Leading by example with and without exclusion power in voluntary contribution experiments*

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Abstract

We examine the effects of leading by example in voluntary contribution experiments. Leadership is implemented by letting one group member contribute to the public good before followers do. Such leadership increases contributions in comparison to the standard voluntary contribution mechanism, especially so when it goes along with authority in the form of granting the leader exclusion power. Whether leadership is fixed or rotating among group members has no significant influence on contributions. Only a minority of groups succeeds in endogenously installing a leader, even though groups with leaders are much more efficient than groups without a leader.

Keywords: Voluntary contribution experiment, leadership, exclusion power, endogenous selection.

JEL-classification: C72, C92, H41

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1 Introduction

Leading by setting an example is an important means to influence the behavior of others when (often incomplete) contractual relationships or hierarchical authority are absent. In fact, many well-known historical persons have relied on this principle of voluntary leadership to promote the well-functioning of groups or society, think of Albert Schweitzer ("Example is leadership.") or Mahatma Gandhi ("We must be the change we wish to see in the world.").

In this paper we provide a comprehensive experimental study on three aspects of leading by example, which we will elaborate in detail below. First we examine the effects of leadership and the influence of leader's strength on behavior in voluntary contribution games. Second, we check whether it makes a difference for overall contributions if one single group member is always the leader or if all group members rotate in the leader's role. Third, we address whether groups want to install a leader by voting and how the outcome of the vote is related to contribution behavior.

Only recently (an early exception is von Stackelberg, 1934) the issue of leadership has received attention in the economics literature. From a theoretical perspective, Hermalin (1998) presents a model of leadership in the presence of asymmetric information between leaders and followers. He shows that a leader can induce others to follow suit either by example or by sacrifice. Arce (2001) and Foss (2001) identify leadership in their models as a means to achieve efficient outcomes in social dilemma games. From an empirical perspective, the effects of leading by example have received particular attention with respect to charitable fundraising. If well-known persons donate to a certain project and this is publicly announced, others often tend to follow (Vesterlund, 2003).[1] A similar effect arises when at the start of a public fundraising campaign a notable fraction of the goal is pledged as seed money (List and Lucking-Reiley, 2002).

Several experimental papers have investigated the effects of voluntarily leading by example. Employing a full information setting, Moxnes and Van der Heijden (2003), Van der Heijden and Moxnes (2003), and Gächter and Renner (2004) have implemented leadership in the laboratory by letting a

[1] One nice example is illustrated in the New York Times report (from March 30, 2002, p. A13) on the grand dame of American Philanthropy, Brook Astor, whose donations often triggered a subsequent flow of additional donations.

leader decide and announce his contribution before the other group members contribute (simultaneously). These studies find that leaders' and followers' contributions are highly correlated even in one shot games (Gächter and Renner, 2004), and that average contributions with leadership are (in most cases significantly) higher than without leadership.

Comparing a full information setting with a situation of asymmetric information - where a leader has private information about the returns from contributing - Potters et al. (2006) show that asymmetric information plays an important role in the success of leadership because it allows the leader to signal the returns from contributing to the follower. These findings of Potters et al. (2006) contrast somewhat with results from Meidinger and Villeval (2002) who report an experimental test of Hermalin's (1998) model of leadership. Meidinger and Villeval (2002) explain the success of leadership by reciprocity on the side of followers, but attribute only little influence to signaling. Parts of these differences as far as the experiments with asymmetric information are concerned might be due to Meidinger and Villeval (2002) relying on a partners design with repeated play in which reciprocity is more important than in the strangers design of Potters et al. (2006). Yet, as far as their full information treatments are concerned, both Potters et al. (2006) and Meidinger and Villeval (2002) report that followers condition their contribution on the contribution of their leaders, meaning that even in the absence of private information leadership can change behavior.

In our paper, we will rely on a full information setting and will concentrate on the following three aspects of leading by example. First, we reexamine the effects of leading by example. An important, but hitherto neglected, aspect of leading by example relates to the leader's formal authority. All previous studies have implemented leadership by letting the leader contribute before the followers, thereby restricting the leader's feasible options to setting an example and to reacting on followers' behavior in previous periods. However, leaders may have formal authority allowing them to discipline misbehaving followers, as it is typical in hierarchically structured organizations or as it is also possible in clubs where club members can use the club goods without rivalry in consumption, but where the president or the board of the club have exclusion power. Hence, we implement a treatment where leading by example is strengthened by the leader's power to exclude one follower from the group in the ensuing period.[2] Installing a leader with exclusion power seems akin to the opportunity of the leader of a work group to dismiss or suspend a member from the group.

Punishment through exclusion has costs not only for the excluded member but also for the group itself, because it reduces the number of potentially contributing members. Consequently, the possible efficiency losses from exclusion are endogenously borne by the group itself.[3] Note that the possibility to exclude someone from contributing to and consuming the public good is at odds with the usual assumptions of public goods games. We therefore speak of voluntary contribution experiments in the following, but rely on the usual public goods scenario as our workhorse, except for the exclusion possibility (which will always apply to the *next* period, as will be explained in section 2).

The second aspect of leading by example that we examine is the way in which a leader is appointed. Previous experiments have concentrated on the case where one single group member carries the burden of leading by example for the entire experiment. However, leading by example often rotates among the members of a given group or institution. For instance, in many European universities there is a tradition that the president of the university is elected in a rotating order from different schools. Similarly, professional organizations - like the American Economic Association - elect their presidents (who are supposed to lead by setting a good example) for a limited time. Given the various ways of determining leaders, we compare a treatment in which leadership is granted to a single group member to a treatment in which leadership rotates among all group members in a predetermined and publicly known order.

The third aspect we are interested in is whether groups actually want some member to lead by example. We examine this issue by letting groups

[2] Cinyabuguma et al. (2005) also consider the effects of the threat of exclusion in a public goods game. In their setting each group member can vote to expel one or more other group members. A subject is expelled (permanently) if he is "voted out" by at least half of the group members. Hence, the threat of exclusion is mutual, but not restricted to a group's leader. Therefore, it is impossible to investigate the relationship between a leader's strength and overall cooperation levels in such a setting.

[3] There are quite a few studies where punishment is implemented by letting group members assign punishment points to each other, rather than by excluding group members (see, e.g., Ostrom et al., 1992; Fehr and Gächter, 2000; Sefton et al., 2006; Andreoni et al., 2003; Masclet et al., 2003). None of these papers have considered the combination of leading by example *plus* punishment power, though.

vote on whether they want to have a leader or not. Allowing for an endogenous determination of leadership may provide insights into why some groups are more efficient than others and which group members are more likely elected as a leader. This aspect of our paper is related to the literature on endogenous institutional choice.

