IHS Working Paper 25
October 2020

Leading by example in a public goods experiment with benefit heterogeneity

Jing Yu
Martin G. Kocher

Institut für Höhere Studien
Institute for Advanced Studies
Vienna

Author(s)

Jing Yu, Martin G. Kocher

Editor(s)

Robert M. Kunst

Title

Leading by example in a public goods experiment with benefit heterogeneity

Institut für Höhere Studien - Institute for Advanced Studies (IHS)
Josefstädter Straße 39, A-1080 Wien
T +43 1 59991-0
F +43 1 59991-555
www.ihs.ac.at
ZVR: 066207973

Funder(s)

University of Munich and Economics Department of the University of Munich

Leading by example in a public goods experiment with benefit heterogeneity*

Jing Yu
University of Munich, Munich, Germany

Martin G. Kocher
Institute for Advanced Studies, Vienna, Austria
Department of Economics, University of Vienna, Austria
Department of Economics, University of Gothenburg, Sweden

October 2020

Abstract: Social dilemmas such as greenhouse gas emission reduction are often characterized by heterogeneity in benefits from solving the dilemma. How should leadership of group members be organized in such a setting? We implement a laboratory public goods experiment with heterogeneous marginal per capita returns from the public good and leading by example that is either implemented exogenously or by self-selection. Our results suggest that both exogenous and self-selected leadership only have a small effect on contributions to the public good. We do not find significant differences in contributions for exogenous and self-selected leadership. Leaders seem to need additional instruments to be more effective when benefits are heterogeneous.

Keywords: Public goods experiment; heterogeneous benefits; leading by example.

JEL classification: C91, D03, D64.

---

* Financial support from the Ideenfonds of the University of Munich (financed through the excellence initiative) and the Economics Department of the University of Munich is gratefully acknowledged. We are grateful for many comments and suggestions at seminars, workshops and conferences, including very helpful remarks by Marie Claire Villeval in the context of a formal discussion of our paper, as well as by Lata Gangadharan and Jingjing Zhang.

Authors' addresses:
Jing Yu, Department of Economics, University of Munich, Geschwister-Scholl-Platz 1, D-80539 Munich, Germany; E-mail: yj0787@googlemail.com.
Martin G. Kocher, Institute for Advanced Studies, Vienna, Josefstaedter Str. 39, A-1090 Vienna, Austria; E-mail: martin.kocher@univie.ac.at. (Corresponding author)

1. Introduction

Social dilemma situations in which the collective interest is at odds with private interests are widespread. Cooperation among decision makers leads to the Pareto optimum, but free riding is a dominant strategy and results in a Pareto inferior outcome. In this paper we analyze a specific social dilemma that involves different benefits from cooperation to different types of players (*benefit heterogeneity*) and that introduces leadership (*leading by example*) either by appointment (*exogenous leadership*) or by voting (*self-selected* or *endogenous leadership*).

Economists have analyzed social dilemmas in the context of public goods provision. In the experimental laboratory, the simultaneous linear public goods game (also known as the voluntary contribution mechanism) has been the main workhorse to study cooperation empirically (Isaac et al., 1985; Ledyard, 1995; Chaudhuri, 2011). A general finding from economic experiments on the public goods game is that decision makers are willing to cooperate, i.e. willing to contribute voluntarily to the public good, but that cooperation declines over time unless there is an enforcement mechanism such as punishment.

Leading by example turns the simultaneous linear public goods game (partly) into a sequential game, without changing incentives or enforcement possibilities. The first-mover can set an example with her contribution, but has no other means of coercion. Many existing experimental results indicate that leading by example leads to higher levels of contributions (Dannenberg, 2015; Güth et al., 2007; Moxnes & van der Heijden, 2003; Pogrebna et al., 2011; Rivas & Sutter, 2011). However, there are also several studies reporting weak and non-significant leadership effect (Gächter & Renner, 2018; Gürerk et al., 2018; Haigner & Wakolbinger, 2010; Jack & Recalde, 2015; Potters et al., 2007; Sahin et al., 2015).[1] Even if not finding an average increase in cooperation levels, almost all studies show that there is a positive correlation between leaders' and followers' contributions.

Heterogeneity of group members – though common outside the experimental laboratory– is often not considered explicitly in experiments. The general gist of the existing results is that heterogeneity tends to lead to less cooperation. If group members have other-regarding or pro-

[1] Cartwright et al. (2013) explore the effect of leading by example in a weakest-link game and report a limited effect of both exogenous and endogenous leading by example in increasing coordination.

social concerns, they have to coordinate on cooperating, respectively on the level of cooperation; heterogeneity makes coordination more difficult. Existing studies finding negative effects of heterogeneity or null effects have, for instance, looked at heterogeneity in endowments (Buckley & Croson, 2006; Chan et al., 1999; Charness et al., 2014; Cherry et al., 2005; Ostrom et al., 1994; Reuben & Riedl, 2013), heterogeneity in benefits through different returns from the public good (Fischbacher et al., 2014; Fisher et al., 1994; Kube et al., 2015; Reuben & Riedl, 2013), heterogeneity in the source of endowment (earned endowment versus allocated endowment; Oxoby & Spraggon, 2013), and heterogeneity from other observable characteristics such as religion, ethnic affiliation, nationality, or other identities (e.g., Chen et al., 2014; Habyarimana et al., 2007).[2]

The current paper combines benefit heterogeneity and leading by example. In our laboratory experiment, groups of four members can contribute to a linear public good. Two group members have a higher return rate from the public goods than the other two, but it is still a dominant strategy for all group members to contribute nothing to the public good, i.e. to free-ride. Four treatments allow us to study the effects of leadership by example. We implement two treatments in which either one randomly selected *low-benefit member* or one randomly selected *high-benefit member* contributes first, and her contribution level is communicated to the other three members that then contribute simultaneously. A baseline treatment requires all four members to contribute simultaneously. We introduce a fourth treatment that allows all members to volunteer for leadership. It changes the exogenous assignment of leadership by example to

[2] Several previous experimental studies have explored the effectiveness of punishment in promoting cooperation with benefit heterogeneity (Kölle, 2015; Nikiforakis et al., 2012; Reuben & Riedl, 2009, 2013). They observe that punishment is less effective in increasing contributions in heterogeneous groups than in homogeneous groups, and has no impact on group efficiency in heterogeneous groups. Gangadharan et al. (2017) investigate how the combination of communication and reward affects cooperation in groups with benefit heterogeneity. They find that, on top of the reward effect, communication has a positive impact on contributions and group efficiency, but the effects are smaller than in a homogenous benefit environment. A general explanation for these results is that, when people obtain different benefits from the public good, there is a normative conflict between contribution equality and payoff equality. Specifically, high-benefit group members consider equal contributions of all group members as the social norm, whereas low-benefit group members try to enforce the norm that all group members earn the same. Different contribution norms among people can thus lead to a negative impact on group efficiency and undermine the power of otherwise effective mechanisms in promoting cooperation. It is unclear, however, whether leading by example helps promoting cooperation under normative conflict caused by benefit heterogeneity.

an endogenous assignment (choice) by self-selected leaders.

We are the first to analyze leadership by example by group members with benefit heterogeneity using a linear public goods setting. There is a nascent literature in experimental economics that looks at heterogeneity, more generally, in social dilemmas *with leaders*. For instance, heterogeneity in endowments (Levati et al., 2007; Neitzel & Sääksvuori, 2013), heterogeneity from different identities (Drouvelis & Nosenzo, 2013), heterogeneity in the length of group membership (Angelova et al., 2019), heterogeneity in religions (Keuschnigg & Schikora, 2014), and heterogeneity in opportunity costs (Collins, 2016; Dasgupta & Orman, 2013) have been considered in different studies.[3]

Levati et al. (2007) find that leading by example works effectively in heterogeneous endowment populations if all group members rotate in the leader's role, whereas Neitzel & Sääksvuori (2013) do not find such a positive effect with a fixed group member being the leader in repeated interaction. Drouvelis & Nosenzo (2013) show that group members having the same group identity fosters the effectiveness of leading by example, whereas Keuschnigg & Schikora (2014) and Angelova et al. (2019) find that leading by example is likely to reduce cooperation in culturally diverse populations and in communities with group members of different group membership tenures, respectively. Collins (2016) and Dasgupta & Orman (2013) investigate heterogeneous opportunity costs of contributing. They report evidence that contributions are higher when subjects with low opportunity costs contribute first compared to when subjects with high opportunity costs contribute first.[4]

Ananyev (2019) concurrently developed a similar setup for leading by example with heterogeneous benefits. He finds that leading by example does not promote cooperation with heterogeneous benefits, which is in line with our results. He also implements a voting treatment, in which voters can determine the benefit level, i.e. the type, of the leader, but not the leader herself, and most voters prefer the high benefit type to become leader. In contrast, our

[3] The experiment in Glöckner et al. (2011) shows that followers respond to leaders more strongly when contributing is not a dominant strategy for leaders. Similar evidence is provided by Cappelen et al. (2016) and van der Heijden et al. (2013), who suggest that leaders' influence on followers is weak when leaders get a high compensation for leading or have no cost of setting good examples.

[4] Notice that our setting of heterogeneous benefits is different from heterogeneous opportunity costs. In our setting, the marginal costs of contributing are the same for all group members, but the benefits from the group project varies.

endogenous treatment is based on volunteering for leadership.

Our treatment with self-selected leaders also adds to the literature on endogenous leadership (e.g., Arbak & Villeval, 2013; Bruttel & Fischbacher, 2013; Cappelen et al., 2016; Dannenberg, 2015; Haigner & Wakolbinger, 2010; Préget et al., 2016; Rivas & Sutter, 2011). In general, there is a tendency that self-selected or endogenous leadership works more effectively than assigned leadership, but details matter.[5]

The findings from our experiment suggest a limited effect of leadership by example with heterogeneous benefits. Our baseline treatment and the two treatments with exogenous leadership do not differ statistically in terms of contribution levels, irrespective of whether a high-benefit member or a low-benefit member is the leader. Only when pooling the data of the two exogenous treatments, we observe a marginally significant increase in contributions relative to the baseline. However, we do not want to overinterpret this result. This general finding masks a lot of heterogeneity in contribution paths over time in different groups, with an indicative result that with high-benefit leaders that contribute a lot initially, group contributions are effectively raised.

We also find that voluntary leadership, in particular voluntary low-benefit leadership, can raise contributions significantly. However, voluntary low-benefit leaders are, on average, strongly exploited by followers, leading to a declining tendency for them to volunteer for leadership over time. Not surprisingly, groups exhibit extremely low contribution levels when they have no volunteers for leadership. This weakens the positive effect otherwise brought by voluntary leadership. Consequently, there is only a slight increase in contributions, on average, in the endogenous leadership treatment over the baseline level.

Imperfect conditional cooperation by followers, i.e. contributing less than leaders that set good examples, combined with conflicts about the social norm regarding the "adequate" contribution level within heterogeneous group, hampers the effectiveness of leading by example. This is reflected in the conditional cooperation pattern of followers. Followers whose benefit is different from the leader try to reciprocate according to their perceived contribution

[5] Apart from leading by example other implementations of sequential public good provisions have been analyzed in the experimental laboratory (see, for instance, Gächter et al., 2010; Nosenzo et al., 2011; Potters et al., 2005).

norm: when led by high-benefit leaders, low-benefit followers reciprocate on a lower level than high-benefit followers; when led by low-benefit leaders, high-benefit followers reciprocate similarly as low-benefit followers.

Our results have implications for public goods provision with heterogeneous benefits. Team work is a relevant example, with a team output that is a public good, and with different benefits from this public good by different team members. Leading by example seems to be important in many cases. Take, for instance, an academic project that leads to a paper. Somebody whose tenure clock is ticking has different benefits from a joint project than somebody who has just received tenure. On a more global scale, greenhouse gas emission reduction as a global public good involves both heterogeneous benefits and the necessity of leading by example. Our results seem to indicate that it requires additional instruments to make leading by example work under benefit heterogeneity, regardless of leaders are appointed or volunteer.

The remainder of the paper is organized as follows. Section 2 describes the design and procedures of the experiment. Section 3 presents the main results, and Section 4 provides concluding remarks.

2. Experimental design and procedures

Our basic game is a four-person linear public goods game that is repeated for ten periods in fixed groups. In each period, each of the four group members receives an endowment of 20 tokens and is asked to decide about how many tokens to contribute to a group account. The tokens not contributed remains in one's private account. Each group member's contribution to the group account in period *t*, C_{it}, must satisfy $0 \leq C_{it} \leq 20$. The payoff function for an individual *i* in period *t* is

$$\pi_{it} = 20 - C_{it} + \beta_i \times \sum_{i=1}^{4} C_{it}$$

Among the four group members, two subjects are randomly selected to be of type A (low-benefit members) and two of type B (high-benefit members).[6] The marginal per-capita return

[6] We use neutral language in the experimental instructions so as not to bias decisions. For convenience, players of

from the public account (β_i) is set at 0.4 for members of type A and 0.8 for members of type B. That is, each token a subject keeps in her private account is worth 1 point to her, regardless of her type; in addition, she earns 0.4 points for each token all group members (including herself) contribute to the group account if she is of type A, while she earns 0.8 points for each token she or any other group member contributes to the group account if she is of type B. At the beginning of the first period, each group member is randomly assigned an ID from 1 to 4. They learn their own types and ID (that remain the same throughout the experiment). Design details are described in the experimental instructions, and by reading them aloud at the beginning of the experiment they are made common knowledge to all participants.

We implement the following four treatments in a between-subject design: (1) Baseline (BASE): All 4 group members make private contribution decisions simultaneously. (2) Exogenous high-benefit leader (HBL): One high-benefit member is randomly selected in each period as the leader. The leader contributes first, and the other three members contribute simultaneously after receiving information about the leader's contribution. (3) Exogenous low-benefit leader (LBL): Similar as HBL, except that the leader is randomly chosen from the two low-benefit members in each period. (4) Endogenous leader (EN): In each period, all members could choose whether they want to become leader or not. If none of the four members chooses to become leader in a given period, the four group members contribute simultaneously and privately in that period, just like in BASE; if there is only one member who chooses to become leader in a period, this member makes her contribution decision before the other three group members, just as in HBL or LBL (depending on the type of the volunteer); if there are at least two members who are willing to become leader, a random draw determines the actual first mover in that period. After their choice, those subjects who have volunteered learn whether they are leader for the given period. For those who have volunteered but are not chosen as leader, they obviously learn that they are not the only group member to volunteer.

