Leadership with Individual Rewards and Punishments: Do Incentives Reinforce Leading by Example?

Gürerk, Özgür and Lauer, Thomas and Scheuermann, Martin

RWTH Aachen University, University of Cologne

17 July 2015

Leadership with Individual Rewards and Punishments: Do Incentives Reinforce Leading by Example?

Özgür Gürerk*, Thomas Lauer[§], Martin Scheuermann*

*RWTH Aachen University, [§]University of Cologne

October 5, 2016

Abstract: Leading by example and the provision of incentives are considered as two important means to influence teammates' behavior and increase team cooperation. How do these two aspects of leadership interact with each other? Do incentives reinforce leading by example, or do they even weaken its effect? With this experimental study, we clearly disentangle the effects of incentives from the effect of leading by example. We find that individual rewards and punishments are more effective in fostering team cooperation than leading by example as such. Perhaps more importantly, incentives do not reinforce the effect of leading by example, but they rather weaken it – surprisingly even more so with rewards than with punishments.

Keywords: Leadership; Incentives; Punishment; Reward; Leading by Example; Public Goods

JEL classification: C9, H4, M5

Corresponding Author: Özgür Gürerk (e-mail: ozgur.gurerk@rwth-aachen.de): Experimental Economics, RWTH Aachen University, Templergraben 64, D-52056 Aachen, Germany

Thomas Lauer (e-mail: thomas.lauer@uni-koeln.de): Experimental and Behavioral Economics, University of Cologne, Universitätsstraße 22a, D-50937 Köln, Germany

Martin Scheuermann (e-mail: martin.scheuermann@rwth-aachen.de): Experimental Economics, RWTH Aachen University, Templergraben 64, D-52056 Aachen, Germany

Acknowledgements: We thank participants of the 2014 Economic Science Association Conference in Prague, and the 2014 meeting of the Gesellschaft für experimentelle Wirtschaftsforschung in Passau for helpful comments. Financial support granted by the Deutsche Forschungsgemeinschaft (DFG) through GU 954/3 and LA 3372/1, is gratefully acknowledged.

1. Introduction

"The most important thing I learned is that soldiers watch what their leaders do. You can give them classes and lecture them forever, but it is your personal example they will follow."

General Colin Powell[1]

''The [. . .] most obvious way to bring about cooperation between employees [. . .] is to pay for cooperation or to punish uncooperative behaviour."

Edward P. Lazear[2]

Leadership may induce cooperative behavior by influencing the beliefs of team members and coordinating on efficient outcomes (Foss 2001). One possibility to exert such influence is leading by example, which is considered as one of the most defining characteristics of good leadership in groups and organizations. Empirical evidence provide a rationale why it may so. Many people are conditional cooperators, who prefer to match the contributions of others (Fischbacher et al. 2001). In the presence of conditional cooperators, leaders' cooperative efforts can influence the followers' subsequent contributions and lead to high cooperation levels. The problem is, however, that many conditionally cooperative agents slightly undercut others' contributions (Fischbacher and Gächter 2010). This fact often leads to a decline of average cooperation over time and weakens the effect of leading by example.

One possibility to ensure cooperation in teams and avoid the decay of cooperation is the use of incentives like reward or punishment mechanisms (see e.g., Fehr and Gächter 2000, Sutter et al. 2010). Indeed, leaders in organizations are often equipped with incentives to individually reward or punish their subordinates. The specific configuration of these incentives and their exact utilization depend on the requirements of the organizational form (Yukl 2013). In companies, individual rewards may be monetary, such as bonus payments or a salary increase. Rewards may be non-monetary, too, like the provision of a better work environment, or status symbols like a representative car. On the other hand, leaders can exert effective individual punishments, like ending a job contract, assigning the employee less preferable tasks, or withholding expected bonuses. In the military, leaders may even exert a disciplinary "non-judicial-punishment" and send their subordinates into the jail, up to several weeks.

[1] Taken from http://www.themilitaryleader.com/resource-recommendations/quotes/ on August 29, 2016.
[2] Lazear (1998, pp. 269–270).

Given the frequent occurrence of individual rewards and punishments in organizations as sketched above, it is surprising that no experimental study systematically investigated the leader's influence with individual reward or punishment power on team cooperation. In this paper, we fill this gap.

To disentangle the effect of individual rewards and punishments from the effect of leadership, we conduct carefully designed 2x3 factorial between-subjects treatments. More specifically, we first inquire in the leader's influence on team cooperation in the absence of any incentives. We then investigate whether leaders are more effective in using reward and punishment, compared to peers (in a leader-free team). Finally, we disentangle whether the presence of the incentives or the appointment of a leader is more beneficial for maintaining cooperation in teams.

Our main findings are as follows: First, in the absence of any incentives, leader-free teams achieve similar cooperation levels as teams with leaders. Second, individual incentives are helpful to increase cooperation, both in teams with and without leaders. Third, if individual incentives are available to leaders, this does not result in higher team cooperation – compared to teams with leaders lacking any incentives. We conclude, that in our setting, not the presence of the leader, but the use of incentives seem crucial for achieving high cooperation levels.

2. Related Literature

2.1. Theoretical Contributions

Scholars proposed different theoretical justifications for the existence of leaders in teams. In an asymmetric-information model, Hermalin (1998) considers a team where only one single member knows about the team's overall productivity. Hermalin (1998) shows, that the team can achieve a higher welfare, if the informed team member exerts effort as a leader before her teammates do. With her costly commitment, the leader can credibly signal being in the preferred high-productivity state, and motivate her teammates to exert high effort, too. This model nicely demonstrates that the existence of a leader may result in high cooperation in teams.

In a fundraising context, Vesterlund (2003) presents a similar theoretical prediction, when there is uncertainty about the quality of a charity, i.e., the value of the public good. To increase overall contributions, fundraisers of high-quality charities should announce the first contribution. This model again provides rationale for the effectiveness of having a leader for increasing contributions.

Huck and Rey-Biel (2006) consider a team production problem with two players. In their model, assuming inequality aversion for the players, team output and payoffs are higher, if a leader exerts effort first, compared to simultaneous play. Huck and Rey-Biel (2006) also show how leadership can arise endogenously, and to maximize group output, one should select the least productive member as leader.

2.2. Experimental Studies

2.2.1. Leadership Experiments in the Absence of any Incentives

Sequential public goods games emerged as the workhorse for the experimental investigation of leaders' influence team cooperation.[3] In these experiments, the leader usually contributes first. Since other teammates, also denoted as followers, are informed about the leader's contribution before contributing themselves simultaneously, the leader has the possibility to set an example.