Early experimental studies of endogenously changing the institutional structure in common-pool-resource dilemmas have been carried out by Messick et al. (1983), Samuelson et al. (1984), and Samuelson and Messick (1986). Participants in these experiments could delegate their decision on how much to extract from a common pool resource via a collective vote to a leader. When the common pool was near depletion, subjects had a stronger tendency to delegate their decision to a leader. Vyrastekova and Van Soest (2003) have explored in a common pool experiment whether allowing resource users to vote on a natural resource management's incentive structure enhances the efficiency of resource use. In fact, compared to games in which appropriate incentives are imposed exogenously, behavior is more cooperative if a majority has voted for that structure. However, the quorum for implementing the appropriate incentives is failed in more than half of the cases what leads to less efficiency. Recently, Potters et al. (2005) have shown in a setting with asymmetric information that pairs of one leader and one follower are remarkably often successful in the endogenous sequencing of contributions. When given an option to vote on whether the leader's contribution shall be disclosed to the follower, more than 80% of leaders and 99% of followers support such an endogenous sequencing.

Our results show that leading by example has a positive impact on contribution levels. Moreover, strong leaders with exclusion power induce substantially higher contributions than leaders without such formal power. The way of appointing a leader – either a single group member or all group members in turn - has no significant influence on efficiency. When given the opportunity to endogenously select a leader, only about 40% of groups succeed in appointing a leader, even though groups with a leader outperform groups without a leader by far.

The paper proceeds as follows: Section 2 introduces the voluntary contribution game. Section 3 is devoted to the experimental design. The experimental results are presented in Section 4. A concluding discussion is offered in Section 5.

2 The voluntary contribution game

The basic game is the voluntary contribution mechanism (hereafter, VCM), as introduced by Isaac et al. (1984). Let $I = \{1, \ldots, 4\}$ denote a group of 4 individuals who interact for $t = 1, \ldots, T$ periods. In each period t, individual $i \in I$ is endowed with income e, which can be either privately consumed or contributed to a group activity. Each individual's contribution $c_{i,t}$ must satisfy $0 \leq c_{i,t} \leq e$. Denoting by C_t the sum of individual contributions in t, i.e., $C_t = \sum_{j=1}^{4} c_{j,t}$, the monetary payoff of individual i in period t is linear in $c_{i,t}$ and C_t, and takes the following form:

$$u_{i,t}(c_{i,t}, C_t) = e - c_{i,t} + \beta C_t, \tag{1}$$

where $0 < \beta < 1 < 4\beta$. Due to $\beta < 1$, the dominant strategy for each player is to contribute nothing. If this is done by all, every individual i earns $u_{i,t} = e$ in each period. Since $4\beta > 1$, the socially efficient outcome (maximizing the sum of $u_{i,t}(\cdot)$ over $i \in I$) is, however, to contribute everything, yielding a period payoff of $u_{i,t} = 4\beta e$ for all $i \in I$.

We consider three types of this game: the standard-VCM, the VCM with leadership, and the VCM with strong leadership. Our control treatment is the standard-VCM, in which all 4 group members make their contribution decisions privately and simultaneously.

The VCM with leadership has two decision stages in each period. First, the *leader*, l, chooses his contribution $c_{l,t}$, which is announced to the *followers*. Then, the followers f $(\neq l)$ decide simultaneously about $c_{f,t}$. Applying backward induction and assuming commonly known monetary payoff maximization, the theoretical prediction for the VCM with leadership coincides with that for the standard-VCM: Because of $\beta < 1$, the followers' dominant strategy in stage 2 is to contribute zero; a rational leader will anticipate this and free-ride as well in stage 1.

The VCM with strong leadership adds a third stage to the previous ones. After being informed about the followers' contributions $c_{f,t}$, the leader can select one other individual x $(\neq l)$ whom he excludes from the group in the *next* period $t + 1$. In this case, the excluded individual x earns $u_{x,t+1} = e$ in period $t + 1$ (i.e., he is excluded from contributing to, and consuming, the group activity in the following period), with the remaining group members playing a 3-person voluntary contribution game, implying that $C_{t+1} = \sum_{j \neq x} c_{j,t+1}$. When determining the opportunistic benchmark solution for the VCM with a strong leader, note that a leader is indifferent between excluding another group member or not because the equilibrium contributions of zero in the second stage of the game render the leader's payoff independent of his exclusion decision. Since followers do not follow the leader in the second stage of the game, the leader's optimal decision in the first stage is to choose $c_{l,t} = 0$ as well. Summing up, under the assumption of payoff maximization we can expect the same (zero) contributions in the standard-VCM, the VCM with leadership, and also the VCM with strong leadership.

3 Experimental procedures

The experiment is based on the three types of the VCM introduced in the previous section: the standard-VCM as control (henceforth C-treatment), the VCM with leadership (henceforth L-treatment), and the VCM with strong leadership (henceforth SL-treatment). Each treatment has 24 periods, in which we set $e = 25$ and $\beta = 0.4$. In the treatments with leadership, subjects are informed in the experimental instructions (given in the Appendix) that there are two parts: (1) an exogenous part in periods 1–16, and (2) an endogenous part in periods 17–24, where groups have to decide themselves whether they want a leader or not.

To investigate whether contributions depend on the way in which a leader is appointed, we implement two ways of installing a leader in the exogenous part. In the *fixed* (f-) treatments, *one* of four group members is randomly selected to be the leader and remains in charge for the entire exogenous part. In the *rotating* (r-) treatments, *each* of the four group members is appointed as leader for four consecutive periods where the sequence of rotation is predetermined and commonly known.

The two different ways of installing a leader and the two forms of leadership (with and without exclusion power) yield a 2x2 experimental design with the following four leadership treatments: Lf, Lr, SLf, and SLr.[4] The

[4] In the treatment with rotating strong leaders (SLr) we have ruled out the leader's exclusion power in stage three of the final (i.e. fourth) period of leadership (i.e., the leader cannot exclude anyone for the next round), because that might have caused problems in the next period in case the excluded person were the predetermined next leader. In both strong leader treatments (SLr and SLf), we have also restricted the leader's power to

characteristics of our set of five different treatments (including the standard-VCM as control) are summarized in Table 1.[5] The relation of these treatments to our main research questions is shown in Table 2.