We follow Gächter & Renner (2010) in how beliefs are elicited. Beliefs are elicited in each round of the game, after subjects have made their contribution decisions. Specifically, in the

type A are referred to as low-benefit members, and players of type B are referred to as high-benefit members in this paper.

baseline treatment we ask participants to estimate the average of the other players' contributions within their group, for each type separately. In the leadership treatments, we ask the leader about her estimate of how many tokens the two different-type followers would contribute on average, and how many tokens the other same-type follower would contribute; each follower needs to submit her estimate of the other followers' average contribution, for each type separately, after having seen the leader's contribution. For subjects who are requested to submit two estimates in a period, one estimate is randomly selected to count for their earning. If the belief is correct, the subject receives an additional 3 points; if the belief differs by 1(2) points, the subject receives 2(1) points; in all other cases the subject receives nothing from the estimates.

At the end of each period, subjects get feedback including each group member's type, contribution to the group account, income (excluding earnings from estimates) and identity within the group in leadership treatments (i.e. whether one is first mover or not). They are also informed about their own income from the estimates. Every period of play count towards final earnings.

After the ten periods, all treatments are followed by a monetarily incentivized social value orientation questionnaire, known as the ring test (Liebrand, 1984; Liebrand & McClintock, 1988). Subjects have to make binary choices in 24 different allocation tasks. In each task, a subject has to choose among two allocations that allocate money to herself and another anonymous recipient. All 24 decisions are paid and the pairing is fixed throughout this part. By adding up the subject's 24 decisions, we obtain the total sum of money allocated to herself (x-amount) and to the recipient (y-amount). The subject's social value orientation is calculated as the angle of the vector θ that results from the ratio x/y. Based on the ratio x/y, one can assign each subject to one of eight categories of social orientation (individualism, altruism, cooperation, competition, martyrdom, masochism, sadomasochism, and aggression). A more accurate measure of social value orientation is the exact angle θ, positive in the first quadrant and negative in the fourth quadrant. Almost all subject ratios lie in these two quadrants: thus, the larger this angle, the more pro-social the subject. We will use this measure in our analysis.[7]

[7] One may wonder whether subjects' decisions in the social value orientation test are affected by their experience in the public goods game. However, we believe this should not be a concern for our data analysis. First, the recipient is randomly chosen from all other subjects in the session and is thus not necessarily on of the former group members

From the 24 decisions, one can also measure a subject's consistency in making allocation choices. When using the data from the social value orientation test, we consider only subjects with a consistency measure of at least 50%.[8] At the end of the experiment, subjects learn their total income from the main part of the experiment and from the ring test.

The experiment was conducted in the MELESSA laboratory at the University of Munich. A total of 236 subjects were recruited via ORSEE (Greiner, 2015). Subjects remained anonymous throughout the experiment, and cash payments were made privately. The experiment was programmed and conducted with the software z-Tree (Fischbacher, 2007). We conducted two sessions for each of the treatments BASE, HBL and LBL, and four sessions for treatment EN, with 24 subjects in each session.[9] At the beginning of each session, subjects received the instructions for the public goods game. The instructions for the ring test were handed out to subjects after the end of the main part. However, subjects knew that there would be a second part after the ten periods of the main part and that it would be unrelated to the first part. Instructions were written in neutral language. In order to test the understanding of the rules and the incentive structure subjects were asked to answer control questions after reading the instructions aloud. The experiment did not proceed until all subjects had answered all questions correctly. Sessions lasted, on average, about 75 minutes, and subjects earned approximately € 13.7, on average.

3. Experimental results

We organize the presentation of our results in the following way. Section 3.1 compares average contributions across the treatments and situations. Section 3.2 studies contribution behavior of

from the public goods game. Second, there is evidence that experiencing a public goods game does not significantly affect subjects' social/cooperative preferences (Ackermann et al., 2019; Fischbacher & Gächter, 2010). Third, the ratio from the social value orientation test is anyway only an auxiliary variable in our analysis.

[8] There is no standard with regard to the threshold for the consistency measure. Note that releasing this restriction by shifting the threshold downwards (even including all subjects into the analysis, irrespective of their consistency) does not change any of the results in the results section.

[9] There are 20 subjects in the second session of treatment HBL due to an insufficient number of subjects showing up.

leaders and followers. And, Section 3.3 explains the heterogeneity in contributions across groups in the exogenous high-benefit leadership treatment. Unless specified differently, the non-parametric tests are two-sided Mann-Whitney rank sum tests, with each group as a statistically strictly independent observation. We do not postulate formal hypotheses, since it is very difficult to ex ante specify whether a potential positive effect of leading by example outweighs the potential problems of coordination with heterogeneous benefits or not. Both a positive or a negative sign of the overall effect of leading by example with heterogeneous benefits seem plausible. However, given the results from the relevant literature discussed above, we expect voluntary leadership to work better in raising contributions than imposed leadership.

3.1 Treatment differences

The upper panel of Table 1 and the left panel of Figure 1 give an overview of the average contributions by treatment over time.[10] Contributions start out at about 50% of the total endowment in all treatments and decrease over time in varying degrees. A two-sided Kruskal-Wallis test shows that there is no significant difference between the four treatments in average contributions over all ten periods (p = .82, N = 59).[11] As shown in Figure A1-A4 in the appendix, there is lots of heterogeneity in contributions across groups, in particular in HBL. We will discuss potential underlying mechanisms for the large between-group variance in more detail in Section 3.3.

As the right panel of Figure 1 indicates, there are three possible states of the world in EN: (1) the actual leader is a high-benefit member (which we will refer to as EN_HBL), (2) the actual leader is a low-benefit member (EN_LBL), and (3) nobody volunteers, hence the group has no leader (EN_NL). Using a within-group test by including only those groups that experienced both states, we find that group contributions are highest with voluntary low-benefit leaders and lowest when nobody in the group has volunteered to be the leader, as summarized

[10] Figure A1-A4 present the evolution of contributions by group for each treatment. Figure A6 looks at the contributions of the two player types in treatment BASE.

[11] This is also true for pair-wise comparisons (p > .35 for any pair-wise test). Only in the pooled exogenous leadership treatments do we observe a marginally significant increase in average contributions as compared to the baseline treatment (p = .07, N = 35).

by Table 2.

Table 1: Average contributions by treatment and by state in EN

	Periods 1-10	Periods 1-5	Periods 6-10
BASE	7.2 (1.91)	8.89 (1.49)	5.5 (2.7)
HBL	9.17 (4.76)	10.01 (4.74)	8.32 (5.08)
LBL	8.21 (3.28)	9.0 (2.71)	7.42 (4.45)
EN	8.38 (3.16)	9.71 (3.62)	7.04 (3.55)
EN_NL	4.61 (3.33)	6.99 (4.43)	3.87 (3.28)
EN_HBL	9.12 (3.48)	9.99 (3.67)	7.42 (3.69)
EN_LBL	11.18 (3.32)	11.64 (4.10)	9.62 (4.97)

Note: Standard deviations based on group averages in parentheses.

Table 2: Comparisons of contributions in treatment EN

Within-group comparison	Contributions	# of observations
EN_NL vs. EN_HBL	4.61 vs. 9.24***	N=21
EN_NL vs. EN_LBL	4.83 vs. 11.43***	N=18
EN_LBL vs. EN_HBL	11.18 vs. 9.31**	N=21

Note: Two-sided Wilcoxon signed-ranks tests: * p < .1, ** p < .05, *** p < .01

Figure 1: Average contributions in the treatments (left) and the three states in EN (right)

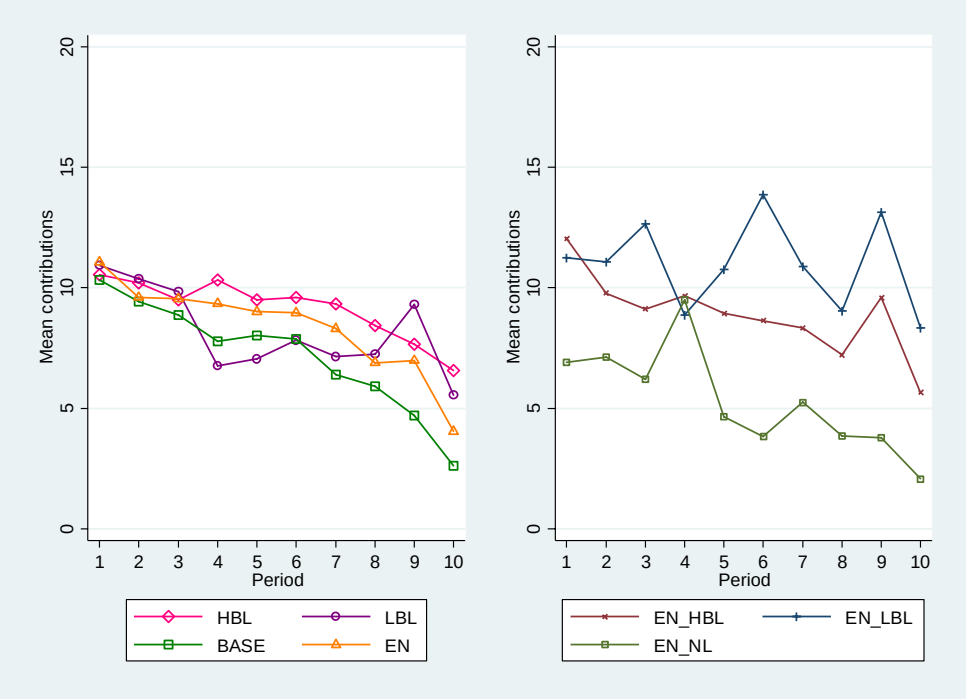


Table 3: Random effects regression of group-level contributions

Dependent variable: Average group contributions	(1)	(2)	(3)	(4)	(5)	(6)
HBL	1.970	1.970	2.072			2.057
	(1.482)	(1.485)	(1.390)			(1.399)
LBL	1.012	1.012	1.634			1.565
	(1.063)	(1.064)	(1.303)			(1.285)
EN	1.182		1.574*	1.853*	-0.213	
	(0.833)		(0.872)	(1.088)	(1.167)	
EXO				1.584*	0.701	
				(0.873)	(1.178)	
EXO*Period					0.376**	
					(0.174)	
EN*Period					0.161	
					(0.179)	
EN_NL		-2.695***				-1.701*
		(0.875)				(0.941)
EN_HBL		1.937**				2.297**
		(0.890)				(0.923)
EN_LBL		3.519***				3.236***
		(0.923)				(1.008)
Period			-0.534***	-0.534***	-0.746***	-0.463***
			(0.072)	(0.072)	(0.135)	(0.066)
Average SVO of own benefit type			3.055**	3.120**	3.120**	2.760*
			(1.446)	(1.438)	(1.439)	(1.429)
Average SVO of the other benefit type			2.538	2.604	2.604	2.244
			(1.616)	(1.634)	(1.635)	(1.601)
High-benefit type			5.354***	5.354***	5.354***	5.354***
			(0.607)	(0.607)	(0.608)	(0.608)
Constant	7.196***	7.196***	0.553	0.515	1.680	0.327
	(0.535)	(0.536)	(1.312)	(1.310)	(1.265)	(1.276)
R^2 overall	0.02	0.12	0.27	0.27	0.27	0.30
N	590	590	1180	1180	1180	1180

Note: The reference category in the regression is the baseline treatment. The variables "HBL", "LBL", "EN", "EXO", "EN_NL", "EN_HBL" and "EN_LBL" are dummy variables indicating the treatments or states. SVO is the angle of the vector elicited in the social value orientation task: the larger this value is, the more pro-social the subject is. "Average SVO of own benefit type" is the average angle of own benefit type; "Average SVO of the other benefit type" is the average angle of the other benefit type; "High-benefit type" is a dummy variable that is 1 if the type receives high benefits from the public good. Cluster robust standard errors in parentheses (clustered on group level). * p < .1, ** p < .05, *** p < .01.

Using each group for the periods in which the state is in effect as the unit of observation, we can also compare contributions in the three states of EN (as shown in the lower panel of

Table 1), to contributions in BASE. It turns out that average contributions with voluntary leadership (EN_HBL+EN_LBL) are significantly higher than those in BASE (9.73 vs. 7.20, $p < .05$, $N = 36$).[12] However, average contributions in EN_NL are significantly lower than those in BASE (4.61 vs. 7.20, $p < .01$, $N = 33$), which undermines the positive effect brought by voluntary leadership. Compared to imposed leadership, voluntary leadership is more effective only when leaders are of the low-benefit type (11.18 in EN_LBL vs. 8.21 in LBL, $p < .01$, $N = 33$; 9.12 in EN_HBL vs. 9.17 in HBL, $p = .72$, $N = 35$).

Table 3 reports results for a random effect regression of group-level contributions. Model (1) only includes the four treatment dummies as independent variables, and it confirms the non-parametric results. In Model (2), we further split the treatment dummy "EN" into three state dummies. Both the coefficients of "EN_HBL" and "EN_LBL" are positive and significant, indicating that group contributions with voluntary leaders are significantly higher, regardless of the leader type. The significantly negative coefficient of "EN_NL" clearly reflects the drawback in EN: when nobody is willing to take the lead and all group members contribute simultaneously, group contributions are significantly lower than in BASE and other states of EN ($p < .0001$, Wald test). Also, we confirm that voluntary low-benefit leadership is more effective than voluntary high-benefit leadership ($p = .02$, Wald test) and imposed low-benefit leadership ($p = .03$, Wald test).

Models (3) to (6) add controls for group average cooperation preferences using subjects' ring test scores. Since excluded subjects (those whose answers are inconsistent in the ring test) might differ in terms of the benefit type across treatments/states, we compare group-level contributions, after controlling for the benefit type. The time trend is also included. In Model (3), where we add these control variables, the coefficient of the treatment dummy "EN" becomes marginally significant at the 10%-level. There is no significant difference in contributions between "HBL" and "LBL" ($p = .82$, Wald test). We thus pool the two exogenous leadership treatments in Model (4). In line with the non-parametric results, there is a marginal increase in group contributions in the pooled exogenous leadership treatments as compared to

[12] Contributions are significantly higher in EN_LBL than in BASE, and contributions are higher in EN_HBL than in BASE but the difference is not significant at conventional levels ($p < .01$ for EN_LBL vs. BASE; $p = .12$ for EN_HBL vs. BASE).

the baseline treatment. Model (5) further shows that the decay in contributions under exogenous leadership is slower than in the baseline treatment. In Model (6), where we add control variables on top of Model (2), we still find a positive effect of voluntary leadership and a negative effect of no voluntary leadership. However, we do not find significant evidence anymore that voluntary low-benefit leadership is more effective in raising contributions than other leadership conditions (p = .26 for EN_HBL vs. EN_LBL; p = .2 for LBL vs. EN_LBL, Wald tests).

