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Leading by example in intergroup competition: An experimental approach*

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Abstract

We investigate leading by example in a public goods game in scenarios with and without intergroup competition. Leading by example is implemented via a sequential decision protocol. We examine both one-shot and repeated interaction and make use of the strategy method to characterize followers' conditional responses to the leader's contribution. The results show that only follower but not leader behavior is affected by the introduction of intergroup competition. The change in follower behavior is best described as an increase in cooperation which is not conditional on the leader's decision. When groups interact repeatedly, we do not find that leading by example is able to foster cooperation by itself. It only significantly improves contributions when it is accompanied by intergroup competition.

Keywords: Public goods; Leading by example; Intergroup competition; Strategy method

JEL Classification: C72; C91; C92; D74; H41

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1 Introduction

Effective leadership is an important element in modern organizations. It serves as a means to motivate effort from personnel in circumstances of incomplete contracts or where formal authority is lacking. Leading by example is, perhaps, the most basic form of leadership. It comes in many forms: the CEO working for a symbolic salary of 1$ when his company demands pay cuts from its employees, the foreman being the first on the site and the last to leave or union leaders joining the street protests. Historical examples outside for-profit organizations include Martin Luther King's participation in the freedom marches or Joseph Stalin's decision to stay in Moscow during World War II (Hermalin, 1998).

This study reports on an experiment in which we extend the research on leading by example to a situation relevant to many organizations: a scenario of intergroup conflict within the firm. Intergroup conflict occurs when the interests of two or more groups are in opposition. This readily translates to the organizational context as groups, like departments or work teams, compete over scarce resources imposed by limitations in space, budget or labor supply. The notion of group conflict is often exclusively associated with detrimental consequences which may arise as rivals have the incentive to waste resources for conflict-related activities. It may, however, also be used to the benefit of the organization (de Dreu and van de Vliert, 1997).[1] Examples include Oppenheimer's use of competing groups in the Manhattan Project (Gosling, 1999) and within-firm R&D competitions, e.g., at Samsung (Chen and Li, 2007).

The experimental literature examines leading by example in the environment of linear public goods games – an experimental paradigm, which is often used to study team work. Leading by example is implemented via a semi-sequential decision protocol. The leader acts as the first mover. His decision is revealed to the remaining group members who then decide simultaneously on their contributions. The experimental literature on leading by example includes, among others, Moxnes and van der Heijden (2003), Güth et al. (2007), and Levati et al. (2007). These studies generally show that leaders are willing to give good examples. Followers, however, do react only partially and undercut the leaders' contributions. As a result, leading by example only weakly increases overall contributions to the public good. The basic paradigm of leading by example has, e.g., been extended to incorporate different forms of heterogeneity (Levati et al., 2007, Glöckner et al., 2011),

[1]The term intergroup competition seems to capture this notion more convincingly than intergroup conflict. The literature, however, treats these terms as interchangeable and it does not seem possible to act upon this issue in the present article.

endogenous leader selection (Güth et al., 2007, Rivas and Sutter, 2008), or voluntary leadership (Haigner and Wakolbinger, 2010, Rivas and Sutter, 2011). None of the previous studies, however, dealt with a situation involving more than one group.[2]

Intergroup competition has received attention in a number of disciplines. For an excellent review on the experimental research in social psychology, see Bornstein (2003). A recent laboratory study in evolutionary biology is Puurtinen and Mappes (2008). Experimental studies in economics include, e.g., Nalbantian and Schotter (1997), Gunnthorsdottir and Rapoport (2006), Tan and Bolle (2007), and Abbink et al. (2010). The evidence from all disciplines shows quite clearly that intergroup competition can lead to an increase in intragroup cooperation in a large set of circumstances. The underlying mechanisms root in both strategic as well as motivational sources. They relate to in-group favoritism and social preferences – concepts closely linked with reciprocity which most likely is crucial to leading by example. This will be discussed in greater detail in Section 2.

We complement the existing literature in three ways. First, we generalize the paradigm of leading by example to a scenario of intergroup competition. We examine both one-shot and repeated interaction. The former abstracts from strategic considerations and allows us to investigate leader and follower behavior in a clean environment. The latter accounts for the fact that real life intergroup conflict mostly entails multiple encounters. Second, we use the strategy method when eliciting followers' decisions. This enables us to fully characterize followers' types and to examine the change in conditional follower responses when intergroup conflict is introduced.[3] Third, we elicit group identification and analyze its relation to the effect of intergroup competition.

Our results for the one-shot interactions show that intergroup competition has differential effects on leader and follower behavior. While leaders are largely insensitive to the presence of intergroup conflict, followers display an increased willingness to cooperate. This increase does not depend on the leaders' actions. When groups interact repeatedly, we do not find that leading be example is able to foster cooperation by itself. It only significantly improves contributions when it is accompanied by intergroup competition. Our data does not support the conjecture that intergroup competition leads to higher group identification.

[2]For theoretical and experimental work on leading by example with information asymmetries between leaders and followers, see Hermalin (1998) and Potters et al. (2007).

[3]Gächter et al. (2010) also elicits followers' choices via the strategy method, but in a two-person game. In such a setup a follower's choice does no longer entail any behavioral uncertainty which is present in our design. Their measurement is thus more closely related to the elicitation of conditional cooperative attitudes (see, e.g., Fischbacher et al., 2001).

The paper proceeds as follows. Section 2 illustrates our hypotheses. Section 3 describes the experimental design, Section 4 presents the results and Section 5 concludes.

2 Theoretical considerations and hypotheses

Embedding a social dilemma in an intergroup conflict affects individuals' decisions in two important ways. First, it changes incentives. If groups enter a competition for an exogenously given price as, e.g., in winner-takes-all or rent-seeking (or Tullock) contests, cooperation becomes more profitable because it increases the chances for winning the prize (see, e.g., Bornstein et al., 1990, Abbink et al., 2010).

Intergroup conflict has a second and purely motivational effect on intragroup cooperation and we are exclusively interested in the latter.[4] Its existence has been a long-standing conjecture in social psychology (see, e.g., Messick and Brewer, 1983, Brown, 1988). Yet, Bornstein and Ben-Yossef (1994) were the first to provide a clean experimental test. They designed an experiment to compare behavior in a single group prisoner's dilemma (PD) and in an intergroup prisoner's dilemma game (IPD). Both games were identical with respect to their intragroup social dilemma structure. The IPD, however, models two competing groups, where cooperation in any one of them inflicts a negative external effect on the respective opponent. Bornstein and Ben-Yossef (1994) report twice as much cooperation in the IPD than in the PD. Since both games were identical with respect to material incentives of individuals and groups, the authors attributed the effect to purely motivational reasons. More specifically, they state that the difference in behavior *"[...] cannot be explained by assuming that subjects were motivated by self-interest, group-interest, or some fixed combination of both." (p. 64).* Since, in the IPD, a cooperative act benefits the own group and hurts the out-group at the same time, a greater concern for the in-group's outcome or spite toward the out-group remained possible explanations. Halevy et al. (2008) presents evidence on this distinction. In their experiment participants have the choice whether their cooperative act shall decrease the out-group's outcome in addition to increasing the in-group's. The results show that the vast majority of participants chooses not to hurt the out-group. In conjunction with the results in Bornstein and Ben-Yossef (1994) this evidence strongly suggests that intergroup competition leads to enhanced concerns for the in-group's overall outcome.

We implement intergroup competition in the same way as Bornstein and Ben-Yossef

[4] In fact, our experiment is expressly designed to abstract from the afore mentioned incentive effect.

(1994) who examine pure one-shot interaction. It is therefore reasonable to expect similar results in our one-shot encounters. It is more difficult to foresee behavior in the repeated interaction setup as empirical results are mixed. Bornstein et al. (1996), e.g., find that the motivational effect of intergroup competition diminishes with repetition. We state our first hypothesis:

Hypothesis 1. *When interaction is one-shot, intergroup competition leads to an increase in intragroup cooperation.*

The motivational effect associated with intergroup competition might impact leading by example. First, we expect that leaders contribute more to the public good if they assign greater weight to the outcome of their group. Since we know from previous experiments that followers' contribution decisions are positively correlated with those of leaders, such a behavioral change would yield higher overall cooperation. Followers, in turn, might be willing to reciprocate a leader's contribution more forcefully given that the group's outcome figures more prominent for their decisions. Such a behavioral shift would counteract the followers' general tendency to undercut leaders' contributions, which previous studies identified as the most serious obstacle for leading by example to effectively increase cooperation.