Table 1 and Table 2 about here

Leadership in the endogenous part is determined as follows: Periods 17–24 are split into two phases of four periods each. Before periods 17 and 21, subjects vote on leadership for periods 17–20 and 21–24, respectively. In the f-treatments, a leader is installed if the leader himself wants to remain leader *and* all three followers accept him as leader. Otherwise, the group has no leader and all group members contribute simultaneously to the group activity in the respective four-period phase. In the r-treatments, subjects have to indicate for each group member (including themselves) whether they would accept that member as leader. If there is a single member within a group who is unanimously accepted, this person becomes the leader and stays in charge throughout the respective 4-period phase. If more than one member is unanimously accepted, one of these members is randomly selected as leader. In all other cases, the group has no leader and all members contribute simultaneously. Both in the f- and r-treatments, group members are informed about the other group members' contributions in the exogenous part before voting in periods 17 and 21.

All experimental sessions were run computerized with the help of z-Tree (Fischbacher, 1999) at the laboratory of the Max Planck Institute of Economics in Jena (Germany) between November 2003 and March 2004. For each of our five treatments we ran two sessions with 7 four-person groups (in partners design), yielding 14 independent observations per treatment. A total of 280 undergraduate students from various disciplines participated in

exclude only *one* other group member, because if the leader excluded more than one other member any contribution would be inefficient not only individually, but also for the group as a whole (because $n\beta < 1$ for $\beta = 0.4$ and $n \leq 2$).

[5] We ran an additional 'control' treatment by implementing the Lr-treatment *without* the endogenous part, i.e. with 16 periods only (denoted $Lr16$). Contributions in all treatments with leadership might, indeed, depend on the prospect of the endogenous vote on leadership, which was announced right from the start. To provide evidence that there is no spillover from the endogenous to the exogenous part, we compared contributions in $Lr16$ with those in the exogenous part of Lr, finding that there is no significant difference between them, neither in overall averages nor in single periods (detailed results are available upon request; $N = 14$ in $Lr16$, as in the other treatments). This evidence makes us confident that our results do no depend on the presentation of the endogenous phase already at the beginning of the experiment (see instructions in the Appendix).

at most one session, earning on average about 14 Euro (including a show-up fee of 2.50 Euro).

Participants received written instructions which were read aloud to establish common knowledge. Understanding of the rules was assured by a control questionnaire that subjects had to answer before the experiment. After each period, participants got feedback on all individual contribution decisions in their group, identified by membership number, and their period payoffs. Concerning the vote on leadership before periods 17 and 21, group members were only informed about whether and which group member had been installed as the leader, but not about individual voting behavior.

4 Results

4.1 Leading by example in the exogenous part

4.1.1 The impact of (strong) leaders on contribution levels

Table 3 presents the contribution averages and standard deviations in the control-treatment, the treatments with a leader, and those with a strong leader.[6] Regarding periods 1–16, average contributions range from 10.0 (out of 25) in the C-treatment to 19.8 in the SL-treatments. Groups with leadership contribute (weakly) significantly more than the control groups without leadership ($p < 0.08$ for C vs. L; $p < 0.01$ for C vs. SL; two-sided Mann-Whitney U-test; $N = 42$ in both cases). The standard deviation of contributions is not significantly different between C and L, but is significantly smaller in SL than in C ($p < 0.01$; two-sided Mann-Whitney U-test; $N = 42$). In sum, the following result by and large corroborates previous experimental evidence.

Result 1 *Leading by example increases private contributions.*

Table 3 about here

Table 3 also indicates that contributions are significantly higher with a strong leader (19.8 in SL) than with a weak one (13.4 in L) ($p < 0.01$; Mann-Whitney U-test; $N = 56$), though the standard deviation of contributions is not significantly different. This yields our second result.

[6] In this subsection, we pool the data from Lf and Lr, and from SLf and SLr in order to study the pure effects of (strong) leadership. In the next subsection we will show that pooling is justified.

Result 2 *Contributions are substantially higher when leaders have exclusion power than when this is not the case.*

Figure 1 about here

Figure 1 shows the time path of average contributions in each class of treatments. In each single period, average contributions are always the lowest in the C-treatment and the highest in the SL-treatments, with the L-treatments in between. Contributions in the C- and L-treatments decline significantly in the course of the experiment (with slope coefficients of -0.41 in C, and -0.33 in L; $p < 0.05$; OLS-regression with clustering of groups), but the slopes are not significantly different from each other. The latter result implies that the higher overall contributions in the L-treatments are due to a shift in the level of contributions (i.e. a higher intercept in the regression), but not to a less steep downward trend of contributions across time. Contributions in the SL-treatments are basically stable (slope -0.03; $p > 0.4$; OLS-regression with random effects and clustering of groups in order to control for the dependency of observations within groups). Both the intercept and the slope are significantly larger in the SL-treatments than in the C- and L-treatments.

4.1.2 The effects of rotating versus fixed leadership

Table 4 reports averages and standard deviations of contributions in each treatment with leadership. Figures 2 and 3 display the time paths of the average contributions in the exogenous part (i.e. periods 1-16). As regards the L-treatments, the way in which a leader is appointed - either once and for all as in Lf or in a predetermined and rotating scheme as in Lr - does not have a significant influence on average contributions (13.1 in Lf vs. 13.7 in Lr; $p > 0.6$; two-sided Mann-Whitney U-test and Kolmogorov-Smirnov-test; $N = 28$) and their standard deviation (4.0 in Lf vs. 5.3 in Lr; $p > 0.15$; two-sided Mann-Whitney U-test; $N = 28$). Looking at Figure 2 we also see that the average contributions in Lr and Lf frequently intersect in the course of periods 1-16.

Table 4 and Figures 2 and 3 about here

Turning to the SL-treatments, overall average contributions are weakly significantly higher when the leader is fixed (20.8 in SLf) than when he rotates (18.8 in SLr) ($p = 0.062$ in two-sided Mann-Whitney U-test; $p = 0.06$ in Kolmogorov-Smirnov-test; $N = 28$). However, Figure 3 reveals that contributions in SLr are markedly lower than in SLf only in every fourth period, where rotating leaders have no power to exclude another group member from interaction in the next period. Therefore, if we consider only those periods where exclusion is possible, average contributions in SLr rise to 19.9 and are no longer significantly lower than in SLf ($p > 0.2$; two-sided Mann-Whitney U-test; $N = 28$). Therefore we state

Result 3 *Whether a leader is appointed once and for all or in a rotating order has no significant influence on contributions.*

4.1.3 Leaders' and followers' contributions and profits

Table 5 presents the average contributions and profits of leaders and followers in the exogenous part of the experiment. Within each single treatment, leaders' contributions are significantly higher than followers' contributions ($p < 0.05$ in any treatment; two-sided Wilcoxon signed-rank tests; $N = 14$ in each treatment[7]). However, leaders' and followers' contributions are highly significantly correlated. Spearman rank correlation coefficients are 0.97 in Lf, 0.91 in Lr, 0.64 in SLf, and 0.78 in SLr ($p < 0.02$ in each single treatment). This evidence can be summarized by

Result 4 *Contributions of leaders and followers are very highly and positively correlated. Hence, followers actually follow, but also exploit their leaders by contributing significantly less than them.*

Table 5 about here

Concerning the payoffs of leaders and followers in periods 1−16 (indicated on the right hand side of Table 5), we find that followers earn more than leaders in any treatment ($p < 0.05$; two-sided Wilcoxon signed-ranks test; $N = 14$ in each treatment).

