Leadership in Intergroup Contests

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Leadership in Intergroup Contests

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Leadership in Intergroup Contests

Abstract:
The paper studies how leadership recommendations and leading-by-example shape behavior in intergroup contests. The experimental results show that the leader is a key driver of aggregate contest expenditure. Leaders increase their expenditure substantially once they make recommendations to the followers. The specific expenditure recommendations have a highly significant impact on the investments of followers. The additional impact of leading by example is rather small. A second experiment replicates the treatments in a noncompetitive voluntary contribution game. It reveals a remarkable consistency in the leader-follower-relationship across the two games despite significant differences in the impact of the treatments on leadership behavior.
I. Introduction

Social scientists, and in particular economists, increasingly use experiments to study leadership in groups (Zehnder, Herz and Bonardi, 2017). Experiments allow for a random assignment of leadership roles (Huck and Rey-Biel, 2006, Arbak and Vlleval, 2011) and a controlled variation in the availability of leadership instruments. The task for the experimental leader resembles the challenges of ‘real world’ group leaders. They want to overcome cooperation problems among group members in order to implement mutually beneficial outcomes. Therefore, experiments typically implement public good games or other voluntary contribution mechanisms that impose a social dilemma. This paper provides a novel approach and focuses on group leadership in intergroup contests, i.e. a situation in which two groups with multiple members compete for a given prize.

The behavioral analysis of leadership in intergroup contests does not just help understanding how famous people rise to prominence, e.g. as generals in a war, as team captains in sport tournaments or as successful managers in competitive markets. Perhaps more importantly, intergroup contests have some specific characteristics relative to voluntary contribution mechanisms that provide novel insights regarding leadership instrument and the relationship between leaders and followers.

First, the incentive structure in intergroup contests is peculiar (see section 3 of this paper, or, for more general theoretical considerations, Kolmar (2013)). Unlike typical public good games, contests with predetermined, and strictly positive, prizes generate an incentive to invest some resources for the benefit of the entire group. If all other members of the competing groups abstained from any contest expenditure, a minimal effort investment by one group member could decisively change the odds in favor of the own team.

Second, increasing efforts by some group members decrease the investment incentives of the other group members if they have the same belief about the behavior of the opposing group. These investments are strategic substitutes. Hence, if leaders contribute heavily to their group’s cause, they may induce followers to lower their own effort. In noncompetitive social dilemmas, the investments of one group member do not affect the

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1 Note, that another strand in the literature experimentally investigates the personality traits and incentives, which motivate individuals to acquire or to delegate power (e.g. Fehr, Herz and Wilkening, 2013)
incentives of the other group members. The investments become strategic complements if the group members have a preference for reciprocity, equity and/or fairness concerns (Potters, Sefton and Vesterlund, 2005, 2007, Gächter, Nosenzo, Renner and Sefton, 2013). Because of the aforementioned peculiar incentive structure in intergroup contests, such preferences must be stronger for followers to act accordingly.

Third, group members generate two types of external effects if they provide effort for their group. Not only do they generate a benefit to their fellow group members (as in a typical voluntary contribution scheme). They simultaneously harm the members of the opposing group because the other group has a reduced chance to win the prize. This negative externality has no monetary incentive effect but it can foster a preference for winning (Mago, Samak and Sheremeta, 2013, Sheremeta, 2013) or parochial altruism, i.e. when altruism towards one’s own group goes along with hostility towards the opposing group (Abbink, Brandts, Herrmann and Orzen, 2012). In consequence, contestants make rather large contributions to improve the odds of their own side (Abbink, Brandts, Herrmann and Orzen, 2010, Sheremeta, 2015). Such seemingly excessive investments mitigate the social dilemma within the group and, therefore, limit the scope for leadership.

The paper also contributes to the understanding of the mechanisms of Leading by Example (LbE) as an instrument of leadership. LbE implies that a group of followers learns about the decision of their leader before they commit themselves in the social dilemma. Several papers show that such LbE promotes cooperation in voluntary contribution games (e.g. Güth, Levati, Sutter and Van Der Heijden, 2007, Levati, Sutter and Van der Heijden, 2007, Gächter et al., 2013). They also reveal that groups perform best when led by those who are cooperatively inclined. Drouvelis and Nosenzo (2013) find that a shared group identity enhances this effect. Cartwright, Gillet and Van Vugt (2013) and Gächter and Renner (2014) identify how leaders shape the beliefs of followers in this context.

It is unclear whether LbE is still effective in circumstances that foster intra-group cooperation anyway. Therefore I study leadership instruments in a context in which non-binding investment recommendation allow for simple “cheap-talk” coordination. The literature does not provide clear insights on this issue. Pogrebna, Krantz, Schade and Keser (2011) observe that non-binding verbal statements of a leader have a similar
aggregate effect like LbE while Dannenberg (2015) reports a relatively low effect of such chat messages. Meanwhile Koukoumelis, Levati and Weisser (2012) show that one-way communication has a beneficial impact on cooperation.

The evidence derives from a laboratory experiment in which two groups with three members each compete in a Tullock contest (Tullock, 1980). In the baseline treatment each group member can make a private investment in order to increase her group's chance of winning the prize. In the second treatment, one randomly chosen group member in each group, the 'leader', recommends a contribution level before the actual decision. The third treatment induces leading by example. The leader recommends an investment level and decides about her own contribution. The other group members, the 'followers', see both the recommendation and the actual investment decision of the leader when they decide about their own contribution. In order to obtain a behavioral benchmark, I replicate the treatments in a second experiment in which each group faces a social dilemma in the context of a noncompetitive voluntary contribution mechanism (VCM).

