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**Conference Paper**

## Teams Contribute More and Punish Less

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# TEAMS CONTRIBUTE MORE AND PUNISH LESS\*

**Heike Auerswald, Carsten Schmidt, Marcel Thum and Gaute Torsvik**

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## **Abstract**

Many decisions in politics and business are made by teams rather than by single individuals. In contrast, economic models typically assume an individual rational decision maker. A rapidly growing body of (experimental) literature investigates team decisions in different settings. We study team decisions in a public goods contribution game with a costly punishment option and compare the group decisions to those of individuals in a laboratory experiment. We also consider different team decision-making rules (unanimity, majority). We find that teams contribute significantly more and punish less, regardless of the team decision rule. Overall, teams yield higher payoffs than individuals.

JEL classification numbers: C72, C92, H41

Keywords: Group Decision Making, Public Good, Experiment, Punishment

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## **1. Introduction**

Important real-world decisions are often made by teams rather than by individuals. A family jointly decides where to live and work, the board of directors selects a firm's investments and countries send teams of delegates to negotiate international treaties. In contrast, most economic models of decision-making assume individual decision makers. The rapidly growing (experimental) literature on team decisions attempts to fill this gap by analyzing how teams make decisions and whether they make different decisions than individuals do.

Our focus is on teams that jointly provide a single public good. We analyze whether teams contribute significantly more or less than individuals in a standard public goods game with and without a punishment option. We extend the standard public goods game with four players to a setting with four teams jointly providing the public good. Each team consists of three individuals. We analyze team behavior under different decision-making rules (majority and unanimity rule) and assess the extent to which these behaviors differ from the individual reference treatment. We analyze the contributions to the public good, the use of punishment and the final payoff.

Teams in our experiment contributed significantly more to the public good than individuals if there was no punishment option. In treatments with punishments, teams punished significantly less than individuals. In terms of net profits, teams performed better than individuals.

In section 2, we develop our working hypotheses. Section 3 describes the experimental setting in detail. Section 4 discusses the findings and their significance. Section 5 provides some preliminary explanations for the somewhat surprising result that teams contribute more if there was no punishment option. Section 6 provides conclusions and suggestions for further research.

## **2. Literature and Hypotheses**

Charness and Sutter (2012) and Kugler, Kausel and Kocher (2012) provide recent surveys on team decisions. According to Charness and Sutter, the majority of research concludes that teams tend to behave more in line with game theoretic predictions than do individuals. They identify three reasons for the difference between decisions made by teams and individuals (p. 171). First, individual knowledge is aggregated in teams, and thus teams make qualitatively better decisions (e.g., investment decisions). Second, teams exhibit more detailed reasoning when making strategic decisions (e.g., in the beauty contest game and the trust game). Teams are better able to anticipate the reaction of the other player and his/her best strategy.

Third, teams have a stronger focus on payoffs. Fairness and reciprocity seem to play a minor role in team decision-making, perhaps because the other members of one's own team – rather than members of the other teams – serve as reference points, and in-group thinking replaces out-group thinking. Kugler, Kausel and Kocher (2012) refer to the “social support of shared self-interest” hypothesis proposed by Insko and Schopler (see also Kugler, Bornstein, Kocher and Sutter 2007). Through the aggregation of preferences in groups, the members support each other in their views and facilitate the expression of higher profit orientation and less altruism towards other groups. In addition, Kugler et al. (2007) discuss Insko and Schopler's “schema-based distrust” hypothesis, which aims at explaining why groups are more likely to defect in a prisoner's dilemma. Groups tend to expect other groups to act more selfishly and thus to defect more often; they protect themselves from being exploited by choosing defection as well.

These arguments may explain why teams often behave more in line with game theoretic predictions with regard to strategic interactions. The list of games analyzed in this context is long, but it lacks the standard public goods game, which is the game-theoretical mirror image of numerous real-world problems; environmental protection, combating maritime piracy, military protection, vaccination programs and financial stability are among the numerous relevant examples. We also consider punishment because it is an important instrument to foster cooperation and because it is frequently used in real world politics; for example, trade restrictions are linked to non-cooperation in international environmental policy.<sup>1</sup>

The interactive tasks in which team behavior more closely resembles the predictions of standard economic theory include the ultimatum game (Robert and Carnevale 1997, Bornstein and Yaniv 1998), the dictator game (Luhan et al. 2009), the beauty contest game<sup>2</sup> (Kocher and Sutter 2005), the centipede game (Bornstein et al. 2004), the gift-exchange game (Kocher and Sutter 2007), the trust game (Kugler et al. 2007) and the sequential market game (Stackelberg duopoly, Cardella and Chiu 2012).<sup>3</sup> However, there are also three experiments in which teams behave less in line with game theory or are less able to process information efficiently. Cason and Mui (1997) were among the first to study team decisions in an

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<sup>1</sup> In general, the restriction of trade per se has no benefit for the home country but is employed as a punitive measure if the foreign country does not contribute sufficiently to the public good of “global environmental quality.” Among others, Barrett (2003) discusses this linkage in the context of international environmental agreements.

<sup>2</sup> Groups tend to perform better during the game due to improved reasoning abilities, but not in the first period.

<sup>3</sup> Cooper and Kagel (2005) find that teams are closer to the predicted equilibrium strategy in a signalling game with limit pricing and market entrance. Teams learn faster than individuals to act strategically in “Acquiring a Company”.

economic experimental framework. In a dictator game, they found: “[...] *that when a team consists of members who have made different individual offers [in a previous individual stage of the game, authors’ note], the team offer tends to be dominated by the more other-regarding member*” (Cason and Mui 1997, p. 1477). They refer to psychological group polarization theories and evaluate whether the Social Comparison Theory or the Persuasive Argument Theory is more likely to explain the difference in the behavior of teams.<sup>4</sup> They conclude that social preferences seem to be more important than the persuasiveness of arguments. However, this result may depend on the specific framing of the experiment with 2-person teams and face-to-face communication. Luhan, Kocher and Sutter (2009) repeated the game in a different environment (communication via electronic chat, 3-person-teams). They found that teams act more selfishly and that the most selfish player in a team has the strongest influence.