An increased willingness to reciprocate leaders' examples is conceivable in different forms. One possibility is that the enhanced cooperation in intergroup competition is associated with a greater concern for the group's success which is not conditional on the decisions of other group members. In this case, we would expect that followers increase their contributions to every possible leader decision by some fixed amount. An alternative would be that intergroup competition leads to an increased willingness to cooperate that is conditional on the other group members' readiness to forego their individual monetary interest as well. In other words, intergroup competition might lead to a greater tendency for conditional cooperation. In this case, we would expect that followers' marginal responses to increases in leaders' contributions are strengthened in a scenario of intergroup competition.[5] Our use of the strategy method when eliciting followers' choices will help to shed light on this issue. In summary, we state the following hypotheses with respect to role-specific behavior:

[5]Huck and Rey-Biel (2006) explain the effect of leading by example by way of assuming conformist follower types. In their model, an increased tendency for conditional cooperation would translate to a higher degree of conformism.

Hypothesis 2. *Leaders contribute more in a social dilemma when it is embedded intergroup competition than when it is not.*

Hypothesis 3. *Followers react more cooperatively to the leader's example when the social dilemma is embedded in intergroup competition.*

According to Bornstein and Ben-Yossef (1994), the motivational effect of intergroup conflict might be mediated by group identification. Social identity theory (or SIT), as introduced by Tajfel and Turner (1986), promotes the idea, that actions are influenced by the social category of the decision maker. Key to SIT are the assumptions that people strive for a positive self-concept, that their group-membership can provide them with a value which contributes positively or negatively to their self-concept and that these evaluations come from favorable or unfavorable comparisons with other groups (see Tajfel and Turner, 1986, p. 16). Not every possible comparison matters, however. Only if the decision maker identifies with a group, he will care about the outcome of a comparison. Intergroup competition has the potential to affect personal attachment to a group as it is said to serve *"[...] as a unit-forming factor, that enhances group identification [...]"* (Bornstein and Ben-Yossef, 1994, p. 64). Research on social identity has also picked up in economics. A recent experiment by Chen and Li (2009) investigated the mechanism underlying the effect of group identification. The results connect to the findings in Halevy et al. (2008). They demonstrate that social preferences may be affected by group identification in that the likelihood for positive reciprocal and social welfare maximizing actions increases. The original result in Bornstein and Ben-Yossef (1994) was replicated several times (Probst et al., 1999, Baron, 2001, Tan and Bolle, 2007). None of these studies directly tested whether the motivational effect of competition works through increased group identification. By measuring identification, our results will shed light on this possible mechanism.

3 Experimental design

3.1 The basic game

The basic game follows the taxonomy of a standard linear voluntary contribution mechanism (Isaac et al., 1984). Participants interact in groups of $N = 3$ for $t = 1, \dots, T$ periods. At the beginning of every period, each participant is given an endowment of $E = 10$ ECU (Experimental Currency Units) which she can consume privately or contribute to a group project. Every ECU that is consumed privately benefits the individual decision maker 1 ECU. Every ECU contributed to the group project benefits every member of the group $\beta = 0.5$ ECU. Thus, the payoff for individual i in period t is given by

$$(1) \quad \pi_{i,t} = 25 - c_{i,t} + 0.5 \times \sum_{j \in G_i} c_{j,t} \quad ,$$

where $c_{i,t}$ is individual i's contribution to the public project in period t, G_i is the set of members in individual i's group, and $\sum_{j \in G_i} c_{j,t}$ are the total (i.e., the sum of) contributions to the public good in individual i's group in that period. Since $\beta < 1$, a pure money maximizer's dominant choice is to contribute nothing to the group project. This result holds for one-shot interactions and can be generalized to finitely repeated interactions by means of backward induction if we assume rational monetary payoff maximizers and common knowledge. Socially optimal behavior, on the other hand, would prescribe full contribution to the public good, since $N \times \beta > 1$.

3.2 Implementing leading by example and intergroup competition

In the basic game, interaction takes place simultaneously. Leading by example is implemented by means of a semi-sequential decision protocol: One member of the group is randomly appointed to be the "leader," who decides about his contribution to the group project before the other group members do. The leader's decision is communicated to the two other group members, or the "followers," who then decide simultaneously about their contributions.[6] Since, in a last period, contributing nothing is still the dominant choice for followers, the first mover is also always better off contributing zero. I.e., assuming monetary payoff maximizers, the semi-sequential move structure does not alter the behavioral predictions.

Our implementation of intergroup competition follows Bornstein and Ben-Yossef (1994). It involves real payoff consequences but is designed to preserve the intragroup incentive structure of the public goods game.[7] Pairs of groups are formed and after participants decided on their contributions, the groups' total contributions are compared in every pair. This comparison takes place after each period. The group with the higher total

[6] The instructions used neutral wording: leaders were described as "first movers."

[7] The most significant deviation from the setup in Bornstein and Ben-Yossef (1994) is that the individual decision to cooperate is no longer dichotomous.

contributions wins the comparison and receives a transfer from the loosing group. The transfer equals 0.3 times the absolute difference in total contributions between the opposing groups. Its benefits and costs are shared equally by the respective groups' members. In order to account for the fact that an individual's marginal per capita return (MPCR) of contributing 1 ECU is increased by $\alpha = 0.1$ due to the transfer, we reduce the return from the group project to $\beta_c = \beta - \alpha = 0.4$. In the treatments with intergroup competition, individual i's payoff in period t can be summarized by

$$\pi_{i,t} = 25 - c_{i,t} + 0.4 \times \sum_{j \in G_i} c_{j,t} + 0.1 \times \left(\sum_{j \in G_i} c_{j,t} - \sum_{j \in G_{-i}} c_{j,t} \right) , \quad (2)$$

where G_{-i} is the set of members in the group which opposes individual i's. If we assume common knowledge of payoff maximizer preferences and rationality, full free-riding remains the theoretical prediction also with intergroup competition, since the MPCR is still below unity.[8] Moreover, we control for the overall MPCR ($\beta = \beta_c + \alpha = 0.5$), such that the marginal incentives to contribute are identical in all conditions. This is necessary since a higher MPCR empirically yields higher contributions (Ledyard, 1995) and would thus constitute a possible confounding effect.[9] Since the transfer constitutes a zero-sum transaction, the overall efficiency for pairs of groups is reduced in treatments with intergroup competition. Preferences for efficiency (see, e.g., Engelmann and Strobel, 2004) would therefore predict contributions to be lower than in the case of isolated groups. This effect runs counter our hypothesis that intergroup conflict promotes intragroup cooperation. Note that, unlike in Bornstein and Ben-Yossef (1994), socially optimal behavior would still prescribe full contribution as $\beta_c \times 3 > 1$. This corresponds to our view that competition can be efficiency-enhancing in an organizational context.

3.3 The experiment's structure

The experiment is divided into two stages. The first stage addresses sequential decisions with and without intergroup competition. The two treatments are labeled *S1-SeqC* and *S1-SeqNC*, respectively, and are played between-subjects. Interaction in this stage is one-shot (i.e., $T = 1$) in order to abstract from potential effects from reputation building (Kreps et al., 1982). In this one period, leaders move first but instead of communicating

[8] Other ways of implementing competition include awarding fixed exogenous prices (see, e.g., Nalbantian and Schotter, 1997) or Tullock-like contests (see, e.g., Abbink et al., 2010). These approaches do, however, yield Nash equilibria with non-negative contributions.

[9] A control for the overall MPCR is missing, e.g., in Puurtinen and Mappes (2008).

the leaders' decisions we employ the strategy method (Selten, 1967) eliciting followers' conditional responses to each possible contribution by the leader.[10] After collecting contribution choices, we additionally elicit the participants' identification with their group and their perception about the competitiveness of the situation.[11] Participants were informed about the decisions in the first stage only after the end of the second stage to prevent behavioral spill-overs across the two stages and in order to keep the group identification elicitation clean.

The second stage contains a 2×2 between-subjects design with simultaneous vs. sequential decisions as the first dimension and intergroup competition vs. no intergroup competition as the second. The treatments are labeled *S2-SimNC* and *S2-SimC* for the simultaneous move conditions without and with intergroup competition and, accordingly, *S2-SeqNC* and *S2-SeqC* for the sequential move conditions. In all second stage treatments participants interact in a ($T =$) 10 periods repeated partners design with feedback after every period. The feedback contains information about individual contributions in a participant's own group and, in case of competition, the total contributions of the opposing group. We also elicit first order action beliefs about the average contribution in the own group (excluding the leader) and the average contribution in the competing group, where applicable. These beliefs are incentivised following the procedure in Fischbacher and Gächter (2010): if the expectation differs by 0 (1) ECU from the rounded average contribution, the participant receives 3 (2) ECU. In all other cases the participant receives nothing.[12]

Every subject participates in both stages of the experiment. We keep group composition and the matching into pairs of groups constant across stages.[13] All groups that participated in treatment S1-SeqNC are divided equally to continue either in treatment S2-SimNC or in S2-SeqNC. All pairs of groups that participated in treatment S1-SeqC are divided equally to continue either in treatment S2-SimC or in S2-SeqC. This procedure insures that participants experience either the competition or the no competition environment but not both. Whenever decisions are recorded sequentially in the second

[10]It has been argued that employing the strategy method facilitates (cold) decisions based on reason rather than (hot) decisions based on emotions. The empirical evidence on this issue is, however, inconclusive (see, e.g., Brandts and Charness, 2011). If follower behavior is based on emotions and if competition influences those emotions, our use of the strategy method might bias the results toward finding smaller behavioral differences across treatments.