Result 1: *Relative to BASE, contributions are marginally significantly higher only when we pool the exogenous leadership treatments and in treatment EN. Group contributions decay at a significantly slower rate in the pooled exogenous leadership treatments than in BASE.*

Result 2: *Groups with voluntary leaders, in particular voluntary low-benefit leaders, contribute significantly more than groups in BASE. When nobody is willing to volunteer for leadership, group contributions are significantly lower in EN than in BASE.*

Figure 2: The frequency of the three possible states overall (left) and over time (right)

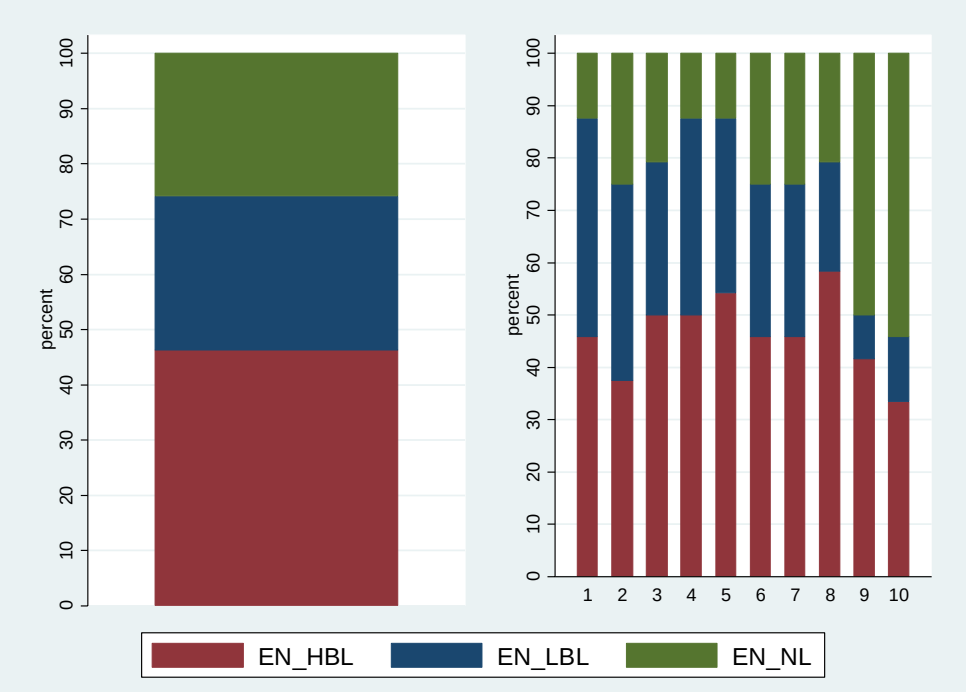


Figure 2 plots the overall frequency of the three possible states in EN and the frequency

dynamics over time.[13] Overall, leadership is implemented 74% of the time. Broken down, 46% of the time the group has a voluntary high-benefit leader and 28% of the time a voluntary low-benefit leader. As indicated in the right panel of Figure 2, over time the instances of EN_LBL decrease, while the instances of EN_HBL remains rather stable (Spearman's ρ=-0.21, $p < .01$ for EN_LBL, and Spearman's $\rho = -0.02$, $p = .74$ for EN_HBL). Towards the end, EN_NL becomes frequent. Indeed, high-benefit members, on average, volunteer to be the leader much more often than low-benefit members (39.4% vs 22.7%, $p = .01$, two-sided Wilcoxon signed-ranks test).[14] A probit regression on subjects' willingness to be the leader (as shown in Table A2 in the appendix, with individual benefit type, cooperation preference and the time trend as independent variables) confirms this result and reveals that individual cooperation preference is another important determinant of the decision to lead: the more pro-social a subject is, the more likely she is willing to be the first mover. Model (3) in Table A2 further shows that over time, low-benefit members have a significantly decreasing willingness to become the leader.

Result 3: *Subjects' willingness to lead is influenced by their benefit type, their cooperation preference and the time trend: (1) High-benefit members are more likely to volunteer than low-benefit members; (2) the more pro-social a member is, the more likely she is willing to be the leader; and (3) low-benefit members exhibit a decreasing motivation to become the leader.*

3.2 Leader and follower behavior

The success of leadership relies on two factors: leaders setting good examples, and followers responding to the leaders' examples. Figure 3 illustrates the evolution of contribution of leaders and their counterparts: the left panel shows high-benefit members and the right panel low-benefit members.[15] Contributions of high-benefit members decline significantly over time in BASE (Spearman's $\rho = -0.49$, $p < .01$). In contrast, high-benefit leaders' contributions are fairly

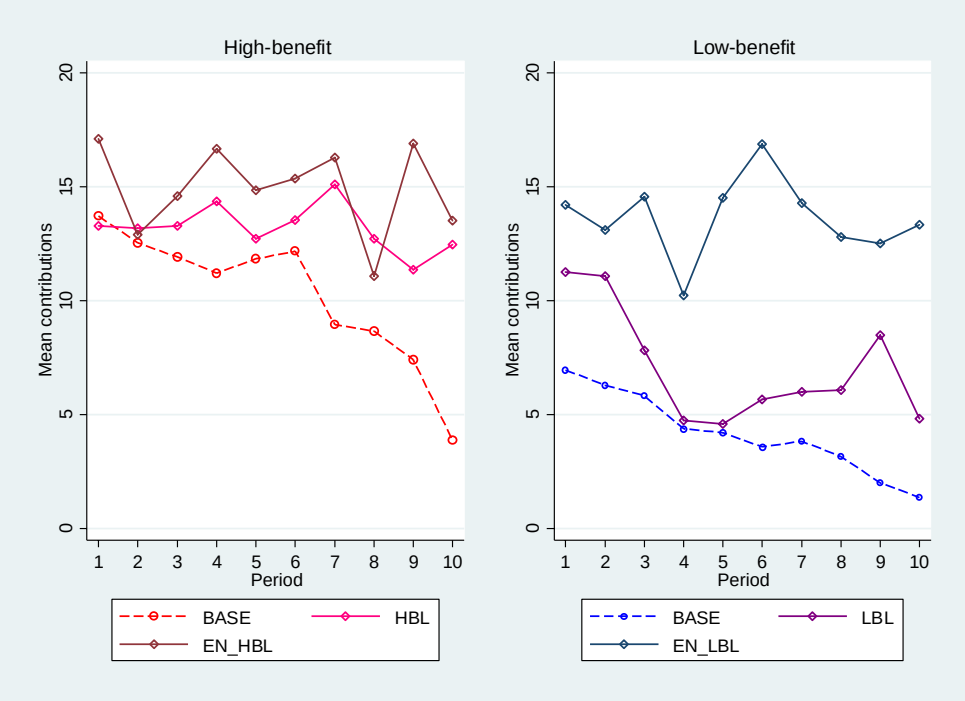
[13] Table A1 in the appendix reports the number of observations in each possible state of EN by period.

[14] This result is confirmed by a chi-square test ($p < .01$). Figure A5 in the appendix shows the fraction of volunteers over time for each player type. The difference in terms of the tendency to volunteer for leadership between the two types of players already exists in the first period (50.0% vs. 33.3%, p = .07, two-sided Wilcoxon signed-ranks test).

[15] Table A3 in the appendix displays average contributions of group members by type in each treatment.

stable (Spearman's ρ = -0.02, p = .81 in HBL; Spearman's ρ = -0.04, p = .69 in EN_HBL). Over all periods, high-benefit leaders contribute more than their counterparts in BASE, but the difference is only significant in EN_HBL (p = .18 for HBL; p = .01 for EN_HBL). Leaders' contributions are higher in EN_HBL than in HBL, but the difference is not significant (p = .51).

Figure 3: Average contributions of leaders and their corresponding counterparts



Note: High-benefit members in the left panel and low-benefit members in the right panel.

The right panel shows the comparison between low-benefit leaders and their counterpart members. In BASE, low-benefit members contribute about half as much as high-benefit members initially, and contributions decrease significantly over time (Spearman's ρ = -0.39, p < .01). In contrast, leaders in LBL start out at a medium contribution level that is only slightly smaller than the initial leader contribution in HBL. However, contributions drop quickly to about half of the number of high-benefit leaders. There is an overall decreasing trend in leaders' contributions in LBL (Spearman's ρ = -0.22, p = .02), while this is not the case in EN_LBL with voluntary leaders (Spearman's ρ = .07, p = .55). Over all ten periods, imposed low-benefit leaders contribute significantly less than imposed high-benefit leaders (p < .01, N = 23), whereas voluntary leaders contribute similar amounts, irrespective of their benefit type (p = .99,

N = 21, two-sided Wilcoxon signed-ranks tests).[16] Nonetheless, under both forms of low-benefit leadership, leaders' contributions are significantly higher than their counterparts in BASE (p = .04 in LBL; p < .01 in EN_LBL). Still, leaders' contributions are significantly larger in EN_LBL than in LBL (p < .01).

Table 4 reports a random effects regression comparing contributions of leaders and their corresponding counterparts. Models (1) to (3) compare between high-benefit leaders and their high-benefit counterparts, while Models (4) to (6) compare between low-benefit leaders and their low-benefit counterparts. The coefficients of treatment dummies in both Models (1) and (4) are significantly positive, indicating that high-benefit leader and low-benefit leader contributions are significantly higher than their corresponding counterparts in BASE, regardless of the way how leadership is generated. The magnitude of the effect, however, is largest for EN_LBL. We get qualitatively the same results when controlling for the time trend and leaders' cooperation preferences, as shown in Model (2) and (5), indicating that leadership behavior cannot simply be attributed to time or self-selection effects.

In Models (3) and (6), we add the time trend and interaction terms between the time and treatment dummies. Model (3) shows that high-benefit leaders' contributions have a completely different time trend than their counterparts. An F-test further confirms the stable trend of high-benefit leaders' contributions by failing to reject the null hypothesis that the combined effect of Period and Period*HBL (or Period*EN_HBL) is equal to zero (p = .32 for HBL and p = .17 for EN_HBL). The picture looks a bit different for low-benefit leaders. We only find a stable trend of low-benefit leaders' contributions in EN_LBL (p = .52 for the combined effect of Period and Period*EN_LBL; p = .06 for the combined effect of Period and Period*LBL). In addition, the significantly positive dummy EN_LBL in Model (6) indicates that relative to their counterparts, voluntary low-benefit leaders shift their contributions upward from the beginning of the game, which is also reflected in the right panel of Figure 3.

Result 4: *Over all periods, leaders, in particular voluntary leaders, contribute significantly*

[16] For this analysis, we include only those groups that experienced both states of leadership. This result also holds in regressions where we add the time trend and leaders' cooperation preference as control variables (see Table A4 in the appendix).

more than their corresponding counterparts in treatment BASE.

Table 4: Random effects regression analysis of leaders' contributions

Dependent variable:	High-benefit			Low-benefit		
Leaders' contributions	(1)	(2)	(3)	(4)	(5)	(6)
HBL	3.118*	3.319**	-0.857			
	(1.708)	(1.623)	(1.683)			
EN_HBL	4.182***	4.051***	0.297			
	(1.155)	(1.230)	(1.570)			
Period*HBL			0.762***			
			(0.221)			
Period*EN_HBL			0.698***			
			(0.220)			
Period		-0.608***	-0.925***		-0.487***	-0.590***
		(0.118)	(0.147)		(0.122)	(0.164)
SVO		4.273***	4.287***		-0.194	-0.179
		(1.622)	(1.614)		(1.295)	(1.312)
LBL				2.782**	3.222**	1.957
				(1.410)	(1.413)	(2.059)
EN_LBL				10.071**	9.884***	8.183***
				(1.392)	(1.345)	(2.139)
Period*LBL						0.228
						(0.255)
Period*EN_LBL						0.367
						(0.383)
Constant	10.229**	12.427***	14.168***	4.162***	6.515***	7.080***
	(0.762)	(1.240)	(1.287)	(0.938)	(1.222)	(1.447)
R^2 overall	0.09	0.15	0.18	0.24	0.30	0.31
N	461	449	449	427	410	410

Note: The reference category is high-benefit members in BASE in Models (1) to (3) and low-benefit members in BASE in Models (4) to (6). The variables "HBL", "LBL" "EN_HBL", "EN_LBL" are dummy variables indicating leaders in those treatments/states. "SVO" is the angle of the vector elicited in the social value orientation task: the larger this value is, the more pro-social the subject is. Cluster robust standard errors in parentheses (clustered on group level). * p < .1, ** p < .05, *** p < .01.

