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

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Abstract: Leading by example is considered as an important means to influence followers and to increase team performance. In most organizations, however, leading by example does not come alone. To influence followers, leaders simultaneously use a variety of instruments. Most frequently, leaders possess power to administer positive and negative incentives to followers. Do these incentives reinforce the impact of leading by example on team performance? Because of confounding factors, it is difficult to investigate leading by example using field data. Here, we investigate the effects of leading by example and its interaction with incentives on team performance in controlled laboratory experiments. We find that incentives are more effective in fostering team performance than leading by example as such. Surprisingly, leading by example's effect on team performance interacts negatively with incentives, interestingly more so with rewards than with punishments.

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

JEL classification: C9, H4, M5

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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]

Leaders may induce cooperative behavior by influencing their followers and coordinating them on efficient outcomes (Foss 2001). According to conventional wisdom, one possibility to exert such influence is through leading by example. If leaders exert high efforts first, followers are supposed to mimic them. The commander of a platoon, the captain of a football team, the head of a political party; all are expected to engage themselves in a particular way, and serve as role models to motivate soldiers, fellow teammates, or supporters.

In addition to leading by example, leaders usually use a variety of other instruments simultaneously. Often, leaders are equipped with incentives to reward or punish their subordinates individually. Rewards may be monetary, such as bonus payments or a salary increase, or they may be non-monetary, like the provision of a better work environment, or a representative car. On the other hand, leaders can exert individual punishments, like ending a job contract, assigning the employee less preferable tasks, or withholding expected bonuses. In the military, leaders may even use a disciplinary "non-judicial-punishment" and send their subordinates to jail, up to several weeks.

Given the frequent co-occurrence of leading by example and individual incentives in organizations, it is surprising that no experimental study yet systematically investigated the interaction between leading by example and individual incentives on team performance. In this paper, we fill this gap by examining the following questions: What is the effect of leading by example on performance if the leader can administer individual incentives at own discretion? Do incentives reinforce leading by example's assumed cooperation enhancing effect, or possibly not?

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

Since many other confounding factors may play a role, investigating leading by example is not easy. The advantage of controlled lab experiments is that we can disentangle the effect of individual incentives from the effect of leading by example, and identify possible interaction effects. To do this, we conduct 2x3 factorial between-subject treatments, with and without leaders.

We have three main contributions to the existing literature. First, we inquire in the leader's influence on team performance in the absence of any incentives. Since some previous studies experimentally investigated this question, we contribute to the literature with a robustness check. Second, we systematically investigate the effect of individual incentives (rewards as punishments) on team performance, in teams with and without leaders. Third, we ask whether incentives reinforce leading by example with respect to increasing team performance. By comparing different treatments, we are able to identify the interaction between leading by example and individual incentives. This last point is our novel contribution to the literature.

Our main findings are as follows: First, in the absence of any incentives, leader-free teams achieve similar performance levels as teams with leaders. Second, individual incentives are helpful to increase performance, 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 leading by example, but the use of incentives seems crucial for achieving high team performance.

2. Related Literature

2.1. The Mechanics of Leading by Example

Leading by example may work via (social) preferences. Empirical evidence shows that many people are conditional cooperators, who prefer to match others' contributions (Fischbacher et al. 2001). In the presence of conditional cooperators, leaders' high efforts can influence the followers to exert high efforts, too. Experimental evidence, however, shows that many conditional cooperators slightly undercut others' efforts (Fischbacher and Gächter 2010), which often leads to a decline of average cooperation over time. This "leader's curse" weakens the effect of leading by example (see, e.g., Gächter and Renner 2014).

Leading by example could also work by shaping the followers' beliefs. It seems, however, that the initial behavior of leaders is decisive, making the initial efforts in a repeated setting important. In the subsequent rounds, followers seem to put more weight on the fellow teammates' behavior than the leader's efforts (Gächter and Renner 2014). Related to this,

Cartwright and Patel (2010) theoretically show that an individual may prefer to contribute first in a sequential public goods game if she believes that a sufficient number of other players would imitate her contribution.