In a public bad experiment, Moxnes and van der Heijden (2003) show that the presence of a leader significantly improves the group outcome. Leaders, however, earn less than followers do. In a public goods game, Güth et al. (2007) observe higher overall contributions, if a leader is present, compared to a no-leader setting. Levati et al. (2007) also find a positive effect of a leader's existence on contributions, especially for the case of heterogeneous endowments.

There are also studies reporting no significant leader effect compared to a setting without a leader (Gächter and Renner 2003, Sturm and Weimann 2007, Haigner and Wakolbinger 2010, Sahin et al. 2015). Hence, leaders' influence on overall cooperation is not fully clear from the existing literature. In general, there is a strong correlation between leaders' and the followers' efforts (see e.g., Gächter and Renner 2003). The followers, however, persistently undercut the leader's contribution, which leads to a decay of cooperation over time, similar to what one observes in simultaneous contribution experiments without a leader.

2.2.2. Centralized Execution of Reward and Punishment versus Peer Execution in simultaneous settings

Ample evidence from public goods experiments shows that *decentralized* (peer) rewarding or punishment can foster cooperation (Balliet et al. 2011, Milinski and Rockenbach 2012). The absence of a coordination device, however, often hinders the efficient use of these incentives. A small number of studies investigated *centralized* use of reward and punishment when team members contribute *simultaneously*. O'Gorman et al. (2009) find that centralized execution of

[3] While leadership is also found to be beneficial in coordination experiments (see e.g., Cartwright et al. 2013, Brandts et al. 2014), in this paper, we focus on cooperation in public goods settings.

punishment does not increase cooperation more than peer punishment. Nosenzo and Sefton (2014) report a similar result in case of both rewards and punishment.

In contrast to the simultaneous contribution setting, a central authority (leader) in a *sequential* setting is possibly more effective in increasing contributions, since she can set a clear example. If reluctant teammates do not follow, she can use rewards and punishments to motivate them.

2.2.3. Leadership Experiments in the Presence of Incentives

Only a few studies investigated a voluntary contribution setting with a punishment or reward power of the leader. In Güth et al. (2007), the team leader can punish just one team member, by temporarily excluding her from the team and from the team output. When leaders have such exclusion power, contributions increase. Sutter and Rivas (2014) report a treatment in which the leader can reward just one single follower. In this setting, contributions are higher, compared to a control treatment without leader. In Gürerk et al. (2009), in a simultaneous public goods setting, leaders can choose between a positive and a negative incentive scheme. The chosen scheme is used for 10 consecutive periods. While initially 19 out of 20 leaders prefer the reward scheme, many of them switch to the punishment scheme after observing decreasing contributions in their group. In the final and third phase, the majority of leaders choose the punishment scheme, which generates higher cooperation levels than the reward scheme.

Our study is different from the above mentioned in some important ways: In the present study, unlike in Güth et al. (2007), leaders cannot exclude players from the group but can reward (or punish) teammates by increasing (or reducing) their payoffs. Different from Sutter and Rivas (2014), where leaders may only sanction one group member, we give the leaders the possibility to reward or punish each teammate individually. Finally, in contrast to Gürerk et al. (2009), in our setting, leaders contribute first, so that group members are aware of the leader's contribution before contributing themselves.

3. Experimental Design

3.1. Treatments

We explain our experimental design with respect to treatments in three steps. By comparing different treatments in each step, we gain more insight into our research questions.

(1) First, to investigate the leader's influence in the *absence* of any incentives, we conduct two treatments: the leader treatment L, in which the leader contributes first, and the peer treatment P without a leader, but with simultaneous contributions of the peers.

(2) Then, to investigate the leader's influence in the *presence* of individual reward and punishment possibilities, we conduct four more treatments: the treatment L-REW with reward possibilities for the leader, and the treatment L-PUN with punishment possibilities for the leader. We compare these treatments to the peer treatments P-REW and P-PUN, in which peers have the possibility to reward or punish each other, respectively.

(3) Finally, to disentangle the effect of rewards and punishments on cooperation from the leader's influence, we compare the L treatment with L-PUN, and with L-REW, respectively.

3.2. The Game

In the treatments L and P without any incentives, we deploy a one-stage public goods game with voluntary contribution mechanism. In the other four treatments with incentives, in addition to the public goods stage, we have an additional stage with the possibility to allocate rewards and punishments. The game is played for 20 periods, in groups of four, with identical group composition over the rounds.

Public Goods Stage: In each period, each player receives an endowment of $e = 20$ and decides on her contribution $0 \leq c_i \leq e$ to the public good. The sum of contributions $C = \sum_{i=1}^{4} c_i$ is multiplied by 1.6 and equally split among all group members ($MPCR = 0.4$). After each period, each player is informed about individual contributions and payoffs. In the leader treatments, in each group, one player is randomly chosen to serve as the leader for all periods. Leaders contribute first, the followers after receiving feedback about the leader's contribution.

Reward and Punishment Stage: In the leader treatments L-REW and L-PUN, the leader is equipped with additional 20 points that she can either keep for the private account or use for individual rewards or punishments. In the peer treatments P-REW and P-PUN, each subject is given 5 additional points which she can either keep in the private account or use to reward (or to punish) other teammates individually. In all treatments with incentives, every allocated reward point increases the receiver's payoff by 3 points, and every punishment point decreases the receiver's payoff by 3 points. In all treatments, players keep the "unused" points in their private accounts.

Payoffs: The payoff π_i for player *i* for each treatment is given below. The sum of reward or punishment points that a player *i* allocates to others is given by r_i and p_i, with r_{-i} and p_{-i} being the sum of the points that player *i* receives from other players.

(1) L and P: $\pi_i = 20 - c_i + 0.4C$

(2) L-REW: $\pi_i^{Leader} = 20 - c_i + 0.4C + 20 - r_i,\ \pi_i^{Follower} = 20 - c_i + 0.4C + 3\,r_{-i}$

(3) L-PUN: $\pi_i^{Leader} = 20 - c_i + 0.4C + 20 - p_i,\ \pi_i^{Follower} = 20 - c_i + 0.4C - 3\,p_{-i}$

(4) P-REW: $\pi_i = 20 - c_i + 0.4C + 5 - r_i + 3r_{-i}$

(5) P-PUN: $\pi_i = 20 - c_i + 0.4C + 5 - p_i - 3p_{-i}$

3.3. Game-theoretical and Behavioral Predictions

Assuming money-maximizing actors with self-centered preferences, and applying backward-induction, it is straightforward to see that no leader or follower should engage in costly punishment or reward. Following the same rationale, it is also obvious that no player contributes to the public good. In contrast, models assuming social preferences (e.g., Bolton and Ockenfels, 2000; Fehr and Schmidt, 1999) show that players may contribute to public goods and forego parts of their earnings to punish uncooperative players. Evidence from the aforementioned experimental literature support the predictions of these social preferences models.