The results show that followers do not free-ride on the investments of the leaders. They also reveal some differences in investment levels across the treatments. However, the leaders are the main drivers of this effect. They tend to underinvest but increase their expenditure substantially once they make recommendations to the followers. Leading by example, i.e. the visible ex-ante investment commitment of the leader, has no discernible additional impact on the investment level and a small positive impact on followership.

The second experiment shows that the behavioral differences between the two games are remarkably small, starting with the observation that they induce the same investments in the baseline treatments without recommendations. The key difference between the two games is the observation that the VCM induces leaders to increase expenditure more strongly than in the inter-group contest once they make

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2 The Tullock contest is arguably the most widely used model for the experimental study of conflicts (Abbing, 2010, Dechenaux, Kovenock and Sheremeta, 2012, Kimbrough, Laughren and Sheremeta, 2017). The group members can invest resources in order to increase the probability to win a prize. Any increase in investment simultaneously reduces the probability of the opposing group to win the prize in the specific round.
recommendations. This extra-large increase in investments does not affect the comparative statics of followership.

The paper now proceeds as follows. The next sections explain the design of the intergroup contest, derive the behavioral predictions and present the results. Section V introduces the voluntary contribution mechanisms and compares the two experiments. Section VI provides the conclusions.

II. Design of the Intergroup Contest Experiment

In the experiment two groups competed against each other in a Tullock contest. The experiment lasted for 20 rounds, each round the group faced a randomly chosen opponent. A group consisted of three players, one leader and two followers, who kept their roles throughout the entire experiment.3 Table 1 summarizes the sequence of the stage game and the treatment differences. The game did not vary across the rounds in a specific treatment.

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3 Appendix A provides an English translation of the experimental instructions (original in German). The instructions did not mention terms like leadership or followers and used neutral labels, referring to players A, B and C (the leader). This procedure should minimize demand effects that beset many applied experimental studies (Sturm and Antonakis, 2015). I used a partner-matching protocol which implies that the group composition does not change across rounds.
Table 1: The Design of a round in the Experiment

<table>
<thead>
<tr>
<th>Step</th>
<th>Baseline</th>
<th>Recommendation</th>
<th>Leading by Example (LbE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Each player gets an endowment of 100 points</td>
<td>Leader makes a non-binding investment recommendation</td>
<td></td>
</tr>
<tr>
<td>1a</td>
<td></td>
<td></td>
<td>Leader decides about investment</td>
</tr>
<tr>
<td>1b</td>
<td></td>
<td>Followers learn about the recommendation</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Followers learn about the recommendation and the leader’s investment.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Leader and followers decide about investment</td>
<td>Followers decide about investment</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>All players learn whether the group has won the prize.</td>
<td>Leaders learn about the individual investments of the followers and the aggregate investments of the other group.</td>
<td></td>
</tr>
</tbody>
</table>

I now explain the game in a round in the Baseline Treatment in greater detail. Afterwards, I describe the differences between the treatments.

**Baseline Treatment**

Each player received an endowment of 100 points in a round, with 120 points exchanging into 1 €. The player could keep the points in a private account or invest them in order to enhance the chances of the own group in the intergroup contest. The groups compete for a prize of 300 points. Irrespective of the individual investments, each group member receives 100 points if her group wins. The winning probability of a group is determined by its members’ investments relative to aggregate investment in both groups. At the end of a round, the followers learn about their own payoff, i.e. whether the group has won the prize. The leaders also receive information about the individual investments of group members and the aggregate investments of the opposing group.
**Recommendation Treatment**

In the Recommendation Treatment the leader makes a non-binding investment recommendation to her followers. All group members see this recommendation when they make their subsequent investment decision.

**Leading-by-Example Treatment**

In the Leading-by-Example Treatment the leader also makes a non-binding investment recommendation to her followers. Afterwards the leader makes her own investment decisions. The followers see the recommendation and the actual contest expenditure of the leader when they make their subsequent investment decision.

**III. Predictions**

In this section I present a set of competing hypotheses. The first set derives from standard game theory assuming common knowledge that all actors are rational and want to maximize their own payoff.

The stage game is a contest between two groups, 1 and 2. Each group includes a leader \( L_i \) (with \( i \in \{1; 2\} \)) and two followers \( F_ia \) and \( F_ib \). The groups compete for a prize \( P > 0 \), the winning groups divides the prize in equal shares among its three members. Each group member receives an endowment \( X > 0 \) and can spend \( 0 \leq x \leq X \) to enhance the winning probability of her group. The winning probability of a group in Tullock contest is determined by the members’ investments relative to aggregate investment in both groups.

Now we study the payoff function of a risk-neutral follower in group 1. The payoff increases in the endowment \( X \) as well as the product of the winning probability and the share of the prize \( P \). It decreases in the contest expenditure. The follower chooses the expenditure to maximize the expected payoff

\[
\max_{x_{F1a}} \frac{X_1}{X_1 + X_2} \left( \frac{P}{3} \right) - x_{F1a},
\]

with \( X_1 = x_{L1} + x_{F1a} + x_{F1b} \) denoting the investments of leaders and followers in the first group and \( X_2 = x_{L2} + x_{F2a} + x_{F2b} \) for the second group. A transformation of the resulting first order condition yields \( \frac{X_2}{(X_1 + X_2)^2} \left( \frac{P}{3} \right) = 1 \), and accordingly for the other
Together, the two optimality conditions imply that both groups make the same aggregate expenditure \((X_1 = X_2)\). The resulting simplification of the first optimality condition gives us

\[
\frac{p}{12} = X_1
\]

And, because of \(X_1 = x_{L1} + x_{F1a} + x_{F1b}\), we obtain the investment of the follower

\[
\frac{p}{12} - x_{L1} - x_{F1b} = x_{F1a}
\]

This result shows that the investments of the group members are strategic substitutes \(\left(\frac{\partial x_{F1a}}{\partial x_{L1}} = -1\right)\), which implies the aforementioned incentive against leading by example.

