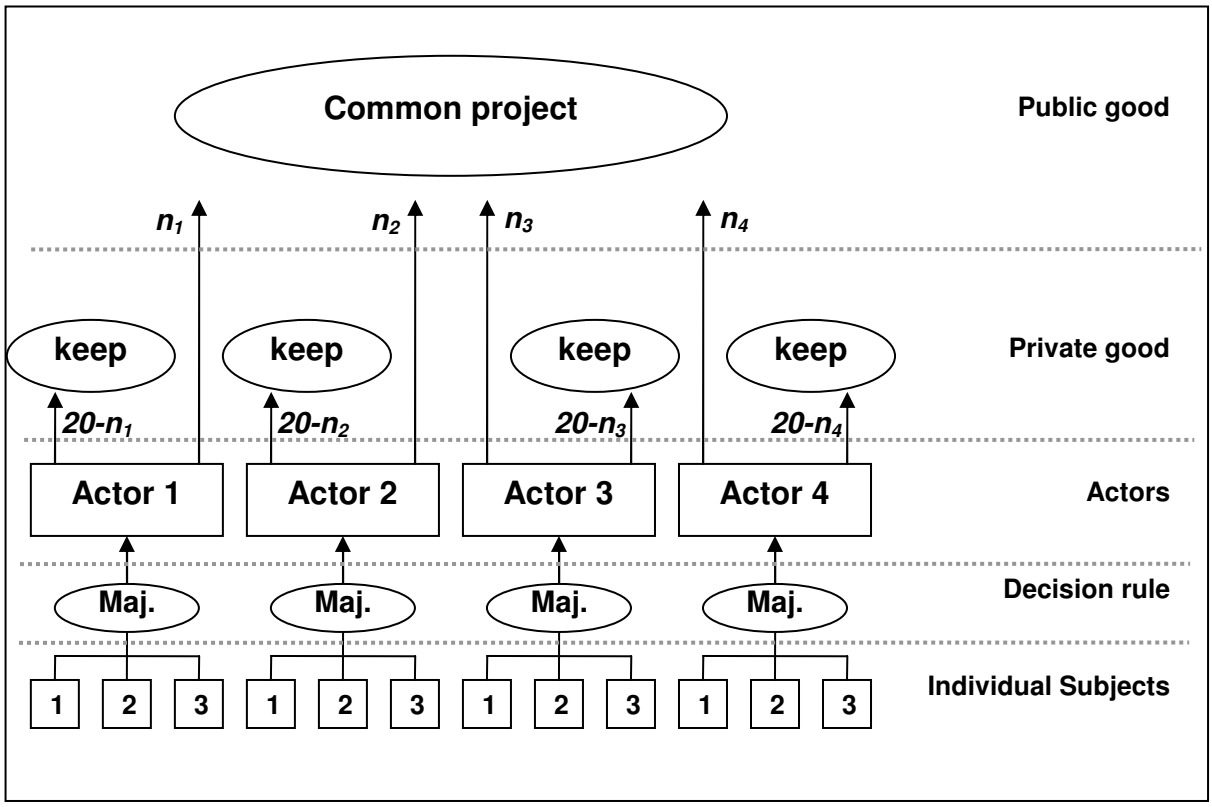

Figure 1. Schematic illustration of a community in the group treatment

While individual actors entered their contribution to the project directly, group actors faced an additional within-group decision. Groups decided by majority rule over their contribution n_i to the project. Each group member had one vote which they casted simultaneously. To reach a decision, at least two subjects had to vote for the same contribution to the project. If no n_i got at least two votes in the first ballot of a period, all group members received information of

how the other group members just had voted and a new ballot was held. This procedure was repeated until a majority voted for an identical n_i. A single group decision could thus consist of several ballots. All actors decided simultaneously. Hence, while still deciding over its own contribution, no actor was informed about contributions of other actors in the current period. After all actors had made their decisions they learned about the contributions of the other actors in their community and their points earned in the current period.