[11]See the procedures for the exact wording of the questions.

[12]Gächter and Renner (2010) report that this form of belief elicitation can affect contribution decisions. We are, however, mainly interested in treatment differences and it is not obvious why the belief elicitation should affect behavior differently in different treatments.

[13]Participants learn this not until the beginning of the second stage.

stage, the group's leader was also the leader in the first stage of the experiment. This was known to the participants. Table 1 summarizes the structure of the experiment.

Table 1: The experimental treatments

	Stage 1		Stage 2			
Treatment	S1-SeqNC	S1-SeqC	S2-SimNC	S2-SeqNC	S2-SimC	S2-SeqC
Sequential decisions	✓	✓	–	✓	–	✓
Intergroup competition	–	✓	–	–	✓	✓
Strategy method for second mover	✓	✓	–	–	–	–
One-shot	✓	✓	–	–	–	–
10 periods	–	–	✓	✓	✓	✓
Belief elicitation	–	–	✓	✓	✓	✓
# sessions	4	7	2	2	3	4
# groups	25	52	13	12	24	28
# subjects	75	156	39	36	72	84

Note: A checkmark (dash) means that a design feature is (not) present in the respective treatment. The matching across stages is such that participants of treatment S1-SeqNC continue either with treatment S2-SimNC or S2-SeqNC and that those who participated in S1-SeqC continue either with treatment S2-SimC or S2-SeqC.

Participants were paid according to their decisions in only one of the two stages. This method prevents the possibility of hedging behavior across stages. Payment for the first stage equals the earnings according to the contribution decisions. Payment for the second stage equals the sum of the earnings from the contribution decision and those for the accuracy of beliefs in one randomly selected period.[14]

3.4 Procedures

The experiment was programmed in z-Tree (Fischbacher, 2007) and conducted in the experimental laboratory of the Max Planck Institute of Economics in Jena, Germany. The participants were undergraduate students from the Friedrich Schiller University Jena. They were recruited using the ORSEE system (Greiner, 2004). Upon arrival, participants were seated at visually separated computer terminals. The instructions were divided

[14]Paying only one randomly chosen period theoretically controls for wealth effects on risk attitudes (Lee, 2008). Paying both the contribution decision and the belief statement in principle allows for hedging risks between these two activities. Blanco et al. (2010), however, investigate this issue in a sequential prisoner's dilemma game and find no evidence for such behavior.

into two sets according to the separate stages and distributed just before the start of each stage.[15] All instructions were read aloud. The first set announced the experiment's division into two stages but did not specify further information about the second stage. It was common knowledge that only one stage would randomly be selected for payment. Before the start of the first stage, subjects' understanding was tested by means of a set of control questions. Participants' questions were answered privately at the their seats.

The payoff relevant stage was determined via a coin toss at the end of the experiment. If the second stage was selected, the payoff relevant period was determined by drawing a ball from an urn, which contained 10 balls numbered from 1 to 10. Both random draws were performed by one subject and applied to all participants in a session. The subject was chosen based on an experimenter's draw from a second urn. To be as credible as possible, all draws were performed publicly.

To measure perceived competitiveness and identification participants were asked to rate their agreement to specific statements on 7 point Likert-scales (1="not at all" to 7="very much"). Perceived competitiveness was measured using the statement "I perceived the situation among groups to be very competitive." The items measuring identification were taken from Leach et al. (2008) and read "I feel committed to [In-group]," "I am glad to be [In-group]," "I feel solidarity with [In-group]," and "It is pleasant to be [In-group]." Groups were identified with an individual color.

All sessions were conducted between September and December 2010. The number of sessions, groups and subjects per treatment are summarized in Table 1. Overall, 231 subjects participated in the experiment. Sessions lasted between one and a half and two hours. Given the exchange rate of 0.80 euro cents per ECU, subjects earned on average 12.70 euro, ranging from 6.50 euro to 21.80 euro.

4 Results

Results are going to be presented as follows. First we provide a manipulation check. Next, we report on differences in leader and follower behavior with and without intergroup competition using first stage data. Afterward, we focus on the results for the repeated interactions in the second stage.

[15] All sets of instructions can be found in Appendix B.

4.1 Manipulation check

We implemented intergroup competition via a transfer between groups. In order to check whether the manipulation was successful, we compare the perceived competitiveness (measured on a Lickert scale from 1="not at all" to 7="very much") across conditions in stage 1. Since stage 1 does not include any feedback, every participant's response can be treated as an independent observation. With 75 and 156 observations and means of 2.8 and 4.2 for S1-SeqNC and S1-SeqC, respectively, the difference is highly significant ($p < 0.01$, Wilcoxon rank sum test, two-sided). We are thus confident that we successfully manipulated the perception about the environment. Next we test the conjecture that competition yields higher identification with the in-group. We calculate each individual's mean identity score as the average response to all four items. Comparing conditions S1-SeqNC and S1-SeqC, the mean identity scores are virtually identical at 3.65 ($p = 0.82$, Wilcoxon rank sum test, two-sided).[16] This provides an indication that intergroup competition might affect behavior in other ways than by inducing in-group identification. On the individual level the measures of identification and competitiveness are correlated in S1-SeqC (Spearman's $\rho = 0.35$, $p < 0.01$) but not in S1-SeqNC ($\rho = 0.12$, $p = 0.29$). Over the full sample the Spearman correlation coefficient is $\rho = 0.26$. While this correlation is significant ($p < 0.01$), its magnitude points to a rather weak interdependence of perceived competitiveness and group identification.

4.2 One-shot interaction

Overall contributions. We begin the analysis examining average group behavior. The first stage involves a pure one-shot interaction. However, since followers' decisions are conditional on those of leaders, each group constitutes the basis for one independent observation. This leaves us with 25 and 52 independent observations for S1-SeqNC and S1-SeqC, respectively. A group's average contribution is calculated as the mean of the leader's contribution and the two followers' *actual* contributions. The latter are those conditional choices of followers which correspond to the leader's actual decision. Following our first hypothesis, we expect higher contributions with intergroup competition. The mean contributions are depicted in the first two bars in Figure 1, panel a. They amount to 3.84 ECU in S1-SeqNC and 4.53 ECU in S1-SeqC. The difference is significant ($p = 0.049$, Wilcoxon rank sum test, one-sided), which confirms our expectation. This yields our first

[16] There are no significant differences for responses to any of the single items.

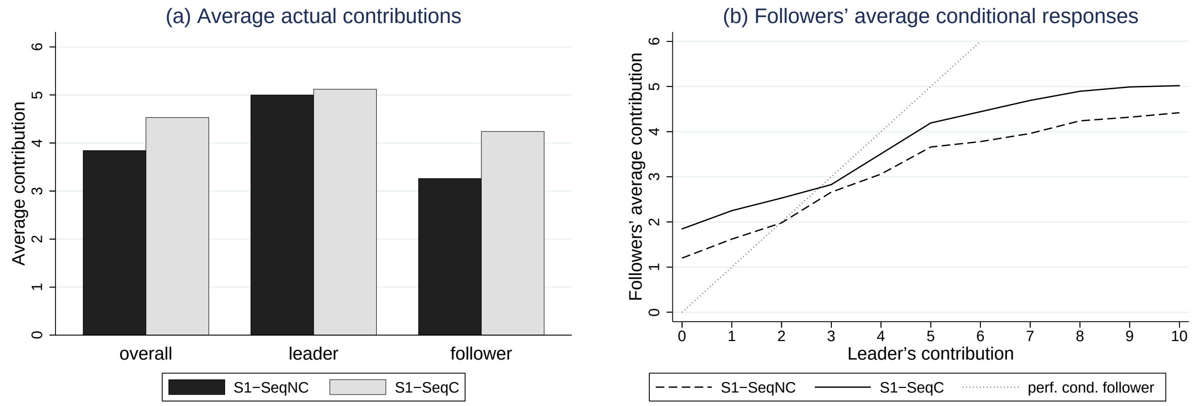

Figure 1: Average contributions in stage 1

result:

Result 1. *Three person groups consisting of one leader (first mover) and two followers (second movers) contribute more to a public good when the social dilemma is nested in an intergroup conflict.*

Leader and follower behavior. To what extend can this effect be attributed to differences in leader and follower behavior with and without intergroup competition? Bars 3 – 6 in Figure 1, panel a, depict the role-specific contributions for both experimental conditions. Hypothesis 2 postulates higher contributions from leaders in the presence of intergroup competition. Bars 3 and 4, however, suggest that leaders' choices remain unaffected by competition This impression is corroborated by a one-sided Wilcoxon rank sum test ($p = 0.35$). How do followers react? Visual inspection suggests that followers' actual contributions are higher in S1-SeqC than in S1-SeqNC. We use a Wilcoxon rank sum test for statistical analysis. Since, in each group, both followers' actual contributions depend on the same leader decision, we calculate their average as one independent observation. Using the resulting 25 and 52 observations for S1-SeqNC and S1-SeqC, respectively, the test confirms that intergroup competition leads to higher follower contributions ($p = 0.023$, Wilcoxon rank sum test, one-sided). In connection with the observation that leaders' contributions are seemingly insensitive to intergroup conflict, this finding supports Hypothesis 3. A leader's example is followed more closely if the social dilemma is embedded in intergroup competition.