Leading by example may work even better "in the dark" (Weber 2015), if followers do not have full information on the productivity of the team project. 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 and her revelation of private information may result in high cooperation in teams. Komai et al. (2007) extend Hermalin (1998), by showing that some cases exist, where preventing full revelation of the state may induce followers to exert higher efforts, compared to if the leader revealed the state fully with her action (as in Hermalin 1998).

In a fundraising context, Vesterlund (2003) presents a similar theoretical prediction as Hermalin (1998), when there is uncertainty about the quality of a charity (the value of the public good). To increase overall contributions, fundraisers of high-quality charities should publicly announce the first contribution. This model again provides a rationale for the effectiveness of having a leader for increasing contributions.[3]

In this study, we focus on a setting with symmetric information on the productivity of the team project. Thus, in the following, we restrain us to discuss previous studies with similar settings.

2.2. Experimental Studies

2.2.1. *Leadership Experiments without Incentives*

Sequential public goods games emerged as the workhorse for the experimental investigation of leaders' influence on team cooperation.[4] In these experiments, the leader 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.

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[3] 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. In their setting, to maximize group output, one should select the least productive member as the leader.

[4] Leadership by example is found to be beneficial in coordination experiments (Cartwright et al. 2013), as well as in settings with asymmetric-information on the value about the team project (Potters et al. 2007, Komai et al. 2011). In this paper, we focus on leading by example in public goods settings with symmetric information on the value of the team project (public good).

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, however, at least as much studies reporting no significant leader effect (Gächter and Renner 2014, Sturm and Weimann 2007, Haigner and Wakolbinger 2010, Sahin et al. 2015). Hence, for experiments with symmetric information on the value of the public good, existing literature is clearly not conclusive on leaders' influence on overall cooperation.

In general, leaders' and the followers' efforts are highly correlated (see, e.g., Gächter and Renner 2014). The followers, however, persistently undercut the leader's contributions, 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 Incentives versus Peer Execution in simultaneous settings*

Ample evidence from public goods experiments shows that peer (decentralized) 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 the centralized use of reward and punishment when team members contribute simultaneously. O'Gorman et al. (2009) find that centralized execution of punishment does not increase cooperation more than peer punishment. Nosenzo and Sefton (2014) report a similar result in a setting with both rewards and punishments.

In contrast to the simultaneous contribution setting, a central authority (leader) in our *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 with 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 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

selected scheme is used for ten 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. In an experimental study applying within-subject design, Harrell and Simpson (2016) investigate, whether the introduction of punishment leads to higher team performance when only the leader has punishment power compared to peer punishment. Here, it seems that there is no significant contribution difference between the leader and the peer punishment treatments (cf. Figure 2, Harell and Simpson 2016). Teams with prosocial leaders contribute more than teams with proself leaders, but no more than in the peer punishment treatment.

Our study is different from the works mentioned above 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. 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. Finally, unlike Harrell and Simpson (2016), we have a between-subject design and investigate the effects of both positive and negative incentives.

3. Experimental Design

3.1. Treatments

We explain our experimental design with respect to treatments in three steps. Each step corresponds to one of our three research questions.

First, to investigate the leader's influence in the absence of any incentives, we conduct two treatments. While in the leader treatment L, the leader contributes first, in the leader-free treatment P, peers contribute simultaneously. Second, to investigate the leader's influence in the presence of individual incentives, 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 opportunity to reward or punish each other, respectively. Third, to disentangle the effect of incentives on team performance from the leader's influence, we compare the three leader treatments, L 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, there is an additional stage with the possibility to allocate rewards or 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 is equally split among all group members. Thus, the marginal per capita return *MPCR* amounts to 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.[5]

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.[6] 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: $\pi_i^{Leader} = 20 - c_i + 0.4C + 20 - r_i, \ \pi_i^{Follower} = 20 - c_i + 0.4C + 3 \, r_{-i}$