The second study that deviates from the main stream of literature is that by Cox and Hayne (2006), who studied a common value auction with risky outcomes. They identified a “curse of information.” If additional information is provided on the value of the auctioned item, individuals and teams bid less rationally. In addition, this “curse of information” effect is even stronger for teams.

The third and most recent study is by Müller and Tan (2013). They set up a sequential two-player market game (Stackelberg duopoly) and found no significant difference between individuals and teams in a one-shot game. In the repeated game, team decisions were less in line with game-theoretic predictions compared to individual decisions.

In summary, the studies conducted thus far have analyzed team decisions with respect to rationality, performance and the decision-making process within teams. We extend this work and apply it to a public goods framework. This framework is of special interest because it simultaneously addresses both dimensions that are particularly prominent in the literature: the game-theoretic rationality and the performance of teams. In contrast to most of the previous literature, however, in our case, the two effects work in opposite directions. If teams behave more in line with game-theoretic individual rationality, this may lead to an inferior overall performance and vice versa. If teams are superior in terms of “emotional rationality”, e.g., by correctly anticipating the willingness to cooperate, they may show a better overall performance than individuals. Our aim is to address the following research question: Do

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<sup>4</sup> Social Comparison Theory assumes that individuals act according to what they believe to be socially desirable. They try to appear more social than the average person. Persuasive Argument Theory assumes that individuals follow the number and weight of pro and con arguments they recall when facing the decision. For more details, see Cason and Mui (1997). For further discussion, see also Sutter (2009) and Charness and Sutter (2012).

teams outperform individuals in a public goods setting with and without punishment? To answer this question, we examine the level of cooperation (contributions). We test for rationality in the context of punishment levels. We also assess whether the decision-making process within a team affects performance; therefore, we implement different decision-making rules, namely majority and unanimity.

The standard public goods models assume a purely selfish individual and predict extensive free-riding. The level and structure of cooperation observed in the experiments indicate that players are partly driven by other factors, such as altruism, fairness or reciprocity. From the experimental literature, we expect teams to behave in a more competitive and self-oriented manner when competing with other teams than individuals competing against individuals (see Charness and Sutter 2012). We also know that teams behave more in line with game-theoretic predictions in many interactive tasks. Thus, our working hypothesis addressing cooperation is:

***H1: Teams contribute less.***

If average contributions in treatments with teams are lower than in the individual treatment, this would provide support for this hypothesis.

We expect teams to punish less in the presence of a punishment option. Punishment is costly and destroys resources. The literature provides evidence that teams are more rational in many different situations, and in our setting, not punishing at all is rational. Our second working hypothesis is:

***H2: Teams punish less.***

While there is an incentive to free-ride on the others' contributions to a public good in the standard economic decision-making model, contributions increase *welfare* from a collective perspective. In line with recent approaches (Gächter et al. 2008, Ambrus and Greiner 2012), we also account for the welfare effects of different treatments. For our welfare analysis, we abstract from potential "warm glow" effects and altruism, which may enter the welfare function, and focus on payoffs as our welfare measure. The overall outcome depends on both contributions and punishment. In the absence of a punishment option, a corollary of hypothesis H1 is that teams should perform worse. For the treatment with a punishment option, the conclusion is less straightforward. As contributions are typically close to the maximum level when a punishment option is available, we expect the type of decision maker (team vs. individual) to be of minor importance for contributions. More rational team

decisions, however, would imply that teams punish less, which would lead to higher payoffs ceteris paribus. We state the following hypothesis:

***H3: Teams yield lower payoffs in the absence of punishment but perform better in the presence of punishment.***

We are also interested in the question of whether the decision rule itself makes a difference. Decision-making processes within teams remain a largely neglected field in economic research, as Kugler et al. (2012, p. 25) note: “Economic theory is surprisingly silent about decision making of unitary groups, [...]”

A plausible first intuition regarding decision-making in the majority-rule treatment is that the median voter prevails. However, concerning unanimous decisions, we lack a widely accepted theory. A priori, it is far from obvious whether the de facto veto power in the unanimity treatment provides an advantage to homo economicus players or players emphasizing social norms and therefore how the quality of the decision deviates from majority decisions. What we can expect is that decision-making under the unanimity rule takes longer than under the majority rule because all three versus two of three players must coordinate. Blinder and Morgan (2005) find support for this mechanism, and we would expect the same for our setting:

***H4: Teams deciding by majority rule reach decisions more rapidly than teams deciding by unanimity rule.***

Concerning the quality of decisions, the literature provides ambiguous results (Kerr and Tindale 2004 (p. 641), Blinder and Morgan 2005 and Gillet, Schram and Sonnemans 2009). Gillet, Schram and Sonnemans (2009) identify only a minor advantage of decisions made under the unanimity rule compared to decisions reached by majority rule. If the quality of the decision-making process is more or less the same in the unanimity and majority treatments, we might nevertheless observe a difference in the punishment patterns. The punishment stage can be used to sanction low contributions that are regarded as anti-social behavior. In the unanimity case (as in individual play), punishment affects players that demonstrate a low willingness to contribute. In the majority treatment, however, the punishment may also affect innocent bystanders. If the majority decides in favor of a low contribution, a minority of the team may nevertheless have favored a high contribution. Therefore, we might expect punishment to be employed more cautiously in the majority treatment.<sup>5</sup>

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<sup>5</sup> On the other hand, one might argue that information aggregation will be superior in the unanimity treatment.

## *H5: Teams deciding by majority rule punish less.*

### **3. Experimental Design and Procedure**

The general framework is a standard public goods game (Ledyard 1997) with and without punishment (Fehr and Gächter 2000). An experimental group of four teams or four individuals was formed. Each team consists of three players. Each team/individual received the same endowment (20 tokens) in each round and had to decide how many (integer) tokens to invest in the public good. The marginal per capita return for each token invested in the public good was 0.4, which accrued to each of the four teams.<sup>6</sup> All tokens not invested in the public good were retained by the team/individual; this was equivalent to a marginal return of 1 for the investment in the private good.