There is an optimal aggregate best response to the behavior of the opposing group. Whatever the leader provides to this best response does not have to be provided by the followers. If the leaders do not provide any investments, the followers make all the investments. Followers should reduce their investments if they see a high investment of the leader. Note also, that the leader’s recommendations are actually irrelevant in this context.

We get multiple equilibria within groups that share one crucial characteristics, namely the aggregate investment of all group members is \(x_{L1} + x_{F1a} + x_{F1b} = \frac{p}{12}\). With \(P = 300\) points, the predicted aggregate group expenditure is 25 points.

Hypothesis 1 (common knowledge about payoff maximizing preferences):

a) Aggregate group expenditure does not differ across the treatments.

b) In the Baseline and the Recommendations Treatments, the investments of leaders and followers do not correlate with each other.

c) In the Leading by Example Treatment the investments of the followers decrease with increasing investments of the leader. Leaders will invest less than followers in this treatment.

These hypotheses are not in line with an intuitive understanding of leadership. Leading by example as a concept implies that leadership behavior sets a standard the others should follow. They also contradict two well established patterns about decision making in intergroup- contests and the leader-follower relationship in noncompetitive
environments. First, we know that group members make seemingly excessive investments in competitive environments (Abbink et al., 2010, Abbink et al., 2012, Sheremeta, 2015). To rationalize this behavior, Mago et al. (2013) incorporate a ‘joy-of-winning’ parameter in their model. Second, leadership studies in noncompetitive environments games (e.g. Güth, Levati, Sutter and Van Der Heijden, 2007, Levati, Sutter and Van der Heijden, 2007, Gächter et al., 2013) and seminal theoretical papers on conditional cooperation (e.g. Levine, 1998, Fehr and Schmidt, 1999, Falk and Fischbacher, 2006) show that people adjust their behavior to the observed decisions of other group members, in particular a first moving group member.

To incorporate these observations I extend the utility function of a follower in group 1 with an additional parameter $\alpha(T, x_{l1})$. Again, I assume common knowledge that the parameter does not differ between the participants in a specific contest

$$\max_{x_{f1a}} U = \frac{X_1}{X_1 + X_2} \left( \frac{P}{3} + \alpha(T, x_{l1}) \right) - x_{f1a}$$

The new parameter depends on the treatment $T$ and increases in the (assumed) investment of the leader $x_{l1}$ (with $\alpha|_{x_{l1} = 0} = 0$ and $\frac{\partial \alpha(Base,x_{l1})}{\partial x_{l1}} > \frac{\partial \alpha(Rec,x_{l1})}{\partial x_{l1}} > \frac{\partial \alpha(Base,x_{l1})}{\partial x_{l1}} > 0$). It resembles the joy-of-winning-parameter in Mago et al. (2013) as it implies a nonmonetary additional benefit on top of the prize if the group is successful. The parameter also contains a reciprocal element because it increases in the investment of the leader. The assumed differences between the treatments in the comparative statics take into account that the Leading-by-Example Treatment, at least, removes the uncertainty about the actual behavior of the leader. The transformed optimality condition is now

$$\frac{X_2}{(X_1 + X_2)^2} \left( \frac{P}{3} + \alpha(T, x_{l1}) \right) = 1$$

The aforementioned common knowledge assumption ensures homogenous aggregate investments at the group level and we obtain the following investment of the follower.

$$\frac{P}{12} + \frac{\alpha(T, x_{l1})}{4} - x_{l1} = x_{f1b} = x_{f1a}$$
The analysis of the comparative statics reveals that the investments of the group members are no perfect strategic substitutes anymore \( \left( \frac{\partial x_{F1a}}{\partial x_{L1}} = \frac{1}{4} \frac{\partial r(x_{L1})}{\partial x_{L1}} - 1 \right) \). The investments of the followers increase in the investment of the leader if the change in the new parameter is sufficiently high.

Hypothesis 2:

a) Aggregate contest expenditure per group \( i \) is ordered as follows across the treatments:

\[
X_{i, Base} < X_{i, Rec} < X_{i, LbE}
\]

b) The correlations between the investments of leaders and followers increase across the treatments in the following order

\[
0 = \text{corr}(x_{L1}, x_{F1})_{Base} < \text{corr}(x_{L1}, x_{F1})_{Rec} < \text{corr}(x_{L1}, x_{F1})_{LbE}
\]

IV. Results

Procedure

The data were gathered in nine sessions, three for each treatment, with a total of 216 subjects. All sessions took place in autumn 2016 at the Lakelab at the University of Konstanz. Subjects were students from the University of Konstanz who were recruited with the software “ORSEE” (Greiner, 2015). To gain more independent observations, each session was divided into two different matching groups of four groups each. The opposing group was always chosen from the same matching group. The experiments were computerized with the software “z-Tree” (Fischbacher, 2007). Each subject participated in one of the treatments only. They received written instructions and comprehension questions that had to be answered correctly before the experiment could start. An English translation of the instructions is included in Appendix A of this paper. The sessions lasted approximately 50 minutes and subjects received on average about 19 Euro (about 21 US Dollars in 2016). All subjects received their payment privately at the end of their session.