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[5] We deliberately decided to use a random selection mechanism. For one thing, to avoid confounds between our variables of interest and the potential effect from selection procedures, and for another thing to keep our design comparable to the previous studies mentioned in section 2. We are also aware of potential effects of the selection modus (random) of the leader on team performance. Previous studies show a rotating leader (Güth et al. 2007) who is chosen exogenously does not significantly affect leader contributions or the followers' propensity to follow the leaders' example. On the other hand, if the leader accepted to lead endogenously, this seem to increase team cooperation (see, e.g., Haigner und Wakolbinger 2010). The focus of this study, however, is on the effectiveness of leading by example as such and its interaction with individual incentives. Hence, we have deliberately chosen to use random leader selection.

[6] To clearly separate contribution behavior and the use of incentives, we provide additional tokens for the reward and punishment stage.

(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. The 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. 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. Each subject was paid privately. The average payoff was €12.70.

4. Hypotheses

4.1. Hypotheses on Team Performance

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.

Based on the evidence from the experimental literature discussed in Section 2 we state the following three hypothesis corresponding to our three main research questions.

Hypothesis 1: *Teams with leaders achieve higher performance than leader-free teams.*

Hypothesis 2: *Teams with incentives achieve higher performance than teams without.*

Hypothesis 3: *Teams with leaders and incentives achieve higher team performance than i) leader-teams without incentives, and ii) leader-free teams with incentives.*

4.2. Hypotheses on Leader-Follower Interaction

Do teammates follow the leader more closely in the presence of the incentives? We expect a positive reinforcement between the impact of the leaders' contribution and her power to reward

or punish. Assuming that leaders tend to reward those who contributed more than the leader herself and to punish those followers who contributed less, followers should mimic the leader's contribution more closely than they would do in the absence of rewards and punishments.

Hypothesis 4. *Team members' contributions follow leaders' example more closely if the leader has incentives at her disposal than if the leader has no incentives.*

Let us now look at the reward and punishment behavior in detail. Should we expect differences in the use of incentives between a leader and by the peers in a leader-free team? Are leaders more efficient in administrating rewards and punishments than peers?

In leader-free teams, 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. 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. In addition, unlike in leader teams, peers have to coordinate on who should reward or punish, and on the level of rewards and punishment. In case of punishment, for example, due to the lack of coordination a non-cooperative player might even go unpunished. Since leaders 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 team performance.[7] Assuming that a leader, who is in a first-mover position, is less prone to anti-social punishment and will, therefore, be able to use punishment more effectively, there should be less anti-social punishment in the leader treatment with punishments L-PUN, compared to P-PUN.

Hypothesis 5. *Teams with leaders apply less anti-social punishment than the leader-free teams.*

Do leaders induce stronger (contribution) reactions to rewards and punishments? Compared to peer teams, a leader's incentive decisions may higher acceptance by the other members, since by contributing first, the leader exposes herself to the risk of being exploited. The higher potential acceptance, in turn, may lead followers to stronger contribution reactions to incentives. Thus, controlling for the magnitude of rewards and punishment points a teammate gets, we expect larger changes in the contribution level of that teammate in the leader treatments, compared to the peer treatments.

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[7] 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).

Hypothesis 6. *For a given reward or punishment level, in teams with leaders, the reaction of the followers in terms of contribution change are larger than in leader-free teams.*

5. 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 regarding contributions. Finally, we analyze the payoffs of the teams with and without a leader.

5.1. The Effect of Leadership on Team Performance in the Absence of Incentives

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 (MWU), two-sided, $p = 0.564$).[8]

Result 1. *In the absence of any incentives, 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 (Wilcoxon-matched-pairs test (WMP), two-sided, $p = 0.021$). This result is in line with previous studies. We do not find a difference between the followers' contributions in the leader treatment L and the teammates' contributions in the peers treatment P ($p = 0.453$).

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[8] This result may be 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.