Let us now look at the reward and punishment behavior in detail. Should we expect differences in the use of rewards and punishments between peers and a leader?

Are groups with leaders more efficient?

A first difference in behaviors may stem from the fact that peers have to coordinate on who should reward or punish, and on the level of rewards and punishment. Note that, in the peer treatments, the execution of reward or punishment creates a second level public good, with incentives to withhold from rewarding or punishing. These free-riding incentives may lead to an under- or oversupply with the rewards and punishments. In case of punishment, for example, the lack of coordination result in that a non-cooperative player might even go unpunished. Both, under and oversupply with punishment may lead to efficiency losses of the punishment mechanism. In case of rewards, the under-supply of rewards is an issue.

Since the leader can decide in own discretion about the level of rewards and punishments, compared to peers treatments, leaders should possibly be less prone to the problems mentioned above. In addition to that, in the punishment treatment with peers, possible anti-social punishment may further reduce the efficiency of the team output.[4] Assuming that a leader, who is in a first-mover position, is less prone to anti-social punishment and will therefore be able to

[4] In public goods experiments with peer punishment, a non-negligible fraction of peers punish those who contributed more than themselves (see e.g., Nikiforakis 2008).

use punishment more effectively, there should be less anti-social punishment in the leader treatment with punishments L-PUN, compared to P-PUN.

Do leaders induce stronger reactions to rewards and punishment?

Another possible advantage of having a leader may result from a higher acceptance for rewards and punishment decisions made by a leader who exposed herself to the risk of being exploited by contributing first. The higher acceptance in turn may lead to stronger contribution adaptions after a teammate was punished or rewarded by the leader. Thus, for given amount of rewards and punishment points a teammate receives, we expect bigger changes in the contribution level of that teammate in the leader treatments, compared to the peer treatments.

Do teammates follow the leader more closely in the presence of the incentives?

Finally, we expect a positive reinforcement between the impact of the leaders' contribution and her power to reward and punishment. Assuming that leaders tend to punish those followers who contributed less than the leader herself and reward those who contributed more, followers should mimic the leader's contribution more closely than they would do in the absence of punishment and reward instruments.

3.3. Procedures

We programmed the experiment with z-Tree (Fischbacher 2007) and conducted it at the RWTH Aachen University using ORSEE (Greiner 2015) for subject recruitment. In our six treatments, 288 subjects participated in 72 independent observations (12 per treatment). After the experimenter read the instructions (see Appendix) aloud, subjects could privately ask clarifying questions. Sessions lasted about 60 minutes. When a session was finished, each subject was paid privately. Average payoff was €12.70.

4. Results

We first focus on the average team output as our main variable of interest. After that, we analyze individual contribution behavior. We then investigate the use of rewards and punishments, by the leaders and by the peers, and teammates' reactions in terms of contributions. Finally, we analyze the payoffs of the teams with and without a leader.

4.1.Effect of Leadership on Cooperation in the Absence of Reward and Punishment Possibilities

Table 1 shows the average contributions, payoffs, and the average rewards and punishments for all treatments. What is the effect of leadership on cooperation in the absence of any punishment

and reward possibilities? As can be seen, over all periods, the leader treatment L induces lower cooperation than the peer treatment P, however the difference is not statistically significant (Mann-Whitney-U test, two-sided, $p = 0.564$[5]).[6]

Result 1. In the absence of any punishment or rewarding possibilities, teams with leaders do not achieve higher levels of cooperation than teams with peers.

As also can be seen from Table 1, the followers in the L treatment contribute significantly less than the leaders do ($p = 0.021$). This result is in line with previous studies. We do not find a difference in contributions between the followers of the leader treatment L and the teammates' contributions in the peers treatment P ($p = 0.453$).

4.2.Effect of Leadership on Cooperation in the Presence of Reward & Punishment Possibilities

To investigate the leaders' influence on cooperation in the presence of the individual reward and punishment possibilities, we compare the average contributions of the L-REW treatment to P-REW, and the contributions in L-PUN treatment to P-PUN, respectively. Over all 20 periods, we observe no significant differences between the treatments L-REW and P-REW ($p = 0.237$), and between L-PUN and P-PUN ($p = 0.106$). In fact, the average contributions even tend to be higher in the peer treatments (see Table 1).

Result 2. In the presence of reward and punishment possibilities, cooperation in the leader treatments is not higher than the average cooperation level in the corresponding peer treatments.

[5] Unless otherwise stated, in the results section, we utilize the Mann-Whitney-U test for between treatment comparisons, and the Wilcoxon-matched-pairs test for within treatment comparisons. We always report p-values of the two-sided tests.

[6] This result may considered as somewhat surprising since some of the prominent previous studies (mentioned in Section 2.2.1.) report that groups with leaders tend to have higher or at least similar cooperation levels as treatments without leader. Therefore, we look a bit closer at the single observations of the leader treatment L. We indeed find a very unusual contribution pattern in one of the groups (group identification number 1201). In that group, the leader does not contribute a single point to the public good, in any period. The followers imitate the leader very strictly, so this group ends with an overall average contribution of 0.24. If we exclude this group, the average contribution of the remaining 11 groups in the L treatment amounts to 10.6 points, still being lower than the average contribution in the P treatment (p = 0.394).

Table 1: Treatment averages over all periods. Standard deviations in parentheses.

			Contributions			
Treatment	**L**	**P**	**L-REW**	**P-REW**	**L-PUN**	**P-PUN**
All	9.8 (8.7)	11.3 (8.0)	14.5 (7.8)	15.9 (7.4)	13.8 (8.2)	16.9 (5.5)
Leader	11.2 (8.4)	-	13.1 (7.7)	-	14.6 (8.0)	-
Follower	9.3 (8.7)	-	15.0 (7.7)	-	13.5 (8.2)	-

			Payoffs from the public goods stage excluding rewards and punishment			
Treatment	**L**	**P**	**L-REW**	**P-REW**	**L-PUN**	**P-PUN**
All	25.9 (6.3)	26.8 (6.0)	28.7 (6.2)	29.5 (5.8)	28.3 (5.8)	30.1 (3.9)
Leader	24.4 (5.8)	-	30.1 (6.8)	-	27.5 (6.6)	-
Follower	26.3 (6.3)	-	28.2 (5.9)	-	28.5 (5.5)	-