Subjects interacted anonymously via a computer network. We ran the experiments using the software z-tree (Fischbacher, 2007). Direct communication between subjects was prohibited. We recruited subjects using the Online Recruitment System ORSEE developed by Ben Greiner (2004). Most of the participants (67%) were students of Economics, Business Administration or related fields. After arriving at the laboratory, subjects were randomly assigned to cubicles where they read the instruction. Questions were answered privately. We used a short questionnaire to test whether all participants understood the instructions correctly. At the end of the experiment, subjects filled in a second questionnaire asking for demographical data and attitudinal dispositions. The experiments took place in the Cologne Laboratory for Economic Research. Overall, we conducted six sessions on November 24th and 25th 2008. 96 subjects participated in 8 communities in GT and 56 subjects formed 14 communities in IT. Participants were paid privately. They received €0.10 per six points earned during the experiment. Including a show-up fee of €2.50 participants earned on average €10.90. GT sessions lasted about 60 minutes, IT sessions about 50 minutes.

Hypotheses

Assuming rationally acting and purely selfishly motivated individuals, IT has a unique equilibrium prediction. Each player has a dominant strategy of keeping the complete 20 points to herself. A contribution of one point to the project yields a marginal return of 0.5 points which is less than just keeping the point, regardless of the other players' actions. Hence, there is an unique Nash Equilibrium in IT in which all actors opt for $n_i = 0$. GT lacks a unique prediction for individual behavior. If all three group members vote for an identical $n_i > 0$, no group member can improve her payoff by individually voting for a different contribution to the project. So in GT, there exist additional Nash Equilibria with $n_i > 0$. However, voting for $n_i = 0$ is a weakly dominant strategy because voting for $n_i = 0$ yields at least the same payout than voting for another n_i, given the other actors' contributions. Therefore, we hypothesize that egoistically motivated individuals opt for $n_i = 0$ in IT and GT. The self-interest assumption thus yields us a common prediction which can be contrasted with actual behavior in our experiments.

Earlier studies of the public goods game with individual actors clearly refute the self-interest hypothesis (see Ledyard, 1995; Zelmer, 2003). Usually, in the first round of the public goods game, we observe average contributions of around 50% of the endowment. Contributions decline over the course of the game, but hardly ever reach the predicted equilibrium of no contributions to the public good. We expect that we are able to replicate that pattern in IT. For actual behavior in GT we have partially competing hypothesis. If majority rule does not have an influence on the willingness of group actors to cooperate, following the findings from social psychology, we hypothesize that we will observe an interindividual- intergroup discontinuity effect in GT compared to IT. Under this condition group actors in GT will contribute less than individual actors in IT in the first round of the experiments and contributions to the project will decline faster in GT than in IT. Additionally, we assume that the most egoistic individual will have the greatest influence on the within-group decision. If majority rule does have an influence, we hypothesize that the median player will be the most influential player in a group. As argued above, the influence of majority rule on the groups' willingness to cooperate depends on the distribution of selfish and other-regarding individuals. If the median player prefers higher contributions to the project than the average player, we will observe more cooperation in GT than in IT. However, if the median player prefers lower contributions than the average player, groups in GT will cooperate less than individuals in IT.

4. Results

Our experimental results confirm our claim that the intra-group decision rule has an important effect on group behavior. We can show that the incentives set by majority rule dominate the discontinuity effect. Looking at aggregated group and individual behavior reveals that the discontinuity effect is not a dominant phenomenon in comparisons of group and individual interactions. Figure 2 shows the mean contributions in GT and IT.