Treatment	Contributions					
	L	**P**	**L-REW**	**P-REW**	**L-PUN**	**P-PUN**
All	9.8 (5.7)	11.3 (4.6)	14.5 (5.0)	15.9 (4.2)	13.8 (6.8)	16.9 (4.4)
Leader	11.2 (5.6)	-	13.1 (5.9)	-	14.6 (6.5)	-
Follower	9.3 (5.9)	-	15.0 (5.4)	-	13.5 (7.2)	-

Treatment	Payoffs from the public goods stage excluding rewards and punishment					
	L	**P**	**L-REW**	**P-REW**	**L-PUN**	**P-PUN**
All	25.9 (3.4)	26.8 (2.8)	28.7 (3.0)	29.5 (2.5)	28.3 (4.1)	30.1 (2.6)
Leader	24.4 (4.2)	-	30.1 (5.2)	-	27.5 (5.7)	-
Follower	26.3 (3.4)	-	28.2 (3.1)	-	28.5 (3.9)	-

Treatment	Net Payoffs including rewards and punishments					
	L	**P**	**L-REW**	**P-REW**	**L-PUN**	**P-PUN**
All	25.9 (3.4)	26.8 (2.8)	38.8 (5.1)	40.4 (4.9)	31.6 (4.4)	32.6 (4.1)
Leader	24.4 (4.2)	-	40.0 (1.9)	-	45.8 (5.9)	-
Follower	26.3 (3.4)	-	38.4 (6.9)	-	26.9 (4.3)	-

Treatment	Average allocated rewards and punishments (average of the team's total)					
	L	**P**	**L-REW**	**P-REW**	**L-PUN**	**P-PUN**
All	-	-	-	11.7 (5.1)	-	2.5 (2.3)
Leader	-	-	10.2 (5.1)	-	1.6 (1.4)	-

5.2. The Effect of Leadership on Team Performance in the Presence of Incentives

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. *With incentives, average team performance in the leader treatments is not higher than the average team performance in the corresponding peer treatments.*

5.3. Decomposing the Leader Influence from the Effect of 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 (MWU, $p = 0.018$). Average contributions in L-PUN are also considerably higher than the contributions in L (MWU, $p = 0.106$), 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 the team performance.*

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

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 average contribution 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, WMP, $p = 0.007$), (P treatment: 13.7, and 8.8, WMP, $p = 0.006$).

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, WMP, $p = 0.023$, P-REW: 16.9 and 14.8, WMP, $p = 0.034$). 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, WMP, $p = 0.969$), whereas contributions are significantly higher in the second half in P-PUN (16.3 and 17.5, WMP, $p = 0.050$).