In the public goods game with punishment, the contribution stage was followed by a punishment stage. In line with the recent literature on punishment, we implemented the following punishment technology: a 3-token reduction in the payoff of another participant cost the punishing participant 1 token (see Gächter, Renner and Sefton 2008). We set up three between-subject treatments: individual (IND), majority team (MAJ) and unanimity team (UNA). In the majority treatment, a minimum of two out of three team players had to agree. In unanimity teams, all members had to agree on contribution and punishment.

Subjects were informed that the experiment consists of several parts, and instructions for each part were distributed at the beginning of the part (surprise restart). In Part I, all participants played an individual, one-shot public goods game. This one-shot game reveals some information about the type of the player, e.g., regarding his/her selfishness.<sup>7</sup> No feedback was provided in part I to avoid learning at this stage. At the beginning of Part II, participants were randomly assigned to treatments (IND, MAJ and UNA). In the team treatments, assignment to teams was determined randomly. Then, participants played a 10-period standard public goods game as a team member or an individual.<sup>8</sup> After each period, every player received feedback concerning his/her results and anonymized information on the decisions of the other

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<sup>6</sup> The individual payoff of a team member is equal to the team result. Technically, the experimenter tripled the team's profit and awarded an equal share to each team member. Thus, the incentives in the individual and team treatments were identical.

<sup>7</sup> The degree of selfish or altruistic preferences is certainly not the only determinant of contribution levels. In particular, conditional cooperation, which is endogenous to other players' behavior, is crucial in determining contributions; see Fischbacher and Gächter (2010).

<sup>8</sup> Participants were assigned to the same treatment for all 10 periods.



teams/individuals. In Part III, participants were re-matched within their treatments (MAJ, UNA) such that no participant was matched with a former teammate. This procedure was common knowledge. The re-matching ensured that participants had no prior information concerning the cooperative behavior of his/her teammates. Participants played a 10-period public goods game with punishment. Again, all team players remained on the same team for 10 periods. After each contribution and punishment stage, each player received feedback on his/her results and anonymized information on the decisions of the other teams/individuals. After Part III had been completed, we disclosed the results of Part I.

We implemented a structured method of team decision-making in the spirit of Gillet, Schram, and Sonnemans (2009). At the beginning of each period, each team member could propose a contribution to his/her teammates. Specifically, each team member had to type in a number (0...20) as his/her proposed contribution to the public good. Once all three team members had entered their numbers, the proposals were shown to the team. Under majority rule, two out of the three proposals had to be equal to result in a decision. Under unanimity rule, all three proposals had to be equal. If an agreement was reached according to the team decision rule, it was automatically implemented as the team decision. In total, 10 rounds of proposals could be made before a default rule applied. If a team had not reached a decision after 10 rounds of proposals, the decisions of another team that has reached a compromise was randomly selected as the undecided team's choice and the team's payoff for this period was set to zero. The restriction to 10 proposals was non-binding for all majority team decisions and in the vast majority of cases of unanimous decision making. At the contribution stage, coordination failures occurred in only 15 cases out of a total of 1,600 unanimity team decisions. At the punishment stage, teams failed to agree on the assignment of punishment points in 8 out of 800 cases of unanimous decisions. Participants had full information about the default rule.

At the punishment stage, individuals/teams could penalize other individuals/teams. When all decisions regarding contributions had been made, each participant (team or individual) received anonymous feedback concerning the contributions of the other participants. Then, the participants could decide about the allocation of punishment points to the other three participants. Reducing the payoff of another participant by three tokens cost the punishing participant 1 token. Each of the three other teams was allowed to purchase a maximum of 5 tokens; as in the contribution stage, players were only allowed to select integer values when choosing the number of tokens. In team decisions, each player on a team could propose a punishment schedule, for example, team A: 0 tokens, team B: 1 token and team C: 5 tokens. If the punishment schedules of two (three) team members were identical, the team decision was

automatically implemented by the program according to majority (unanimity) rule. The default rule was the same as for the contribution stage.

The experiment was programmed and conducted using z-tree software (Fischbacher 2007). Sessions were held in the experimental laboratory at the University of Mannheim from September to November 2012. Subjects were recruited using a database of volunteers (Greiner 2003). In all treatments, subjects were invited to participate for 90 minutes. In general, baseline sessions lasted approximately 60 minutes, sessions using the majority treatment lasted 75 minutes and those using the unanimity treatment up to 90 minutes. In total, 280 students, approximately half of which were bachelor-level business administration students, participated in the experiment. After being randomly seated in separated cubicles in front of a computer, which was subsequently used to run the experiment, participants received the instructions for Part I. The experiment began after all subjects had passed a quiz ensuring that all subjects understood the instructions. The instructor answered questions individually and in private. No communication among participants was allowed during the experiment. The exchange rate for tokens was 2 Eurocents per token. Payments were made anonymously in cash immediately following the experiment with an average payoff of 11 Euro.

#### **4. Results**

Table 1 contains the summary statistics on the number of subjects in each treatment, average contributions, average punishment (when applicable) and average net profits. Each experimental group of 4 individuals/teams provides an independent observation. Thus, we have 10 observations for each treatment (no punishment/punishment) and each decision rule (majority/unanimity/individual). We now test the 5 hypotheses from the previous section by analyzing these data in detail.

Table 1: Summary Statistics: Average Contributions, Punishment and Net Profits in the Treatments

	<u>Part I</u>		<u>Part II</u>		<u>Part III</u>		
	One-shot PG w/o Feedback	10-period PG with Feedback	10-period PG with Feedback	10-period PG with Feedback	10-period PG with Punishment and Feedback		
	N	Avg.	Avg.	Avg.	Avg.	Avg.	Avg.
	Participants	Contribution	Contribution	Net Profits	Contribution	Punishment <sup>a</sup>	Net Profits
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Unanimity	120	9.08	9.76	25.24	16.24	0.53	27.27
Majority	120	9.62	8.98	25.39	14.95	0.59	26.62
Individual	40	8.95	7.56	24.54	14.89	1.11	24.51
Teams <sup>b</sup>	240	9.35	9.37	25.32	15.60	0.56	26.95

Note: <sup>a</sup> Average number of assigned punishment points, equaling the average cost of punishment; <sup>b</sup> “Teams” consists of the majority and unanimity treatments.