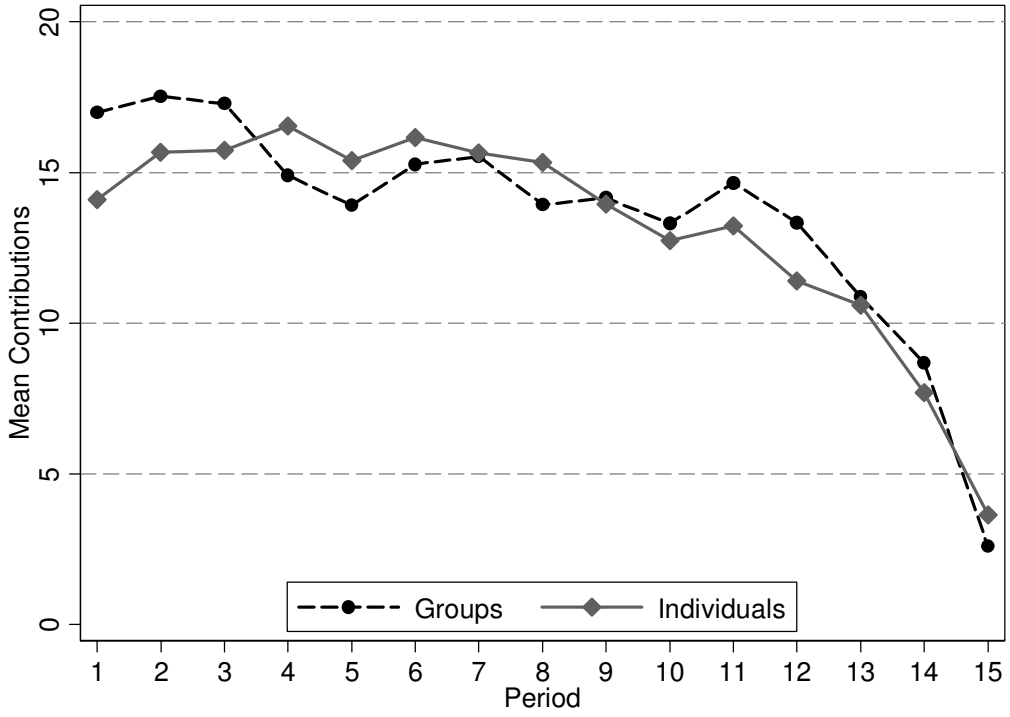

Figure 2. Mean contributions to the project

Contrary to existing experimental evidence, we found no difference between group and individual behavior. Figure 2 clearly shows that mean contributions of groups deciding by majority rule and individual actors were almost identical. In comparison to other public goods experiments, initial levels of cooperation in both treatments were quite high. Groups contributed on average 17.00 points (85% of their endowment) in the first period of the experiment. Individuals started a little bit lower contributing 14.11 points (70.55% of their endowment). In fact, this is the only (weakly) significant difference between mean contributions in a given period ($p > 0.075$; Mann–Whitney U-test; $N = 22$). Due to the low number of observations, we do not want to exaggerate that finding, but contrary to earlier experimental evidence of group behavior, groups behaved *less* egoistically than individuals in the first period of our experiment. In both treatments, cooperation could be stabilized at a high level of about 15 points (75%). Only after period 11, there was a steep decline in cooperation, which we interpret as an end-game effect.[10]

Hence, there is no evidence for a discontinuity effect in the aggregate data. To check whether there is an effect on the individual level, we examined the initial preferences of individual participants. As a proxy for their initial preferences we took the first voting decisions of individual group members in the first period of GT and the contributions of

[10] We also conducted a trial session with two communities playing GT for 10 periods. We found the same pattern there. In this session, cooperation broke down after the seventh period.

individual actors in the first period of IT. At this point, no subject had interacted with another subject. Hence, these first decisions are statistically independent. Again, we found no significant difference between subjects playing GT or IT. On average, group members in GT initially voted for a contribution of 15 points to the project. Individual actors in IT decided to contribute 14.11 points in the first period. The difference is not statistically significant ($p > 0.457$; Mann–Whitney U-test; $N = 152$).