			Net Payoffs including rewards and punishments			
Treatment	**L**	**P**	**L-REW**	**P-REW**	**L-PUN**	**P-PUN**
All	25.9 (6.3)	26.8 (6.0)	38.8 (7.7)	40.4 (7.5)	31.6 (11.0)	32.6 (6.3)
Leader	24.4 (5.8)	-	40.0 (4.8)	-	45.8 (8.5)	-
Follower	26.3 (6.3)	-	38.4 (8.4)	-	26.9 (7.0)	-

			Average allocated rewards and punishments (average of the team's total)			
Treatment	**L**	**P**	**L-REW**	**P-REW**	**L-PUN**	**P-PUN**
All	-	-	-	11.7 (6.1)	-	2.5 (4.0)
Leader	-	-	10.2 (6.0)	-	1.6 (4.0)	-

4.3.Decomposing the Leader Influence from the Effect Rewards and Punishment

To see, whether there is a leader effect on cooperation that interacts with rewards and punishment, we compare the treatment L to L-PUN, and to L-REW, respectively. In L-REW, the cooperation level is significantly higher than in L ($p = 0.018$). Average contributions in L-PUN are also considerably higher than the contributions in L ($p = 0.106$), although the difference is marginally not significant. Hence, in conjunction with the Result 2, we conclude that incentives as such seem to be the key for higher cooperation levels, and not the leader's influence.

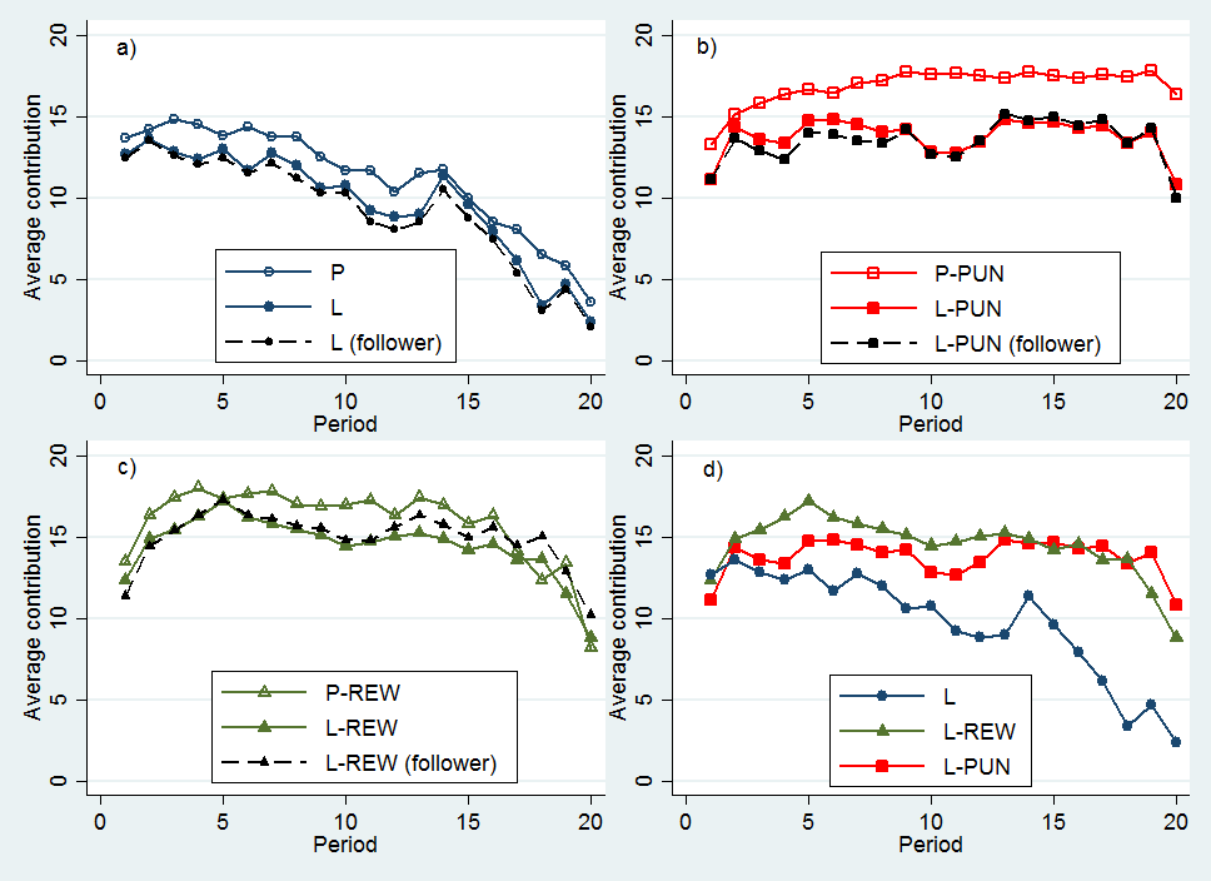
Result 3. Leaders have no additional effect in increasing cooperation level.

The effect of incentives remain stable. If we look at the second half of the experiment (period 11-20), for reward settings, the cooperation level in the peer treatment in the second half is significantly higher than in the leader treatment (L-REW: 13.6 and L: 7.3, $p = 0.009$), and for punishment settings, it is weakly significantly higher (L-PUN: 13.8 and L: 7.3, $p = 0.061$).

4.4.Evolution of Contributions

Panel a) of Figure 1 shows the evolution of contributions in treatments L and P. Note, for the leader treatment L, we plot the overall team average, and additionally, the contribution average for the followers. Over time, cooperation both in L and P treatments shows a decreasing trend. Compared to the first half of the experiment (periods 1-10), average contributions both in L and P are significantly lower in the second half (average of the periods 1-10 in L: 12.2 points, in periods 11-20: 7.3 points, $p = 0.007$), (P treatment: 13.7, and 8.8, $p = 0.006$).

Figure 1: Average contributions.



Both in L-REW and P-REW treatments, contributions in the second half are significantly lower than in the first half (L-REW: 15.3 points and 13.6, $p = 0.023$, P-REW: 16.9 and 14.8, $p = 0.034$). Interestingly, this decreasing trend is absent in both punishment treatments. While we observe a non-decreasing trend in the L-PUN treatment, we even see a clearly increasing trend in the P-PUN treatment: We find no difference in average contributions in L-PUN (13.8 in

periods 1-10 and 13.8 in periods 11-20, $p = 0.969$), whereas contributions are significantly higher in the second half in P-PUN (16.3 and 17.5, $p = 0.050$).

4.5.Individual Contribution Behavior (Does Leading by Example Work?)

To analyze teammates' individual contribution behaviors, we ran a series of panel regressions presented in Table 2. In column (I), we compare the treatments with and without leading by example (L and P). In column (II) and (III), we present the same comparison with rewards and punishment, respectively. Column (IV) aims at disentangling the effects of leaders' contributions and their sanction behavior.

Table 2: Determinants of contributions (all periods).

