

# Endogenous Leadership in an Asymmetric Public Goods Game

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Leadership has been shown to be a coordination device that improves cooperation (see [Güth et al., 2007](#); [Gächter et al., 2012](#); [Frackenhohl et al., 2016](#)). Moreover, it is the simplest mechanism to implement, as it does not require any existing upper-level institutions to maintain the rules of the game or to execute judgment, just a sequential move structure, which is then called leading-by-example. There, one person makes a decision first (the leader), the others (the followers) observe this decision and make their decisions afterwards. Groups that implement leading-by-example do not have to pay any direct costs for having a leader. In this light, leading-by-example seems to be an important and inexpensive mechanism that can possibly improve cooperation in social dilemmas. Moreover, many papers on endogenous leadership suggest that contributions should be higher in the setups with endogenously appointed leaders compared to those with exogenously appointed leaders (see [Güth et al., 2007](#); [Haigner and Wakolbinger, 2010](#); [Rivas and Sutter, 2011](#)) at least in *symmetric groups*. In this paper I test which kind of leader groups try to implement in asymmetric groups using a voting procedure (a leader with high or low stakes in the provision of the public good).

The effect of the leadership mechanism has been widely studied in symmetric groups, in which equal contributions lead to equal payoffs. However, little is known how leading-by-example performs in asymmetric groups.<sup>1</sup> The main problem with asymmetric groups is that there can be less uniform perceptions about equity, equality and efficiency. Different leaders can lead differently, and this, in turn, can be perceived differently. Furthermore, inequality considerations in groups with heterogeneity in returns can prevent the formation of efficient institutions meant to foster cooperation (see, for example, [Kube et al., 2015](#)), whereas in symmetric groups adopting a voting procedure on the institution to be implemented endogenously is usually shown to enhance cooperation (see [Güth et al., 2007](#); [Levy et al., 2011](#); [Andreoni and Gee, 2012](#); [Markussen et al., 2013](#)).

I use an economic experiment to study individual decisions on contributions in a sequential public goods game with heterogeneous returns from the public good. I study whether followers reactions differ between exogenous leadership institutions, in which leaders returns are predetermined, and endogenous ones, in which they are established by a voting procedure.

## The design of the experiment

The payoff structure in a public goods game is given as follows: the payoff  $\pi_i$  of player  $i$  given his contribution  $c_i$  (and contributions of others) is given by

$$\pi_i = (20 - c_i) + \gamma_i \sum_{j=1}^n c_j, \quad i = 1, \dots, n, \quad (1)$$

where  $\gamma_i \in \{\gamma_L, \gamma_H\}$  represents individual's marginal per capita return (MPCR) from the public good, with  $\gamma_H = 0.75$  and  $\gamma_L = 0.5$ .

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<sup>1</sup>[Levati et al. \(2007\)](#); [Au and Chung \(2007\)](#); [Neitzel and Sääksvuori \(2013\)](#) study sequential move structure in groups with heterogeneous endowments.

Players randomly form groups of 3 people, with randomly assigned roles: one first-mover, the leader, and two second-movers, followers. The followers always have different MPCR, high and low, called later high (H-) type and low (L-) type, correspondingly.

The two treatments with exogenous composition of return vary with the type of the leader (leader's return from the public good), high or low, called H-HL and L-HL, correspondingly. There is one treatment with endogenous composition of returns (call it Endo later).

In treatments with exogenous composition of returns, in a one-shot game, first, the leader makes a decision on his contribution. Second, followers make their contribution decisions according to the strategy method (see [Selten, 1967](#)), in a contribution table — state their contributions for *each* possible contribution of the leader.

In the treatment with endogenous composition of returns, the leader states how much he would like to contribute if he is of high type, and how much if he is of low type. Then, the followers vote on whether they want the leader to be of high or of low type, with ties split randomly. After that the followers decide on their own contributions in the form of contribution table, *separately for each possible type of the leader*. The realized type, as well as actual contributions and payoffs are then calculated according to the choices. In addition to contribution decisions I elicit players' beliefs about contributions of others: leaders' beliefs on contributions of the followers (after the leader decided on contribution himself), and followers' beliefs on contributions of another follower, conditionally on leader's contribution. In the Endo treatment, all players were asked to do that for *each* possible type of the leader.