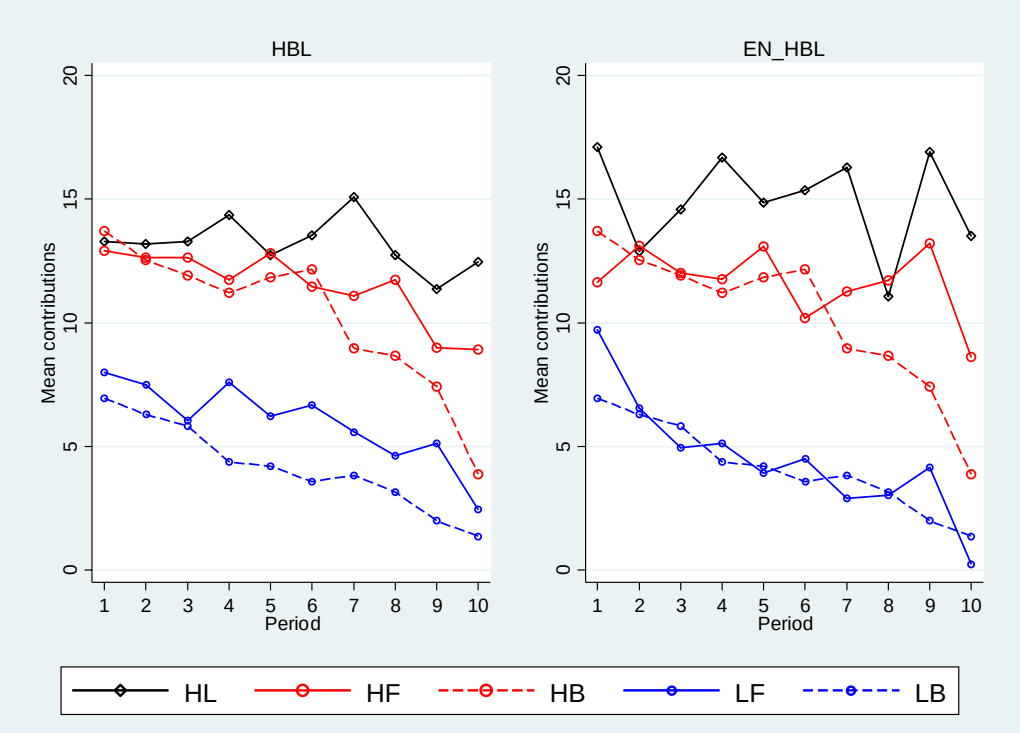
Result 5: *Imposed low-benefit leaders contribute about half as much as imposed high-benefit leaders, while voluntary low-benefit leaders contribute similar amounts as voluntary high-benefit leaders.*

Does setting good examples pay off for leaders? For high-benefit leaders, their contributions and profits are positively correlated (Spearman's $\rho = .8$, $p < .01$ in HBL, $N = 16$; Spearman's $\rho = .62$, $p = .02$ in EN_HBL, $N = 14$). In contrast, for low-benefit leaders, there is no positive relationship between contributions and profits (Spearman's $\rho = -0.03$, $p = .92$ in

LBL, $N = 16$; Spearman's $\rho = -0.17$, $p = .61$ in EN_LBL, $N = 11$). We also run random effects regressions on leaders' payoffs (with leaders' contributions, the time trend and followers' cooperation preference as independent variables, as shown in Table A5 in the appendix). The results of these regressions confirm that setting good examples pays off for high-benefit leaders, but is not beneficial for low-benefit leaders. As shown in Figure A7 in the appendix, under voluntary low-benefit leadership, the leader earns only slightly above the initial endowment and needs to bear the largest disadvantageous inequality in terms of earnings within the group. These findings explain why we see a declining trend in leaders' contributions in LBL and why there is a declining willingness of low-benefit members to volunteer.

Result 6: *Setting good examples is, on average, beneficial for high-benefit leaders, but not for low-benefit leaders.*

Figure 4: Average contributions by identity and type under high-benefit leadership

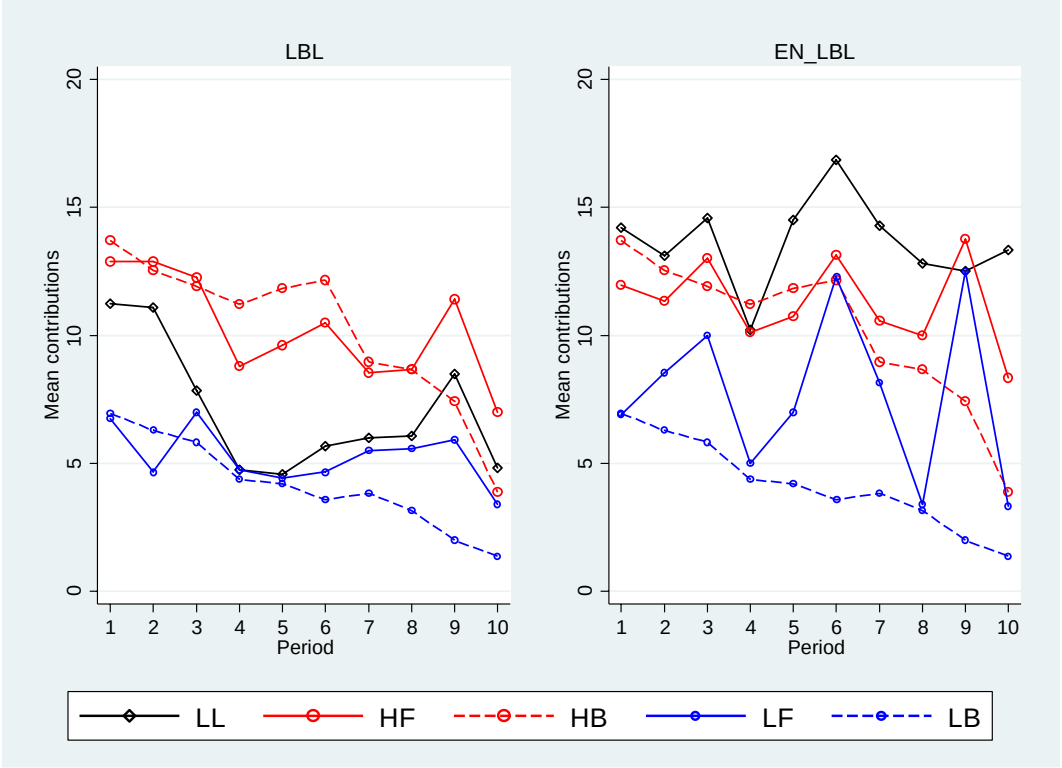


Note: "HL" represents high-benefit leaders. "HF"/"LF" represents high- and low-benefit followers respectively, while "HB"/"LB" represents high- and low-benefit members in BASE.

In the remainder of this section, we turn to the behavior of followers. Figures 4 and 5

present contribution dynamics of leaders and followers under high- and low-benefit leadership. We add contribution dynamics of group members in the baseline treatment, as illustrated by the two dashed lines. As shown in Figure 4 that considers only the situation of high-benefit leadership, high-benefit followers undercut leaders' contributions significantly (two-sided Wilcoxon signed-ranks test: p = .04 in HBL and p = .01 in EN_HBL). Low-benefit followers contribute about half of the amount of the leader in the first period and decrease contributions over time. Their contributions are significantly lower than those of high-benefit leaders (p < .005 in HBL and p < .0001 in EN_HBL). Using data from all periods, we do not observe a significant difference in contributions between followers and their corresponding counterparts in treatment BASE (p > .3).

Figure 5: Average contributions by identity and type under low-benefit leadership



Note: "LL" represents low-benefit leaders. "HF"/"LF" represents high- and low-benefit followers respectively, while "HB"/"LB" represents high- and low-benefit members in BASE.

Figure 5 displays contributions under low-benefit leadership. Low-benefit followers also contribute significantly less than leaders (two-sided Wilcoxon signed-ranks test: p < .005 in LBL and p = .0001 in EN_LBL). For high-benefit followers, their contributions are marginally

significantly higher than leaders in LBL (p = .06), and significantly lower than leaders in EN_LBL (p = .02). Yet, there is no significant difference in contributions between followers and their corresponding counterparts in treatment BASE (p > .3).

Table 5 presents a random effects regression of followers' contributions on treatment/state dummies. Models (1) and (2) compare high-benefit followers with their high-benefit counterparts in treatment BASE; Models (3) and (4) compare low-benefit followers with their low-benefit counterparts in BASE. All coefficients on treatment dummies are positive, indicating a positive effect on followers' contributions, but the only significant coefficient is the one for low-benefit followers in EN_LBL.

Table 5: Random effects regression analysis of followers' contributions

Dependent variables:	(1)	(2)	(3)	(4)
Followers' contributions	HF	HF	LF	LF
HBL	1.303	1.442	1.824	2.124
	(1.798)	(1.744)	(1.721)	(1.597)
LBL	0.025	0.359	1.201	1.968
	(1.568)	(1.687)	(1.409)	(1.437)
EN_HBL	1.472	1.556	1.037	1.484
	(1.328)	(1.381)	(1.200)	(1.096)
EN_LBL	0.940	0.354	3.150**	3.266**
	(1.106)	(1.199)	(1.600)	(1.626)
Period		-0.522***		-0.472***
		(0.108)		(0.072)
SVO		3.517**		2.751**
		(1.401)		(1.169)
Constant	10.229***	12.187***	4.162***	5.642***
	(0.760)	(1.186)	(0.936)	(1.039)
R^2 overall	0.01	0.07	0.03	0.12
N	835	801	869	850

Note: The reference category is high-benefit members in BASE in Models (1) and (2), and is low-benefit members in BASE in Models (3) and (4). "HF"/"LF" represents high- and low-benefit followers respectively. The variables "HBL", "LBL" "EN_HBL", "EN_LBL" are dummy variables indicating followers in those treatments/states. "SVO" is the angle of the vector elicited in the social value orientation task: the larger this value is, the more pro-social the subject is. Cluster robust standard errors in parentheses (clustered on group level). * p < .1, ** p < .05, *** p < .01.

Taken together, leadership has little effect in promoting follower contributions. Only under voluntary low-benefit leadership do we observe a significant increase in low-benefit followers'

contributions. Moreover, voluntary leadership does not seem to have more influence than imposed leaders in our setting. In contrast, followers exploit voluntary leaders to a stronger extent than imposed leaders. The distance between leaders' and followers' average contributions is larger with voluntary leaders than with randomly assigned leaders ($p = .11$ for HBL vs. EN_HBL; $p < .001$ for LBL vs. EN_LBL). The asymmetry in the group appears to provide an excuse that leads to a reduction of a potentially positive leadership effect for both exogenous and endogenous leadership, with an even more pronounced reduction for voluntary leadership.

Result 7: *Relative to their corresponding counterparts in treatment BASE, we only find a significant increase in low-benefit followers' contributions in EN_LBL. Followers exploit leaders more strongly when leaders volunteer than when leadership is imposed.*

Table 6 reports the results of a random effects regression on how followers respond to their leaders' contributions. Except for leaders' contributions, we include the time trend, the follower type, the interaction term between leaders' contributions and the follower type, and individual cooperation preference as independent variables. Table 6 indicates that, with high-benefit leaders, it is mainly the high-benefit followers who reciprocate, irrespective of whether the leader has been randomly assigned or volunteered. For every additional token the high-benefit leader contributes in a given period, a low-benefit follower contributes, on average, about 0.15 tokens. The level of reciprocity of high-benefit followers is significantly higher, with an average of about 0.6 tokens in HBL and 0.55 tokens in EN_HBL. Hence, high-benefit leaders' examples mainly have an impact on the same-type followers.

The last two columns of Table 6 show that low-benefit leaders have a significant influence on low-benefit followers. For every additional token the low-benefit leader contributes in a given period, low-benefit followers contribute 0.28 tokens in LBL and 0.35 tokens in EN_LBL. The interaction term is positive in LBL but not significant, implying that reciprocity from high-benefit followers is not significantly stronger than the one from low-benefit followers when they face a low-benefit leader. It seems that for followers who are of a different type as the leader, reciprocity towards the leader is based on a self-serving perception of contribution

norms: with high-benefit leaders, low-benefit followers tend to balance their *payoff* with high-benefit members, and thus reciprocate on a much lower level; with low-benefit leaders, high-benefit followers try to balance the reciprocation level in *contributions* with low-benefit members. We shall argue that the self-serving perception of contribution norms is one reason for the inefficiency of leadership in the presence of benefit heterogeneity.

Table 6: Followers' responses to leader's example

Dependent variables:	(1)	(2)	(3)	(4)
Followers' contributions	HBL	EN_HBL	LBL	EN_LBL
High-benefit follower	-0.106	1.146	2.994	3.691*
	(1.186)	(1.621)	(2.409)	(2.074)
Leader's contribution	0.156***	0.143***	0.282***	0.352***
	(0.059)	(0.042)	(0.106)	(0.103)
High-benefit follower	0.452***	0.391***	0.219	-0.015
*Leader's contribution	(0.105)	(0.117)	(0.159)	(0.149)
Period	-0.422***	-0.461***	-0.138	-0.393*
	(0.122)	(0.077)	(0.108)	(0.230)
SVO	5.299***	2.685*	3.600**	4.629***
	(1.857)	(1.631)	(1.679)	(1.621)
Constant	4.681***	4.736***	3.694***	3.440**
	(1.078)	(0.837)	(0.987)	(1.493)
R^2 overall	0.42	0.37	0.26	0.27
N	330	325	337	199

Note: "High-benefit follower" is a dummy variable which is 1 if the follower is of the high-benefit type. "SVO" is the angle of the vector elicited in the social value orientation task: the larger this value is, the more pro-social the subject is. Cluster robust standard errors in parentheses (clustered on group level). * p < .1, ** p < .05, *** p < .01.

Result 8: *High-benefit followers reciprocate more strongly than low-benefit followers under high-benefit leadership. The two types of followers reciprocate at a similar level under low-benefit leadership. We allegedly observe a self-serving perception of contribution norms.*

3.3 Path dependency in HBL

Gächter & Renner (2018) report no significant difference in contributions between their leadership treatment and a treatment without leadership, but they observe path dependency in group contributions in both treatments: groups that start at high (low) cooperation levels maintain high (low) cooperation in later periods. This finding, combined with the result that the

initial leader contributions correlate positively with the initial group contributions, implies that the initial leader's contribution has a long-lasting effect on the group's overall contribution in the leadership treatment. Taking each group as the unit of independent observation, we find significantly positive correlations between average group contributions in period 1 and average group contributions from period 2 to 10 under high-benefit leadership, i.e., there is strong path dependency in group contributions in HBL and EN_HBL (Spearman's $\rho = .78$, $p < .01$ in HBL, $N = 11$; Spearman's $\rho = .80$, $p <. 01$ in EN_HBL, $N = 11$).[17] The correlation, however, is not significant with simultaneous contributions or in other leadership conditions. Since voluntary high-benefit leadership does not necessarily start in period 1, in the following we mainly focus on exogenous high-benefit leadership and explore the reasons for group heterogeneity in performance in HBL.[18]