For leaders it is interesting to check whether they earn at least more than the average payoff in the control treatment with no leader. In fact, leaders without exclusion power earn slightly less than subjects in the C-treatment, implying that leadership does not pay off for the leader himself,

[7] For statistical testing, we matched the leader's average contributions with the average contribution of all followers in order to get one independent observation per group.

even though the difference is far from being significant. Only strong leaders gain significantly compared to subjects in the C-treatment ($p < 0.01$ in C vs. SLf, $p = 0.06$ in C vs. SLr; two-sided Mann-Whitney U-test; $N = 28$ for each comparison). In contrast, followers gain from leadership when compared to average earnings in the C-treatment (with $p < 0.1$ in C vs. Lf, and $p < 0.05$ in any other comparison of C with either Lr, SLf or SLr; two-sided Mann-Whitney U-tests; $N = 28$ for each comparison). These observations lead us to our next result.

Result 5 *Compared to the average payoffs in the control-treatment, leadership always pays for followers, but for leaders only when they are endowed with exclusion power.*

4.1.4 Causes and consequences of exclusion

The main cause for exclusion can be seen from Figure 4. On the horizontal axis, this figure shows a follower's deviation from the other followers' average contribution. On the vertical axis, it indicates the relative frequency with which a follower is excluded if his deviation from the other followers' average contributions is in a given interval. The numbers above the bars indicate the total number of observations in the various deviation intervals.[8]

Figure 4 about here

As one can see from the left hand side of Figure 4, the less a group member contributes in comparison to the other two followers[9], the more likely this member is excluded. For instance, if a group member contributes 10 or more units *less* than the other followers' average, then the relative frequency of being excluded is in both treatments 40% or higher. About 20% of group members with a deviation in the interval $[-10, -2.5)$ are still excluded. From the middle part of Figure 4 we can see that only about 2% of followers are excluded when they basically match the other followers' average contributions (see interval $[-2.5, 2.5]$) and that the large majority

[8] Note that when a follower is excluded in a given round (and therefore must contribute zero) we do not include that as an observation for a particular deviation interval.

[9] The same picture would practically result if we took into account deviations from the *leader's* contribution. Since contributions of the leader and the followers are highly significantly correlated, deviations from the followers' average contribution are qualitatively equivalent to deviations from the leader's contribution.

of contributions are close to the other followers' average. Overall, we find that excluded group members contribute significantly less than the other followers in their group ($p < 0.01$ for both SLf and SLr, two-sided Wilcoxon signed-rank tests; $N = 14$ in each treatment).

The frequency of exclusion differs between SLr and SLf. In the rotating scheme (SLr), leaders exclude one other group member in 24% of the possible cases, whereas fixed leaders (SLf) exclude another group member in only 13% of cases, which is significantly less frequent than in SLr ($p < 0.05$; two-sided Mann-Whitney U-test; $N = 28$). This difference might be due to the (insignificantly) lower average contributions of followers in SLr than in SLf (see Table 5).

The consequences of being excluded seem to be rather similar in both treatments, though. Comparing an excluded group member's contribution *before* ($c_{x,t-1}$) and *after* ($c_{x,t+1}$) being excluded in period t (where $c_{x,t} = 0$ is imposed), we can reject the null hypothesis of $c_{x,t+1} = c_{x,t-1}$ in favor of the alternative $c_{x,t+1} > c_{x,t-1}$ in both treatments ($p < 0.01$ in SLf, $p < 0.05$ in SLr).[10] We sum up the evidence from this subsection in the next result.

Result 6 *Exclusion is more frequent the more a follower deviates negatively from the other followers' average contributions. Excluded group members react to exclusion by increasing their contributions significantly.*

4.2 Leading by example in the endogenous part

Table 6 summarizes the relative frequency of successfully appointing a leader (either in period 17 or in period 21), and the average contributions with and without a leader. About one third of the groups in the L-treatments choose to have a (weak) leader, and about one half of the groups install a strong leader in the SL-treatments. Groups with a leader in the endogenous part contribute, on average, significantly more than groups without a leader (see columns [2] and [3] in Table 6; $p < 0.05$ in any treatment, two-sided Wilcoxon signed ranks tests[11]). The difference is particularly striking in the

[10] We used a one-sided Wilcoxon signed-ranks test here and took individuals as units of observation. Yet, each individual (that was excluded at least once) entered only once because we took an individual's average pre-exclusion contribution and matched it with the average post-exclusion contributions of this participant.

[11] We use a conservative measure for testing by including only those groups which experienced both having and not having a leader in periods 17–24. The frequency of appointing

Lf-treatment, where groups with leaders contribute on average 15.6, compared to 3.6 if there is no leader. Columns [4] and [5] in Table 6 show the contributions of leaders and followers in case a leader has been appointed. Like in the exogenous part, leaders contribute significantly more than followers in each single treatment ($p < 0.05$, two-sided Wilcoxon signed ranks tests), and even followers contribute significantly more than groups without a leader (with the exception of Lr, in all other treatments we have $p < 0.05$; two-sided Mann-Whitney U-tests). We summarize these findings as follows.

Result 7 *Only about 40% of groups successfully appoint a leader. Contributions in groups with a leader are substantially higher than in groups without a leader.*

Table 6 and Table 7 about here

To examine in more detail what triggers endogenous leadership, Table 7 reports the results of a probit regression with a group's appointment of a leader (= 1) as dependent variable. The group's average contribution across periods 1-16 ("Contribution P1-16") has a significantly positive impact on the probability of appointing a leader in period 17 and in period 21. The strength of the leader ($SL = 1$) and the existence of a rotation scheme in the exogenous part ($r = 1$) do not significantly affect this probability. A larger difference between the leader's and the followers' contributions in periods 1-16 ("Lead_con − follow_con P1-16") has a weakly significantly negative impact on the likelihood of appointing a leader in period 17. The latter result indicates that appointing a leader is less likely if followers do not follow. Since the appointment as such can be regarded as a public good (it increases, indeed, overall contributions), 'leadership' may be at risk when the followers let down the leader by contributing much less.