### Behavioral predictions

Different models of social preferences predict different equilibria in a public goods game, most often transforming the game into a coordination problem with multiple equilibria. Rather than using a particular model of social preferences, I hypothesize on differences in contributions between players of different types using a contribution rules approach. The possible contribution rules for asymmetric public goods games were first analyzed in [Reuben and Riedl \(2013\)](#). Following their approach I select three main contribution rules: equality of payoffs rule, which represents equilibrium outcomes in the model with inequality averse players ([Fehr and Schmidt, 1999](#)), efficiency rule, that can appear if one assumes instead that players have preferences for efficiency (e.g. [Charness and Rabin, 2002](#)), and equality of contributions rule, that may arise if one assumes players having the utility function with a quadratic loss from non-compliance to preferred contribution norm (introduced in [Cappelen et al., 2007](#)).

Based on these contribution rules, I expect the following differences to occur. First, *ceteris paribus*, contributions of the followers should be higher in L-HL groups than in H-HL groups (some players might prefer equality of payoffs, which directly leads to higher contributions of followers in L-HL in response to the same contribution of the leader). Second, if one considers leader's contribution as a signal of a contribution norm, this signal should be clearer in L-HL groups (high contribution of a low type leader excludes the possibility that the leader suggests equality of payoffs rule). Also, one can expect higher chances to observe efficient allocations in L-HL groups, as efficiency does not cause there any monetary losses, only inequality in payoffs.

Regarding the selection of the leader's type in the Endo treatment, it is an empirical question, whether the followers take into account the "clarity" of the signal from the leader of the elected type, are willing to follow, and vote "low", or they vote "high" and shift responsibility for the provision of the public good to the leader, expecting him to contribute large amount and exploiting the leader by contributing lower amounts.

### Results

The results show that, first, in groups with exogenous composition of returns (and a certain

leader’s type, i.e. with a certain return from the public good) conditional contributions of followers are well explained by leader’s contribution and followers’ conditional beliefs about the contribution of another follower. Second, in groups with exogenous composition of returns, contributions of followers differ systematically between treatments (between groups with high and with low type leaders), but this is not the case for the treatment with endogenous composition of returns, in which followers are able to choose leader’s return in a voting procedure. There, the followers’ contributions are not affected by leader’s contributions at all, but explained by conditional beliefs about contribution of another follower, group composition and own voting decisions. Moreover, it is own voting decision that turns out to be the most influential determinant of followers’ conditional contributions. Given that more than 80% of all players vote for the leader to be of high type (see Table 1), this result suggests that followers might have voted strategically, in order to shift the responsibility for the provision of the public good to their leader.

Table 1: Voting decisions (percent) of followers of different types

<i>Follower</i>	<i>Voted</i>	
	<b>Low</b>	<b>High</b>
L-follower	12.5	87.5
H-follower	25	75

## Discussion

My findings suggest that endogenizing such an institution as leading-by-example may backfire the intended goals and might result in lower provision of the public good. This could potentially happen due to strategic voting by followers — they could vote for a leader to have higher stake in the provision of the public good in order to motivate the leader to contribute larger amount, and lower their own contributions, thus, decreasing efficiency of the leadership institution. This goes in contrast with the findings from the treatments with exogenous composition of returns — there, the followers are more likely to follow their leaders, especially when the leader has lower return from the public good.

The findings presented in this paper may be particularly interesting for behavioral theories of other-regarding preferences. While contribution behavior in homogeneous groups is usually well explained by models of inequality aversion, the observed differences in followers’ reactions to contributions of the leaders are not. Perhaps, the most promising direction for further theoretical investigation of cooperation behavior in asymmetric social dilemmas are reciprocity models that incorporate a choice of a specific reference point or endogenous peer selection.

Heterogeneous reactions to group composition underline the importance of belief management (see also the discussion in [Fischbacher et al., 2014](#)). One can expect the signal obtained from an exogenously appointed low-benefiting leaders to be more valued by other group members than the one obtained from highly-benefiting leaders. At the same time, the possibility to exploit leaders rise when the benefits of the leaders can be determined by their followers.

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