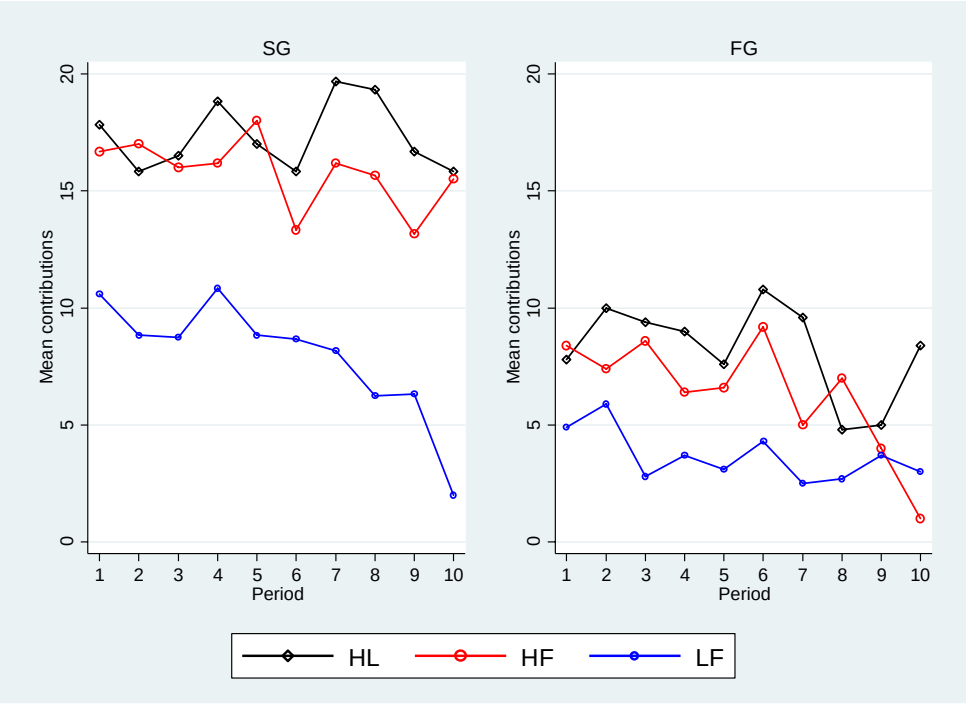
Does the effectiveness of repeated exogenous high-benefit leadership depend on the contribution of the initial leader? In HBL, we classify all groups into two categories, based on the median group contribution level, and denote them as successful groups and failed groups, respectively. Figure 5 shows the contribution dynamics of leaders and followers in successful and failed groups in HBL. Over all periods, leader contributions are significantly higher in successful groups than in failed groups ($p = .01$). This distinction between the two categories of groups already exists in the first period ($p = .04$, 7.8 vs. 17.8). Among the five failed groups, four groups exhibit initial leader contributions that are at most 9 tokens. In contrast, all leaders in the six successful groups contribute at least 10 tokens in the first period. Similar to Gächter & Renner (2018), the initial leader contribution is positively correlated with initial followers' contributions (Spearman's $\rho = .57$, $p = .07$) and the group contribution in the first period (Spearman's $\rho = .79$, $p < .01$). Consequently, we find significantly higher followers' contributions ($p = .01$, 6.1 vs. 12.6) and group contributions ($p = .01$, 6.5 vs. 13.9) in the first

[17] The correlation in EN_HBL includes only those groups that experience high-benefit leadership in the first period. As shown in Figure A4, not all groups in EN_HBL experience high-benefit leadership in the first period.

[18] Recall that the variance in contributions across groups is largest in HBL. Figures A8 and A9 display the contribution dynamics of leaders and each type of follower by group in HBL and LBL. In HBL, we observe a significantly positive correlation between leader contributions in period 1 and leader contributions from period 2 to 10 (Spearman's $\rho = .73$, $p = .01$, $N = 11$). It seems that in HBL some leaders underestimate the effect of their cooperative examples, from the beginning.

period in successful groups. All this suggests that in HBL, it is partly in the hand of the initial leader to determine the group performance in the long run.

Figure 6: Successful and failed groups in HBL



Note: "SG"/"FG" represents successful groups/failed groups in HBL. "HL" represents high-benefit leader. "HF"/"LF" represents high- and low-benefit followers respectively.

What determines the initial leader's contribution? Gächter et al. (2012) find that both the cooperative attitude and the belief towards others' cooperativeness affect leader contributions. In the initial period, given that there are not enough observations for regressions, we calculate the Spearman rank correlation between leaders' contributions and their beliefs/cooperation preferences. We find that leaders' initial contributions and their beliefs are strongly correlated in the first period (Spearman's $\rho = .92$, $p = .0001$ for the belief towards the same-type follower; Spearman's $\rho = .82$, $p = .002$ for the belief towards different-type followers). The correlation between leaders' initial contributions and their cooperation preferences, however, are much smaller both in terms of size and significance (Spearman's $\rho = .53$, $p = .09$). Indeed, initial leaders' beliefs, in particular beliefs about their same-type followers' cooperativeness, are significantly higher in successful groups than in failed groups (11.3 vs. 6.5, $p = .1$ for average belief towards all followers; 14.3 vs. 7.6, $p = .06$ for the belief towards the same-type follower;

9.83 vs. 6, $p < .12$ for beliefs towards different-type followers); while no significant difference in initial leaders' cooperation preferences (0.28 vs. 0.21, $p = .78$) is detected between successful and failed groups.

The influence of the imposed high-benefit leader's period 1 contribution and beliefs on the long-run group-level contributions is also confirmed in Table A6 in the appendix. In Model (1), we control for the initial leader's contribution, the initial followers' cooperation preferences and the time trend. We further add the initial leader's cooperation preference to Model (2). The results of the first two columns indicate that the initial leader's contribution positively relates to the whole group's overall contributions. In Models (3) to (5), we replace the initial leader's contribution with the initial leader's beliefs. The significant positive effect of beliefs in the last three columns, in particular beliefs towards the same-type follower, confirms the previous findings and suggests that increasing the initial high-benefit leader's beliefs about others' cooperation can be a potential way to raise contributions under normative conflict.

Result 9: *In HBL, increasing the initial high-benefit leader's beliefs about others' cooperation helps raising contributions under normative conflict.*

4. Conclusion

In collective action problems in the wild, group members are likely to gain different benefits from the provision of a public good. Our evidence suggests that, when there is benefit heterogeneity in a group, the conflict between different equity and contribution norms is difficult to overcome, even with a mechanism – leading by example – that has often been proven as extremely useful in homogenous populations. This paper examined the effect of leading by example on cooperation when individuals have different benefits from the group account by using a linear public goods experiment.

We find that, under benefit heterogeneity, the effect of leading by example is limited in promoting cooperation. Average contributions do not differ significantly between situations with and without either type of randomly selected leadership. We only find a marginal increase in contributions when the two types of randomly selected leadership – high-benefit leadership and low-benefit leadership – are pooled, and we do not want to over-interpret this marginal

result. With voluntary leaders, in particular voluntary low-benefit leaders, contributions are significantly higher than those in the simultaneous contribution mechanism. However, the motivation for low-benefit members to become voluntary leaders is decreasing quickly over time. This trend, combined with the fact that contributions are lowest in case nobody in the group volunteers to become the leader, raises contributions only marginally in the endogenous treatment relative to our baseline treatment with simultaneous contributions. Nonetheless, in our exogenous high-benefit leadership setting, there is strong path dependency in group contributions, and contributions by followers can be promoted significantly when initial leaders are optimistic. Since high-benefit leaders mainly influence high-benefit followers, selecting optimistic high-benefit members as initial leaders might be more effective when there are enough high-benefit members in the group. Future research could look at groups that consist of three high-benefit members and one low-benefit member and vice versa.

We argue that the limited success of leadership in our setting is mainly attributed to two aspects: leader contributions are not high enough and followers do not reciprocate enough, on average. Leaders do not seem to believe that their good example can elevate the group outcome, and if they do so, many seem to be disappointed quickly with the followers' responses, leading to a rapid decay in contributions and/or the willingness to become leader. Followers appear to condition the level of reciprocity on the leader type. Specifically, low-benefit followers reciprocate to the high-benefit leader, but the level of their reciprocity is particularly low. High-benefit followers reciprocate to low-benefit leaders in a similar way as low-benefit followers, which is not enough to promote cooperation. In addition, followers under voluntary leadership strongly exploit leaders, in particular low-benefit leaders.[19]

Via a laboratory experiment, our study provides evidence on the limited effect of leading by example in promoting cooperation in populations with benefit heterogeneity. It also poses some questions for future research: How can groups with heterogeneity overcome the coordination problem regarding different contribution norms, when there is a leader? Perhaps, in such a situation the leader needs more than just the good example. For instance, it would be

[19] Table A7 shows the relative frequency of chosen contribution norms for all conditions and further confirms our conclusion.

interesting to study situations with benefit heterogeneity in which leaders have additional coercive power such as a punishment option or ostracism power. An alternative would be introducing a communication option for leaders in order to alleviate the coordination problem. Another promising route of research in view of our results is appropriate selection mechanisms for leaders. It seems that type and nature of leaders matter when it comes to the effectiveness of leadership. Relevant characteristics could be considered in appointment or selection (voting) procedures.

References

Ackermann, K. A., Murphy, R. O., 2019. Explaining cooperative behaviour in public goods games: How preferences and beliefs affect contribution levels. Games 10, 15.

Ananyev, M., 2019. Shifting responsibility: Leadership in an asymmetric public goods game. Working Paper, University of Bonn.

Angelova, V., Güth, W., Kocher, M., 2019. Leadership in a public goods experiment with permanent and temporary members. Working Paper.

Arbak, E., Villeval, M.C., 2013. Voluntary leadership: Motivation and influence. Social Choice and Welfare 40(3), 635–662.

Bruttel, L., Fischbacher, U., 2013. Taking the initiative. What characterizes leaders? European Economic Review 64, 147–168.

Buckley, E., Croson, R., 2006. Income and wealth heterogeneity in the voluntary provision of linear public goods. Journal of Public Economics 90(4-5), 935–955.

Cappelen, A. W., Reme, B.-A., Sørensen, E. Ø., Tungodden, B., 2016. Leadership and incentives. Management Science 62(7), 1944–1953.

Cartwright, E., Gillet, J., Van Vugt, M., 2013. Leadership by example in the weak-link game. Economic Inquiry 51(4), 2028–2043.

Chan, K. S., Mestelman, S., Moir, R., Muller, R. A., 1999. Heterogeneity and the voluntary provision of public goods. Experimental Economics 2(1), 5–30.

Charness, G., Cobo-Reyes, R., Jiménez, N., 2014. Identities, selection, and contributions in a public-goods game. Games and Economic Behavior 87, 322–338.

Chaudhuri, A., 2011. Sustaining cooperation in laboratory public goods experiments: A selective survey of the literature. Experimental Economics 14, 47–83.

Chen, Y., Li, S. X., Liu, T. X., Shih, M., 2014. Which hat to wear? Impact of natural identities on coordination and cooperation. Games and Economic Behavior 84, 58–86.

Cherry, T. L., Kroll, S., Shogren, J. F., 2005. The impact of endowment heterogeneity and origin on public good contributions: evidence from the lab. Journal of Economic Behavior and Organization 57(3), 357–365.

Collins, S., 2016. Relay the right way: Harnessing heterogeneity in sequential team production. Managerial and Decision Economics 37, 407–423.

Dannenberg, A., 2015. Leading by example versus leading by words in voluntary contribution experiments. Social Choice and Welfare 44(1), 71–85.

Dasgupta, U., Orman, W. H., 2013. Does heterogeneity help in overcoming the public goods dilemma in a sequential contribution environment? Group Decision and Negotiation 23, 1219–1239.

Drouvelis, M., Nosenzo, D., 2013. Group identity and leading-by-example. Journal of Economic Psychology 39, 414–425.

Fischbacher, U., 2007. 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 100 (1), 541–556.

Fischbacher, U., Schudy, S., Teyssier, S., 2014. Heterogeneous reactions to heterogeneity in returns from public goods. Social Choice and Welfare 43(1), 195–217.

Fisher, J., Isaac, M.R., Schatzberg, J.W., Walker, J.M., 1994. Heterogeneous demand for public goods: Effects on the voluntary contribution mechanism. Public Choice 85, 249–266.

Gächter, S., Nosenzo, D., Renner, E., Sefton, M., 2010. Sequential vs. simultaneous contributions to public goods: Experimental evidence. Journal of Public Economics 94(7–8), 515–522.

Gächter, S., Nosenzo, D., Renner, E., Sefton, M., 2012. Who makes a good leader? Cooperativeness, optimism and leading-by-example. Economic Inquiry 50(4), 867–879.

Gächter, S., Renner, E., 2010. The effects of (incentivized) belief elicitation in public goods experiments. Experimental Economics 13(3), 364–377.

Gächter, S., Renner, E., 2018. Leaders as role models and 'belief managers' in social dilemmas. Journal of Economic Behavior and Organization 154, 321–334.

Gangadharan, L., Nikiforakis, N., Villeval, M. C., 2017. Normative conflict and the limits of self-governance in heterogeneous populations. European Economic Review 100, 143–156.

Glöckner, A., Irlenbusch, B., Kube, S., Nicklisch, A., Normann, H., 2011. Leading with (out) sacrifice? A public-goods experiment with a privileged player. Economic Inquiry 49(2), 591-597.

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

Gürerk, Ö., Lauer, T., Scheuermann, M., 2018. Leadership with individual reward and punishment. Journal of Behavioral and Experimental Economics 74, 57–69.

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(5-6), 1023–1042.

Habyarimana, J., Humphreys, M., Posner, D. N., Weinstein, J. M., 2007. Why does ethnic diversity undermine public goods provision? American Political Science Review 101(4), 709–725.

Haigner, S. D., Wakolbinger F., 2010. To lead or not to lead: Endogenous sequencing in public goods games. Economics Letters 108(1), 93–95.

Isaac, M. R., McCue, K. F., Plott, C. R., 1985. Public goods provision in an experimental environment. Journal of Public Economics 26(1), 51–74.

Jack, B. K., Recalde, M. P., 2015. Leadership and the voluntary provision of public goods: Field evidence from Bolivia. Journal of Public Economics 122, 80–93.

Keuschnigg, M., Schikora, J., 2014. The dark side of leadership: An experiment on religious heterogeneity and cooperation in India. Journal of Behavioral and Experimental Economics 48, 19–26.

Kölle, F., 2015. Heterogeneity and cooperation: The role of capability and valuation on public goods provision. Journal of Economic Behavior and Organization 109, 120–134.

Kube, S., Schaube, S., Schildberg-Hörisch, H., Khachatryan, E., 2015. Institution formation and cooperation with heterogeneous agents. European Economic Review 78, 248–268.

Ledyard, J., 1995. Public goods: A survey of experimental research. In J. Kagel and A. Roth (Eds.), The Handbook of Experimental Economics. Princeton University Press.

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.

Liebrand, W. B. G., 1984. The effect of social motives, communication and group size on behavior in an n-person multi-stage mixed-motive game. European Journal of Social Psychology 14, 239–264.

Liebrand, W. B. G., McClintock, C. G., 1988. The ring measure of social values: A computerized procedure for assessing individual differences in information processing and social value orientation. European Journal of Personality 2, 217–230.

Moxnes, E., van der Heijden, E., 2003. The effect of leadership in a public bad experiment. Journal of Conflict Resolution 47(4), 773–795.