Figure 1: Average contributions.
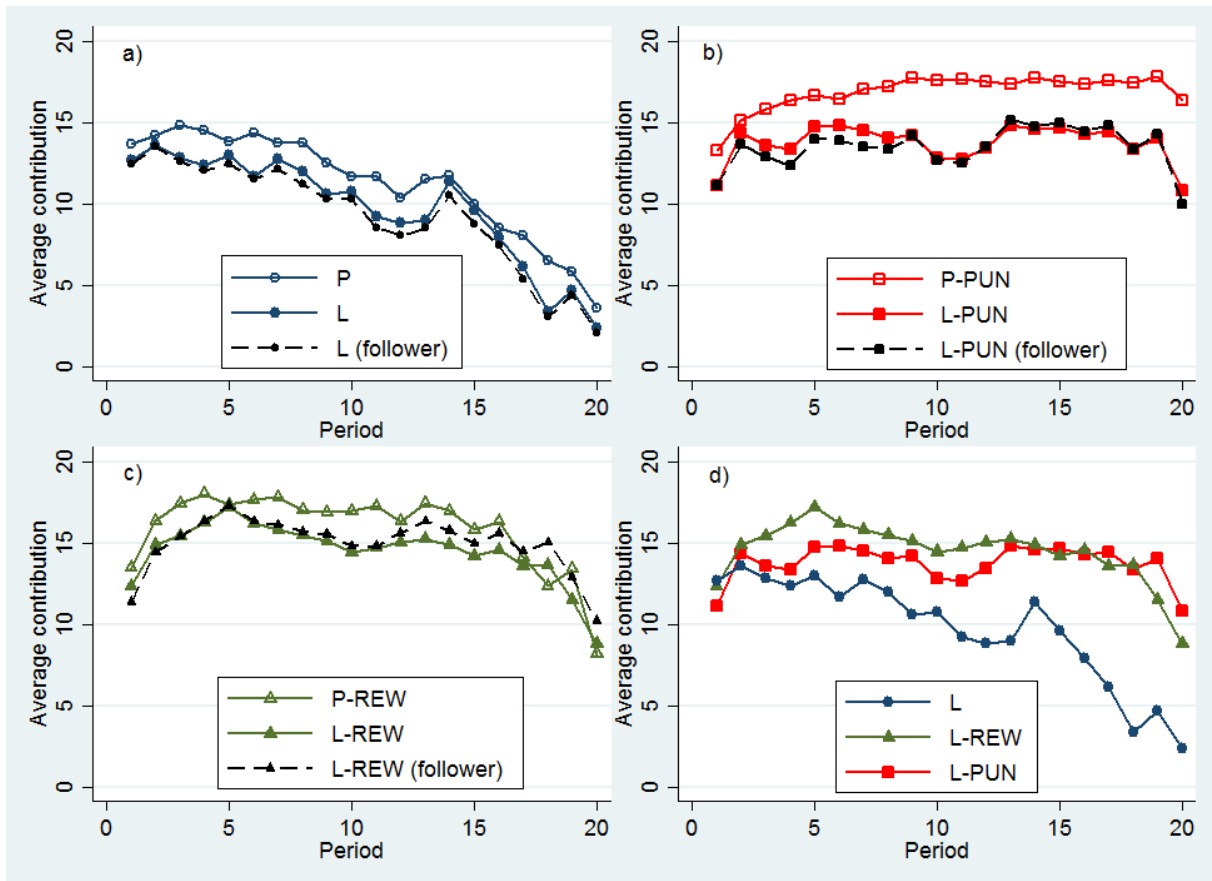
5.4.Individual Contribution Behavior (Does Leading by Example Work?)

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 the effect of their use of incentives.

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 effect 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).

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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	(V) P-REW, P-PUN & P
(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)	0.738*** (0.036)
(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)	1.463*** (0.511)
(6) Reward x Leader contribution				−0.255*** (0.082)	
(7) Punishment dummy				3.724** (1.752)	2.079*** (0.555)
(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)	2.524*** (0.543)
Observations	1596	1596	1596	2052	2736
R^2 overall	0.549	0.341	0.650	0.580	0.514

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

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 Spearman's rho = 0.746) in the L treatment, the leaders impact is much smaller in L-PUN (average Spearman's rho 0.504) and even less in L-REW (0.205). The average correlation coefficients (rho) obtained in the L treatment are significantly higher than the coefficients in the L-PUN and L-REW (L and L-PUN: MWU, $p = 0.003$, L and L-REW: MWU, $p = 0.002$). Comparing the impact of rewards (5) and punishment (7) shows that sanction points allocated by a leader (IV) affect contribution behavior much stronger than peer (V) rewards or punishment (Wald-test, rewards: $p = 0.003$, punishment: $p = 0.002$).

Result 4. *The effect of leading by example (measured as the correlation between leader and follower contributions) is less strong if the leader has incentives at hand.*

5.5. Use of Rewards and Punishments

As can be seen in Table 1, leaders as well as peers clearly allocate more reward points than punishment (MWU, $p < 0.001$ in both cases). On average, leaders do not invest more in incentives (points) than peers do, neither in rewards (MWU, $p = 0.544$), nor in punishments (MWU, $p = 0.299$).[9] 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).[10]

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, teammates on average allocate the most reward points to peers who contributed the same amount as they did.

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[9] 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, MWU, $p = 0.71$), nor between L-PUN and P-PUN (5.9 and 5.6, MWU, $p = 0.85$).

[10] 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.