Dependent variable: Teammate's contribution	(I) L & P	(II) L-REW & P-REW	(III) L-PUN & P-PUN	(IV) L-REW, L-PUN & L
(1) Leader	−0.952 (0.608)	1.423 (2.639)	−0.904 (2.316)	
(2) Leader contribution	0.441*** (0.034)	0.142** (0.058)	0.212*** (0.082)	0.404*** (0.036)
(3) Other followers' (peers') average contribution in t-1	0.818*** (0.032)	0.645*** (0.090)	0.680*** (0.078)	0.430*** (0.045)
(4) Leader x Other followers' (peers') average contribution in t-1	−0.447*** (0.067)	−0.225* (0.121)	−0.255** (0.105)	
(5) Reward dummy				6.208*** (1.777)
(6) Reward x Leader contribution				−0.255*** (0.082)
(7) Punishment dummy				3.724** (1.752)
(8) Punishment x Leader contribution				−0.164* (0.085)
Constant	1.585*** (0.376)	5.501*** (1.584)	5.578*** (1.613)	0.472 (0.481)
Observations	1596	1596	1596	2052
R^2 overall	0.549	0.341	0.650	0.580

* Significant at 10%, ** at 5%, *** at 1%. Panel regression with cluster robust standard errors in parentheses (clustered on group level).

The independent variable "leader" (1) indicates whether the group has a leader or not. Interestingly, the mere existence of a leader has no effect on teammates' contributions, in any of the comparisons. In all leader treatments, the leader's contribution (2) has a significant influence on followers' contributions, but to a smaller extent than the influence of other

followers' contributions (3) which is also significant. The interaction between these two influencing factors (2) and (3) shows that the existence of a leader significantly reduces the impact from teammates' average contribution (4).

A closer look at the interaction of leaders' contributions and the availability of rewards (6) and punishments (8) reveals that the mere possibility to punish or to reward reduces the impact of leaders' contributions. It seems that leading by example becomes less important as soon as the leader is equipped with additional means to influence followers' contribution behavior. The following correlations also support this claim. While leaders' and followers' contributions are highly correlated (average of rho = 0.746) in the L treatment, the leaders impact is much smaller in L-PUN (average rho 0.504) and even smaller in L-REW (0.205). The average correlation coefficients (ρ) obtained in the L treatment are significantly higher than the coefficients in the L-PUN and L-REW (L and L-PUN: $p = 0.003$, L and L-REW: $p = 0.002$).

4.6. Use of Rewards and Punishments

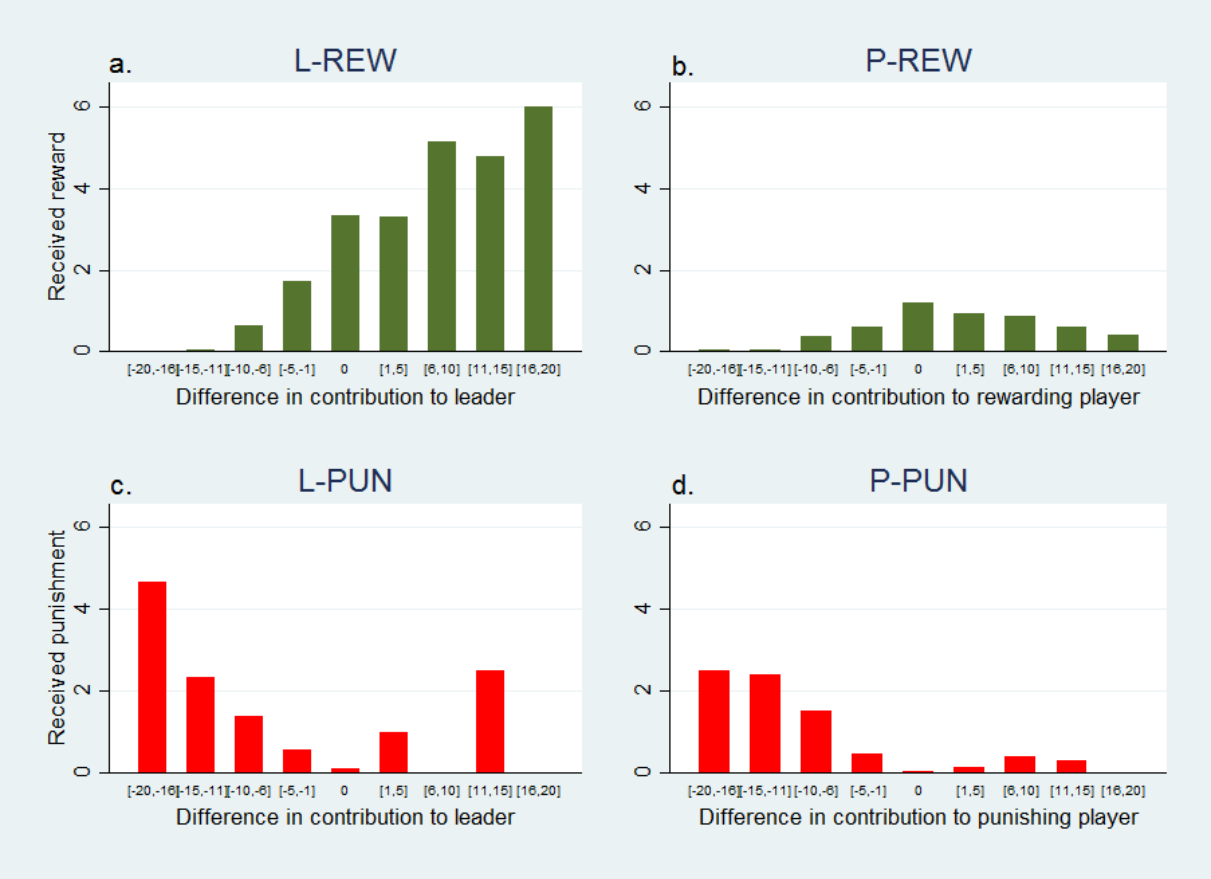
As can be seen in Table 1, leaders as well as peers clearly allocate more reward points than punishment ($p < 0.001$ in both cases). On average, leaders do not invest more in incentives (points) than peers do, neither in rewards ($p = 0.544$), nor in punishments ($p = 0.299$).[7] Figure 2 shows the average points a teammate receives, dependent on the contribution difference between her and the rewarding/punishing leader, or in the peers treatments, the difference between her and the rewarding/punishing team member, respectively (averages include zeros if no reward or punishment point was assigned).[8]

Let us first look at the rewarding behavior. In both the L-REW and the P-REW treatments, teammates who contributed a higher amount than the rewarding leader/teammate receive on average higher rewards. In L-REW, leaders allocate the highest average rewards to those teammates who contributed much more than the leaders themselves. Interestingly, all leaders rewarded (at least one time) followers who contributed exactly the same amount or even less. In the P-REW treatment, on average teammates allocate the most reward points to peers who contributed the same amount as they themselves.