The high level of cooperation in both treatments of our experiment is also a finding which deserves closer examination. We again analyzed the initial preferences to find an explanation. On the one hand, design parameters of the experiments could be responsible for the high cooperation rates. The first is the partner matching procedure. Earlier studies demonstrate that in comparison to stranger matching, partner matching enhances cooperation in the public goods game (see for example Fehr and Gächter, 2000). Additionally, in our experiment the marginal return from the public goods was 0.5 which is slightly higher than usual. In most studies a marginal return of 0.4 is used. In a meta-analysis of linear public goods experiments Zelmer (2003) found a significant positive influence of the marginal return on the level of cooperation. On the other hand, individual attributes of the participants could be responsible for our finding. Since we were able to collect demographic data of our participants, we can test whether individual characteristics have an influence on our results.

Table 1. Individual characteristics of participants

	Number	Mean	Minimum	Maximum
Gender: Women/Men	72/80			
Age (Years)		23.91	19	50
Student of Economics or related field (yes/no)	102/50			
Number of semesters studied		6.00	1	17
Experimental experience		9.07	0	45
Knowledge of the game (yes/no)	97/55			

Table 1 contains information on individual properties of our participants. All participants were students. 102 of our 152 participants studied economics or a related field like business administration. We had 72 women and 80 men. The average participant was almost 24 years old and had participated in 9 experiments conducted before our experiment. So there is considerable experimental experience among our participants. 97 of 152 said that they had

already participated in an earlier experiment with similar rules. We doubt that participants might have learned to cooperate in earlier experiments. Both, experimental experience and knowledge of the game have no influence on initial preferences in the first period of our experiment. The same is true for gender, age and number of semesters studied. We only found one (weakly) significant effect of students of economics contributing slightly more than their fellow students (15.17 points vs. 13.70 points; $p > 0.054$; Mann–Whitney U-test; $N = 152$), a finding contrary to Marwell and Ames (1981) who found less cooperation of economists in the public goods game. Overall, we conclude that individual characteristics cannot explain the exceptional high level of cooperation in GT and IT. We thus conjecture that strategic incentives set by the partners matching procedure and the marginal return from the public good were responsible for that finding.

Above, we have hypothesized that groups deciding by majority rule do not necessarily behave more selfishly than individual actors, and indeed, we found no difference between mean contributions of collective and individual actors. Secondly we hypothesized that if the decision rule had an important influence on group behavior, the median player should be decisive in a group deciding by majority rule. We will now test this second hypothesis analyzing the majority decisions of all collective actors in GT. First of all, groups had no problem reaching a decision. The number of ballots necessary to decide on the contribution of a group varied between 1 and 18 with an average of only 1.8. For each decision we first identified the initial preferences of the group members. As a proxy we took the individual decisions in the first ballot held in a period. We ordered the members of a group according to their first vote. We thus identified low, median, and high preferences in each group. Imagine group member 1 voted for a contribution of 15 points, member 2 voted for 2 points, and group member 3 voted to contribute 8 points in the first ballot of a period. In this period, the low preference would be 2, the median preference would be 8 and the high preference would be 15 points.[11] We compared these initial preferences to the actual group decision in the given period. Table 2 shows the results.

[11] Low, median, or high preferences can also be identical. If group members 1 and 2 voted for a contribution of 17 points and group member 3 voted to contribute 3 points, 3 would be the low preference and the median and high preference would be 17.

Table 2. Comparision of initial preferences and final decisions per period

	Initial preferences		
	Low	**Median**	**High**
Group decision equal	211	376	263
Group decision higher	267	50	2
Group decision lower	2	54	215
Closest prediction	265	395	274

Overall, we observed 480 group decisions. Table 2 shows that the initial median vote is by far the best predictor of the final result.[12] In 376 decisions the initial median preference is equal to the final group decision. 50 times the final contribution of a group was higher than the median preference of its members and 54 times it was lower. In only 211 group decisions the actual decision was exactly equal to the lowest initial preference and in 263 decisions the group decision corresponds to the highest initial preference. The last row shows the number of times the respective initial preferences exhibited the lowest difference to the final group decision. Again, the median preference is the best explanation of the results. Low and high initial preferences are less precise predictions of group decisions.