Figure 2: Average reward or punishment, based on single rewards and punishments, not the totals a subject might have received in a period. As peers only have 5 points to allocate, in the panels on the right-hand side, we only see bubbles for the received reward/punishment categories zero and the interval [1, 5]. The diameter of a bubble reflects the relative frequency of the respective incentive level.
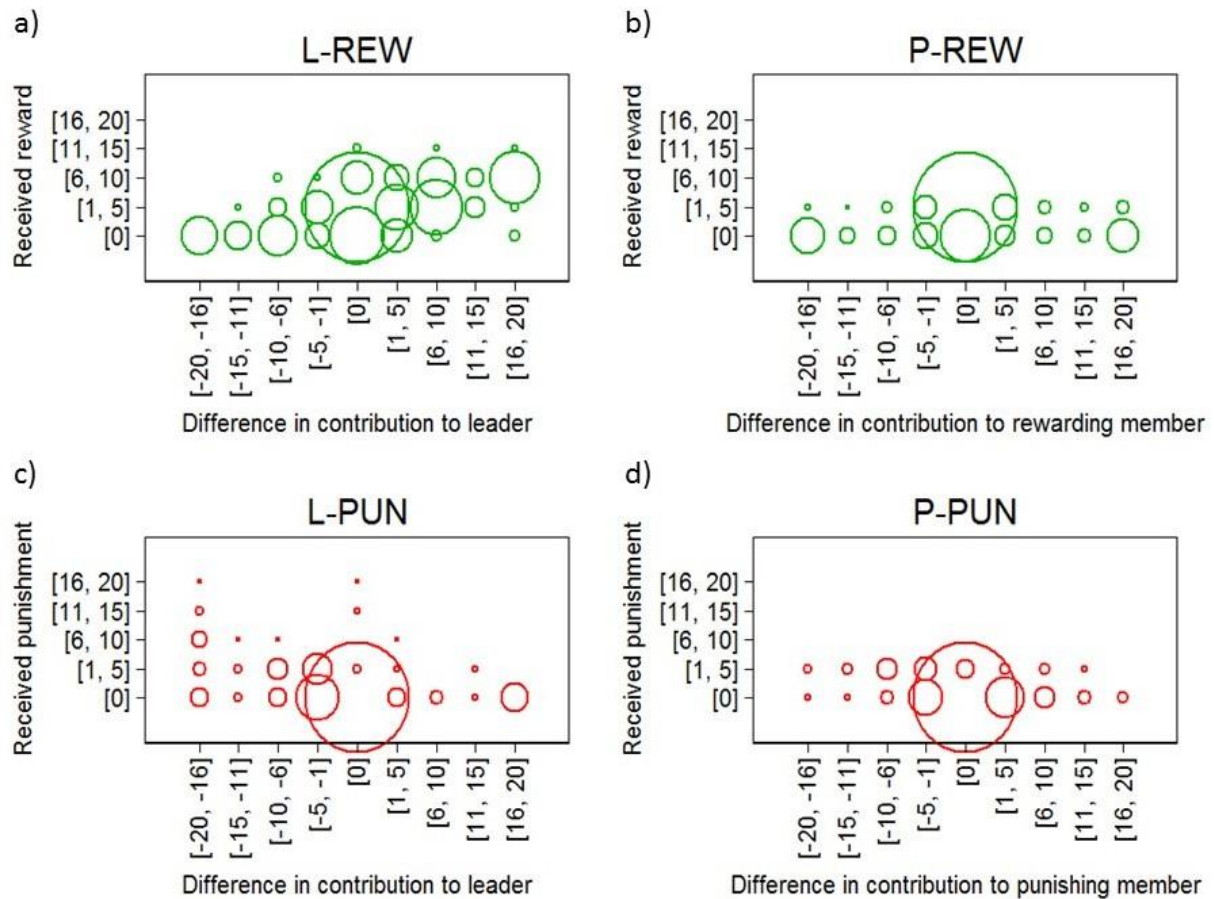
Now, turn to punishment. In both PUN treatments, on average, teammates punish those players more heavily who contributed less than they contributed themselves, compared to teammates who contributed equal or more. Teammates punish others more harshly, the greater the contribution differential between 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, MWU, $p = 0.046$). This observation serves as an example, why it may be advantageous to have a team leader.