Descriptive Statistics

Table 2 shows the leaders’ average investment recommendations and the actual contest expenditure of both leaders and followers in the three treatments across the 20 rounds.
The following comparisons rely on group averages across rounds, using Wilcoxon rank-sum and signed-rank tests.

**Table 2: Investment recommendations and actual contest expenditure of leaders and followers (standard deviations in parenthesis)**

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Recommendations</th>
<th>Leading by Example (LbE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leader recommendations</td>
<td>---</td>
<td>54.28 (14.82)</td>
<td>46.06 (16.44)</td>
</tr>
<tr>
<td>Leader investments</td>
<td>27.29 (19.61)</td>
<td>41.17 (17.33)</td>
<td>39.43 (16.13)</td>
</tr>
<tr>
<td>Follower investments</td>
<td>33.63 (13.50)</td>
<td>42.04 (16.32)</td>
<td>36.31 (14.88)</td>
</tr>
</tbody>
</table>

N per cell: 24 Leaders / 48 Followers

The main impression is that leaders react more strongly to the treatment differences than followers do. The leaders’ investments are significantly higher in the Recommendations and Leading-by-Examples treatments than in Baseline (p = .03 and .01). Leaders also invest insignificantly less than followers in the baseline treatment (p = .16, according to the Wilcoxon signed-rank test) but significantly more if they lead by example (p = .02, according to the Wilcoxon signed-rank test). Meanwhile, the follower’s investments increase if the leader just makes a recommendation (p = .053, according to the Wilcoxon rank-sum test) but they are not higher in the LbE treatment when they also observe the leader's actual investment decision.

Furthermore leaders inflate recommendations if they do not have to reveal their own decisions. The leaders’ recommendations are higher in the Recommendations Treatment than in then Leading-by-Example Treatment (p = .08, according to the rank-sum test). They are also significantly higher than leader efforts in that treatment (Wilcoxon signed-rank test, p < .01) while they are not in the LbE Treatment.

**Leaders**

Now I study the treatment differences in greater detail. The first focus is on the investment of the leaders. The estimations in the first two models in Table 3 confirm the significantly lower investments in the Baseline Treatment. The Recommendations
Treatment serves as a benchmark in these models. Model 2 includes additional control variables which increase the explained variance but have no qualitative impact on the treatment comparisons. They reveal a significant decline in investment over time (Round $t$, see also Figure 1) and a strong persistence of behavior across rounds (Investment $t_{-1}$). Model 3 estimates the statistical relationship between the leaders’ recommendations and their own investments in LbE and Recommendation Treatments. This relationship is highly significant. Interestingly, it does not differ between the two treatments even though the followers cannot identify in the Recommendations Treatment whether the Leader sticks to her own advice.

**Table 3: OLS Estimations on Treatment Differences in Leader Investments (with Recommendations Treatment as reference)**

<table>
<thead>
<tr>
<th>Dep. Var: Investment Leader</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3 (w/o Baseline)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline Treatment</td>
<td>-13.881** (5.037)</td>
<td>-6.107** (2.784)</td>
<td></td>
</tr>
<tr>
<td>Leading by Example Treatment</td>
<td>-1.742 (4.554)</td>
<td>-.861 (2.460)</td>
<td>2.030 (5.028)</td>
</tr>
<tr>
<td>Leader recommendation</td>
<td>.481*** (.062)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LbE × Recommendations</td>
<td>.021 (.128)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Round $t$ (1-20)</td>
<td>-0.532** (0.100)</td>
<td>-.359*** (0.089)</td>
<td></td>
</tr>
<tr>
<td>Winner $t_{-1}$</td>
<td>-.923 (1.211)</td>
<td>-.268 (1.205)</td>
<td></td>
</tr>
<tr>
<td>Investment $t_{-1}$</td>
<td>0.547*** (0.061)</td>
<td>.390*** (.105)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>41.173*** (3.249)</td>
<td>24.407*** (4.164)</td>
<td>2.483 (4.154)</td>
</tr>
</tbody>
</table>

R$^2$: 0.051, 0.353, .525

N (obs/Matching Group): 1440/18, 1368/18, 912/12

In parentheses: standard errors clustered at the matching group level. Each matching group included four groups that were randomly matched into contests across the rounds. ***: $p < .01$; **: $p < .05$; *: $p < .1$. 
Figure 1: Investments and Recommendations of Leaders across treatments and over time.

Followers

In Table 2, the seemingly small differences of the followers’ investments across the treatments suggested that leadership has a rather limited impact in the experiment. However, an analysis of the behavioral relationship within groups reveals that this is not the case. Table 4 shows a increase in the correlation between leader and follower investments if leaders can make a recommendation. This correlation increases again if the leaders lead by example. Unsurprisingly, the followers focus their decision more strongly on the leader’s investment than her recommendation.
### Table 4: Correlations between Recommendations and Investments across the Treatments