In a next step we used OLS regression analyses to confirm our findings. Table 3 shows the results. In a first model we regressed the final group decisions on low, median, and high initial preferences. We found a highly significant positive influence of both low and median initial preferences on the outcome of majority decisions. However, the effect of the median group member is much larger than the effect of the low preference. The coefficient of the median preference almost approaches unity. In our majority decisions, group contributions increased by 0.94 points if the median preference increased by one point. A one point increase in low initial preferences only led to an increase of 0.11 points in the final group decision. The initially most cooperative group member had no significant influence on the final group decision. Overall, initial preferences explain 83% of the variance in the data.

[12] Notice that row entries of Table 2 do not necessarily add up to 480 because it is possible that low, median, or high initial preferences are identical. For example, if two group members voted for 16 points in the first ballot of a period and group member 3 voted for 4 points, high and median initial preferences would be the same. Since the group reached a decision in the first ballot of the period both were equal to the final group decision.

Table 3. OLS Regression results for group contributions per period

Model	(1)	(2)	(3)	(4)	(5)
Low preference	0.114 *** (0.026)	0.089 *** (0.027)	0.093 *** (0.027)	0.100 *** (0.028)	0.098 *** (0.028)
Median preference	0.941 *** (0.035)	0.930 *** (0.036)	0.918 *** (0.037)	0.932 *** (0.039)	0.937 *** (0.037)
High preference	-0.039 (0.043)	-0.044 (0.045)	-0.059 (0.046)	-0.078 (0.048)	-0.074 (0.046)
Fixed effects communities		X	X	X	X
Fixed effects periods			X	X	
Lagged mean community				-0.085 ** (0.033)	-0.086 ** (0.033)
Constant	0.134 (0.590)	1.131 (0.788)	3.097 ** (1.110)	1.392 (1.197)	1.495 (0.814)
Adjusted R^2	0.831	0.834	0.839	0.843	0.840
N	480	480	480	448	448

** Statistically significant at the 0.01 level (two-tailed).
*** Statistically significant at the 0.001 level (two-tailed).
Standard errors in parentheses

Our first model treats every single group decision as a statistically independent observation. This assumption, however, is clearly violated in our data. Group members interacted repeatedly with other groups in their community for 15 periods. Hence, we have a panel of decisions of groups which are nested in communities. The following models deal with these dependencies in our data. Model 2 incorporates fixed effects for communities to deal with the fact that group actors are nested into communities. Introducing fixed effects did not alter our prior results. The coefficients of low and median preferences hardly changed and remained highly significant. High initial preferences still had no influence. The same is true for model 3 in which we additionally included fixed effects for periods to account for possible dependencies in behavior over time.

In a next step, we modeled the time dependencies in our data explicitly. For each group actor, we calculated the difference of the group's contribution to the mean contribution of the group's community. We inserted this variable lagged by one period in regression model 4 (The last column of Table 2 shows the results of the same regression model without fixed effects for periods). We thus assumed that the behavior of the other actors in a community in period *t-1* had an influence on group behavior in period *t*. The results of model 4 show that this was actually the case. While in model 3 several coefficients of the period dummies were highly significant, none of the period dummies was significant in model 4 (not shown in Table 3). We therefore conclude that the lagged mean community contribution models the time