Result 5. *Leaders exert anti-social punishment less-frequently than peers.*

5.6. Do Leaders Use Incentives Differently than Peers Do?

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 of 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:	Probit: probability of subject *i*'s to be punished (rewarded)				Tobit: the amount of punishment (reward) subject *i* receives			
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
	L-PUN	L-REW	P-PUN	P-REW	L-PUN	L-REW	P-PUN	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 R²	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).

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.

Result 6. *While rewards do not have a significant effect on the contributions next round, punishments have. As hypothesized, the effect is stronger in teams with leaders.*

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 does not exist in the punishment treatments. In the L-PUN treatment, we even observe a

positive trend, which is weakly significant.[11] Summing up, if used at all, punishment seems the more effective instrument in increasing the next round contribution than reward.

Payoffs

We focus on net payoffs, i.e., payoffs including (after) rewards and punishments.[12] 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 (MWU, $p = 0.002$, $p = 0.005$). We do not observe significant differences, neither between L-REW and P-REW (MWU, $p = 0.453$), nor between L-PUN and P-PUN (MWU, $p = 0.564$).

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, WMP, $p = 0.908$). 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, WMP, $p < 0.001$).

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 (MWU, $p = 0.028$), 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 (MWU, $p < 0.001$). In other words, as a leader it pays off to be in the punishment setting. For a follower, the rewards setting is more advantageous.

6. Discussion and Conclusion

In this study, conducting six treatments, we disentangle the effects of individual rewards and punishments on team performance from the pure influence of leading by example. Our main findings are as follows:

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[11] 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.

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

First, in the absence of any incentives, groups with a leader do not perform better than groups without a leader. Some might find this result surprising in light of the early influential experimental literature on leading by example. If, however, we consider the more recent literature, and some unpublished work (Gächter and Renner 2014), we see that the commonly held belief of the positive influence of leading by example seems not robust. As mentioned before in the literature section, while early papers by Moxnes and van der Heijden (2003), Güth et al. (2007), and Levati et al. (2007) show a positive effect of leading by example; more recent studies find little to no effect (Gächter and Renner 2014, Sturm and Weimann 2007, Haigner and Wakolbinger 2010, Sahin et al. 2015). Information symmetry could possibly explain the ineffectiveness of the leader in our setting. In studies with asymmetric information, leading by example seems to work better (Potters et al. 2007, Komai et al. 2011). Second, if incentives are available, leader-free teams as well teams with leaders perform better than teams in the absence of incentives. Third, if reward and punishment possibilities are available, groups with leaders do not perform better than leader-free teams. The comparison of the leader treatment L without any instruments to L-REW and L-PUN treatments reveals that in our setting leading by example does not reinforce the effect of rewards and punishments.

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.

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).

The observations from our three different leader treatments indicate, to effectively increase team performance, leaders should possess some additional power. By comparing our L-PUN and L-REW treatment to the corresponding P-treatments, we see the positive effect on efforts in our leader treatments is mainly driven by rewards and punishments, and not by leader's example. Note, however, the performance of teams with leaders equipped with incentives is not superior to teams with peer incentives, rather lower. Hence, our results imply that in small teams

with clear mutual monitoring possibilities, to increase team performance, a leader may not be necessary. The willingness of the teammates to invest in costly bilateral rewards and punishments may suffice for maintaining cooperation. Indeed, many organizations are relying on flat hierarchies, sometimes even with temporary or no leader at all. The most prominent example of such companies is *Valve*, a major game developer and digital distribution company, which is organized in self-managing "boss-free" teams.[13] Other examples with similar, non-rigid hierarchies and flexible organizational structure are *W.L. Gore* or *Partake*.[14]

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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:

<div align="center">80 points = 1 Euro.</div>

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.

Calculation of you round income

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.