<table>
<thead>
<tr>
<th></th>
<th>Leader investments</th>
<th>Follower investments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline Treatment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leader investments</td>
<td>1</td>
<td>.122</td>
</tr>
<tr>
<td>Follower investments</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Recommendations Treatment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leader recommendations</td>
<td>1</td>
<td>.576</td>
</tr>
<tr>
<td>Leader investments</td>
<td>1</td>
<td>.437</td>
</tr>
<tr>
<td>Follower investments</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Leading by Example Treatment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leader recommendations</td>
<td>1</td>
<td>.652</td>
</tr>
<tr>
<td>Leader investments</td>
<td>1</td>
<td>.682</td>
</tr>
<tr>
<td>Follower investments</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Table 5 explores these correlations in greater detail. Its models estimate the investments of the followers and their statistical relationship with the investments of the leader across the treatments. Again, the Recommendations Treatment serves as reference. Model 1 shows that all treatment differences are insignificant if we control for the investment of the leader. Model 2 compares the statistical relationship between the investments of the leader and the followers across the treatments. This relationship is at its lowest in the Baseline Treatment (in which it is insignificant), increases in the Recommendation Treatments (in which the leaders recommendations provide a causal link between the two investments) and has the highest coefficient in the Leading by Example Treatment where one can claim a clear causal impact of leadership investments on those of the followers. Model 3 includes additional control variables. The coefficients regarding the statistical relationship of the investments in the different treatments become smaller but remain significant.
Table 5: OLS Estimations on the Relationship between the Investments of Leaders and Followers (with Recommendations Treatment as Reference Treatment)

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dep. Var: Investment Follower</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investment Leader</td>
<td>.548*** (.114)</td>
<td>0.529*** (.124)</td>
<td>.310*** (.080)</td>
</tr>
<tr>
<td>Baseline Treatment</td>
<td>-.794 (4.646)</td>
<td>7.112 (8.548)</td>
<td>8.104* (3.860)</td>
</tr>
<tr>
<td>Baseline × Investment Leader</td>
<td>-0.299* (.161)</td>
<td>-0.273*** (.078)</td>
<td></td>
</tr>
<tr>
<td>Leading by Example</td>
<td>-4.770 (4.045)</td>
<td>-18.808** (7.857)</td>
<td>-7.950** (3.423)</td>
</tr>
<tr>
<td>Leading by Example × Leader</td>
<td>0.355** (.152)</td>
<td>.140* (.073)</td>
<td></td>
</tr>
<tr>
<td>Round t (1-20)</td>
<td></td>
<td>-0.148* (.079)</td>
<td></td>
</tr>
<tr>
<td>Winner t-1</td>
<td>-1.122 (1.303)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investment t-1</td>
<td></td>
<td>0.591*** (0.044)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>19.470*** (5.648)</td>
<td>20.240*** (6.615)</td>
<td>6.610** (3.411)</td>
</tr>
<tr>
<td>R²</td>
<td>.097</td>
<td>.117</td>
<td>0.430</td>
</tr>
<tr>
<td>N (obs/matching group)</td>
<td>2880/18</td>
<td>2880/18</td>
<td>2736/72</td>
</tr>
</tbody>
</table>

In parentheses: standard errors clustered at the matching group level. Each matching group included four groups that were randomly matched into contests across the rounds. ***: p < .01; **: p < .05; *: p < .1.

The aforementioned results contradict some key predictions derived from economic theory. In particular, they show that the investments of leaders and followers are strategic complements. We also observe some differences in investment levels across the treatments. However, the leaders are the main drivers of this effect. They tend to underinvest in the Baseline Treatment but increase their expenditure substantially once they make recommendations to the followers. Leading by example, i.e. the visible ex-ante investment commitment of the leader, has no discernible impact on the investment level and a small positive impact on followership.
V. Comparison with voluntary contribution mechanism (VCM) game

This section discusses whether the preceding results are the result of a peculiar characteristic of the inter-group contest or whether they reflect more general aspects in the relationship between leaders and followers. Hence, I replicate the experimental design in the context of a voluntary contribution mechanism (VCM) as it has been used in the experimental literature on leadership so far (Güth et al., 2007, Levati et al., 2007, Gächter et al., 2013).

Design and Procedure

This second experiment also lasted for 20 rounds, using a partner-matching protocol throughout the experiment. Again, each group consists of three randomly chosen players, one leader and two followers who kept their roles throughout the entire experiment. Each player received an endowment of 100 points in a round, with 120 points exchanging into 1 €. The player could keep the points in a private account or invest them in order to enhance the welfare of all group members. More specifically, one point invested implied a marginal per-capita return for each group member of .5. points and aggregate return of 1.5 points. Hence, it is efficient to invest all points but an individual who focuses just on her own payoff will not invest any point. The Recommendation and the Leading by Example Treatments proceeded as described above. At the end of a round, the followers learned about their own payoff. The leaders also received information about the individual investments of group members. This second experiment was conducted also at the University of Konstanz in May and June 2016 with 120 students from the same subject pool. The smaller sample size also reflects that groups constitute truly independent observations in this experiment. The procedural aspects were the same as in the first experiments.

Descriptive Statistics

Table 6 summarizes the results of leadership in the voluntary contribution mechanism. The Recommendations and the Leading by Example Treatments treatments see a particularly strong increase in contest expenditure. The followers’ investments are higher in Recommendations and LbE than in baseline (p < .01 and p = .047, respectively; see also Figure 2), and so are the investments of the leaders (both p-values <.01). Interestingly, recommendations are significantly higher than leader efforts in both treatments (p = .01 and .03, respectively).
Table 6: Investment recommendations and actual contest expenditure of leaders and followers in the VCM (standard deviations in parenthesis)

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Recommendations</th>
<th>Leading by Example (LbE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leader recommendations</td>
<td>---</td>
<td>81.66 (13.89)</td>
<td>73.34 (21.84)</td>
</tr>
<tr>
<td>Leader investments</td>
<td>27.56 (14.94)</td>
<td>65.47 (26.59)</td>
<td>67.33 (25.75)</td>
</tr>
<tr>
<td>Follower investments</td>
<td>31.41 (14.00)</td>
<td>65.40 (25.50)</td>
<td>57.35 (30.44)</td>
</tr>
<tr>
<td>N (leader/follower)</td>
<td>16/32</td>
<td>8/16</td>
<td>8/16</td>
</tr>
</tbody>
</table>

Figure 2: Investments and Recommendations of Leaders across treatments and over time in the VCM

Figure 3 shows that the two experiments can easily be compared because both Baseline Treatments yield similar investment levels of leaders and followers in both experiments.
The rank-sum tests yields $p = .47$ for the followers and $p = .72$ for the leaders. Furthermore, other behavioral patterns persist across the games. For example, follower investments are higher (insignificantly) than those of leaders in baseline, do not differ from them in Recommendations, and are lower in LbE (Signed-rank test $P = .01$).