Moving from the aggregate group level to the level of individual group members and their voting behavior we start by examining who is elected as leader. In the r-treatments (Lr, SLr), leaders are appointed in 20 out of 56 possible cases. In 12 of the successful cases, leadership is assigned to the group member with the highest contribution as leader in the exogenous part (periods 1–16). In eight cases, leadership is granted to the member with

a leader does not differ between periods 17 and 21. Over all four treatments, 20 (27) out of 56 groups appointed a leader for periods 17-20 (21-24). Only 12 groups managed to elect a leader in both phases, whereas 22 never agreed on a leader.

the highest contributions as follower (which always coincides with being the runner-up concerning the contributions as leader). In the f-treatments (Lf, SLf), the exogenously determined leader is endogenously reappointed in 27 out of 56 cases, where re-appointment depends positively on the overall average contributions (as shown in Table 7). Therefore, when only one group member is eligible as leader, subjects clearly condition their support of leadership on its success in the exogenous part.

Given that the presence of a leader in the exogenous part triggers higher contributions, it is, of course, interesting to check why the appointment of a leader may fail. It turns out that the leader's strength has a remarkable influence. Whereas failure in the L-treatments is typically due to the (weak) leader refusing leadership, it is the followers who turn down the (mostly willing) strong leader in the SL-treatments.

In more detail, 11 out of 18 failures to appoint a leader in Lf are exclusively due to the (fixed) leader's dissent - when all followers want him as leader -, whereas such a reason accounts only for 1 out of 11 failures in SLf. On the contrary, only 4 out of 18 failures in Lf, but 8 out of 11 failures in SLf are caused by at least one follower's dissent - when the leader himself wants to serve as leader. Judging by a Fisher-exact test, the Lf- and SLf-treatments differ significantly with respect to why leadership fails ($p < 0.05$). In the middle part of Table 8 we report a probit regression with the decision to vote for a leader (= 1) in period 17 as the dependent variable. One's own contributions make it more likely to support leadership. The others' contributions enter negatively, but not significantly so. If the leader has exclusion power ("Strong leader" = 1) subjects vote significantly less often for leadership, which is most due to the fear of followers of getting excluded.[12] Leaders themselves ("Subject is leader" = 1) vote significantly less often for leadership. However, the negative impact of the variable "Subject is leader" is exclusively due to the Lf-treatment. This can be inferred from the positive interaction term "Subject is leader*SLf". Hence, weak leaders typically reject serving as a leader, whereas strong leaders do not.

Table 8 about here

[12] In fact, a separate estimation for SLf shows that the frequency of having been excluded in periods 1-16 has a significantly negative effect on the likelihood of accepting leadership.

The r-treatments with rotating leadership in the exogenous part show similar patterns as the f-treatments. Note that in these treatments any group member is eligible as leader. Here we focus on whether subjects are willing to act as leader. In Lr, 14 out of 20 failures to appoint a leader are caused by one member refusing leadership when all others want him as leader, whereas only 6 out of 16 failures in SLr are due to the same reason ($p < 0.06$; Fisher-exact test).[13] The right-hand side of Table 8 provides the estimates for the factors that determine whether a subject votes for himself as leader. The larger one's own contributions, the more likely a subject's willingness to accept leadership. However, the smaller the others' contributions, the less likely such a willingness is. Hence, subjects shy away from the burden of leadership if others have been observed to contribute relatively little. The results on voting behavior are summarized in our last result.

Result 8 *Leaders with exclusion power want to remain leaders, but followers often turn them down. Leaders without exclusion power typically refuse to take on the burden of leadership, even though their followers want them as leaders.*

5 Conclusions

We have studied the influence of leading by example in a voluntary contribution experiment. Our results show that leading by example (i.e., leadership by moving first) results in a marginally significant increase in contributions, compared to a situation without leadership. When leaders are equipped with the authority to exclude other group members, they achieve - *and sustain* - very high levels of cooperation that are significantly higher than the levels prevailing with pure leadership by example.

Leading by example increases efficiency because second movers follow their leaders. That means that followers condition their voluntary contributions on their leader's earlier contribution. This result provides clear

[13] Concerning individual voting patterns we note that in Lr it is never the case that a subject votes for himself as leader, but rejects all other group members as leader. In SLr there are only 4 such individuals. That means that only very few subjects (4 out of 112) consider leadership so attractive as to veto all others while at the same time promoting themselves. 19 out of 112 subjects show the opposite voting pattern of excluding themselves as leader, but accepting all others.

evidence of conditional cooperation, meaning that subjects are more cooperative the more other subjects are (expected to be).[14] Previous experimental studies have established the importance of conditional cooperation (see, e.g. Keser and van Winden, 2000; Brandts and Schram, 2001; Fischbacher et al., 2001; Levati and Neugebauer, 2004), however none of them has addressed its relevance in the context of leadership in groups. If (many) followers are conditionally cooperative and leaders anticipate this correctly, it pays off for the group if leaders go ahead with high contributions. However, if a leader provides a poor example by contributing little, followers can not be expected to provide higher contributions and the group fails to achieve and sustain high contributions.

The treatments with strong leadership have shown that backing up a leader's (good) example with the punishment option of excluding another group member promotes cooperation, even though the higher levels of contributions have to be considered only partly voluntary since they are at least partly caused by the threat of exclusion. This finding enables us to combine two hitherto unrelated strands of experimental work, namely the one on leadership (see, e.g., Gächter and Renner, 2004; Moxnes and Van der Heijden, 2003; Potters et al., 2006; Van der Heijden and Moxnes, 2003) with the one on cooperation and punishment (see, e.g., Ostrom et al., 1992; Fehr and Gächter, 2000; Andreoni et al., 2003; Masclet et al., 2003).

Our experiment has also shown that determining a leader either once and for all or in a predetermined and rotating order does not have a noticable influence on cooperation levels within groups. What matters is the presence of a leader as well as his strength, but not the way in which a group member becomes leader. The latter result extends Gächter and Renner's (2004) finding that it does not matter for contribution levels whether the leader is chosen randomly among the group members or whether the most, or least, cooperative member is (exogenously) assigned to be leader.