Neitzel, J., Sääksvuori, L., 2013. Normative conflict and cooperation in sequential social dilemmas. Working Paper.

Nikiforakis, N., Noussair, C., Wilkening, T. 2012. Normative conflict and feuds: The limits of self-enforcement. Journal of Public Economics 96(9-10), 797–807.

Nosenzo, D., Sefton, M., 2011. Endogenous move structure and voluntary provision of public goods: Theory and experiment. Journal of Public Economic Theory 13(5), 721–754.

Ostrom, E., Gardner, R., Walker, J., 1994. Rules, games, and common-pool resources. Ann Arbor: University of Michigan Press.

Oxoby, R. J., Spraggon, J., 2013. A clear and present minority: Heterogeneity in the source of endowments and the provision of public goods. Economic Inquiry 51(4), 2071–2082.

Pogrebna, G., Krantz, D., Schade, C., Keser, C., 2011. Words versus actions as a means to influence cooperation in social dilemma situations. Theory and Decision 71(4), 473–502.

Potters, J., Sefton, M., Vesterlund, L., 2005. After you – endogenous sequencing in voluntary contribution games. Journal of Public Economics 89(8), 1399–1419.

Potters, J., Sefton, M., Vesterlund, L., 2007. Leading-by-example and signaling in voluntary contribution games: an experimental study. Economic Theory 33, 169–182.

Préget, R., Nguyen-Van, P., Willinger, M., 2016. Who are the voluntary leaders? Experimental evidence from a sequential contribution game. Theory and Decision 81, 581–599.

Reuben, E., Riedl, A., 2009. Public goods provision and sanctioning in privileged groups. Journal of Conflict Resolution 53, 72–93.

Reuben, E., Riedl, A., 2013. Enforcement of contribution norms in public good games with heterogeneous populations. Games and Economic Behavior 77(1), 122–137.

Rivas, M. F., Sutter, M., 2011. The Benefits of Voluntary Leadership in Experimental Public Goods Games. Economics Letters 112(2), 176–178.

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

van der Heijden, E., Moxnes, E., 2013. Leading by example to protect the environment: do the costs of leading matter? Journal of Conflict Resolution 57(2), 307–326.

Online Appendix

Table A1: The number of independent observations for states in EN by period

Period	EN_NL	EN_LBL	EN_HBL	Total
1	3	10	11	24
2	6	9	9	24
3	5	7	12	24
4	3	9	12	24
5	3	8	13	24
6	6	7	11	24
7	6	7	11	24
8	5	5	14	24
9	12	2	10	24
10	13	3	8	24
Total	62	67	111	240

Table A2: Determinants of the decision to lead in EN (Probit)

Dependent variable:	(1)	(2)	(3)
Choose to lead (=1 if yes)	All subjects	High-benefit	Low-benefit
High-benefit type	0.489***		
(=1 if yes)	(0.164)		
SVO	0.773***	0.825***	0.782***
	(0.217)	(0.296)	(0.265)
Period	-0.051**	-0.030	-0.076**
	(0.024)	(0.032)	(0.033)
Constant	-0.649***	-0.284	-0.526***
	(0.161)	(0.173)	(0.179)
Pseudo R^2	0.06	0.03	0.06
N	940	470	480

Note: "High-benefit type" is a dummy which is 1 if the subject is of high-benefit type. "SVO" is the angle of the vector elicited in the social value orientation task: the larger this value is, the more pro-social the subject is. Cluster robust standard errors in parentheses (clustered on group level). * p < .1, ** p < .05, *** p < .01.

Table A3: Average contributions by identity and player type

	HB		LB
BASE	10.23 (2.72)		4.16 (3.35)
EN_NL	6.33 (5.04)		2.89 (2.67)
	HL	HF	LF
HBL	13.2 (5.36)	11.5 (5.62)	5.99 (4.97)
EN_HBL	14.41 (4.14)	11.71 (5.95)	5.18 (3.70)
	HF	LL	LF
LBL	10.25 (4.91)	7.06 (4.01)	5.27 (3.76)
EN_LBL	11.64 (3.80)	14.52 (4.77)	6.90 (5.64)

Note: "HB(LB)" refers to high-benefit (low-benefit) members. "HL(HF)" refers to high-benefit leaders (high-benefit followers). "LL(LF)" refers to low-benefit leaders (low-benefit followers). Standard deviations in parentheses.

Table A4: Leader's contribution across leadership treatments and states

Dependent variable: Leader's contribution	
Voluntary leader	6.606***
	(1.593)
High-benefit leader	6.090***
	(1.863)
Voluntary leader*High-benefit leader	-5.855***
	(2.238)
Period	-0.249**
	(0.100)
SVO	2.961**
	(1.295)
Constant	7.993***
	(1.132)
R^2 overall	0.23
N	399

Note: "Voluntary leader" is a dummy variable which is 1 if the leader is voluntary; "High-benefit leader" is a dummy variable which is 1 if the leader is of high-benefit type; "SVO" is the angle of the vector elicited in the social value orientation task: the larger this value is, the more pro-social the subject is. Cluster robust standard errors in parentheses (clustered on group level). * p < .1, ** p < .05, *** p < .01.

Table A5: Determinants of leader's payoff

Dependent variable:	(1)	(2)	(3)	(4)
Leader's payoff	HBL	EN_HBL	LBL	EN_LBL
Leader's contribution	0.508***	0.474***	-0.080*	-0.119
	(0.174)	(0.124)	(0.048)	(0.076)
Period	-1.011***	-1.200***	-0.220	-0.440*
	(0.310)	(0.196)	(0.144)	(0.266)
SVO of the same-type follower	7.860	7.515*	-1.163	1.718
	(5.444)	(3.918)	(1.898)	(2.052)
Average SVO of different-type followers	20.145*	0.954	3.019	10.146***
	(12.171)	(4.922)	(7.255)	(2.814)
Constant	27.355***	32.094***	27.522***	24.402***
	(4.107)	(1.947)	(2.264)	(1.650)
R^2 overall	0.42	0.29	0.03	0.34
N	110	109	113	67

Note: "SVO" is the angle of the vector elicited in the social value orientation task: the larger this value, the more pro-social the subject is. Cluster robust standard errors in parentheses (on group level). * p < .1, ** p < .05, *** p < .01.

Table A6: Determinants of group contributions in HBL

Dependent variable: Group contribution	(1)	(2)	(3)	(4)	(5)
Initial leader's contribution	0.268**	0.336***			
	(0.112)	(0.074)			
SVO of initial h-follower	6.248***	6.551***	6.820***	6.415***	6.981***
	(1.888)	(1.559)	(1.656)	(1.334)	(1.790)
Average SVO of initial l-followers	12.857***	15.608***	20.139***	19.821***	20.303***
	(4.698)	(5.119)	(5.675)	(5.232)	(5.936)
Period	-0.375***	-0.375***	-0.375***	-0.375***	-0.375***
	(0.135)	(0.135)	(0.135)	(0.135)	(0.135)
SVO of initial leader		-4.175*	-5.353**	-6.195**	-4.558*
		(2.536)	(2.678)	(2.877)	(2.553)
Initial leader's belief about all followers			0.327**		
			(0.142)		
Initial leader's belief about h-follower				0.343***	
				(0.106)	
Initial leader's belief about l-followers					0.282*
					(0.164)
Constant	2.650	1.911	2.272	1.783	2.710
	(1.924)	(2.020)	(2.228)	(1.962)	(2.313)
R^2 overall	0.57	0.62	0.55	0.57	0.54
N	110	110	110	110	110

Note: "h-/l-follower(s)" refers to high-/low-benefit follower(s) respectively. "SVO" is the angle of the vector elicited in the social value orientation task: the larger this value is, the more prosocial the subject is. "Initial leader's belief about all/l- followers" is the initial leader's belief about all/low-followers' average contribution. "Initial leader's belief about h-follower" is the initial leader's belief about the high-benefit follower's contribution. Cluster robust standard errors in parentheses (clustered on group level). * p < .1, ** p < .05, *** p < .01. We obtain similar results when using followers' average contribution as the dependent variable.

Table A7: Distribution of contribution norms for different treatments and states

	BASE	HBL	LBL	EN	EN_NL	EN_HBL	EN_LBL
(a) Equality of contributions	33.33%	18.18%	**50.00%**	37.5%	28.57%	16.67%	**71.43%**
(b) Equality of earnings	-	-	-	-	-	4.17%	-
(c) Proportional to benefits	8.33%	**45.45%**	16.67%	25.00%	28.57%	**37.50%**	14.29%
(d) Between (b) and (c)	33.33%	27.27%	33.33%	29.17%	19.05%	25.00%	9.52%
(e) Others	25%	9.09%	-	8.33%	23.81%	16.67%	4.76%