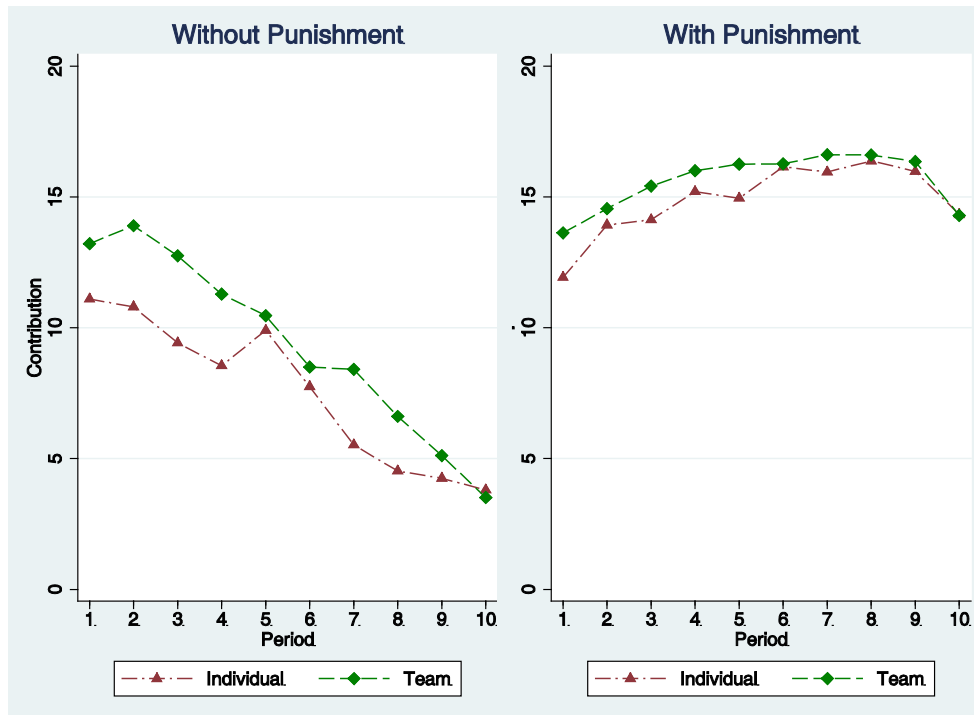
#### 4.1 Comparing Teams and Individuals

##### *H1: Teams contribute less.*

First, we turn to the question of whether teams differ from individuals in terms of contributions. For this purpose, unanimity and majority decisions are uniformly treated as team decisions. Whether there are differences according to the decision rule will be discussed below.

Figure 1 depicts the average contribution for each round. The left panel refers to the treatments without a punishment option and the right panel to the treatments with punishment. The two panels exhibit well-known properties in finite horizon, repeated public good games. Without punishment, cooperation erodes over time and contributions decline. With punishment, cooperation can be sustained (Ledyard 1997, Fehr and Gächter 2000). Our focus is on the effects of team decisions. An initial inspection of the curves for teams and individuals suggests that teams contribute more. In contrast to other experiments, the formation of teams does not shift the outcome towards more selfish behavior.

Figure 1: Average Contributions in the Treatments with and without Punishment



This finding is corroborated by the regression analysis in Table 2 (Columns 1 and 3) where we explain the contributions on the group level with a team dummy, the contributions in the one-shot game and nine period dummies. Without punishment, teams contribute significantly more than individuals. The effect is not only statistically but also economically significant. On average, teams contribute 20 percent more than individuals ( $\approx 1,499/7,56 \times 100$ ). With punishment, the team effect is much smaller (3 percent) and statistically not significant. The regression analysis also reveals that player type matters. We take the contribution from the 1-shot game in Part I as an indicator of an individual's selfishness or other-regarding preferences. A low contribution indicates an orientation towards selfish behavior. In the case of teams, we calculate the average 1-shot contribution across the group. The economic effect is quite large. A 1-token increase in the contribution in the 1-shot game translates into a 0.8-token greater contribution in the repeated game.

Table 2: Regression Results

	<u>Part II</u>		<u>Part III</u>		
	10-period PG with Feedback		10-period PG with Punishment and Feedback		
	Contributions <sup>a</sup>	Profits <sup>a</sup>	Contributions <sup>a</sup>	Punishment <sup>b</sup>	Profits <sup>a, c</sup>
	(1)	(2)	(3)	(4)	(5)
Team	1.499*** (0.443)	0.586** (0.292)	0.452 (0.631)	-0.676** (0.254)	2.209** (0.764)
Contributions				-0.092*** (0.022)	
Contribution in 1-shot game <sup>d</sup>	0.795*** (0.071)	0.473*** (0.047)	0.639*** (0.129)	-0.036 (0.042)	0.569*** (0.135)
Intercept	4.181*** (0.909)	22.76*** (0.587)	6.867*** (1.541)	2.287*** (0.557)	17.417*** (1.552)
<i>N</i>	300	300	300	300	300
<i>R</i> <sup>2</sup>	0.52	0.43	0.12	0.05	0.14

<sup>+</sup>  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ , standard errors in parentheses,

<sup>a</sup> OLS regression with period dummies; coefficients for the period dummies not reported here; robust standard errors,