Concerning the endogenous determination of a leader, we have found that groups with higher contributions in the exogenous part of the experiment are more likely to appoint a leader in the endogenous part. This finding implies that the institution of leadership is more likely maintained if it has

[14] As Fischbacher et al. (2001) suggest, conditional cooperation can be considered as a motivation in its own or, in sequential games, as a consequence of some fairness preferences like inequity aversion or reciprocity (see, e.g., Sugden, 1984; Palfrey and Prisbrey, 1997; Fehr and Schmidt, 1999; Bolton and Ockenfels 2000).

been beneficial in the past. Having a leader in the endogenous part pays off significantly in terms of higher profits because groups with an endogenously selected leader contribute on average almost twice the amount of groups that failed to elect a leader.

Examining the process of appointing a leader in the endogenous part, we have found that leaders with exclusion power typically want to remain leaders, but followers often turn them down, except when the institution has been successful in sustaining very high contribution levels in the exogenous part. Leaders without exclusion power, on the contrary, often feel exploited in case of relatively low contribution levels in the exogenous part, and therefore refuse to act as leaders, even when their followers vote for leadership. Though the reasons for not having a leader in the endogenous part are different, the consequences are the same: Groups without a leader suffer from large efficiency losses.

One can think of several ways of extending the experimental design used in this study to address other interesting questions associated with leadership. In a follow-up, Levati et al. (2005) study the impact of leading by example when group members have different endowments. When the distribution of endowments is common knowledge, leading by example still increases the level of voluntary contributions - compared to a situation without leadership - but less than in case of identical endowments (as used in this paper). If the different endowments are not common knowledge, leading by example does no longer increase voluntary contributions above the level that prevails without leadership. This indicates that the positive effects of leading by example are affected both by information conditions and the distribution of endowments.

One might also consider leadership with a reward option. In many settings, leaders with formal authority do not only have means for sanctioning group members (through exclusion, for instance), but also means for rewarding high contributions (for example through redistributing individual endowments). It might be interesting to compare leadership with exclusion power to leadership with reward options. In a linear public goods game without leadership, Sefton et al. (2006) have shown that rewards seem less effective than sanctions in raising contribution levels. It could be interesting for the organization of working groups whether leadership with reward options would be equally effective as leadership with a punishment option.

Finally, the sequential structure of our leadership treatments might be modified such that all group members move in turns. That would make the voluntary contribution game fully sequential as one after the other would contribute, knowing the previous members' actions. Our conjecture would be that a fully sequential structure increases contributions in comparison to our design because it would partly remove the uncertainty of late followers about the other followers' contributions.[15] In fact, each follower - except for the last one - would also take over the role of a leader for his subsequently moving group members. If leadership works - as we have shown - it seems that having more leaders might be an advantage.

[15]Somewhat related to this possible extension, Greiner and Levati (2005) show that sequential moves in a trust game with a cyclical network structure (where the first player interacts with the second, the second with the third, ... and the last one with the first) increase cooperation in comparison to a situation where all members move simultaneously.

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Tables and Figures

Treatment	Leader is present	Leader has exclusion power	Leader's appointment
C - Control	no	–	–
Lf - Leader fixed	yes	no	fixed
Lr - Leader rotating	yes	no	rotating
SLf - Strong leader fixed	yes	yes	fixed
SLr - Strong leader rotating	yes	yes	rotating

Table 1. Summary of experimental design

Research question	Approach for testing
Is a (powerful) leader better?	(Lf, Lr) vs. (SLf, SLr) vs. C
Does the way of appointment matter?	Lf vs. Lr, respectively SLf vs. SLr
Do groups want to have a leader?	Endogenous part (periods 17-24)

Table 2. Research questions and treatments

Treatment	Periods 1-16	Overall (Periods 1-24)
C - Control/no leader ($N = 14$)	10.04 (5.44)	8.35 (4.85)
L - Leader ($N = 28$)	13.41 (4.62)	11.92 (4.60)
SL - Strong leader ($N = 28$)	19.80 (3.86)	18.26 (4.20)

standard deviation in parenthesis

Table 3. Aggregate average contributions

Treatment	Periods 1-16	Overall (Periods 1-24)
Lf - Leader fixed ($N = 14$)	13.10 (3.98)	11.36 (3.86)
Lr - Leader rotating ($N = 14$)	13.73 (5.27)	12.49 (5.35)
SLf - Strong leader fixed ($N = 14$)	20.76 (2.59)	19.42 (2.94)
SLr - Strong leader rotating ($N = 14$)	18.84 (5.13)	17.10 (5.46)

standard deviation in parenthesis

Table 4. Average contributions in the treatments with leadership

Treatment	Contributions		Profits	
C - Control	10.04		31.02	
	Leaders	Followers	Leaders	Followers
Lf - Leader fixed	15.28	12.37	30.68	33.58
Lr - Leader rotating	16.28	12.88	30.69	34.09
SLf - Strong leader fixed	21.76	20.42	36.42	36.76
SLr - Strong leader rotating	21.43	17.98	33.71	35.89

Table 5. Average contributions and profits of leaders and followers in the exogenous part

	Leader appointed (rel. frequency) [1]	Contributions *without* leader [2]	Contributions *with* leader [3]	With leadership Leaders [4]	With leadership Followers [5]
Lf	0.36	3.61	15.55	16.98	15.08
Lr	0.29	9.47	11.35	17.44	9.32
SLf	0.61	9.33	21.54	22.62	21.18
SLr	0.43	10.73	18.81	22.17	17.69

Table 6. Leadership and contributions in the endogenous part

Probit regression ($N = 56$)	Period 17		Period 21	
dependent variable: leader appointed	coefficient	(p-value)	coefficient	(p-value)
Contribution P1-16	0.12	(0.02)	0.10	(0.06)
Strong leader ($SL = 1$)	0.46	(0.31)	-0.25	(0.54)
Rotation ($r = 1$)	0.25	(0.58)	-0.34	(0.36)
Lead_con − follow_con P1-16	-0.20	(0.08)	-0.08	(0.43)
Contribution P17-20	–	–	-0.05	(0.23)

Table 7. Probability of groups having a leader in periods 17-20 and 21-24

Treatments	$Lf + SLf$ ($N = 112$)		$Lr + SLr$ ($N = 112$)	
dependent variable	vote for leader		vote for oneself	
	coefficient	(p-value)	coefficient	(p-value)
Own contribution P1-16	0.08	0.09	0.15	0.01
Others' contribution P1-16	0.01	0.82	-0.11	0.05
Strong leader ($SL = 1$)	-0.97	0.05	0.12	0.67
Subject is leader ($= 1$)	-1.76	0.01		
Subject is leader * SLf	2.44	0.01		