Figure A1: Group contribution dynamics in treatment BASE

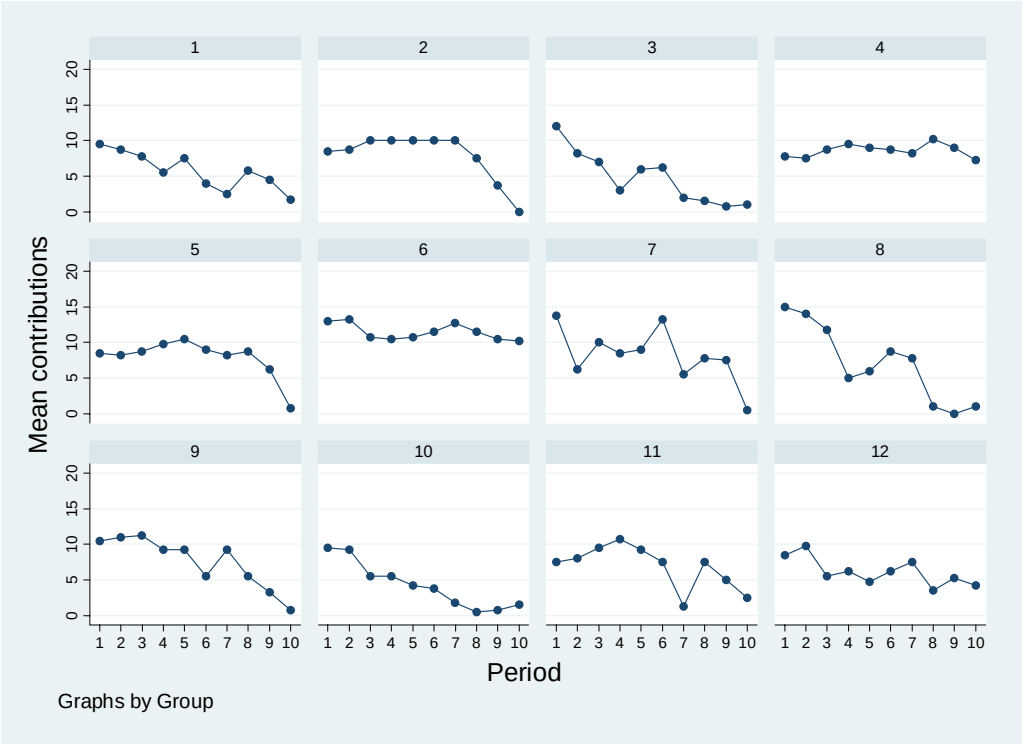


Figure A2: Group contribution dynamics in HBL

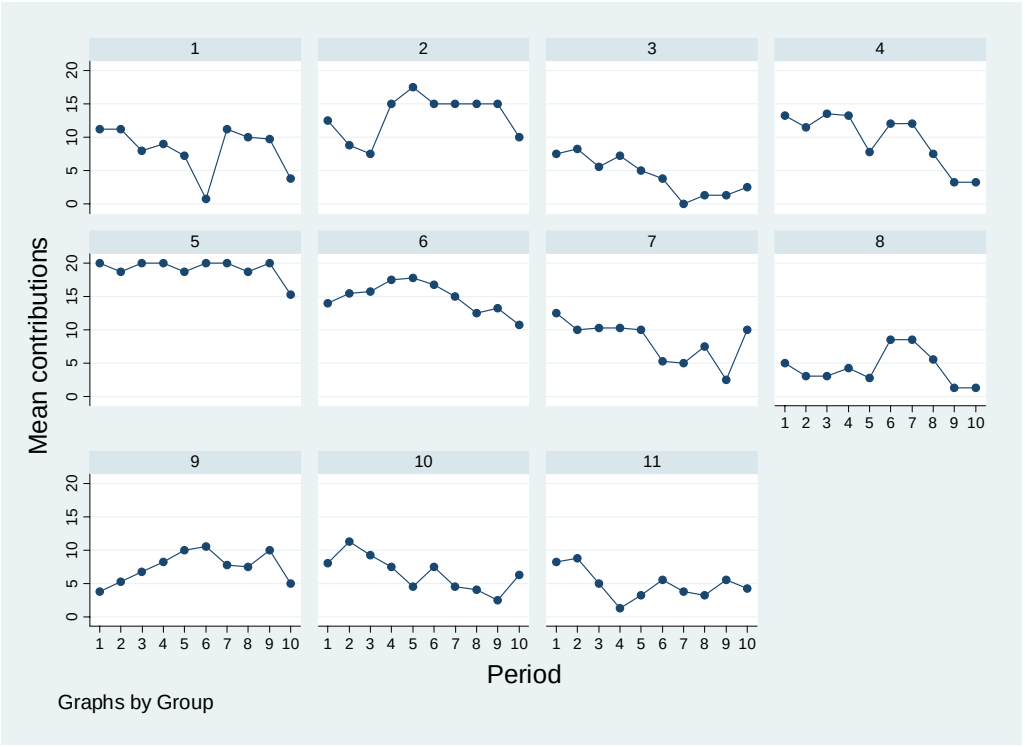


Figure A3: Group contribution dynamics in LBL

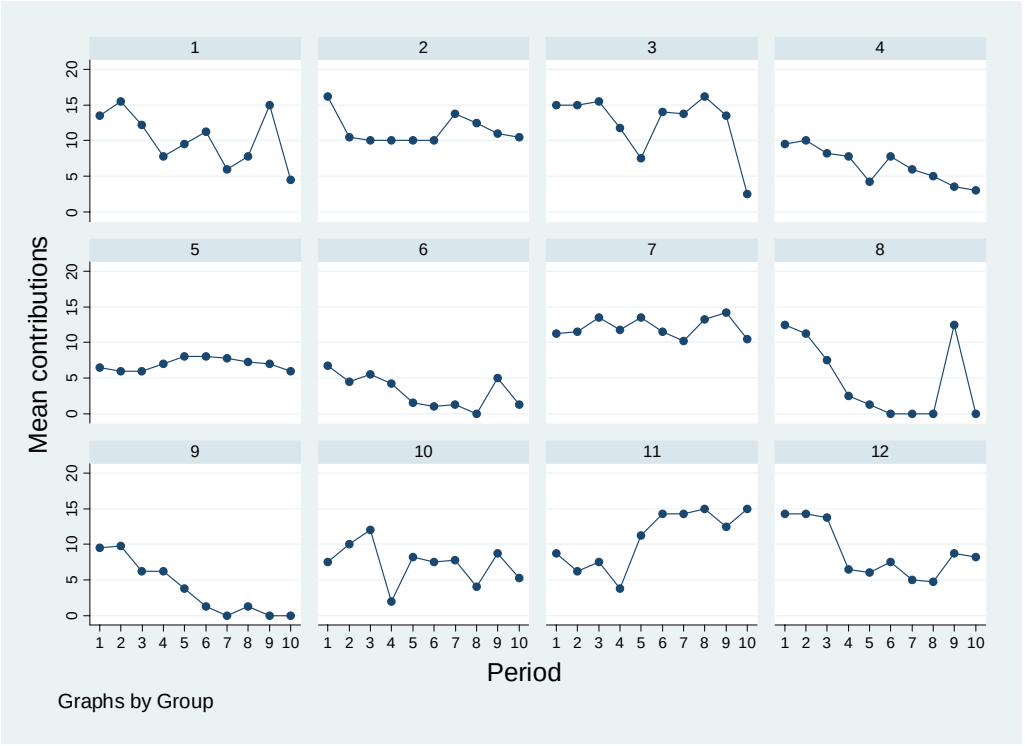
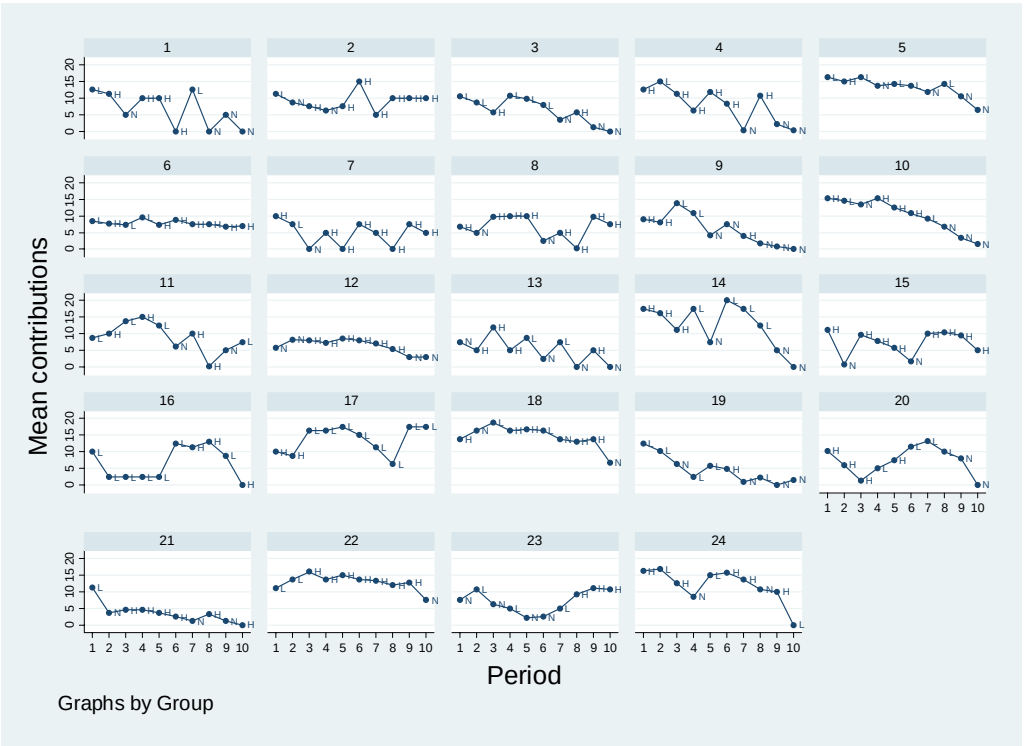
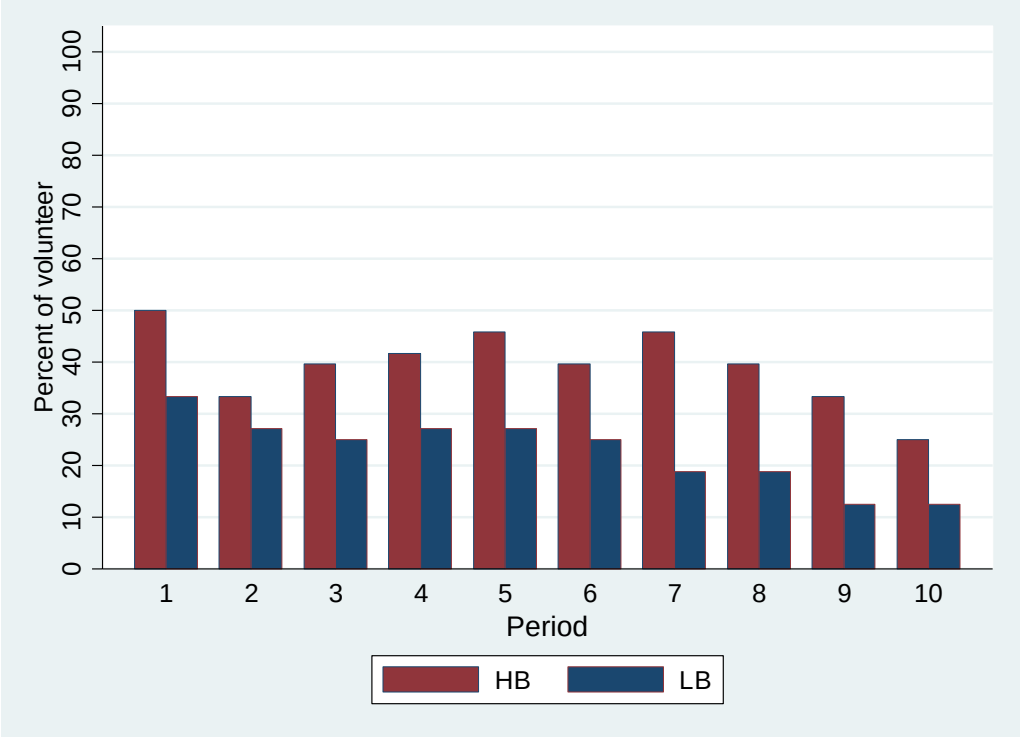


Figure A4: Group contribution dynamics in EN



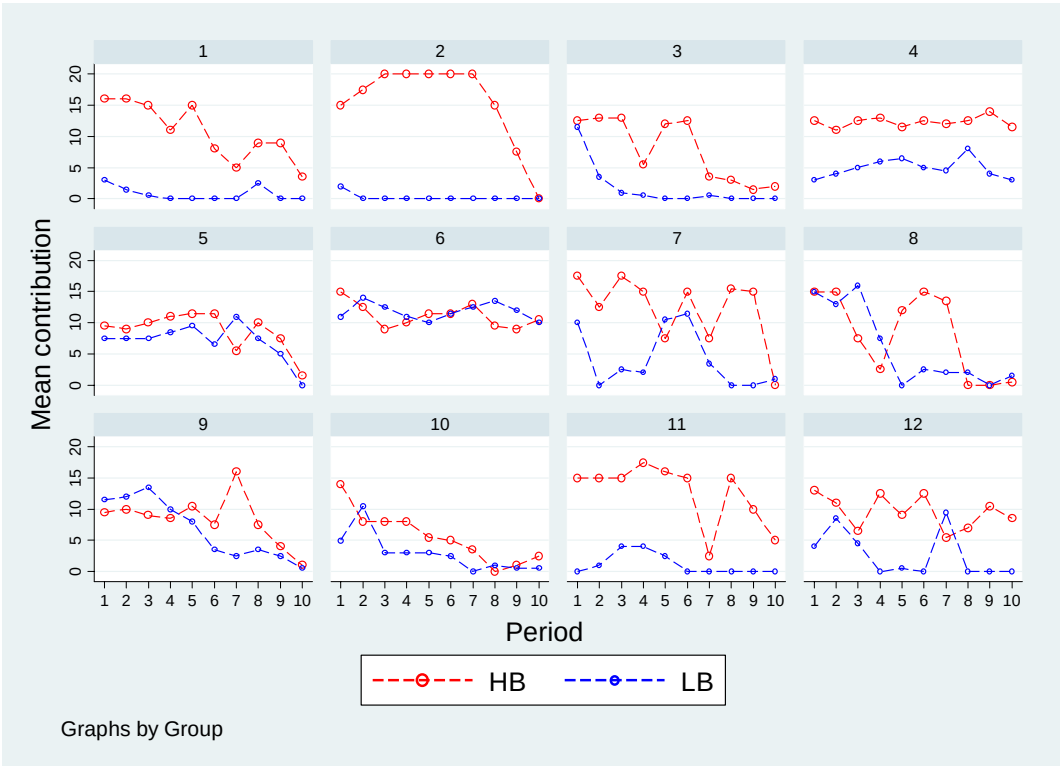
Note: "H"/"L"/"N" represents the state in effect - high-/ low-/no-leadership - in the endogenous treatment.

Figure A5: The fraction of volunteers over time by player type



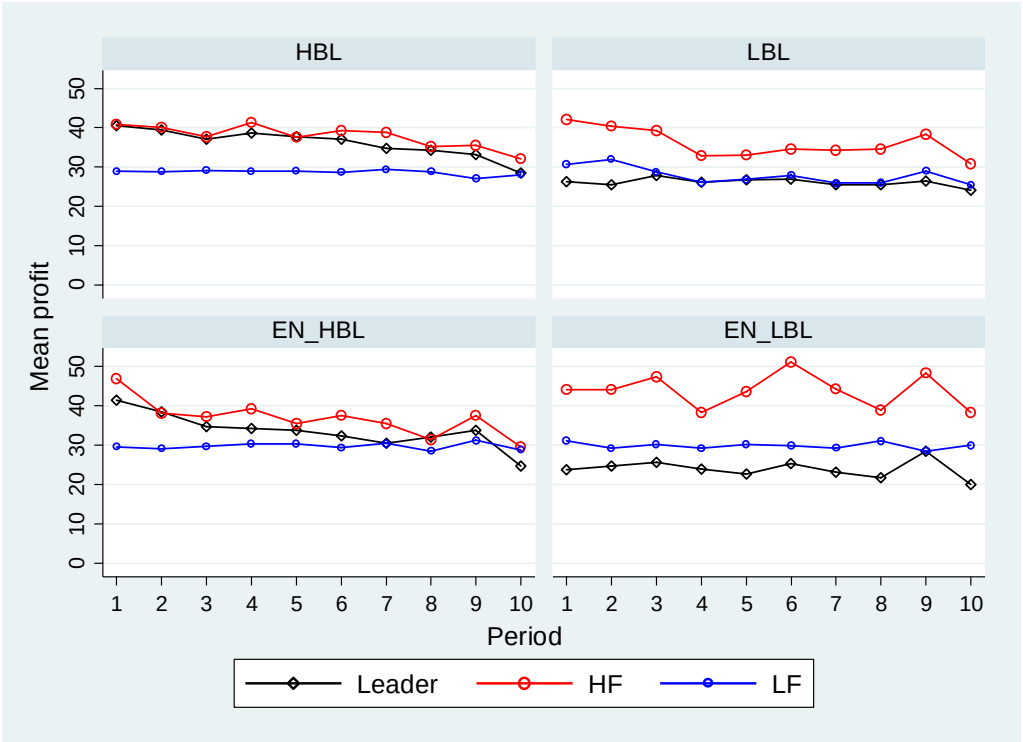
Note: "HB"/"LB" represents high- and low-benefit members.

Figure A6: Group contribution dynamics in BASE by player type



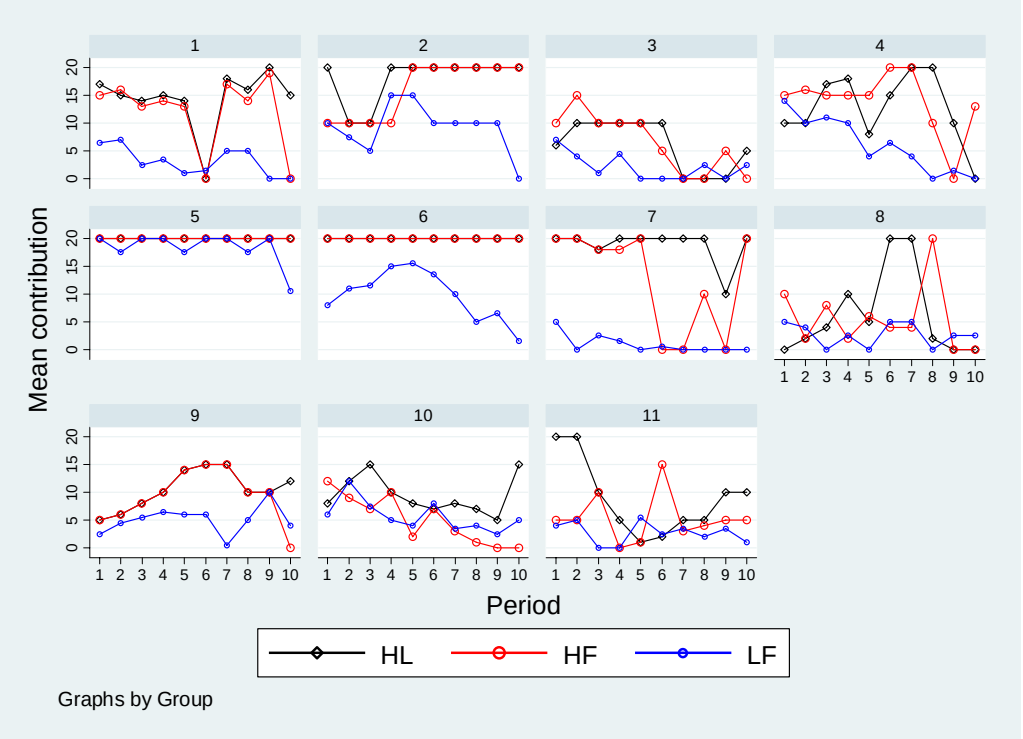
Note: "HB"/"LB" represents high- and low-benefit members respectively.