Followers' conditional responses. The differences in followers' actual contributions could be driven by heterogeneity in leaders' choices which is not captured by their average. The followers' full conditional choice vectors control for this issue. Figure 1, panel b, displays the average vectors by experimental condition.[17] The monotonically upward sloping lines clearly show that followers on average react positively to an increase in the leader's contribution. Nonetheless, the most critical result from previous studies on leading by example proves to be robust: followers tend to undercut the leaders' contributions. This can be seen when comparing the average vectors to that of a hypothetical, perfect conditional follower depicted by the dotted line. It is only for small (<3 ECU) leader contributions that followers contribute the same as or more than leaders. The figure suggests furthermore that followers sustain systematically higher contributions under intergroup competition. We first investigate this issue by means of the average conditional response which can be used as a proxy for the average overall willingness to follow a leader's example. The averages amount to 3.17 ECU in S1-SeqNC and 3.75 ECU in S1-SeqC, where the figures are based on 50 and 104 independent observations, respectively, one for each follower. The difference is small but statistically significant ($p = 0.039$, Wilcoxon rank sum test, one-sided), which indicates that followers' average responses are higher under intergroup competition. Next, we perform an individual regression on each follower's vector of conditional choices and compare the resulting slopes across conditions. This measure can be used to investigate the followers' average marginal responsiveness, as higher values indicate that the followers react more strongly to changes in the leaders' decisions. The mean slopes amount to 0.34 and 0.35 in S1-SeqNC and S1-SeqC, which confirms that followers on average react positively but far from perfectly to a change in the leader's contribution. A Wilcoxon rank sum test fails to reject the null hypothesis that the mean slopes come from the same underlying distribution ($p = 0.78$, two-sided). The difference in followers' average contributions is thus not reflected by steeper reaction functions with respect to the leader's examples. On average, followers rather seems to increment their contribution by an amount which is not conditional on what the leader does. Evidence in support of this conjecture comes from a Wilcoxon rank sum test that compares the followers' predicted responses for the average contribution of a leader (i.e., 5 ECU). We use this measure as a proxy for the constant part of the followers' response functions. The test rejects the null hypothesis at the 10% significance level ($p = 0.08$, two-sided). The evidence on role-specific behavior is summarized by:

Result 2. *The presence of intergroup competition does not affect the contribution behavior*

[17]The average conditional choice vectors are obtained by calculating the followers' mean response for each possible leader contribution.

of leaders but the conditional responses of followers. The change in follower behavior is best described as an increase in the willingness to contribute which is not conditional on the leader's decision.

There is considerable heterogeneity in how followers react to leaders' contributions. As this study is the first to use the strategy method on followers' choices, we are able to provide a more complete picture of these patterns. We categorize followers into five distinct groups according to the pattern of their conditional responses. The first group are *strict non-contributors (SNC)*, who contribute exactly zero ECU for every possible leader decision.[18] *Unconditional contributors (UC)* do also not condition on the leader's decision but contribute strictly positive amounts. *Conditional followers (CF)* are characterized by upward sloping conditional response vectors. Their vectors of conditional choices either increase monotonically with the leader's contribution or exhibit a positive and highly significant ($p<0.01$) Spearman correlation coefficient.[19] The fourth group are *hump-shaped followers (HSF)* who react positively to better examples only up to some specific leader contribution. Beyond this threshold, they react negatively.[20] The last group are *reverse conditional followers (RCF)* who contribute less the more the leader contributes.[21] Such a pattern might reflect a motivation to supply some fixed amount of the public good as a group. A higher leader contribution would lower the burden to contribute for the follower, which implies a downward sloping pattern. The group *no category (NC)* subsumes all remaining followers. Table 2 depicts the observed relative frequencies for each follower category. It is evident that conditional followers constitute the largest group. Strict non-contributors, reverse conditional followers and hump-shaped followers mark the second, third and forth most frequently observed categories. Unconditional contributors are rarely observed. Note that about one fourth of all followers does not fall into any category. This is partly due to our strict requirement on the significance of the Spearman correlation coefficient.[22] Comparing the distributions of types across treatments, we find them to be

[18] We prefer this term to *free-riders* as the latter is already established and describes an actor who contributes nothing independently of the decisions of everyone else in the group (see, e.g. Fischbacher et al., 2001).

[19] These criteria mirror those used in Fischbacher et al. (2001) and Fischbacher and Gächter (2010) for a public goods game with simultaneous decisions.

[20] The decisive criterion is a highly significant positive Spearman correlation coefficient for choices smaller or equal to the threshold and a negative and highly significant coefficient for choice above the threshold.

[21] The conditional responses either monotonically decrease with higher leader contributions or exhibit a negative and highly significant Spearman rank correlation coefficient.

[22] A relaxation of this requirement yields more observations for conditional followers, reverse conditional followers and hump-shaped followers. Results are available on request.

Table 2: Relative frequencies of follower categories

Treatment	SNC	UC	CF	RCF	HSF	NC	# obs
No competition (S1-SeqNC)	10.0	6.0	46.0	8.0	6.0	24.0	50
Competition (S1-SeqC)	10.6	2.9	40.4	8.7	6.7	30.8	104
Total	10.4	3.9	42.2	8.5	6.5	28.6	154

Note: Abbreviations: SNC = strict non-contributors; UC = unconditional contributors; CF = conditional followers; HSF = hump-shaped followers; RCF = reverse conditional followers; NC = no category.

very similar in both conditions. A one-sided Fisher exact test does not reveal a significant difference in the distribution of types ($p = 0.89$). Pairwise comparisons for each individual category also do not indicate any differences in the relative frequencies (the smallest p-value is $p = 0.25$ for *no category*, one-sided). Intergroup competition thus does not seem to have an influence on the distribution of patterns with which followers react to leaders' examples. Figure 2 displays the average contribution vectors by follower category for both experimental conditions. It clearly shows the distinct, type-specific patterns of conditional responses. The figure indicates furthermore that the increase in followers' average conditional responses which is associated with intergroup competition (see Result 2) is mainly due to unconditional contributors, reverse conditional contributors and those who cannot be categorized.[23] In contrast, conditional followers display almost identical average conditional response vectors in both experimental conditions. We summarize as follows:

Result 3. *Followers can be classified into several types according to their conditional responses to leaders' examples. While almost half are conditional followers, we also observe strict non-contributors, unconditional contributors, reverse conditional followers, and hump-shaped followers who each account for a minor percentage of the observations. The distribution of types does not depend on the presence of intergroup competition.*

4.3 Repeated interaction

Investigating one-shot interactions allows for valuable insights as it abstracts from strategic behavior. Real life social dilemmas such as team work situations, however, are often marked by repeated interaction which allows for reputation building or reciprocity concerns. In this section, we extend our analysis to repeated play using data from the second

[23]Wilcoxon rank sum tests that compare followers' average conditional responses between S1-SeqNC and S1-SeqC, however, do not reveal statistically significant differences for any single follower type.