Table 8. Probability of voting for leader in period 17

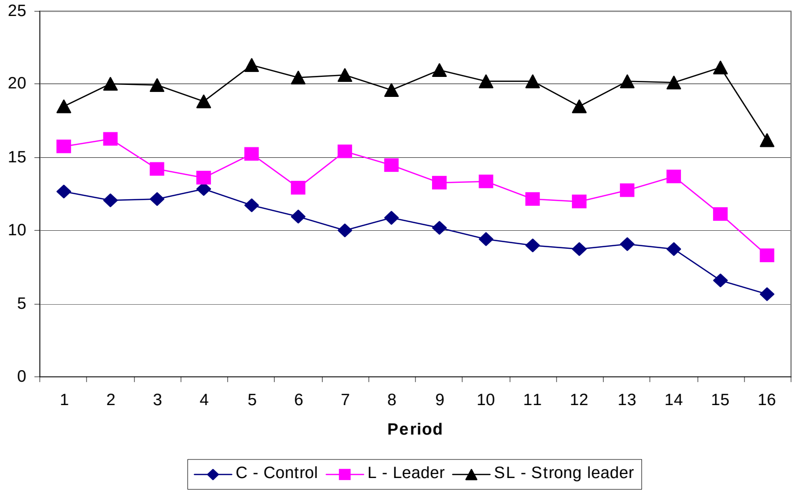

Figure 1. Average contributions in periods 1−16

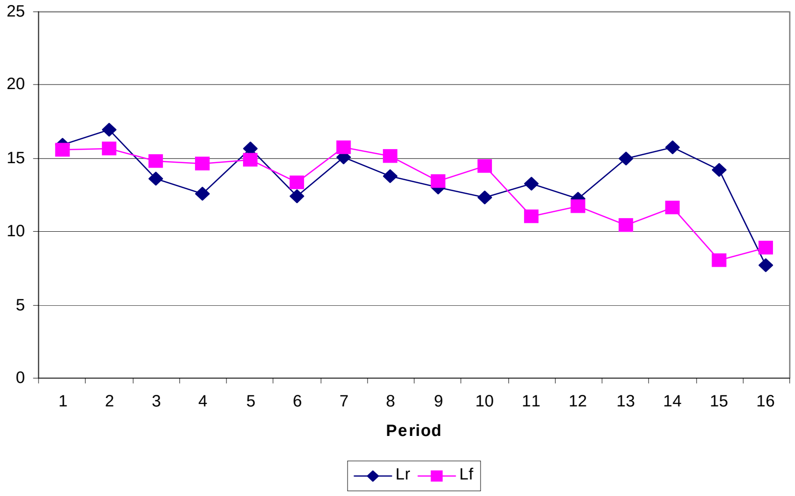

Figure 2. Average contributions in the *L*-treatments

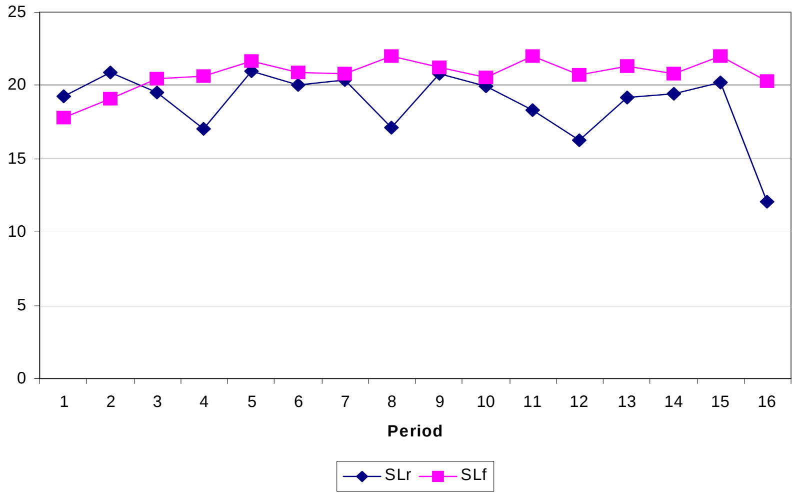

Figure 3. Average contributions in the SL-treatments

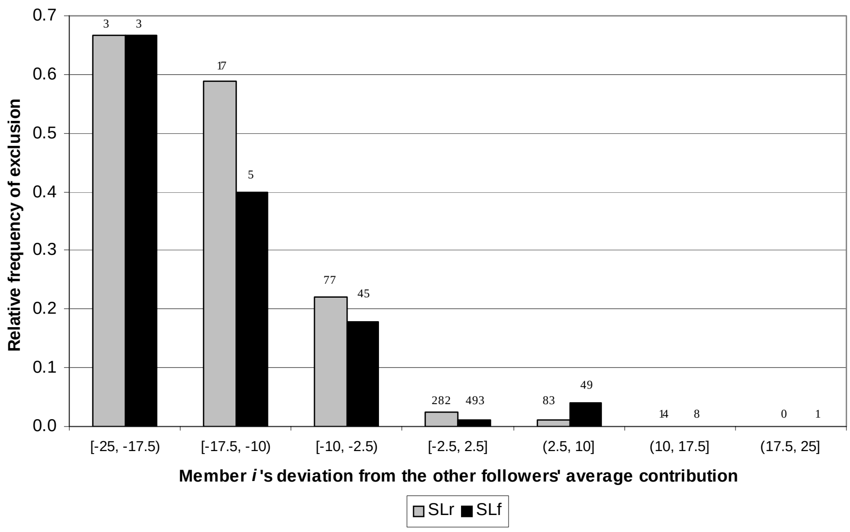

Figure 4. Deviation from other followers' average contributions and frequency of exclusion

Appendix: Experimental Instructions

This appendix contains the instructions (originally in German) we used for the strong leader (SL)-treatments. The instructions for the control (C)- and the normal leader (L)-treatments were adapted accordingly and are available upon request.

Welcome and thanks for participating in this experiment. You receive 2.50 Euro for having shown up on time. If you read these instructions carefully, you can make good decision and earn more. The 2.50 Euro and all additional amount of money will be paid out to you in cash immediately after the experiment.

During the experiment, amounts will be denoted by ECU (Experimental Currency Unit). ECU are converted to euros at the following exchange rate: 1 ECU = 0.06 Euro.

It is strictly forbidden to communicate with the other participants during the experiment. If you have any questions or concerns, please raise your hand. We will answer your questions individually. It is very important that you follow this rule. Otherwise we must exclude you from the experiment and from all payments.

Detailed information on the experiment

The experiment consists of 24 separate periods, in which you will interact with three other participants. The four of you form a group that will remain THE SAME in all 24 periods. You will never know which of the other participants are in your group. The group composition is secret for every participant.