<sup>b</sup> Tobit (marginal effects), robust standard errors,

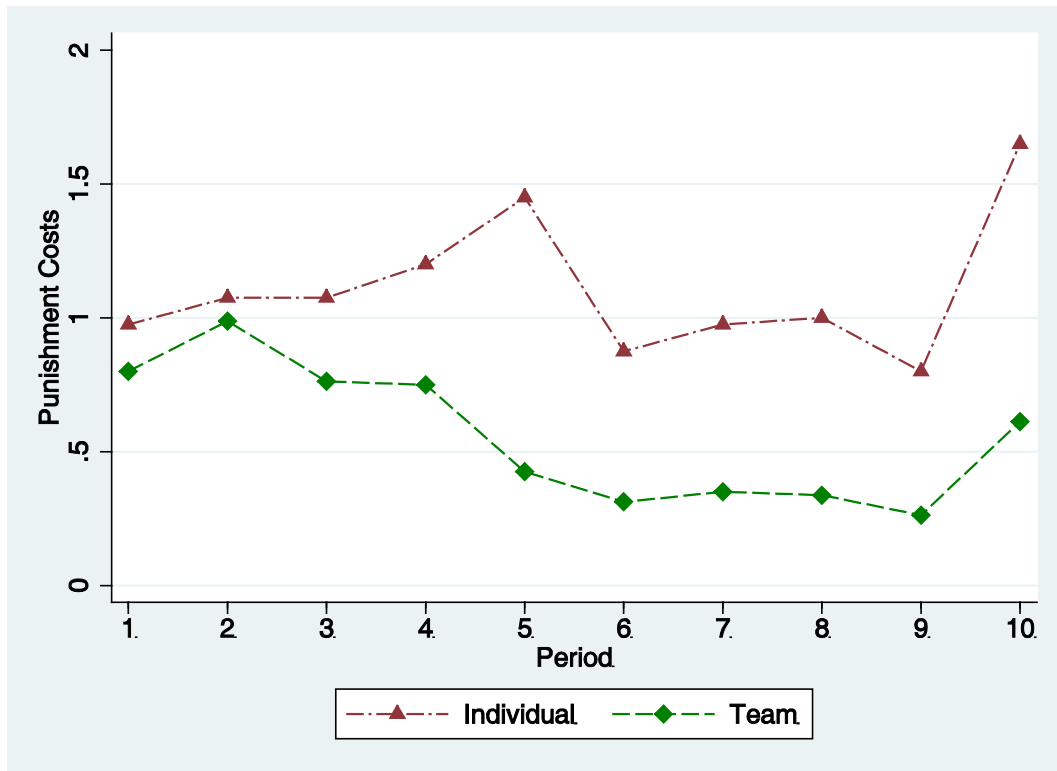
<sup>c</sup> Profits net of punishment costs and punishment received,

<sup>d</sup> Group average.

### ***H2: Teams punish less.***

If teams exhibit a higher degree of rationality, we should observe less punishment in a team setting. Punishment is costly for the punisher and the punished. Independent of whether players are selfish or have other-regarding preferences, destroying resources should not be in the interest of a rational player. Figure 2 depicts the average punishment costs in the team and individual treatments for each period. The level of punishment remains nearly constant over time in the individual treatment and declines slightly in the team treatments.

Figure 2: Average Punishment Costs

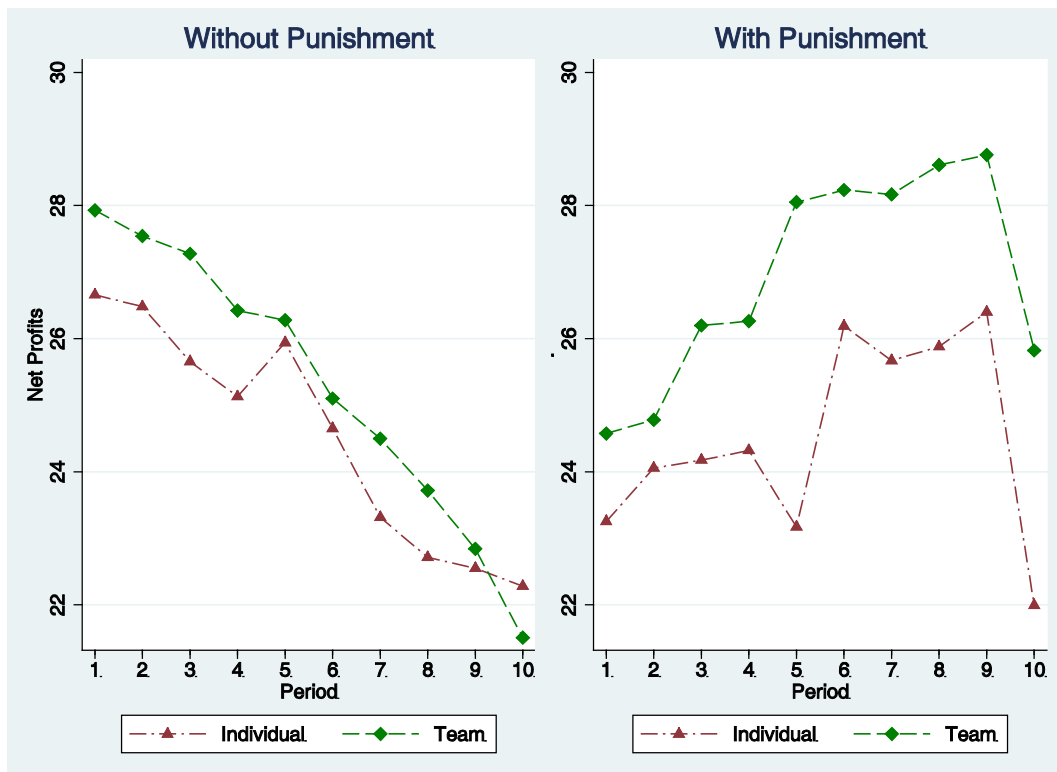


Again, we explore this difference using regression analysis. Because of the left-censored data, a Tobit analysis was used (Ambrus and Greiner 2012). The left-hand side variable is the average punishment cost incurred by the teams. Column 4 in Table 2 indicates that punishment was less common in team treatments than in individual decisions. As expected, a higher contribution level goes along with lower punishments.

***H3: Teams yield lower payoffs in the absence of punishment but perform better in the presence of punishment.***

Next, we compare the (net) profits realized in the different treatments. The net profits of each team/individual are calculated by adding the returns from the public good to the retained tokens and then subtracting the costs of punishing and being punished. Figure 3 displays the average net profits over the 10 periods separately for the treatments without and with punishment (the left and right panels, respectively). Overall, teams performed better. In the treatment without punishment, the team net profit curve is slightly above that of individuals. The improved performance is due to the higher contributions of teams. In the punishment treatment, the individual and team contributions did not differ significantly. In this case, it is mostly the lower level of punishment imposed by teams that leads to increased net profits. If we interpret the results in terms of economic welfare, teams generate higher welfare.