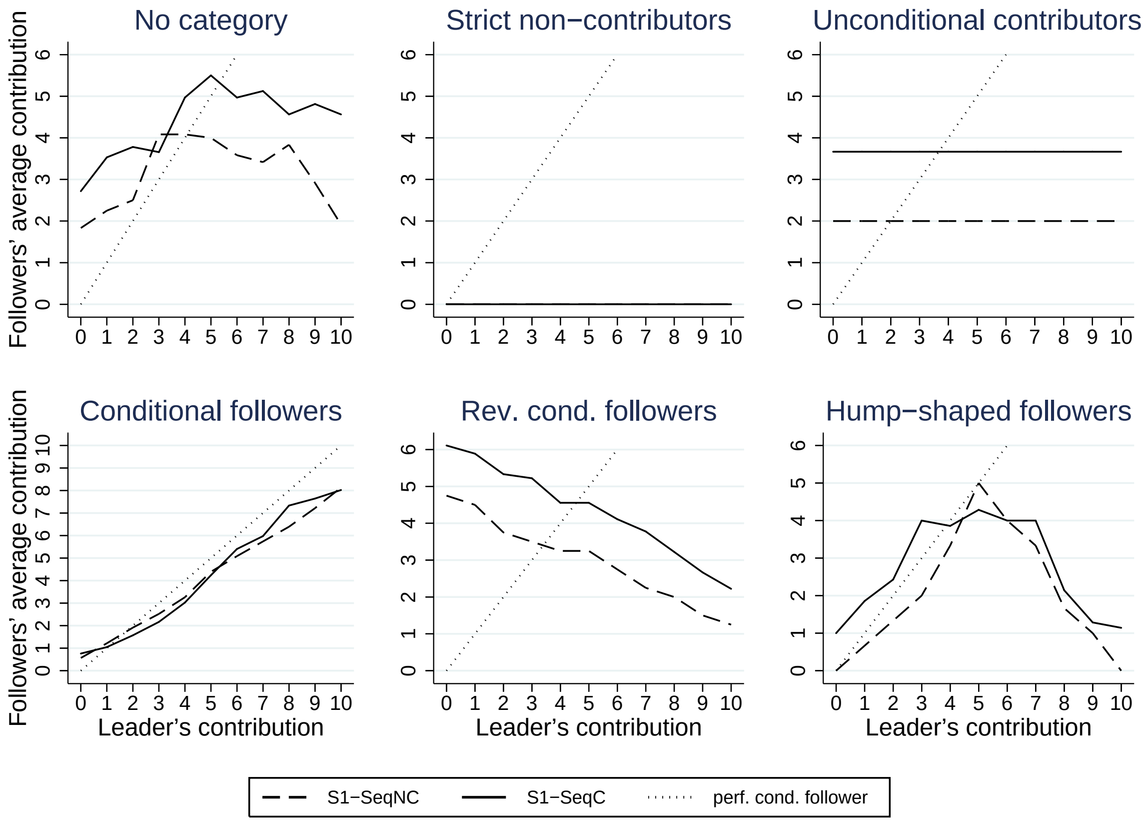

Figure 2: Followers' average conditional responses by follower category

stage of the experiment. Most of the analysis in this section is based on independent observations. Due to the feedback between periods, the unit of an independent observation are group averages in case of isolated groups and averages of pairs of groups in case of intergroup competition.

Treatment effects. Figure 3 depicts the time series of average contributions for each treatment. Treatment S2-SimNC replicates standard findings closely as contributions start at around 50% of the endowment in the first period and decline steadily to 20% of the endowment in the last period. Contributions in S2-SimC are higher than without competition in every period but show the same decline over time. Both treatments with sequential decisions show higher cooperation rates than the respective simultaneous move conditions. While this improvement is only visible for periods 4 to 10 when comparing S2-SeqNC to S2-SimNC, it is sustained over the whole course of the experiment for the treatments with intergroup competition.

In order to assess how the treatments affect overall cooperation, we average contribution over all ten periods. Table 3 provides the relevant descriptive statistics, based

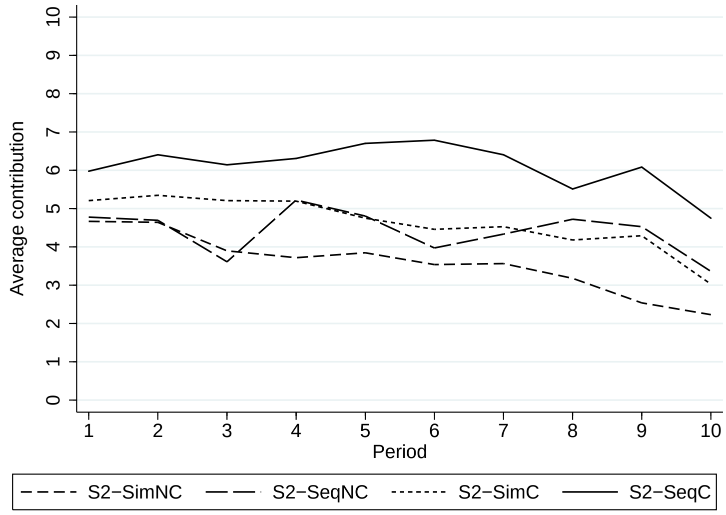

Figure 3: Average group contributions over time

on independent observations. Mean and median contributions indicate what Figure 3 already suggested: intergroup competition seems to foster intragroup cooperation. Pairwise two-sided Wilcoxon rank sum tests, however, fail to reject the null hypothesis that contributions come from the same underlying distribution both for simultaneous ($p = 0.18$) and for sequential decisions ($p = 0.14$). Thus, while intergroup competition leads to higher contributions in our (sequential move) one-shot interactions, this does not prove to be robust in repeated play.[24] In order to assess whether we find the effect of intergroup competition in our overall data set, we pool the data for the simultaneous and sequential treatments. Comparing independent observations, we find the difference to be statistically significant ($p = 0.036$, Wilcoxon rank sum test, two-sided).

Table 3: Descriptive statistics: average contributions over all 10 periods based on independent observation

Treatment	Mean	Median	St. Dev.	# Indep. obs.
S2-SimNC	3.6	3.4	1.96	13
S2-SeqNC	4.4	5.1	2.83	12
S2-SimC	4.6	4.5	1.71	12
S2-SeqC	6.1	6.5	1.59	14

Does leading by example yield an increase in cooperation? Figure 3 and Table 3 indicate that sequential decisions tend to elicit higher average contributions both with

[24]This result is in accordance with previous findings. While Bornstein and Ben-Yossef (1994), Baron (2001) and Probst et al. (1999) show that cooperation is higher in the IPD than in the PD in experiments where interaction is one-shot, this relation is not confirmed in Bornstein et al. (1996) who allow for repetition.

and without intergroup competition. We test this formally using two-sided Wilcoxon rank sum tests. While the test widely fails to reject the null hypothesis that contributions stem from the same underlying distribution when there is no intergroup competition ($p = 0.39$), the null hypothesis is rejected for the condition with intergroup competition ($p = 0.045$). Thus, according to our data, leading by example only has a consistent positive effect on contributions when it is combined with intergroup competition. This also drives the significant effect of sequential vs. simultaneous decisions ($p = 0.037$, Wilcoxon rank sum test, two-sided) when the data is pooled over conditions. The non-significance of the effect of leading by example without intergroup competition runs counter to results in previous studies. It is, however, not possible to attribute this discrepancy to a specific element of the experimental design, since neither of the previous studies on leading by example used three person groups, payed only one period in an repeated partners design or elicited beliefs. The relative increase in contributions of 22% is, moreover, in the same order of magnitude as the ones found in previous studies.[25] We summarize as follows:

Result 4. *Both, leading by example and intergroup competition, significantly increase contributions to the public good. The effect of leading by example is only significant in the condition with intergroup competition.*

A noteworthy feature of the data is that the between (matching-) group variation in cooperation does depend on the treatment. Figure provides 4 a graphical illustration. The Box-Whisker plots indicate that the variation between groups is largest in S2-SeqNC and smallest in S2-SeqC. In fact, S2-SeqNC shows the highest maximum and the lowest minimum average group contribution among all treatments. Comparing the standard deviations of average contributions between S2-SeqNC and S2-SeqC, this difference is significant ($p = 0.026$, robust Levene's-test).[26] It, thus, seems that intergroup competition does not only induce significantly higher average contributions when decisions are sequential but also a reduction in variance. The large variance in S2-SeqNC also explains why leading by example does not seem to have an effect without competition. It is only with intergroup competition, that sequential decisions lead to consistently higher contributions. This result complements the finding in Sausgruber (2009) that intergroup comparison reduces between-group variance in cooperation.

[25] Güth et al. (2007), for instance, find a weakly significant increase of 33%.

[26] None of the other pairwise comparisons reveals significant differences for the respective standard deviations.

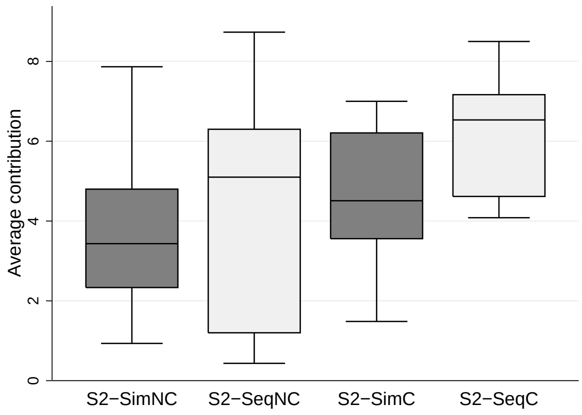

Figure 4: Box-Whisker plots of average contributions over all 10 periods based on independent observation. The boxes depict the 25 percentile, the median and the 75 percentile. The whiskers mark the upper and lower adjacent values.