dimension in our data fairly well. The coefficients of low and median preferences did not change compared to models 1 and 2. Both remained highly significant. We found a negative significant influence of the lagged community's mean contribution. If the group's contribution exceeded the community mean by one point, the respective group decreased its contribution in the following period by almost 0.1 points. Vice versa, a group increased its contribution by the same amount if its contribution in the foregoing period was one point below the community average. This finding is compatible with several popular models incorporating social preferences in individual utility functions. The dynamics in our data could thus be driven by inequality aversion or reciprocity. The utility of inequality averse individuals decreases if their payoff deviates from the payoffs of individuals in their reference group (Bolton and Ockenfels, 2000; Fehr and Schmidt, 1999). In our experiment, inequality averse individuals would thus vote for a group contribution in line with the average contribution in the community. However, behavior observed in our data could also reflect a reciprocal motivation. Individuals motivated by reciprocity reward kind actions of others and punish unkind actions (Falk and Fischbacher, 2006; Rabin, 1993). Since there was no other way to punish or reward kind or unkind actions of other actors in the community, groups could only adjust their own contributions in the following period accordingly, reducing their contributions if other actors contribute on average less and increasing their contribution if other actors had contributed more. The rather small coefficient of the lagged average community contribution of -0.085 indicates that inequality aversion or reciprocity only had weak motivational influence in our experiment. This explains why cooperation could be stabilized at a high level in the first eleven periods of the experiments. A short-term defection of a single actor did not result in an immediate breakdown of cooperation in a community.

Overall, low and median initial preferences display highly significant effects in all model specifications. The effect of the median player, however, is much stronger. We thus conclude that the decision rule has the most important effect on group behavior in our experiment. As we have hypothesized above, the median player is decisive in majority decisions. But, we also found a significant effect of the most egoistic group member which is a sign that the discontinuity effect might also be prevalent in our experimental setting. However, the institutional incentives set by majority rule largely override the psychological effects in group interactions.

5. Conclusion

The experimental literature on group behavior impressively demonstrates that groups act more egoistically than individuals. The driving forces between these patterns of behavior are

greed and fear. In this paper we examine whether under certain constraints these strong impulses, which negatively influence cooperation among group actors, can be repressed. Our main argument is that under majority decision rule the median player emerges as the most powerful actor in a group. Her preferences most likely decide how the group behaves. This means that it is not compelling that groups act more egoistically than individuals, because the distribution of preferences of the median player must not necessarily differ from the distribution of preferences among individuals. The median players' persistence may thus weaken the discontinuity effect. This explains why under certain constraints groups may show similar patterns of behavior as individuals.

In order to prove this argument, we carried out a standard linear public goods game, in which we compare a group treatment and an individual treatment. In the group treatment three members of a group had to decide how much of their endowment they want to contribute to a common project of their community (communities existed of four actors). In the individual treatment four actors had to make the same decision, however without being exposed to a ballot. Thus, our treatments carry similar features with respect to the composition of a community and differ only with respect to the group feature and the majority voting rule.

Our main finding is that under these circumstances the mean contribution of groups and individuals does not differ. We were thus able to show that a condition exists (majority voting) under which groups do not act more egoistically than individuals. This evidence may contribute to a refinement of the group-egoism argument.

However, in order to verify our theoretical claim that the median player emerges as the decisive group actor under majority rule, we needed to show her actual influence on the group decision. We were able to demonstrate this by analyzing the initial preferences of players and the final group decisions. 376 times the initial median preference is identical with the final group decision (480 group decisions observed). We also regressed the final group decision on low, median, and high preferences and found a highly significant influence on median preferences, however also on low preferences. We interpret the latter result as a concealed discontinuity effect which is repressed by the median preference in the experiment.

These are our first results. It might be interesting to see how this argument can be further validated with additional sessions in the laboratory. One way to enhance our understanding of the influence of the decision mechanism would be to repeat the group treatment and establish unanimity rule. In such a treatment the median players' preference will be less decisive due to the veto power of the other players. It would be interesting to know, whether, as a result of this, the discontinuity effect returns.

In many experiments in which group behavior was observed communication was allowed. One could argue if communication in groups is permitted, this might also have an effect on

the median players' power. Communication between group members might give a stronger voice to egoists, but this is not compelling. In general, additional treatments may give us a better knowledge of how group-egoism may be civilized or unleashed. This is central to the understanding of how the tragedy of the commons dilemma may be reduced and what democratic decision rules can contribute.

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