Figure 3: Net Profits



Again, we complement the investigation of net profits with regression analysis. Columns 2 and 5 in Table 2 indicate that the team dummy is positive in both treatments. The regression also illustrates the already familiar pattern in the other variables. A higher contribution in the 1-shot game in Part I led to higher net profits in the “no punishment” treatment.<sup>9</sup>

#### 4.2 Team Decision Process

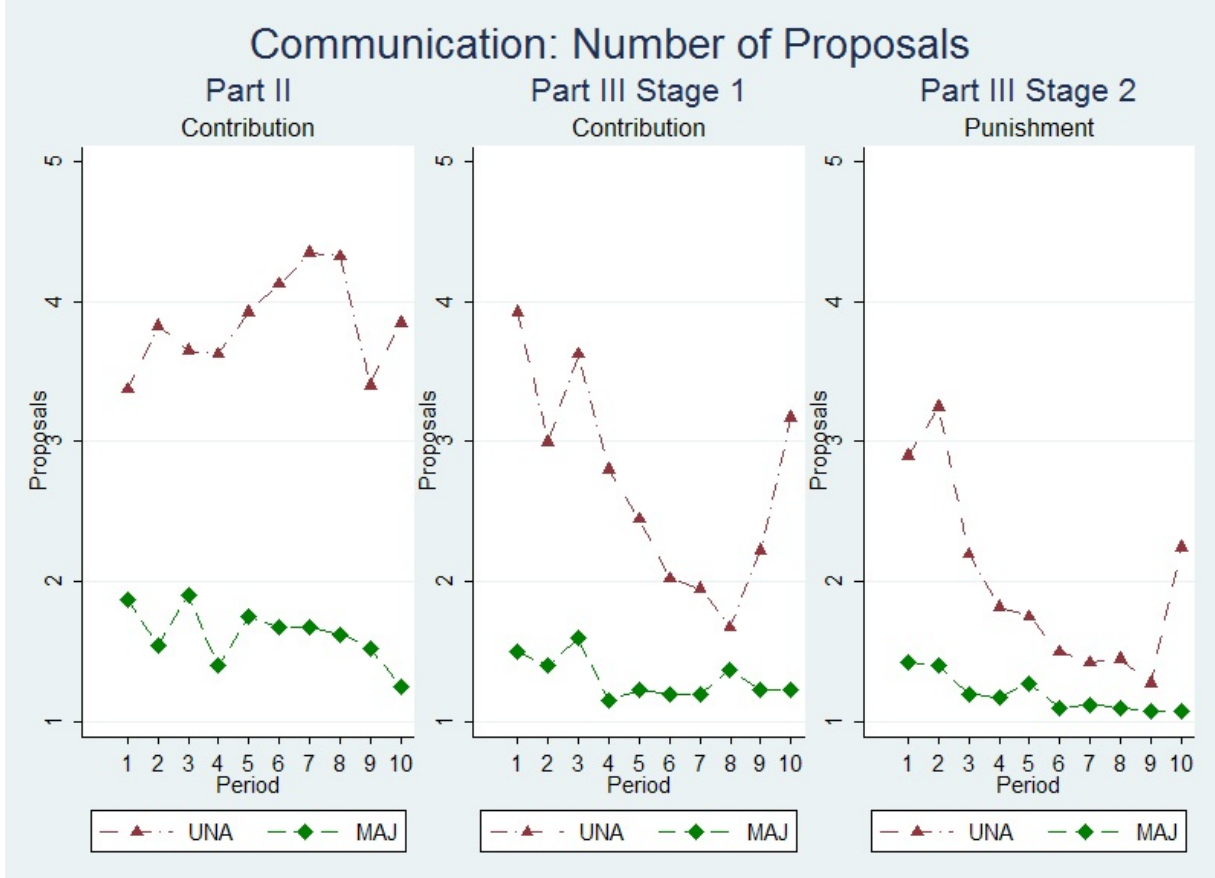
***H4: Teams deciding by majority rule reach decisions more rapidly than teams deciding by unanimity rule.***

Overall, coordination was achieved fairly rapidly, as Figure 4 illustrates. Under majority rule, the teams required 1.6 and 1.3 rounds to reach a decision on average without and with punishment, respectively. Moreover, even in the much more complicated treatment with unanimity, 80 percent of teams reached agreement in 5 rounds or fewer. Here, the average number of rounds was 3.9 and 2.7 without or with punishment, respectively. One reason for the high coordination rate – despite the broad range of possible contributions from 0 to 20 – is

<sup>9</sup> Note that the “contributions in the 1-shot game” capture the average of the entire group. Thus, a group consisting of less selfish players generated higher profits, but this does not imply that a single individual/team gained from being less selfish.

certainly that there are clear focal points. Most participants suggested a contribution of 0, 10 or 20.

Figure 4: Average Number of Proposals Necessary to Reach an Agreement on Contributions and Punishments