*Figure 3: Investments and Recommendations of Leaders across treatments and over time in the Contest and the VCM*

Leaders
The estimations documented in Table 7 show that the Leaders’ investments increase once they have to make recommendations to the followers (Model 1). The investments also correlate significantly with their own recommendations irrespective of whether the followers are informed about their leader's investments or not. (Model 2) Again one can observe a significant decline in investment over time (Round $t$) and a strong persistence of behavior across rounds (Investment $t-1$).
Table 7: Leader Investments in the VCM (with Recommendations Treatment as Reference Point)

<table>
<thead>
<tr>
<th>Dep. Var: Investment Leader</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline Treatment</td>
<td>-14.920*** (5.305)</td>
<td></td>
</tr>
<tr>
<td>Leading by Example Treatment</td>
<td>1.725 (5.065)</td>
<td>15.614 (11.777)</td>
</tr>
<tr>
<td>Leader Recommendation</td>
<td>.607*** (.186)</td>
<td></td>
</tr>
<tr>
<td>LbE × Recommendation</td>
<td>-0.117 (.189)</td>
<td></td>
</tr>
<tr>
<td>Round t (1-20)</td>
<td>-0.569*** (.134)</td>
<td>-0.643*** (0.203)</td>
</tr>
<tr>
<td>Investment t-1</td>
<td>.608*** (.073)</td>
<td>0.442*** (.134)</td>
</tr>
<tr>
<td>Constant</td>
<td>30.879*** (7.616)</td>
<td>-7.086 (5.560)</td>
</tr>
</tbody>
</table>

In parentheses: standard errors clustered at the matching group level. In the first experiment each matching group included four groups that were randomly matched into contests across the rounds. In the second, each group constituted a matching group because the experiment does not allow for interaction between groups. ***: p < .01; **: p < .05; *: p < .1.

Table 8 studies the differences in the outcomes across the two experiments. Both model shows that the VCM yields similar comparative statics regarding leadership behavior as the intergroup contests. However, Model 1 also confirms that the difference between the investments of leaders in the Baseline and Recommendation Treatments is much stronger in the VCM than in the intergroup contest.
Table 8: A Comparison of Leader Investments across the Two Experiments (with Recommendations Treatment as Reference Point)

<table>
<thead>
<tr>
<th>Dep. Var: Investment Leader</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline Treatment</td>
<td>-5.862** (2.522)</td>
<td></td>
</tr>
<tr>
<td>Leading by Example Treatment</td>
<td>-.816 (2.284)</td>
<td>2.107 (4.472)</td>
</tr>
<tr>
<td>Leader Recommendation</td>
<td></td>
<td>.474*** (.058)</td>
</tr>
<tr>
<td>LbE × Recommendation</td>
<td>.018 (.120)</td>
<td></td>
</tr>
<tr>
<td>VCM × Recommendation</td>
<td></td>
<td>.154 (.140)</td>
</tr>
<tr>
<td>VCM × Baseline</td>
<td>-10.727** (5.002)</td>
<td></td>
</tr>
<tr>
<td>VCM × LbE</td>
<td>2.560 (5.989)</td>
<td>12.760 (11.819)</td>
</tr>
<tr>
<td>VCM × LbE × Investment Leader</td>
<td>-.123 (211)</td>
<td></td>
</tr>
<tr>
<td>Round t (1-20)</td>
<td>-.544 (.080)</td>
<td>-.427*** (.085)</td>
</tr>
<tr>
<td>Investment t₁</td>
<td>.566 (.047)</td>
<td>.403*** (.082)</td>
</tr>
<tr>
<td>Constant</td>
<td>23.290 (3.239)</td>
<td>2.878 (3.468)</td>
</tr>
</tbody>
</table>

R² | .462 | .621

N (obs/Matching Group) | 1976/50 | 1216/28

In parentheses: standard errors clustered at the matching group level. In the first experiment each matching group included four groups that were randomly matched into contests across the rounds. In the second, each group constituted a matching group because the experiment does not allow for interaction between groups. ***: p < .01; **: p < .05; *: p < .1.

Followers

Table 9 now studies the relationship between the investments of leaders and followers in this second experiment in greater detail. Like models 2 and 3 in Table 5, it estimates the investments of the followers and their statistical relationship with the investments of the leaders across the treatments. The Recommendations Treatment serves as a benchmark. Model 1 shows the significant relationship between the investments of the leader and the followers. This relationship is significantly stronger than in the Baseline Treatment but (insignificantly) weaker than in the Leading by Example Treatment. Model 2 includes the aforementioned control variables which increase the explained
variance but have little qualitative impact on the results. Model 3 finally provides a combined estimation across the two experiments. Its results show that the qualitative results regarding the leader follower relationships are the same in both experiments. None of the differences between the environments is even approximately significant.