[7] If we only consider cases with positive reward and punishments, still there are no differences between L-REW and P-REW (11.9 and 12.2, $p = 0.71$), nor between L-PUN and P-PUN (5.9 and 5.6, $p = 0.85$).

[8] Recall that in the leader treatments, the leader may assign a maximum of 20 points, in a discretionary way, to one single teammate or to several teammates. In the peer treatments, each teammate may allocate up to 5 points. For this reason, the bars in panel a) are considerably higher than the bars in panel b). Note that we deliberately hold constant the total amount of rewards/punishments points across leader and peer treatments.

Figure 2: Average reward or punishment.



Now, turn to punishment. In both PUN treatments, on average, teammates punish those players more heavily who contributed less than they contributed themselves, compared to teammates who contributed equal or more. Teammates punish others more harshly, the greater the contribution differential between the punisher and the teammate is. Nevertheless, we observe also subjects who punish teammates who contributed more than they themselves did. Interestingly, this "anti-social" punishment is significantly less frequent in L-PUN than in P-PUN (3.3% and 13.3% of all punishments, $p = 0.046$). This observation serves as an example, why it may be advantageous to have a team leader.

Result 4. Leaders exert anti-social punishment less-frequently than peers.

4.7.Do Leaders Use Incentives Differently than Peers (Individual Behavior)?

To investigate how reward and punishment behavior is used on individual level, and whether there are differences in behavior between leaders and peers, we run a series of hurdle

regressions. In the Probit columns (I)-(IV) depicted in Table 3, we estimate how the probability to get a reward or punishment depends on a teammate's contribution. The Tobit columns (V)-(VIII) provide information on the magnitude of the received points by the teammate, given she received a positive amount of reward or punishment.

Let us look first at the probit columns (I) and (III) to see which variables increase the chance to get punished. In L-PUN, a higher contribution decreases the chance to be punished (1), but in P-PUN, the effect is rather small and not significant at all. In both punishment treatments, both the relative contribution compared to others (3), and that to the punishing teammate (2) increase the chances for getting a punishment significantly. Interestingly, when deciding to punish a subordinate, leaders seem to evaluate the contribution of a teammate relative to the other two followers than to their own contribution, as the respective coefficient (3) is considerably higher than (2). The Tobit columns (V) and (VII) show, in both punishment treatments, the magnitude of punishment decreases with the contribution level (1), but only significantly so in the P-PUN treatment. In both PUN treatments, teammates get less punishment, the more they contributed compared to the other two teammates (5), but the effect is not significant.

Now let us turn to rewards. As the columns (II) and (IV) show, in both reward treatments, the own contribution level increases the probability to be rewarded (1). In L-REW, contributing more than the leader (2) increases the chances for a reward significantly, but not the relative contribution compared to other teammates. Interestingly, in P-REW, contributing more than others is decreasing the chances to get a reward. As the Tobit columns (VI) and (VIII) show, in both treatments, if rewarded, the magnitude of reward increases with the own contribution (1). In L-REW, the reward increases with the contribution difference between the reward-receiving teammate and the leader (4). In the P-REW, the reward increases with the contribution difference between the rewarded and the other two teammates (5).

Table 3: Determinants of punishment and reward decisions (all periods).

Dependent variable: punishment (reward) subject *i* receives	Probit				Tobit			
	(I) L-PUN	(II) L-REW	(III) P-PUN	(IV) P-REW	(V) L-PUN	(VI) L-REW	(VII) P-PUN	(VIII) P-REW
(1) *i*'s contribution	−0.030*	0.151***	−0.020	0.136***	−0.153	0.287***	−0.155*	0.159***
	(0.018)	(0.017)	(0.037)	(0.019)	(0.113)	(0.036)	(0.086)	(0.027)
(2) *i* contributes less (REW: more) than the punishing (rewarding) subject (0/1, binary)	0.803**	0.598***	0.846***	-1.093***				
	(0.338)	(0.225)	(0.231)	(0.205)				
(3) *i*'s contribution is lower (REW: higher) than the average contribution of the other two subjects in the group (0/1)	1.713***	−0.250	0.594***	−0.002				
	(0.292)	(0.340)	(0.203)	(0.153)				
(4) Difference between *i*'s and the punishing (rewarding) subject´s contribution					−0.130	0.104***	0.014	−0.103***
					(0.167)	(0.025)	(0.085)	(0.012)
(5) Difference between *i*'s and the average contribution of the other two subjects in the group					−0.690***	0.026	−0.257***	0.076***
					(0.213)	(0.049)	(0.077)	(0.016)
Constant	−1.980***	−1.457***	−1.372*	−1.591***	−5.033*	−1.723***	−1.196	−1.992***
	(0.371)	(0.166)	(0.704)	(0.264)	(2.853)	(0.520)	(1.859)	(0.495)
Observations	720	720	2880	2880	720	720	2880	2880
Pseudo R^2	0.513	0.518	0.242	0.368	0.222	0.242	0.152	0.192

* Significant at 10%, ** at 5%, *** at 1%. Since in P-treatments, each subject can reward/punish the peers, we have four times more observations than in the L-treatment. Cluster robust standard errors in parentheses (clustered on group level).

4.8.Teammates' Reaction to Rewards and Punishments (in the next round)

To what extent do teammates change their contribution in period *t* after being rewarded or punished in period *t*-1 (given they received positive rewards or punishments)? To answer this question, we run regressions as depicted in Table 4, with the contribution differential (contribution in *t* – contribution in *t* – 1) being the dependent variable. We ran separate regressions for each treatment. As the columns (I) and (II) show, perhaps unsurprisingly, receiving a reward does not significantly change a teammate's contribution, neither in L-REW, nor in P-REW. On the other hand, as the columns (III) and (IV) show, punishments have a positive and significant effect on the next contribution of the punished teammate. In the leader treatment L-PUN, the effect is considerable and significant, and it is much larger than in P-PUN where the effect of punishment is rather small and only weakly significant.

Table 4: Contribution change after receiving reward or punishment.