Figure A7: Payoff dynamics of leaders and followers in leadership conditions



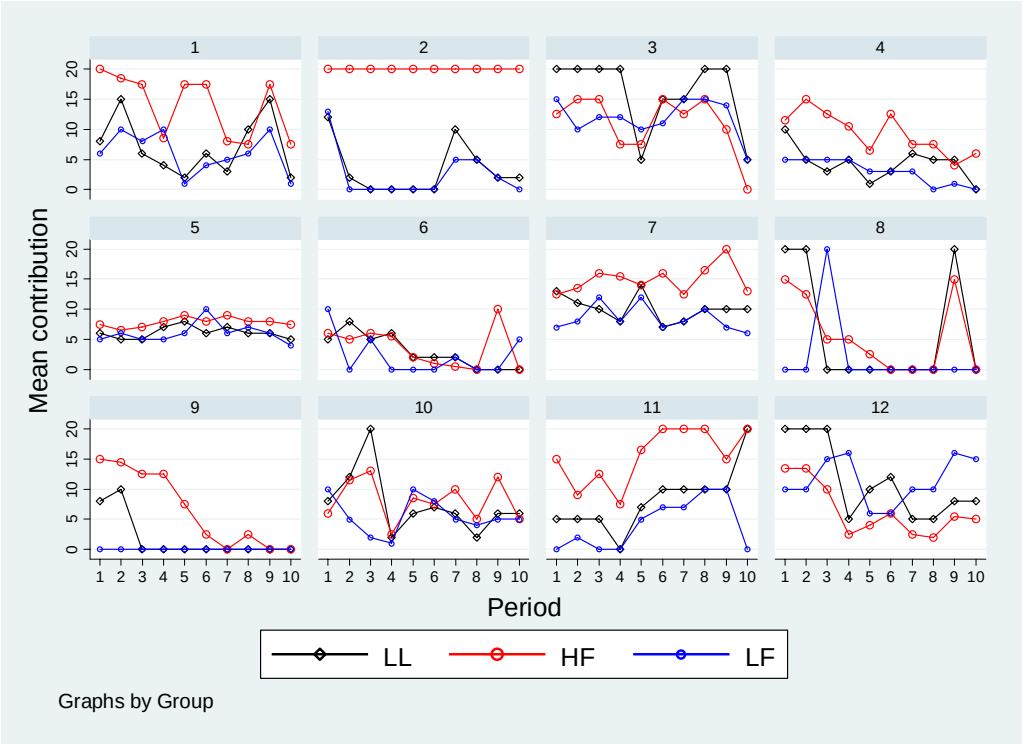
Note: "HF"/"LF" represents high- and low-benefit followers respectively.

Figure A8: Group contribution dynamics in HBL by player identity and type



Note: "HL" represents high-benefit leaders. "HF"/"LF" represents high- and low-benefit followers respectively.

Figure A9: Group contribution dynamics in LBL by player identity and type



Note: "LL" represents low-benefit leaders. "HF"/"LF" represents high- and low-benefit followers respectively.

Experimental instructions

Welcome to this experiment! Thank you very much for participating!

Please do not talk to other participants from now on!

General

This is an experiment on decision making. You receive €4.00 for showing up on time. If you read these instructions carefully, you can make good decisions and earn a considerable amount of money that will be paid out to you in cash at the end of the experiment.

The experiment will last approximately 1 hour. If you have any questions, please raise your hand, and an experimenter will come to you and answer your questions privately. During the experiment, your earnings will be calculated in experimental **points**. At the end of the experiment, all points that you earn will be converted into Euro at the exchange rate announced at the beginning of each part.

In the interest of clarity, we will only use male terms in the experiment. They should be interpreted as being gender-neutral.

Anonymity

You will learn neither during nor after the experiment, with whom you interact(ed) in the experiment. The other participants will neither during nor after the experiment learn, how much you earn(ed). We never link names and data from experiments. At the end of the experiment you will be asked to sign a receipt regarding your earnings which serves only as a proof for our sponsor. The latter does not receive any other data from the experiment.

Means of help

You will find a pen at your table which we kindly ask that you, please, leave on the table when the experiment is over. While you make your decisions, a clock at the top of your computer screen will run down. This clock will inform you regarding how long we think that the maximum decision time will be. However, if you need more time, you may exceed the limit. The input screens will not be dismissed once time runs out. However, the output/information screens (here you do not have to make any decisions) will be dismissed after time is up.

Experiment

The experiment consists of two parts. You will receive instructions for the second part after the first part has ended. These instructions will be read to you aloud. Then you will have an opportunity to study them on your own and to ask questions privately.

Your total earnings in this experiment will be the sum of your earnings in parts 1 and 2. The two parts of the experiment are completely independent, i.e. decisions in part 1 have no consequences for your earnings in part 2.

Part 1

Exchange rate

Any point earned in Part 1 will be converted into Euro at the following exchange rate:

1 Point=0.02 Euro (50 Points = 1 Euro).

The basic decision situation

This part consists of **10 identical periods**. You are randomly assigned into a group of **four** at the beginning of this part. The group composition **does not** change over the 10 periods. That means your group consists of the same people in all 10 periods. Before the first period starts, two group members are randomly selected to be of type A and the remaining two members will be of type B. The meanings of type A and type B will be explained below. You will be informed of your type at the beginning of the first period and your type remains **unchanged** during this entire part. Additionally, each group member receives a random identification number (ID) from 1 to 4. This number will remain **fixed** during this entire part.

In every period, each group member has to decide on the allocation of 20 points. You can keep these 20 points in your **private account** or you can contribute them **fully or partially** to a **group account**. Each point you do not contribute to the group account will **automatically** remain in your private account. Saving points for a later period is therefore not possible.

Your income from the private account:

You will earn one point for each point you keep in your private account. For example, if you keep 20 points in your private account (and therefore do not contribute anything to the group account) your income will amount to exactly 20 points out of your private account. If you keep 6 points in your private account (and therefore contribute 14 points to the group account), your income from this account will be 6 points. No one except you earns something from your private account.

Individual income from your private account =
20 – Your contribution to the group account

Your income from the group account:

Each group member will profit from the amount you contribute to the group account. On the other hand, you will also get a payoff from the other group members' contributions to the group account. The individual income for each group member out of the group account will be determined as follows:

Individual income from the group account =
Sum of all group members' contributions to the group account $\times$ ***type-factor***

If you are of **type A**, your type-factor is **0.4**. If you are of **type B**, your type-factor is **0.8**. That is, for each point contributed by all group members to the group account, you receive 0.4 points if you are of type A and you receive 0.8 points if you are of type B.

Total income:

Your total income is the sum of your income from your private account and that from the group account:

Income from your private account (= 20 – Contribution to the group account)
*+ Income from the group account (= Sum of contributions to the group account × **type-factor**)*
= Your total income

Example: Suppose you contribute 8 points to the group account and the other three members contribute 20 points to the group account altogether. Then your income from the private account will be 12 points (20-8=12). Your income from the group account will be 11.2 points (0.4× (20+8) =11.2) if you are of type A and 22.4 points (0.8× (20+8) =22.4) if you are of type B. Hence, your total income will be 12+11.2=23.2 points if you are of type A and 12+22.4=34.4 points if you are of type B.

How you interact with your group members

At the beginning of each period, the computer will randomly assign the role of "**First mover**" to one of the two members of **type B** [**LBL: type A**] in your group. The **three** remaining members in the group will be assigned the role of "**Second mover**".

Each period consists of the following two stages:
1. First mover decides about his own contribution to the group account before the other second movers.
2. Being informed about the ID and contribution decision of the first mover, the other three second movers decide simultaneously and privately about their own contributions. This means no second mover will be informed about the contribution decision of another second mover before he makes his decision.

Which member of type B [**LBL:** type A] goes first is determined randomly for each period.

[**EN:** At the beginning of each period, you decide if you want to be the **first mover** or a **second mover**.

Being the first mover means that you will make your contribution decision before the other group members. Being a second mover means that before you make your contribution decision, you will be told the type, ID and contribution decision of the first mover in your group. The three second movers make contribution decisions simultaneously and privately. This means no second mover will be informed about the contribution decision of another second mover before he makes his decision.

Only one member can be the first mover in a group eventually. So in case of ties, one member will be randomly selected (with equal probability) to be the first mover. Only the one or those who are involved in the random draw but are not selected will be informed about the existence of the random draw. If no member chooses to be the first mover, all the four group members will contribute simultaneously and privately. This means nobody will be informed about the contribution decision of another group member before he makes his decision.]

[**BASE:** All group members make contribution decisions simultaneously and privately. This means nobody will be informed about the contribution decision of another group member before he makes his

decision.]

Procedure of Part 1

At the beginning of this part you will be informed about your **type and ID**. After checking them, please click "Continue". Then a screen will show you **whether you are the first mover or a second mover**. Please click "Continue" to proceed.

- If you are the **first mover**, you have to **decide how many of the 20 points you contribute to the group account before the other three group members**. The other three group members are second movers and would make their contribution decisions **simultaneously and privately** after seeing your type, ID and contribution. Please insert your contribution in the box on your screen. You can insert integers only (e.g., numbers like 0, 1, 2…20). The difference between 20 and your contribution to the group account is automatically the amount you keep in your private account. After you have chosen your contribution, please click "OK". You cannot change your decision after you have pressed "OK". After clicking "OK", a waiting screen will appear. The experiment continues after all second movers have made their decisions.

- If you are a **second mover**, you will be asked to wait patiently. After the first mover has made his decision, a screen will show you his **type, ID, and contribution to the group account**. In the lower part of that screen, you have to **decide how many of the 20 points you contribute to the group account**. You can insert integers only (e.g., numbers like 0, 1, 2…20). The difference between 20 and your contribution to the group account is automatically the amount you keep in your private account. Please click "OK" if you are ready to continue. A waiting screen will appear until all second movers have pressed "OK".

[**EN:** At the beginning of this part you will be informed about your **type and ID**. After checking them, please click "Continue". Then you will be asked to indicate your **moving position** (**whether you want to be the first mover or a second mover in the current period)**. After choosing your moving order, please click "OK" to proceed. Then a screen will show you **whether you are the first mover or a second mover**, or tell you **nobody in your group chooses to be the first mover**. Please click "Continue" to proceed.

- If you are the **first mover**, you have to **decide how many of the 20 points you contribute to the group account before the other three group members**. The other three group members are second movers and would make their contribution decisions **simultaneously and privately** after seeing your type, ID and contribution. Please insert your contribution in the box on your screen. You can insert integers only (e.g., numbers like 0, 1, 2…20). The difference between 20 and your contribution to the group account is automatically the amount you keep in your private account. After you have chosen your contribution, please click "OK". You cannot change your decision after you have pressed "OK".

- If you are a **second mover**, you will be asked to wait patiently. After the first mover has made his decision, a screen will show you his **type, ID, and contribution to the group account**. In the lower part of that screen, you have to **decide how many of the 20 points you contribute to the group**

account. You can insert integers only (e.g., numbers like 0, 1, 2…20). The difference between 20 and your contribution to the group account is automatically the amount you keep in your private account. Please click "OK" if you are ready to continue.

- If **nobody in your group chooses to be the first mover**, you have to **decide how many of the 20 points <u>you</u> contribute to the group account**. *The only difference from the two cases above is that you make the decision with the other <u>three</u> group members simultaneously and privately.* You can insert integers only (e.g., numbers like 0, 1, 2…20). The difference between 20 and your contribution to the group account is automatically the amount you keep in your private account. Please click "OK" if you are ready to continue.]

[**BASE:** At the beginning of this part you will be informed about your **type and ID**. After checking them, please click "Continue". Then you have to **decide how many of the 20 points <u>you</u> contribute to the group account**. Please insert your contribution in the box on your screen. You can insert integers only (e.g., numbers like 0, 1, 2…20). The difference between 20 and your contribution to the group account is automatically the amount you keep in your private account. After you have chosen your contribution, please click "OK". You cannot change your decision after you have pressed "OK".]

At the end of the period, every group member will receive an information screen regarding the type, ID, moving position (First mover or not) and contribution of each group member, as well as every member's income from that period. After receiving feedback, the next period starts. After 10 periods, Part 1 of the experiment ends.

[**BASE:** At the end of the period, every group member will receive an information screen regarding the type, ID, and contribution of each group member, as well as every member's income from that period. After receiving feedback, the next period starts. After 10 periods, Part 1 of the experiment ends.]

Your earnings from Part 1 will be the sum of your total income from the 10 periods, and it will be paid out in cash to you at the end of the experiment. After the end of Part 1 you will get instructions for Part 2.

Before we proceed, please try to solve the control questions on your screen. If you want to compute something, you can use the Windows calculator by clicking on the calculation symbol on your screen.

Part 2

You are randomly assigned into a group of **two** at the beginning of this part. You have to answer 24 questions, in which you can choose one of two options A or B. Every option results in a positive or negative payoff for you and the other person in your group. The other person answers exactly the same questions. Your payoff in part 2 depends on your decision and the decision of the other person in your group.

A decision example:

	Option A	Option B
Your payoff	10.00	7.00

Other's payoff	-5.00	4.00

- If you choose option A, you receive 10 points, and the other person loses 5 points. If the other person also chooses option A, he, too, receives 10 points and you lose 5 points. In total, you therefore earn 5 points (10 points from your choice minus 5 points from the other person's choice). The other person earns 5 points (10 points – 5 points), too.
- If you choose option B and the other person chooses option A, you earn 2 points (7 points from your own choice minus 5 points from the other person's choice). The other person would earn 14 points (10 points + 4 points).
- The remaining combinations (you choose A and the other person chooses B, or you both choose B) are analogous to these two examples.

Overall you take 24 decisions like the one described above. Your total payoff is computed as follows: The 24 values for "your payoff" are summed up over your decisions. The 24 values for "Other's payoff" are summed up over the other person's decisions. The sum of these two sums determines your total payoff from this part and is converted into Euro at the following exchange rate:

1 Point=0.10 Euro (10 Points = 1 Euro).

Note that you are not receiving information on each single decision taken by the other person in your group. Rather, you will find out only the sum of your decisions for "your payoff", the sum of the other person's decisions for "Other's payoff" and your total payoff from Part 2.

If there are any questions, please raise your hand now. We will come to you and answer your questions privately.

After Part 2, you will be asked to complete two short questionnaires. This will conclude the experiment. You will receive information on your respective income for Parts 1 and 2, and we will pay you your earnings in private.