What you have to do

At the beginning of each period, each participant receives an amount of 25 ECU. In the following, we shall refer to this amount as *your endowment*.

Your task (as well as the task of your group members) is to decide **how much of your endowment you want to contribute to a project.** Whatever you do not contribute, you keep for yourself ("ECU you keep").

In every period, your earnings are the sum of the following two parts:

1. the "ECU you keep";
2. the "income from the project".

The "*income from the project*" is determined by adding up the contributions of the four group members and multiplying the resulting sum by 0.4. That is:

Income from the project = [0.4 × (total group contribution)] ECU

Each ECU that you contribute to the project rises "income from the project" by 0.4 ECU. Since "income from the project" is the same for all four members of the group (i.e., all receive the same income from the project as this is determined by the total group contribution), each ECU that you contribute to the project rises YOUR period-earnings *as well as* the period-earnings of YOUR GROUP MEMBERS by 0.4 ECU. The same holds for the contributions of your group members: Each ECU that any of them contributes to the project increases "income from the project" (and therefore your earnings) by 0.4 ECU.

The "ECU you keep" are your endowment *minus* your contribution to the project. Each ECU that you keep for yourself raises "ECU you keep" and YOUR period-earnings by one ECU. Thus, each ECU that you keep yields money for YOU ALONE.

How you interact with your group members in each period

Within your group you are identified by a number between 1 and 4. This number will be assigned to you privately at the beginning of the experiment.

Each period consists of the following three stages:

1. One group member first decides about his/her own contribution. In the following, we shall refer to the group member who decides first as the "*early contributor*".
2. Being informed about the decision of the early contributor, the other three group members decide simultaneously and privately about their own contribution.
3. The early contributor learns about the contribution of the others, and (s)he can decide to exclude at most one of them from the group *in the next period.*
   • If the early contributor DOES NOT EXCLUDE ANYONE, next period's "income from the project" and the earnings you are due in that period are determined as before.
   • If the early contributor EXCLUDES SOMEONE, in the following period the interacting group members will be three rather than four, and the "income from the project" is determined by adding up only their three contributions. Since the excluded group member stays out of the game, his (her) earnings in the subsequent period are merely equal to his/her endowment (i.e., 25 ECU).

Consider the following example: Member 1 is the early contributor in period 1 and contributes a certain amount. Knowing the contribution of the early contributor, the three other members of the group decide on their contribution, which is then communicated to the early contributor. If the early contributor decides, for instance, to exclude member 2, this means that member 2 is excluded from the group in the next period, i.e., in period 2. Hence, in period 2 only members 1, 3 and 4 interact with each other and their earnings in period 2 are as follows: "*ECU each keeps* + [0.4 × (sum of contributions of members 1, 3, and 4)]". Since member 2 does not participate in the interaction in period 2, (s)he just keeps his/her endowment. Note that member 2 will re-enter the group in period 3.

[*Participants in the rotating-treatment read:* Each group member is appointed to be the "early contributor" for four consecutive periods, starting with member 1 and ending with member 4. In the following, we shall refer to the four consecutive periods in which the same group member is the early contributor as a "*phase*". Therefore:

- member 1 is the early contributor in phase 1 (i.e., in periods 1, 2, 3, and 4);
- member 2 is the early contributor in phase 2 (i.e., in periods 5, 6, 7, and 8);
- member 3 is the early contributor in phase 3 (i.e., in periods 9, 10, 11, and 12);
- member 4 is the early contributor in phase 4 (i.e., in periods 13, 14, 15, and 16).

In the last period of each 4-period phase (i.e., period 4 for member 1, period 8 for member 2, period 12 for member 3, and period 16 for member 4), the designated early contributor cannot exclude anyone. Therefore, in the first period of each phase (i.e., periods 1, 5, 9, 13) all four group members interact with each other.]

[*Participants in the fixed-treatment read:* At the beginning of the experiment, one member of each group is randomly selected to be the "early contributor" for the first 16 periods. The group member who is selected as the early contributor see this in an "Information Window", which will appear on his/her screen at the beginning of the experiment.]

At the end of period 16, there will be two more phases (á four periods). In each of these two phases, group members will have the opportunity to choose themselves [*in the rotating-treatment*: the person whom they want to be the early contributor in their group.] [*in the fixed-treatment*: whether they want the early contributor to keep on being so or not.]

[*Participants in the rotating-treatment read:*

How you choose your preferred early contributor

In periods 17 and 21, you are requested to indicate whether you want a specific group member to become the early contributor. If you want a specific group member to be the early contributor, you must press the “Yes” button on the screen. Otherwise (i.e, if you do not want him/her to be the early contributor), you must press the “No” button. You have to decide on “Yes” or ”No” for each single group member (including yourself). Please note that you can answer “Yes” for more than one group member.

- If there is a single person within your group who receives *four “Yes"*, this person will become the early contributor in the respective phase and the sequence of decisions is as described above.
- If more than one person receives four “Yes", one of these persons will be randomly selected as the early contributor.
- Otherwise (i.e., if there is no person within your group who receives *four “Yes"*), there will be no early contributor, and you as well as your group members must make your contribution decisions simultaneously and privately. This, of course, also means that there will be no opportunity to exclude any group member in this phase.]

[*Participants in the fixed-treatment read:*

How you choose whether you want or not an early contributor

In periods 17 and 21, you are requested to indicate whether you want the early contributor to continue being the early contributor or not. If you want him/her to keep on being the early contributor, you must press the “Yes” button on the screen. Otherwise (i.e, if you do not want him/her to be the early contributor), you must press the “No” button.

- If the early contributor receives *four “Yes"* (i.e., if (s)he wants as well to be the early contributor), (s)he will be the early contributor in the respective phase, and the sequence of decisions is as described above.
- Otherwise (i.e., if the early contributor does not receive *four “Yes"*), there will be no longer an early contributor, and you as well as your group members must make your contribution decisions simultaneously and privately. This,

of course, also means that there will be no opportunity to exclude any group member in this phase.]

The information you receive at the end of each period

At the end of each period, you will receive information about the number of ECU contributed by *each* of your group members as well as about your period-earnings.

Your final earnings

Your final earnings will be calculated as follows:

1. For each of the six phases of the experiment, one period will be randomly selected.
2. Your earnings in these 6 periods will be added up.
3. The resulting sum will be converted to euros and paid out to you in cash.

Before the experiment starts, we will run a control questionnaire to verify your understanding of the experiment.

Please remain seated quietly until the experiment starts. If you have any questions, please raise your hand now.