Dependent variable: Contribution change in t	(I) L-REW	(II) P-REW	(III) L-PUN	(IV) P-PUN
Received reward in t-1	0.293 (0.271)	0.074 (0.181)		
Received punishment in t-1			0.726** (0.359)	0.176* (0.101)
Contribution in t-1	−0.426*** (0.126)	−0.389** (0.176)	−0.488** (0.193)	−0.168** (0.073)
Period	−0.129*** (0.048)	−0.255*** (0.046)	0.199* (0.106)	−0.046 (0.048)
Constant	6.064** (2.355)	8.333*** (3.021)	2.973 (3.896)	3.972*** (1.325)
Observations	515	764	90	204
R^2 overall	0.051	0.104	0.226	0.109

* Significant at 10%, ** at 5%, *** at 1%. OLS with cluster robust standard errors in parentheses (clustered on group level).

We also observe that in both reward treatments, there is a significant negative trend of the contribution change over the periods, as the respective coefficients indicate. Such a negative trend is absent in the punishment treatments. In the L-PUN treatment, we even observe a positive trend, which is weakly significant.[9] Summing up, if used at all, punishment seems the more effective instrument in increasing the next round contribution than reward.

[9] The contribution in period t-1 has a significant negative effect on the contribution differential. This observation can be explained partly by a ceiling effect: the greater the absolute contribution in the previous round, the small room there is for a positive contribution differential. For small values of previous contributions, however, a subject could increase her contribution a lot, which – taken with the aforementioned ceiling effect may constitute a negative relationship that we observe.

4.9.Payoffs

We focus on net payoffs, i.e., payoffs including (after) rewards and punishments.[10] Not surprisingly, due to efficiency increasing reward mechanism (recall each allocated reward point generates two more points), net payoffs in L-REW and P-REW are higher than in L-PUN and P-PUN, respectively ($p = 0.002$, $p = 0.005$). We do not observe significant differences, neither between L-REW and P-REW ($p = 0.453$), nor between L-PUN and P-PUN ($p = 0.564$).

Leaders in L-REW use about half of their 20 additional points to increase the payoffs of the followers. This leads to a rather similar net payoffs for the leaders (40.0 points) and the followers (38.4, $p = 0.908$). In L-PUN, by allocating points, leaders cannot increase followers' payoffs. They rather can decrease the payoffs of their subordinates. Indeed, leaders in L-PUN receive much higher payoffs than followers do (45.8 and 26.9, $p < 0.001$).

Which mechanism pays off more for leaders, and for followers? As the numbers above indicate, leaders with punishment possibilities obtain significantly higher payoffs than leaders with rewards ($p = 0.028$), since leaders in the reward treatments invest a higher portion of their budget for rewards. Due to efficiency enhancing reward mechanism, it is not surprising that followers in the reward treatment L-REW have much higher incomes than the followers in the L-PUN treatment do ($p < 0.001$). In other words, as a leader it pays off to be in the punishment setting. For a follower, the rewards setting is more advantageous.

5. Conclusion

In this study, we systematically investigate the interaction of leading by example and individual incentives in work teams. Conducting six treatments, we are able to disentangle the effects of individual rewards and punishment on team cooperation from the pure influence of a leader.

In the absence of any incentives, groups with a leader do not have higher cooperation levels than groups without any leader. If reward and punishment possibilities are present, groups with leaders do not reach higher cooperation levels than groups without a leader. The comparison of the leader treatment L without any instruments to L-REW and L-PUN reveals that in our setting leadership does not reinforce the effect of rewards and punishments.

Previous experimental findings are inconclusive about the leaders' influence in increasing contributions in sequential public good settings. Our findings from three different leader

[10] For the interested reader, in Table 1, we also depict payoffs from the public goods stage, which are directly proportional to the contributions.

treatments underline, that one indeed should be cautious about the effectiveness of leading by example in increasing cooperation. It seems, to effectively increase team cooperation, leaders should possess some additional power. The possibility to exert individual incentives may be one such source of power. Perhaps, some kind of legitimation that is accepted by the teammates could be another source.

When using incentives, the leaders seem to have different reference contributions for evaluation in case of rewards and punishments. While in case of punishment, the relative contribution of the teammate to other followers is decisive, when giving rewards, leaders evaluate a teammate's contribution to own (the leader's) contribution. In other words, in the L-PUN treatment, a teammate who contributed less than the other followers is more likely to be punished. In the L-REW treatment, a teammate who contributes more than the leader is more likely to get a reward.

Comparing positive and negative incentives, rewards do not seem to motivate teammates as much as punishments do. While in treatments with punishment possibilities, contributions remain stable in the second half of the experiment compared to the first half, in treatments with rewards, cooperation declines significantly. The relative ineffectiveness of rewards compared to punishments is in line with findings of other studies (see e.g., Gürerk et al. 2014, Sutter et al. 2010).

Our results imply that in small teams with clear mutual monitoring possibilities, a leader may not be necessary. Social forces among the peers, in particular their willingness to invest in bilateral rewards and punishments may suffice for maintaining cooperation.

References

Balliet, D., Mulder, L. B., & Van Lange, P. A. (2011). Reward, punishment, and cooperation: a meta-analysis. *Psychological bulletin*, *137*(4), 594.

Brandts, J., Cooper, D. J., & Weber, R. A. (2014). Legitimacy, communication, and leadership in the turnaround game. *Management Science*, *61*(11), 2627-2645.

Bolton, G., & Ockenfels, A. (2000). ERC: A Theory of Equity, Reciprocity, and Competition. *American Economic Review*, 90(1), 166-193.

Cartwright, E., Gillet, J., & Van Vugt, M. (2013). Leadership by Example in the Weak-Link Game. *Economic Inquiry*, *51*(4), 2028-2043.

Fehr, E., & Gächter, S. (2000). Cooperation and Punishment in Public Goods Experiments. *American Economic Review*, 90(4), 980-994.

Fehr E., & Schmidt K. M. (1999). A Theory Of Fairness, Competition, and Cooperation. *Quarterly Journal of Economics*, 114 (3), 817-868.

Fischbacher, U., Gächter, S., & Fehr, E. (2001). Are people conditionally cooperative? Evidence from a public goods experiment. Economics Letters, 71(3), 397–404.

Fischbacher, U. (2007). z-Tree: Zurich toolbox for ready-made economic experiments. *Experimental Economics*, 10, 171-178.

Fischbacher, U., & Gächter, S. (2010). Social preferences, beliefs, and the dynamics of free riding in public goods experiments. *American Economic Review*, 16, 541-556.

Foss, N. J. (2001). Leadership, beliefs and coordination: An explorative discussion. *Industrial and corporate change*, 10(2), 357-388.

Gächter, S., & Renner, E. (2003). *Leading by example in the presence of free rider incentives. University of St*. Gallen. Mimeo.

Greiner, B. (2015). Subject pool recruitment procedures: organizing experiments with ORSEE. *Journal of the Economic Science Association*, 1, 114–125.