Interaction of leading by example and intergroup competition. The presence of the leader yields a relative increase in contributions which amounts to 22% without competition and to 39% with competition. The absolute increase, although being of a small order of magnitude, roughly doubles. This suggests that leading by example and intergroup competition may interact in their effects on overall contributions. In order to formally test for such an interaction effect, we turn to regression analysis. Table 4 presents results from two panel Tobit models, with subject-specific random intercepts.[27] The first model regresses individual contributions on the two dummy variables *Competition* and *Sequential* representing the experimental conditions, a linear trend, *Period*, as well as on *Age* and *Gender* (male=1). The results partly mirror those obtained from the non-parametric tests since both main effects turn out to be positive and significant. In addition, we obtain the expected negative trend over periods and a positive effect of age. The second model augments the first as it adds the interaction of both experimental conditions labeled as *Comp*Sequential*. As expected, its point estimate is positive which indicates that the effect of leading by example tends to be larger with intergroup competition. However, the interaction is not significantly different from zero. The inclusion of the interaction also does not improve the model fit ($p = 0.19$, LR-test). It is, thus, not possible to conclude that leading by example and intergroup competition interact in a meaningful way in their effects on overall cooperation.

Our estimations do not allow contribution decisions to be interdependent within the same group and period. This, however, is likely to be the case as subjects condition their

[27]We report on Tobit models since the dependent variable, contribution, exhibits a large number of corner solution outcomes. In fact, 32% of all observations are either 0 ECU or 10 ECU.

Table 4: Panel Tobit regressions: main and interaction effects

Dep. variable: contribution
Random intercept: individual

	(1)		(2)	
	Coefficient	95% CI (BCa)	Coefficient	95% CI (BCa)
Competition	1.896**	[0.32; 3.22]	1.213	[-0.50; 2.94]
Sequential	1.629***	[0.44; 2.76]	0.703	[-1.91; 2.99]
Comp*Sequential	–	–	1.356	[-1.17; 4.64]
Period	-0.212***	[-0.34; -0.11]	-0.212***	[-0.34; -0.11]
Age	-0.231***	[-0.41; -0.09]	-0.224***	[-0.39; -0.09]
Gender	-0.340	[-1.16; 0.28]	-0.268	[-1.10; 0.46]
Constant	9.044***	[5.33; 12.51]	9.307***	[5.90; 13.26]
St. dev. random intercept	3.470***	[2.90; 3.98]	3.458***	[2.90; 3.99]
St. dev. residual	3.044***	[2.73; 3.65]	3.044***	[2.74; 3.65]
Log likelihood	-4838.2		-4837.3	

Note: The regressions are based on 2310 observations, 231 individuals, and 77 groups. 448 (293) observations are left (right) censored. The bias corrected and accelerated (BCa) confidence intervals are based on non-parametric bootstraps with 500 replications. Sampling respects group composition. ***, **, * indicate significance at levels 1%, 5%, and 10%, based on the BCa confidence intervals.

behavior on the history of choices and because of the semi-sequential decision protocol in the treatments with leading by example. In order to control for this issue, we estimate two Tobit models with group-specific random intercepts and two linear mixed effects models with nested random intercepts for groups and individuals.[28] All previous results are shown to be robust (see Tables 5 and 6, Appendix A).[29] We summarize as follows:

Result 5. *The interaction effect of leading by example and intergroup competition is positive but not statistically significant.*

Leader and follower behavior. Figure 5 depicts the time series of leader and follower contribution decisions for isolated groups (panel a) and intergroup competition (panel b). Both graphs show clearly that second movers tend to follow the leaders' examples over time. The Spearman correlation coefficients between leader and average follower contributions are $\rho = 0.77$ and $\rho = 0.68$ (both $p < 0.01$) for treatments S2-SeqNC and S2-SeqC, respectively.[30] At the same time, it is obvious that leaders consistently contribute more than followers. This is corroborated by two-sided Wilcoxon signed rank tests comparing leader and average follower contributions, averaged over periods ($p =$

[28]Due to a lack of implementation in Stata 11, we are not able to estimate Tobit models with nested random intercepts for groups and individuals.

[29]The only difference is that the coefficient for *Competition* turns out to be significant in the linear mixed effects model that includes the interaction effect *Comp*Sequential*.

[30]We average the contributions of the two followers in one group in order to obtain one number which can be compared to the leader's example.

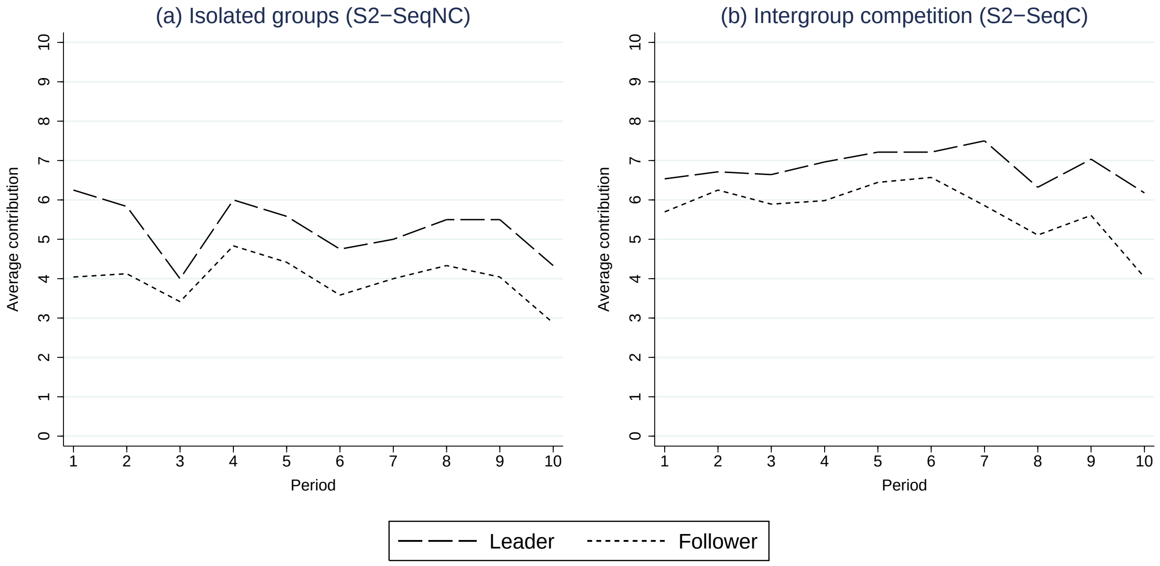

Figure 5: Leaders' and followers' contributions over time for the conditions without (panel a) and with intergroup competition (panel b)

0.007 in S2-SeqNC and $p < 0.01$ in S2-SeqC). As a consequence, leaders' expected earnings based on contribution decisions are lower than those of followers ($p < 0.01$ in S2-SeqNC and $p < 0.01$ in S2-SeqC, two-sided Wilcoxon signed rank test).[31] These results are in accordance with those from Section 4.2 and previous studies (see, e.g., Levati et al., 2007).

5 Conclusion

In this paper we experimentally investigate leading by example in a linear public goods game in environments with and without intergroup competition. The advancement with respect to the previous literature is two-fold.

First, we use the strategy method to characterize followers according to their conditional responses to a leader's contributions. Our results suggest that the usually observed undercutting of the leaders' examples may be the result of type-specific behavior. While the largest group of participants are conditional followers who reciprocate a leader's example, other types like strict non-contributors or hump-shaped followers on average undercut the leader's contribution. A non-negligible fraction of followers even punishes better examples by means of reverse conditional behavior.

Second, we generalize the cooperation enhancing effect of leading by example to a

[31]Note that payment for the second part was based on one randomly chosen period and incorporated payment for belief statements. The tests compare expected earnings for leaders and followers (averaged per group) based on contributions, i.e., excluding those from belief statements.

scenario of intergroup competition. Moreover we show that intergroup competition has differentiated effects on leading by example. While leader behavior remains largely unaffected, followers behave more cooperatively in the presences of intergroup competition. Their change behavior is best described as an increase in the willingness to cooperate that is not conditional on the leader's contribution. Thus, while exemplary effort should always be encouraged, it seems even more beneficial when groups are in competition. The latter statement, however, hinges on our specific parametrization in that a cooperative act benefits the in-group more than it hurts the out-group. The effects of leading by example in destructive intergroup conflict remain to be explored.

In this study, we deliberately abstract from the incentive aspects of intergroup competition in order to concentrate on its purely motivational effects. In real life, however, both these effects are present simultaneously. A possibly fruitful avenue of research is thus to investigate the interplay between leading by example and the structural effects of intergroup conflict. A leader's example might, e.g., constitute a powerful tool for equilibrium selection in competitions that are associated with an exogenously given price (see, e.g., Erev et al., 1993, Abbink et al., 2010) or all-can-win competitions (Reuben and Tyran, 2010).