Table 9: OLS Estimations on the Relationship between the Investments of Leaders and Followers in the VCM (with Recomm. Treatment as Reference Point)

<table>
<thead>
<tr>
<th>Dep. Var:</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment Follower</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investment Leader</td>
<td>0.673*** (0.146)</td>
<td>0.360*** (0.088)</td>
<td>.290*** (.074)</td>
</tr>
<tr>
<td>Baseline Treatment</td>
<td>.216 (11.887)</td>
<td>1.939 (7.461)</td>
<td>7.802** (3.567)</td>
</tr>
<tr>
<td>Baseline × Investment Leader</td>
<td>-0.314* (0.170)</td>
<td>-0.240** (0.103)</td>
<td>-0.267*** (.073)</td>
</tr>
<tr>
<td>Leading by Example Treatment</td>
<td>-22.999* (11.955)</td>
<td>-11.961** (8.140)</td>
<td>-7.296** (3.208)</td>
</tr>
<tr>
<td>LbE × Investment Leader</td>
<td>0.203 (0.167)</td>
<td>0.099 (0.111)</td>
<td>.126* (.070)</td>
</tr>
<tr>
<td>Vol. Contribution Mech.</td>
<td>3.717 (8.861)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VCM × Investment Leader</td>
<td></td>
<td>-.032 (.126)</td>
<td></td>
</tr>
<tr>
<td>VCM × Baseline</td>
<td></td>
<td>-6.965 (9.246)</td>
<td></td>
</tr>
<tr>
<td>VCM × Baseline × Investment Leader</td>
<td>.097 (.151)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VCM × LbE</td>
<td></td>
<td>-1.876 (14.482)</td>
<td></td>
</tr>
<tr>
<td>VCM × LbE × Investment Leader</td>
<td></td>
<td>-.048 (.193)</td>
<td></td>
</tr>
<tr>
<td>Round t (1-20)</td>
<td></td>
<td>-0.422*** (0.122)</td>
<td>-0.231*** (.065)</td>
</tr>
<tr>
<td>Investment t-1</td>
<td>0.474*** (0.055)</td>
<td>.612*** (.038)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>21.326* (11.673)</td>
<td>15.197* (8.186)</td>
<td>6.877*** (3.273)</td>
</tr>
<tr>
<td>R²</td>
<td>0.510</td>
<td>0.626</td>
<td>.502</td>
</tr>
<tr>
<td>N (obs/Matching Group)</td>
<td>1280/32</td>
<td>1216/32</td>
<td>3952/50</td>
</tr>
</tbody>
</table>

In parentheses: standard errors clustered at the matching group level. In the first experiment each matching group included four groups that were randomly matched into contests across the rounds. In the second, each group constituted a matching group because the experiment does not allow for interaction between groups. ***: p < .01; **: p < .05; *: p < .1.
Overall, the results show that the behavioral differences between the two games are remarkably small. This holds in particular for the followers. The impact of leading by example, i.e. the visible ex-ante investment commitment of the leader, is almost negligible in both experiments. The key difference between the two games is the observation that the VCM induces leaders to increase expenditure more strongly than in the inter-group contest once they make recommendations. This additional investment increase does not affect the comparative statics of followership.

VI. Conclusions

This paper studied leadership in intergroup contests, comparing the results with evidence from leadership in a noncompetitive social dilemma. Despite meaningful differences in the incentive structure and in aggregate behavior the results identify remark stable behavioral patterns in the leader-follower relationship across the two games. In both contexts, the results show similar correlations between the investments of leaders and followers across the treatments. Intergroup contests do not exhibit the negative correlation between investments of leaders and followers that standard game theory suggests. Furthermore, the environments are all characterized by overinvestments relative to standard. The most relevant difference between the two games derives from the observation that the treatment effects on aggregate investment are stronger in the voluntary contribution mechanism than in the intergroup contests. In the latter environment leaders coordinate the behavior of the followers but they do not rise significantly which suggests a more limited, but not negligible scope for leadership in intergroup contests.

The paper also contributes to the understanding of the mechanisms of Leading by Example (LbE). It was unclear whether LbE is still effective in circumstances when non-binding investment recommendations by the leader already allow for simple “cheap-talk” coordination. Both experiments show that this additional impact of LbE is indeed insignificantly small. The fact that leaders may not follow their own recommendations if they do not lead by example does not shape the behavior of the followers decisively.

These insights suggest that the leader-follower-relationship is stable across decision making contexts. Leaders can coordinate followers to various levels of cooperation in all
environments. In all contexts, the success of leadership therefore crucially depends on the courage of the leader to go for high investments for the common cause.

References


Kolmar, M. (2013). Group Conflicts: Where Do We Stand?, University of St Gallen, School of Economics and Political Science, Department of Economics.


Appendix A –Instructions for Experiment I

These instructions have been translated from German. All subjects in a treatment received the same instructions. Differences between the instructions across the treatments are highlighted. Numerical examples and On-Screen control questions are not included. The experiment started once all subjects had answered all control questions correctly.

Welcome to this economic experiment.

Your decisions and the decisions of the other participants will affect your payoff. Hence, it is important that you read these instructions carefully. Please contact us before the
experiment starts if you have any question.

Please do not talk with the other participants during the experiment.

Otherwise we might exclude you from the experiment and any subsequent payment.

During the experiments we always talk about points that determine your income. At the end of the experiment we convert all points into Euros, using the following exchange rate.

120 points = 1 Euro

You get your payments at the end of the experiment in cash. Now we explain you the experiment in detail.

Experimental Setup

At the start of the experiment you will form a group with two randomly chosen participants. There are three team members, A, B, and C. Participant C has a special role which we describe below. You will learn at the start of the experiment whether you are A, B, or C. During the experiment your group will meet another group of similar composition. In each you will meet another randomly chosen group.