Gürerk, Ö., Irlenbusch, B., & Rockenbach, B. (2009). Motivating Teammates: The Leader's Choice of Positive and Negative Incentives. *Journal of Economic Psychology*, 30, 591-607.

Gürerk, Ö., Irlenbusch, B., & Rockenbach, B. (2014). On cooperation in open communities. *Journal of Public Economics*, 120, 220–230.

Güth, W., Levati, M. V., Sutter, M., & Van Der Heijden, E. (2007). Leading by example with and without exclusion power in voluntary contribution experiments. *Journal of Public Economics*, *91*, 1023-1042.

Haigner, S. D., & Wakolbinger, F. (2010). To lead or not to lead: Endogenous sequencing in public goods games. Economics Letters, 108, 93-95.

Hermalin, B. E. (1998). Toward an economic theory of leadership: Leading by example. *American Economic Review*, 1188-1206.

Huck, S., & Rey-Biel, P. (2006). Endogenous leadership in teams. *Journal of Institutional and Theoretical Economics JITE*, *162*(2), 253-261.

Lazear, E. (1998). Personnel economics for managers. New York: Wiley.

Levati, M. V., Sutter, M., & Van der Heijden, E. (2007). Leading by example in a public goods experiment with heterogeneity and incomplete information. *Journal of Conflict Resolution*, *51*(5), 793-818.

Milinski, M., & Rockenbach, B. (2012). On the interaction of the stick and the carrot in social dilemmas. *Journal of Theoretical Biology*, *299*, 139-143.

Moxnes, E., & Van der Heijden, E. (2003). The effect of leadership in a public bad experiment. *Journal of Conflict Resolution*, *47*(6), 773-795.

Nikiforakis, N. (2008). Punishment and Counter-Punishment in Public Good Games: Can We Really Govern Ourselves? *Journal of Public Economics*, 92(1), 91-112.

Nosenzo, D., & Sefton, M. (2014). Promoting Cooperation: The Distribution of Reward and Punishment Power, in: P.A.M. van Lange, B. Rockenbach, & T. Yamagishi (Eds), Social dilemmas: New perspectives on reward and punishment. New York. *Oxford University Press*.

O'Gorman, R., Henrich, J., & Van Vugt, M. (2009). Constraining free riding in public goods games: designated solitary punishers can sustain human cooperation. *Proceedings of the Royal Society B: Biological Sciences*, 276, 323-329.

Sahin, S. G., Eckel, C., & Komai, M. (2015). An experimental study of leadership institutions in collective action games. *Journal of the Economic Science Association*, 1(1), 100-113.

Sturm, B., & Weimann, J. (2007). Unilateral emissions abatement. *Environmental economics, experimental methods*, *10*, 157.

Sutter, M., Haigner, S., & Kocher, M. G. (2010). Choosing the Carrot or the Stick? Endogenous Institutional Choice in Social Dilemma Situations. *The Review of Economic Studies*, 77(4), 1540–1566.

Sutter, M., & Rivas, M. F., 2014. Leadership, Reward and Punishment in Sequential Public Goods Experiments, in Reward and Punishment in Social Dilemmas, edited by P. A. M. van Lange, B. Rockenbach, T. Yamagishi. Oxford University Press.

Vesterlund, L. (2003). The informational value of sequential fundraising. *Journal of Public Economics*, *87*(3), 627-657.

Yukl, G. A. (2013). Leadership in Organizations, Eighth Edition. *Pearson Education*.

A.1 Instructions (L-PUN)

General information

We welcome you to this economics experiment. It is very important for you to read the following instructions carefully. If you have any questions please direct them to us.

In this experiment you can earn money. The exact amount of your payout depends on your decisions and on the other participants' decisions.

While the experiment is running, it is not allowed to communicate with other participants. Non-compliance leads to the exclusion from the experiment and from all payments. All decisions are anonymous, i.e. no other participant gets to know the identity of the participant who makes a specific decision. Anonymity is also ensured during the payout process, i.e. no participant gets to know the amount of other participants' payouts.

During the experiment your income will be calculated in points. The earned amount of points will be converted to Euro with the following exchange rate:

80 points = 1 Euro.

At the end of this experiment you will receive your payout according to the total number of accumulated points as well as 2.50 Euro for showing up.

In the following we will provide you with a detailed description of the experiment.

Rounds and group

- The experiment consists of 20 rounds with each round having the same structure.
- You are a member of a group with 4 members in total. During the experiment the group composition will always stay the same.
    - One group member will randomly be assigned the role of a type A participant, the remaining three members will be type B participants.
    - During the experiment you will maintain your role and only interact with members of your group.
    - Each participant receives a starting capital of 100 points.

Course of the experiment

Each round consists of two stages:

Stage 1: Contributions of the group members

- In every round, each group member receives 20 points.
- Each group member has to decide how many of the 20 points he or she wants to contribute for the group. Points which are not contributed remain with the group member. Possible amounts to contribute are integral numbers from 0 to 20. First, the type A member decides how much to contribute for the group.

- After being informed about the contribution of the type A member, type B members decide on their own contribution.
- The sum of the contributions of all group members (type A and type B) gets multiplied with 1.6 and forms the group result.

  (sum of contributions x 1.6 = group result)
- Each group member (type A and type B) receives a quarter of the group result independently from their own contribution (group result / 4 = individual share of the group result).

Stage 2

- The type A member gets to see how much each group member has contributed.
- The type A member now receives 20 additional points and has to decide if and how many of these 20 points he or she wants to assign to each type B member.
- With each point which the type A member assigns to a type B member, the income of the type B member gets reduced by 3 points.
- Points which are not assigned are kept by the type A member.

Please notice: The order in which type B members are displayed will be determined randomly for each round. Therefore, it is not possible to identify a type B member over the rounds by the position on the displayed lists.

<u>Calculation of you round income</u>

Round income for type A members =

20 (endowment for the round)

- your contribution

+ 1.6 x sum of the contributions of all group members / 4

+ 20 (points which can be assigned to type B members)

- sum of points which are actually assigned to type B members

Round income for type B members =

20 (endowment for the round)

- your contribution

+ 1.6 x sum of the contributions of all group members / 4

- 3 x number of received points

Information at the end of each round

At the end of each round you will be provided with an overview of the group results. For each group member you will get to know: contribution for the group, income after stage 1, assigned or received points, round income.

Please notice: The order in which type B members are displayed will be determined randomly for each round. Therefore, it is not possible to identify a type B member over the rounds by the position on the displayed lists.

Total income

The total income will result from the starting capital of 100 points plus the sum of the earnings from each of the 20 rounds. At the end of the experiment your total income will be paid out with the exchange rate of 1 Euro per 80 points. As already mentioned, you will additionally receive 2.50 Euro for showing up.