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Appendix

A Additional empirical results

Table 5: Panel Tobit regressions: main and interaction effects - robustness check

Dep. variable: contribution Random intercept: group				
	(3)		(4)	
	Coefficient	95% CI (BCa)	Coefficient	95% CI (BCa)
Competition	2.029***	[0.63; 3.37]	1.300	[-0.26; 2.96]
Sequential	1.670***	[0.53; 2.78]	0.683	[-1.58; 2.97]
Comp*Sequential	–	–	1.461	[-1.12; 4.43]
Period	-0.214***	[-0.34; -0.11]	-0.214***	[-0.34; -0.11]
Age	-0.100**	[-0.20; -0.01]	-0.100**	[-0.20; -0.01]
Gender	-0.484	[-1.14; 0.06]	-0.479	[-1.14; 0.07]
Constant	6.147***	[3.66; 8.35]	6.608***	[4.27; 9.35]
St. dev. random intercept	3.104***	[2.66; 3.59]	3.087***	[2.67; 3.61]
St. dev. residual	3.290***	[2.94; 3.88]	3.290***	[2.94; 3.88]
Log likelihood	-4842.0		-4841.6	

Note: The regressions are based on 2310 observations, 231 individuals, and 77 groups. 448 (293) observations are left (right) censored. The biased corrected and accelerated (BCa) confidence intervals are based on a non-parametric bootstrap with 500 replications. Sampling respects group composition. ***, **, * indicate significance at levels 1%, 5% and 10%, based on the BCa confidence intervals.

Table 6: Linear mixed effects regressions: main and interaction effects - robustness check

Dep. variable: contribution Random intercepts: group, individual				
	(5)		(6)	
	Coefficient	95% CI (BCa)	Coefficient	95% CI (BCa)
Competition	1.379***	[0.42; 2.23]	1.098**	[0.03; 2.16]
Sequential	1.285***	[0.53; 2.03]	0.906	[-0.63; 2.35]
Comp*Sequential	–	–	0.561	[-1.15; 2.59]
Period	-0.154***	[-0.23; -0.09]	-0.154***	[-0.23; -0.09]
Age	-0.076**	[-0.13; -0.01]	-0.075**	[-0.13; -0.01]
Gender	-0.290*	[-0.60; 0.01]	-0.285*	[-0.60; 0.02]
Constant	6.011***	[4.37; 7.32]	6.181***	[4.63; 7.61]
St. dev. random intercepts				
group intercept	2.044***	[0.61; 0.82]	2.040***	[0.61; 0.82]
individual intercept	1.009	[-0.19; 0.08]	1.009	[-0.19; 0.08]
St. dev. residual	2.262***	[0.75; 0.90]	2.262***	[0.75; 0.90]
Log likelihood	-5375.3		-5375.1	

Note: The regressions are based on 2310 observations, 231 individuals and 77 groups. The bias corrected and accelerated (BCa) confidence intervals are based on non-parametric bootstraps with 500 replications. Sampling respects group composition. ***, **, * indicate significance at levels 1%, 5% and 10%, based on the BCa confidence intervals.

B Instructions

This appendix reports the instructions (originally in German) for all treatments, separated for stages 1 and 2.

B.1 Instructions - stage 1

The instructions for treatment S1-SeqNC incorporate all parts of the instructions common to all treatments in stage 1. The instructions for treatment S1-SeqC can be obtained by inserting and replacing the appropriate paragraphs. The placeholders *[for treatment S1-SeqC, insert paragraph < paragraph name > here]* and *[for treatment S1-SeqC, replace the following paragraph]* indicate which paragraphs have to be added or replaced, where the replacement always has the same heading.

B.1.1 Instructions for treatment S1-SeqNC

INSTRUCTIONS

Welcome and thank you for participating in this experiment. Please remain silent and switch off your mobile!

You will receive €2.50 for showing up on time. Beyond this you can earn more money. In order to do this, please read these instructions carefully. The €2.50 show-up fee and any additional amounts of money you may earn will be paid to you in cash at the end of the experiment. Payments are carried out privately, i.e., without the other participants knowing the extent of your earnings. During the experiment, we shall not speak of euros but of ECU (Experimental Currency Units). ECU are converted to euros at the following exchange rate: 1 ECU = €0.80.

The experiment consists of two parts. Some features of the experiment may change from the first to the second part. The instructions for the first part follow on this page. The instructions for the second part will be distributed after all participants have completed the first part.

It is strictly forbidden to speak to other participants. If you have any questions during the experiment please raise your hand.

DETAILED INFORMATION ON THE FIRST PART

You will first learn about the basic decision situation. The description about the experiment in the first part follows afterwards.

The Basic Decision Situation

Group formation

You will be placed in a group of three players. You will never learn the identity of the other members of your group. Every group will be identified by an individual color.

Decisions

You (as well as the other members of your group) receive an endowment of 10 ECU. You have to decide **how many of these 10 ECU you want to contribute to a project**. The ECU contributed to the group project yield income for you as well as for the other members of your group (you will learn more about the "income from the project" below). You can keep the ECU that you do not contribute for yourself (they yield income just for you).

[for treatments S1-SeqC, insert paragraph < Interaction with another group > here]

[for treatments S1-SeqC, replace the following paragraph]

Period earnings

More specifically, in every period your earnings consist of two parts:

a) "Income from the project" = 0.5 × sum of all group members' contributions (in words, the income from the project is determined by multiplying the sum of the contributions of all group members by 0.5);

b) "ECU you keep" = 10 − your contribution to the project.

Thus, your period earnings summarized in a formula are

Your period earnings	=	**Income from the project**	+	**ECU you keep**
		(0.5 × sum of group's contributions)	+	(10 − your contribution)

Example:

Suppose that all three group members contribute 5 ECU. Then both you and your group members receive an "income from the project" of 7.5 (= 0.5 × 15) ECU. The "ECU you keep" are 5 (= 10 − 5). Hence, your period earnings are 7.5 + 5 = 12.5 ECU.

The Experiment In The First Part

Interaction with your group members

This part of the experiment consists of one period only. This period entails the following two stages:

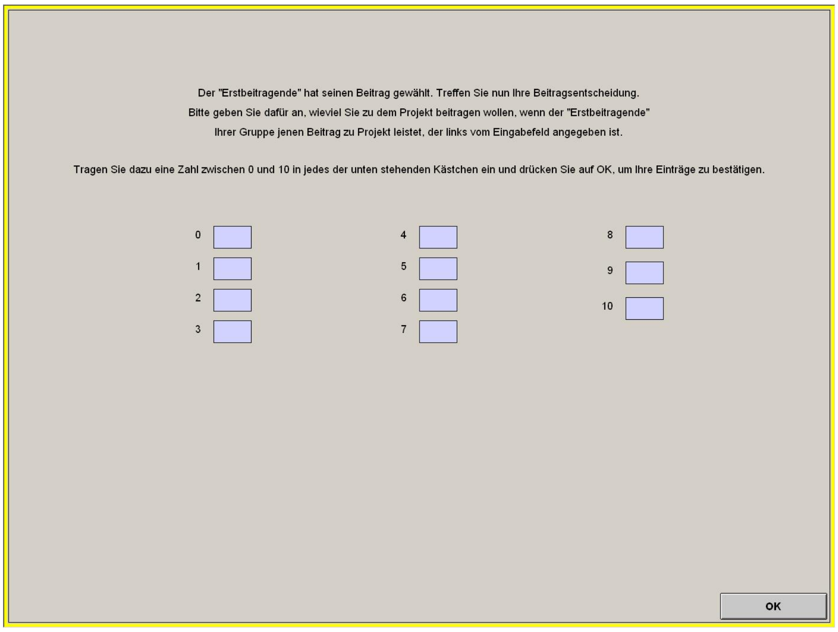
1. One group member decides prior to the others on his/her own contribution. In the following, we shall refer to the group member who decides first as the "early contributor."
2. Without learning the "early contributor's" choice, the other two group members decide simultaneously and privately on their own contributions. You will learn about the format of these decisions below.

At the beginning of the first part of the experiment, one member of each group is randomly selected to be the "early contributor." Every participant will be informed whether he or she is going to act as the "early contributor" in an "Information Window."

How you decide on your contribution

If you are the "early contributor," you enter your contribution in the following screen. You can insert any integer number from 0 to 10.

If you are not the "early contributor," you are going to be asked to indicate your contribution for every possible contribution of the "early contributor." The screen on which you will make your decisions is displayed below.



In each of the 11 boxes you have to indicate how many ECU you wish to contribute, conditional on the "early contributor's" contribution printed on the left of each box. In each box you can insert any integer from 0 to 10. Please bear in mind that the "early contributor" already made his/her decision, which can not be revised. His/her choice determines which of your decisions will actually count. However, since you do not know his/her choice when making your decisions you will have to think carefully about all your decisions because all can become relevant to your earnings. The following example should clarify this.

Suppose that the "early contributor" decided to contribute 5 ECU to the project. Suppose furthermore that you decided on your contributions as displayed in the table below.