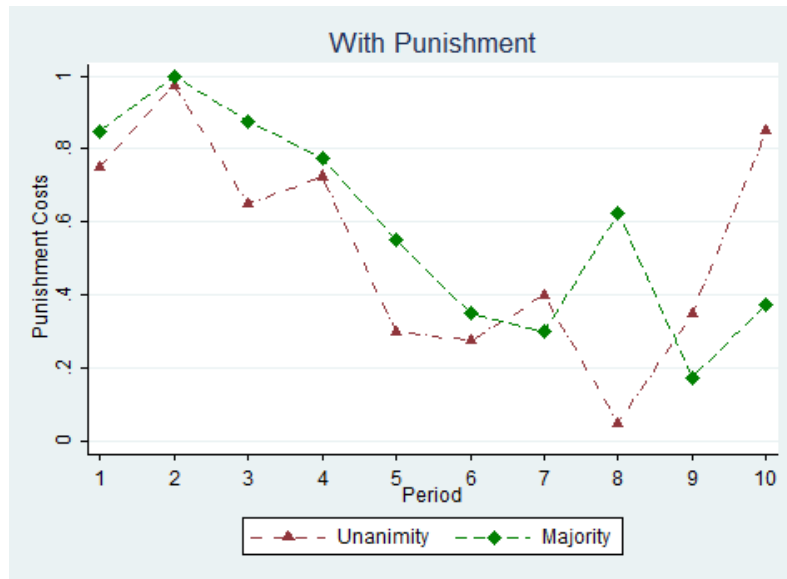


**H5: Teams deciding by majority rule punish less.**

The type of decision-making process itself may matter for the level of punishment. Individuals may be more reluctant to punish an anonymous and possibly heterogeneous group than individuals. If the other group consists of heterogeneous individuals, the punishment may harm individuals in the other group who sought higher contributions. In this case, we should observe more punishment under unanimous decision-making than in majority decisions, as no casual bystanders are present in the former case. Figure 5 separately depicts the punishment costs for the majority and unanimity treatments. According to the averages, the decision rule seems to make no difference. Punishment levels are of the same magnitude in the unanimity and majority treatments.



Figure 5: Punishment Costs in the Majority and Unanimity Treatments



### 5. Three Preliminary Explanations For Why Teams Contribute More

Why do teams contribute more? We suggest three mechanisms, and we check to what extent they are consistent with our experimental evidence.

#### 5.1 Elimination of Extreme Preferences Drives up Contributions

The first explanation focuses on the interaction of (majority) teams. Majority decisions may reduce the variance in the contributions and, in equilibrium, this may drive up the contributions of all teams. In Appendix 1, we sketch a simple model of public good provision where individuals gain utility from payoffs and from own contributions to a public good. We assume that individuals differ in terms of their willingness-to-contribute. This model shows that a reduction in the variance of the willingness-to-contribute parameter leads to higher contributions in equilibrium.<sup>10</sup> As majority decisions in teams eliminate extreme preferences, team formation may lead to more homogeneous contributions. As it turns out, this will induce the players to contribute more. If this hypothesis has some empirical relevance in our experiment, we should observe the variance of contributions to be lower in majority teams compared to individual treatments.

Table 3 compares averages and standard deviations (in brackets) of contributions in the individual treatment and in the majority treatment without punishment for each period. In

<sup>10</sup> This effect depends on the slope of the reaction curves. Note that it is not our aim to show that this effect is always at work. We just want to demonstrate that team formation may alter the outcome when individuals differ in terms of their willingness-to-contribute.

contrast to the theoretical prediction, standard deviations in the majority treatment are not smaller than in the individual treatment. Hence, there is little evidence, that the elimination of extreme preferences and the strategic interaction of teams drive the results.

*Table 3: Average Contribution and Standard Deviation of Contributions*

Period	Individual Treatment		Majority Treatment	
	Average	Standard Deviation	Average	Standard Deviation
1	11.1	7.09	12.7	6.87
2	10.8	7.54	13.4	7.76
3	9.4	7.49	12.4	8.15
4	8.6	7.77	11.1	8.40
5	9.9	7.58	11.2	8.36
6	7.8	7.44	8.0	8.52
7	5.5	6.71	7.4	8.26
8	4.5	6.46	5.4	8.04
9	4.3	6.33	4.9	7.50
10	3.8	6.85	3.4	6.22

Note: Part II (no punishment) only.

## 5.2 Social Approval

A second potential explanation is that team coordination triggers social conformity. It is a well-established result that a desire for social approval can increase cooperation among strangers (Rege and Telle 2004). In contrast to Rege and Telle’s experiments, the identity of the player is not revealed to the others in our setting. However, the team members demonstrate their willingness to behave cooperatively to their fellow team members, and in contrast to individual treatments, this revelation has no immediate consequences for the payoffs. The weaker the link between one’s own actions and the payoff, the more likely it is that individuals will behave according to social norms.<sup>11</sup> If this hypothesis has explanatory power, we should observe that players’ first proposals are higher in the unanimity (and majority) treatment compared to the individual treatment. While the proposal has immediate consequences for payoffs in the individual treatment, the probability that a high first proposal leads to high contributions is negligible as all three team members would have to make the same proposal. Hence, participants might be willing to seek social approval via high first

<sup>11</sup> See Goodin and Roberts (1975) for the example of the “ethical voter.”

proposals in team treatments.<sup>12</sup> Table 4 shows the average first proposals in the contribution stage (in addition to the average contributions in the one-shot game of Part I). Indeed, the first proposals increase when moving from individual to majority to unanimity treatments. The two-sample t-test at the bottom of Columns 3 and 4, however, shows that this increase in proposals is not statistically significant. Only the difference between proposals in the individual and unanimity treatments is marginally significant at the ten percent level.

*Table 4: First Proposals in the Contribution Stage*

		<u>Part I</u>	<u>Part II</u>	<u>Part III</u>
		One-shot PG w/o Feedback	10-period PG with Feedback	10-period PG with Punishment and Feedback
	N Participants	Avg. Contribution	Avg. First Proposal for Contributions	Avg. First Proposal for Contributions
	(1)	(2)	(3)	(4)
Individual (IND)	40	8.95 (1.22)	11.10 (1.12)	11.93 (1.11)
Majority (MAJ)	120	9.62 (0.72)	11.82 (0.68)	12.33 (0.72)
Unanimity (UNA)	120	9.08 (0.67)	12.74 (0.62)	12.38 (0.69)
Two-sample t-test IND-MAJ		p<0.322	p<0.298	p<0.388
Two-sample t-test IND-UNA		p<0.464	p<0.098	p<0.368

### 5.3 Skewness in the Preference Distribution

A third more technical explanation is that the median team member's willingness to contribute is above the average willingness to contribute, and thus the distribution is skewed.

<sup>12</sup> A high first proposal alone cannot explain why teams contribute more in equilibrium. After having signaled a high willingness to contribute, team members might reduce their proposals again. Note, however, that most teams coordinate on a small number of focal points such as (0, 5, 10, 15, 20). Therefore, high initial proposals might lead to coordination on a focal point with higher contributions.