The experiment has 20 rounds. The composition of your group will not change over these rounds. In each round, your group or the other group can get a prize of 300 points. The probability of success of your group depends on the inputs of its members. Each group member gets 100 points irrespective of the personal input if the group gets the prize.

At the start of each round each participant gets 100 points. Any participant can use these points as inputs (from 0 to 100). All points not invested will be added to the participant’s private account.

Once the participants have decided about their inputs, these investments will be summed up. The success probability of your group depends on the ratio of its investments relative to the investments of the other group.

The computer adds up the inputs within a team. The success probability is derived from the ratio between your team’s input and the sum of both teams’ inputs. If both teams
invest the same amount the success probability is 50% for each team. This also holds if both teams invest 0 points. If one team makes a higher investment the success probability is also higher. However, it is not guaranteed that the team with the higher investment also wins the prize. More specifically the formula for the success probability is as follows:

\[
\text{Success probability} = \frac{\text{Input of your team}}{\text{Input of your team} + \text{Input of the other team}}
\]

The income of any group member is determined as follows:

\[
\text{Payoff from the private account} = (100 - \text{Investment}) + 100 \text{ points (if the group wins the prize.)}
\]

\[= \text{total payoff}\]

---

**Participant C**

Participant C has a special role in the Team.

<table>
<thead>
<tr>
<th>Baseline Treatment</th>
<th>Recommendation Treatment</th>
<th>Learning-by-Example Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>---</td>
<td>Participant C can suggest the other group members how many points to use as input. Both A and B get the same recommendation. A and B can never exchange information among themselves.</td>
<td>Player C then decides about her own input. Participants A and B learn about this input before they make their own investment decision.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

At the end of a round each participant receives information about whether the own group has received the 300 points. Only participant C learns about the actual inputs of A and B and the aggregate inputs of the other group.

---

**Numerical Examples**

---
**Timeline**

One round proceeds as follows

1. You get 100 points.
2. *Recommendations and LbE Treatments*: Input recommendation by participant C.
3. *LbE Treatment only*: Input decision of participant C. The invested points will be withdrawn from the 100 point (only in)
4. Input decisions
   - *Baseline and Recommendation Treatments*: All participants decide about their inputs. The invested points will be withdrawn from the 100 point
   - *LbE Treatment*: The participants A and B learn about the input of C. They decide about their inputs. The invested points will be withdrawn from the 100 point
5. Distribution of the Prize. Participant C learns about the actual inputs of A and B and the aggregate inputs of the other group.

The experiment has 20 rounds that all proceed as mentioned above. You will remain in the same group throughout the entire experiment. We will add up all earned points, exchange them into Euro and pay them to you at the end of the experiment in cash.

**Appendix B – Instructions for Experiment II**

*These instructions have been translated from German. All subjects in a treatment received the same instructions. Differences between the instructions across the treatments are highlighted. Numerical examples and On-Screen control questions are not included. The experiment started once all subjects had answered all control questions correctly.*

Welcome to this economic experiment.

Your decisions and the decisions of the other participants will affect your payoff. Hence, it is important that you read these instructions carefully. Please contact us before the experiment starts if you have any question.

Please do not talk with the other participants during the experiment.
Otherwise we might exclude you from the experiment and any subsequent payment.

During the experiments we always talk about points that determine your income. At the end of the experiment we convert all points into Euros, using the following exchange rate.

120 points = 1 Euro

You get your payments at the end of the experiment in cash. Now we explain you the experiment in detail.

**Experimental Setup**

At the start of the experiment you will form a group with two randomly chosen participants. There are three team members, A, B, and C. Participant C has a special role which we describe below. You will learn at the start of the experiment whether you are A, B, or C. The experiment has 20 rounds.

At the start of each round each participant gets 100 points. Any participant can use these points as inputs (from 0 to 100). All points not invested will be added to the participant’s private account.

Once the participants have decided about their inputs, these investments will be summed up. The lab manager increases this sum by 50% and distributes all these points equally among the group members.

All group members benefit in the same way from your investment as you benefit from the inputs of the other group members. The income of any group member is determined as follows:

\[
\text{Payoff from the private account (} = 100 - \text{Investment) + payoff from the inputs (} = 0,5 \times \text{sum of all inputs) = total payoff}
\]

**Participant C**
Participant C has a special role in the Team.

<table>
<thead>
<tr>
<th>Baseline Treatment</th>
<th>Recommendation Treatment</th>
<th>Learning-by-Example Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>---</td>
<td>Participant C can suggest the other group members how many points to use as input. Both A and B get the same recommendation. A and B can never exchange information among themselves.</td>
<td>---</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

At the end of a round each participant receives information about the own payoff. Only participant C learns about the actual inputs of A and B.

- **Numerical Examples** -

**Timeline**

One round proceeds as follows

1. You get 100 points.
2. *Recommendations and LbE Treatments:* Input recommendation by participant C.
3. *LbE Treatment only:* Input decision of participant C. The invested points will be withdrawn from the 100 point (only in)
4. Input decisions
   a. *Baseline and Recommendation Treatments:* All participants decide about their inputs. The invested points will be withdrawn from the 100 point
   b. *LbE Treatment:* The participants A and B learn about the input of C. They decide about their inputs. The invested points will be withdrawn from the 100 point
5. Distribution of the payments. Participant C learns about the actual inputs of A and B.
The experiment has 20 rounds that all proceed as mentioned above. You will remain in the same group throughout the entire experiment. We will add up all earned points, exchange them into Euro and pay them to you at the end of the experiment in cash.