"early contributor's" decision	0	1	2	3	4	5	6	7	8	9	10
your contribution	0	10	0	7	8	8	0	3	2	8	0

Suppose furthermore, that the decisions of the third group member are identical to yours. The decision that counts for both you and the third group member is the one for the 5 ECU contribution of the "early contributor." I.e. you both contribute 8 ECU to the project. The sum of contributions thus equals $5 + 8 + 8 = 21$ ECU.

The information you receive

You will receive no information about any decision at the end of the first part of the experiment. Only when the second part of the experiment is finished you will be informed about the choices from the first part. This information includes (1) the "early contributor's" decision, (2) the corresponding decisions of the two other group members, (3) the income from the project, and *[(in treatment S1-SeqC) (4) the total contributions in your group and the group your's is paired with, and (5)]* (4) your resulting period earnings.

Additional information on the overall experiment

Your final payoff

Your final payoff will be based on only one of the two parts of the experiment. The payoff relevant part will be randomly selected by the flip of a fair coin at the end of the experiment (i.e., after everyone has finished the second part). The outcome of this coin flip will be decisive for everyone. If the first part of the experiment will be selected, you are going to be payed your period earnings in this part in addition to the €2.50 show-up fee. The coin flip is going to be conducted by one of the participants of the experiment. To select the participant, one experimenter will draw a ball from an urn containing as many balls as there are participants in the experiment.

Before the experiment starts, we ask you to answer some control questions, in order to assure that all participants completely and correctly understood the rules of the experiment. Once everybody has answered all questions correctly, six practice periods will be played. During these six periods, you will not be matched with other persons in this room, but with a computer that will determine randomly the others' decisions. You will get no payment for these periods.

Please remain quietly seated until the experiment starts. If you have any questions, please raise your hand now. Please click on OK if you finished reading the instructions.

B.1.2 Additional instructions for treatment S1-SeqC

Interaction with another group

Your group will be randomly paired with another group of three. After the contribution decisions, the total (i.e., the sum of) contributions to the project of your group will be compared with the total contributions to the project of the other group. The group with the higher total contributions (or the "winning" group) receives a transfer from the group with the lower total contributions (or the "losing" group). The "transfer you receive or pay" depends on the difference in total contributions between the two groups and each group member will receive or pay an equal share of the transfer. You will learn more about the "transfer you receive or pay" below.

Period earnings

More specifically, in every period your earnings consist of three parts:

a) "Income from the project" = 0.4 × sum of all group members' contributions (in words, the income from the project is determined by multiplying the sum of the contributions of all group members by 0.4);

b) "ECU you keep" = 10 − your contribution to the project;

c) "Transfer you receive or pay" = 0.1 × difference in total contributions between your group and the other group.

Thus, **if you are a member of the winning group**, your period earnings summarized in a formula are

Your period earnings	=	**Income from the project**	+	**ECU you keep**
		(0.4 × sum of group's contributions)	+	(10 − your contribution)
	+	**Transfer you receive**		
		(0.1 × difference in total contributions)		

If you are a member of the losing group, your period earnings summarized in a formula are

Your period earnings	=	**Income from the project**	+	**ECU you keep**
		(0.4 × sum of group's contributions)	+	(10 − your contribution)
	−	**Transfer you pay**		
		(0.1 × difference in total contributions)		

Example:

Suppose that all three members of your group contribute 5 ECU and all three members of the other group contribute 0 ECU. Then your group's total contributions are 3 × 5 ECU = 15 ECU. The other group's total contributions are 3 × 0 ECU = 0 ECU. This means that your group receives the transfer and the other group pays the transfer. The "transfer you receive" is 1.5 (= 0.1 × (15 − 0)) ECU. The "income from the project" equals 6 (= 0.4 × 15) ECU. The "ECU you keep" are 5 (= 10 − 5). Hence, your period earnings are 6 + 5 + 1.5 = 12.5 ECU.

B.2 Instructions - stage 2

This appendix reports the instructions (originally in German) for stage 2. Those for treatment S2-SimNC are displayed below in full length. They contain all parts which are common to all four treatments in this stage. The instructions for the other treatments can be obtained by inserting and replacing the appropriate paragraphs. The place holder *[for treatment <treatment name>, replace the following paragraph]* indicates which paragraphs have to be replaced, where the replacement always has the same heading. The place holder *[for treatment <treatment name>, insert paragraph <paragraph name> here]* prescribes where new paragraphs have to be inserted.

B.2.1 Instructions for treatment S2-SimNC

DETAILED INFORMATION ON THE SECOND PART

The Basic Decision Situation

In this second part you will face the same basic decision situation as in the first part of the experiment.

Group formation

The group composition is the same as in the first part of the experiment. I.e. you are again interacting with the same group members. *[(in S2-SimC and S2-SeqC:) Also, the group yours is interacting with is the same as in the first part of the experiment.]*

The Experiment In The Second Part

[for treatments S2-SeqNC and S2-SeqC, replace the following paragraph]

Interaction with your group members in each period

This part of the experiment consists of 10 periods. At the beginning of every period, each group member receives an endowment of 10 ECU. In each period, you as well as the other two members of your group decide simultaneously and privately about the amount of ECUs you want to contribute to the project. The screen on which you will make your decisions is displayed below. You can insert any integer number from 0 to 10.

[for treatments S2-SeqNC and S2-SeqC, insert paragraph <How you decide on your contribution> here]

[for treatments S2-SeqNC and S2-SeqC, replace the following paragraph]

Your guess with respect to the own group

In every period, besides making your contribution decision, you have to make a guess. The target is to guess the average contribution of the other two members of your group (rounded to the next integer, 0.5 is rounded up). You will be paid for the accuracy of your guesses as follows:

- If your guess is the same as the target, you earn 3 ECU.
- If your guess deviates by 1 ECU from the target, you earn 2 ECU.
- If your guess deviates by 2 ECU or more, you earn nothing.

[for treatments S2-SimC and S2-SeqC, insert paragraph <Your guess with respect to the other group> here]

The information you receive after each period

After each period you will receive information about (1) the number of ECU contributed by each of your group members *[(in treatment S2-SimC and S2-SeqC) (1) the "early contributor's" decision, (2) the corresponding decisions of the other two group members]* being sorted in descending order, (2) the income from the project, *[(in treatment S2-SimC and S2-SeqC) (4) the total contributions in your group and the group your's is paired with,]* (3) your resulting period-earnings, and (4) the earnings for the accuracy of your guess.

Your final payoff

If the second part of the experiment is selected for payment, you are going to be paid according to one randomly selected period. For this period you will receive the sum of your period earnings and the payoff for the accuracy of your expectation *[(in treatments S2-SimC and S2-SeqC) both your expectations]*. In order to determine which period is payoff relevant, the randomly selected participant will draw a ball from an urn which contains 10 balls, numbered from 1 to 10. The draw will be decisive for everyone.

Please remain quietly seated until the experiment starts. If you have any questions, please raise your hand now. Please click on OK if you finished reading the instructions.

B.2.2 Additional instructions for treatments S2-SeqNC and S2-SeqC

Interaction with your group members in every period

This part of the experiment consists of 10 periods. At the beginning of every period, each group member receives an endowment of 10 ECU. Each period consists of the same two stages as in the first part of the experiment. The positions within each group are the same as in the first part of the experiment. In particular, if you were the "early contributor" in the first part, you are going to be the "early contributor" in the second part as well.

How you decide on your contribution

If you are the "early contributor," you enter your contribution in the following screen. You can insert any integer number from 0 to 10.

If you are not the "early contributor," you are <u>not</u> going to be asked to indicate your contribution for every possible contribution of the "early contributor" like in the first part of the experiment. Instead, you are informed about the "early contributor's" decision. Afterwards you can choose your own contribution. The screen on which you will make your decisions is displayed below, where the "X" is the placeholder for the "early contributor's" choice. You can insert any integer number from 0 to 10.

Your guess with respect to the own group

In every period, besides making your contribution decision, you have to make a guess about the following target.

- If you are the "early contributor," the target is to guess the average contribution of the other two group members (rounded to the next integer, 0.5 is rounded up).
- If you are not the "early contributor," the target is to guess the contribution of the other group member who is in the same position as you.

You will be paid for the accuracy of your guesses as follows:

- If your guess is the same as the target, you earn 3 ECU.
- If your guess deviates by 1 ECU from the target, you earn 2 ECU.
- If your guess deviates by 2 ECU or more, you earn nothing.

B.2.3 Additional instructions for treatments S2-SimC and S2-SeqC

Your guess with respect to the other group

In every period you also have to guess the average contribution of the group yours is compared with (rounded to the next integer). You will be paid for the accuracy of your guesses as follows:

- If your guess is the same as the other group's average contribution, you earn 3 ECU.
- If your guess deviates by 1 ECU from the other group's average contribution, you earn 2 ECU.
- If your guess deviates by 2 ECU or more, you earn nothing.