In the majority treatment in particular, we expect that the team’s median voter prevails. Suppose that the individual willingness to contribute of the three team members amounts to (0, 15, 15). Then, a majority vote would lead to a contribution of 15. If these three players had participated in an individual treatment, we would have observed an average contribution of 10. Thus, with a skewed distribution, the formation of teams may increase contributions. To test whether such skewness could be responsible for our result, we consider the team players’ first proposals in the first round (contribution stage), as this most likely reflects best their true preferences. Columns 1 and 2 in Table 5 show the deviation of the highest and lowest proposal from the median in majority teams.<sup>13</sup> As expected, the distribution is skewed; the median is above the team average. However, the difference is statistically not significant (with and without punishment).

*Table 5: Skewness of Preferences (First Proposals in the First Round)*

	<u>Part II</u>	<u>Part III</u>	
	10-period PG with Feedback	10-period PG with Punishment and Feedback	
	First Proposals for Contributions	First Proposals for Contributions	First Proposals for Punishment
	(1)	(2)	(3)
Maximum – Median	3.450	3.125	0.517
Median – Minimum	4.450	4.600	0.225
Difference	-1.000	-1.475	0.292
p value	0.542	0.364	0.025

Note: Majority treatments only, p value: two-sided p-test.

Table 5 (Column 3) also reveals some information on the punishment behavior of teams. In (majority) teams, the first proposals in the punishment stage show a skewed distribution. The median proposal is much closer to the minimum than to the maximum proposal. This suggests that teams show a higher degree of economic rationality by cushioning the extreme preferences for punishment.

<sup>13</sup> As we have no clear prediction on the outcome in unanimity teams, we restrict the analysis to majority teams where we can expect the median voter to be decisive. A simple regression analysis shows that the median voter’s first proposal significantly explains the final contribution decisions of teams.

## **6. Conclusions and Outlook**

To the best of our knowledge, this is the first paper to analyze team decisions in a public goods setting. The outcomes of our experimental study confirm some but not all of the results of previous studies on team decisions in other games. First, as in prior work, we find that teams exhibit a higher degree of rationality. Teams punish significantly less than individuals; because punishment wastes the resources of the punisher and the punished, punishment is not a rational choice. Second, our results diverge from those of most other studies in that teams do not behave in a manner more similar to game-theoretic predictions. In contrast to our initial expectation and our working hypothesis, teams contribute more to the public good than individuals do. Overall, teams outperformed individual players.

This study suggests several promising avenues for future research. First, we could only make an initial attempt to explain the strikingly high contributions of teams. A more elaborated setting would allow the testing of further hypotheses regarding the high level of cooperation observed in the team setting. Second, mixed treatments where individuals play against teams might be very fruitful in exploring the reasons for the divergent behavior reported here. For instance, we would like to know whether teams are less willing to punish or whether individuals find it more difficult to punish a team (rather than individuals). Third, we would like to study team coordination in greater detail. This will require allowing for controlled communication among team members. For instance, such a setting would help to gain a better understanding of the decision-making process under the requirements of unanimity.

## Appendix 1

We set up a simple model of public good provision where individuals draw utility from monetary payoffs and own contributions (as a proxy for altruism, warm-glow, etc.). For simplicity, we restrict our model to two players. The Cobb-Douglas utility of player 1 amounts to

$$U_1 = [y - (1 - g) \cdot x_1 + g \cdot x_2]^{1-b_1} \cdot [x_1]^{b_1},$$

where  $x_i$  denotes player  $i$ 's contribution to the public good,  $y$  is the player's budget and  $g$  is the private return from investing in the public good. For a collectively profitable investment in the public good, we need  $g > 0.5$ . Finally,  $b_i$  reflects player  $i$ 's willingness-to-contribute.

For the first-order condition, we obtain the individually optimal contribution for player 1 as

$$x_1 = b_1 \cdot \frac{y + g \cdot x_2}{1 - g}.$$

The individual contribution increases in the return to the public good ( $g$ ), the willingness-to-contribute ( $b_1$ ) and the contribution of the other player ( $x_2$ ). The same reaction curve can be obtained for player 2. Solving for the equilibrium contributions of the two players yields

$$x_1^* = b_1 \cdot y \cdot \frac{1 - g \cdot (1 - b_2)}{(1 - g)^2 - b_1 \cdot b_2 \cdot g^2} \quad \text{and} \quad x_2^* = b_2 \cdot y \cdot \frac{1 - g \cdot (1 - b_1)}{(1 - g)^2 - b_1 \cdot b_2 \cdot g^2}.$$

For simplicity, we discuss interior solutions only ( $0 < x_1^*, x_2^* < y$ ), which always prevails for sufficiently small parameters  $b_i$ . In equilibrium, the total contribution of both players amounts to

$$x_{total}^* = y \cdot \frac{(b_1 + b_2) \cdot (1 - g) + 2 \cdot b_1 \cdot b_2 \cdot g}{(1 - g)^2 - b_1 \cdot b_2 \cdot g^2}.$$

Now, we change the heterogeneity of the players in terms of their willingness-to-contribute. Starting from identical players ( $b = b_1 = b_2$ ), we increase one player's willingness-to-contribute and reduce the other player's preference for contributions. Let  $b_1 = b + d$  and  $b_2 = b - d$ . Then, we can write  $x_{total}^*$  as

$$x_{total}^* = 2 \cdot y \cdot \frac{b \cdot (1 - g) + (b^2 - d^2) \cdot g}{(1 - g)^2 - (b^2 - d^2) \cdot g^2}.$$

An increase in  $d$  implies an increase in players' heterogeneity in terms of willingness-to-contribute. Taking the derivative with respect to  $d$  yields

$$\frac{\partial x_{total}^*}{\partial d} < 0.$$

The total contributions to the public good decrease when society becomes more heterogeneous. Put differently, as the median voter prevails in majority decisions, one can expect that extreme preferences are more likely to be eliminated compared to individual decisions. Hence, when moving from individual to team decisions, preferences should become more homogeneous and total contributions to the public good should increase.

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