behavioral sciences

MDPI

Article

How to Select the Leader in a One-Shot Public Goods Game: Evidence from the Laboratory

Shuo Xu [1], Wenhao Zhang [2] and Jie Zheng [2,3,*]

[1] International Business School, Beijing Foreign Studies University, Beijing 100089, China
[2] Center for Economic Research, Shandong University, Jinan 250100, China
[3] Economic Science and Policy Experimental Laboratory, Tsinghua University, Beijing 100084, China
* Correspondence: jie.academic@gmail.com

Abstract: We experimentally study how leadership selection mechanisms affect public goods provision. Introducing leadership does not raise contribution. Voluntary leadership performs the worst, primarily because the absence of leadership signals uncooperative play, and candidates free-ride on other leaders. Voluntary leadership from a randomly selected candidate is a promising endogenous leadership selection mechanism, primarily because assuming leadership by revealed preference signals cooperative play, the absence of leadership leaves the possibility of unlucky cooperative candidates, and sole leadership removes the leader's free-riding incentives.

Keywords: public goods; cooperation; leadership; laboratory experiment; signaling

1. Introduction

Many real-world challenges, such as funding public infrastructure, addressing climate change, or maintaining community resources, ask individuals to balance personal interest and collective welfare. A persistent issue in these public goods games is the free-rider problem, which often leads to suboptimal outcomes, where the public good is underprovided, and collective welfare suffers.

Researchers have explored how introducing leadership can enhance public goods provision (Glowacki & von Rueden, 2015; Pietraszewski, 2020). Leaders can influence group behavior by setting an example (Moxnes & Van der Heijden, 2003; Zhou et al., 2015), coordinating behaviors (Gächter et al., 2012; Gächter & Renner, 2018), or signaling commitment (Antonakis et al., 2021; Kumru & Vesterlund, 2010). However, the effectiveness of leadership depends not just on the presence of a leader but, crucially, on how leaders are selected and the incentives they face. Multiple leaders differ in willingness to cooperate and dilute accountability. The absence of a leader generated from a mechanism with a low barrier strongly suggests pessimism to followers.

This study conceptualizes leadership as the role of the first mover(s) in a sequential public goods game. We assess the effectiveness of four leadership selection mechanisms in comparison to the standard voluntary contribution mechanism in facilitating public goods provision: Random Leadership (*RL*), where a leader is randomly selected; Voluntary Leadership (*VL*), where any player who volunteered becomes a leader; and two hybrid mechanisms, Random Leadership from Voluntary Candidates (*RL-VC*) and Voluntary Leadership from a Random Candidate (*VL-RC*), which combine elements of voluntary and random selection. These mechanisms allow us to explore how different approaches to leadership influence group contributions and cooperation.

check for updates

Academic Editor: Jiaming Fang

Received: 18 February 2025
Revised: 25 March 2025
Accepted: 26 March 2025
Published: 31 March 2025

Citation: Xu, S., Zhang, W., & Zheng, J. (2025). How to Select the Leader in a One-Shot Public Goods Game: Evidence from the Laboratory. *Behavioral Sciences*, *15*(4), 444. https://doi.org/10.3390/bs15040444

Copyright: © 2025 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

Cooperation in public goods experiments with leaders was explained in the literature by behavioral theories such as conditional cooperators (Fischbacher et al., 2001; Gächter et al., 2012), reciprocity (Arbak & Villeval, 2013; Stanc et al., 2009), social norms (Dannenberg, 2015; Gächter & Renner, 2018), signaling (Hermalin, 1998; Potters et al., 2007), altruism (Préget et al., 2016), and legitimacy (Berger et al., 2020; Brandts et al., 2015). We believe that the *informativeness* of signaling and reciprocity theoretically differentiates the effectiveness of four leadership selection mechanisms. Leadership selection mechanisms function as signaling devices as follows: leaders induce reciprocity by signaling generosity (or lack thereof) through contribution levels.[1] Upon observing the contribution levels, followers update their beliefs about their group members' average degree of generosity. Reciprocity then determines the degree to which the followers cooperate.

We conjecture that Voluntary Leadership from a Random Candidate (*VL-RC*) induces the greatest public goods provision, and a more informative "signal" generating process does not necessarily make a mechanism a better one. Random Leadership (*RL*) *forces* a randomly selected member to be the leader. It is normal to expect a randomly selected member to be selfish or generous. *RL* is the least informative mechanism. In Voluntary Leadership (*VL*), *any* member who *volunteers* becomes a leader. The act of becoming a candidate makes followers believe that upon observing positive contributions, the leader is more likely to be generous. The key downside is that upon observing a less-than-expected contribution level, it is more likely that the leader is a selfish person. The effect is augmented by reciprocity as follows: people reward cooperative behavior and punish free-riding. In Random Leadership from Voluntary Candidates (*RL-VC*), any member who volunteers *must be randomly selected* to be the leader. *RL-VC* is a weakened version of *VL*, as follows: followers only observe the contribution level of a *single* leader rather than contributions of *multiple* leaders. The belief on average generosity changes to a lesser degree in *RL-VC* compared to *VL*. Voluntary Leadership from a Random Candidate (*VL-RC*) *forces* a randomly selected member to be the candidate, and the *candidate decides* whether to be the leader or not. A positive contribution level strongly signals a generous person, and a negative signal can be explained by bad luck—the member is *forced* to be the candidate in the first place.

Based on our hypothesis, we tested leadership selection mechanisms in the lab and arrived at four main results. First, introducing leadership does not increase average contributions compared with the baseline treatment (*Control*). The *VL* mechanism is the least effective, with contributions significantly lower than in *Control* and other leadership treatments. This result suggests that introducing leadership without addressing the barriers or incentives for leaders to influence group behavior may not enhance cooperation in public goods settings.

Second, the presence of a leader significantly increases group contributions. Groups with leaders consistently contributed more than those without, highlighting the importance of leadership as a signaling device for cooperation. However, the barrier to becoming a leader amplifies the effect of the signal. Mechanisms like *VL-RC*, which restrict leadership to a single and randomly selected candidate, outperform those allowing multiple voluntary candidates (*VL* and *RL-VC*). This indicates that a higher barrier to leadership can foster greater contributions by reducing free-riding and enhancing the perceived credibility of the leader.

Third, leaders in all treatments contributed more than the followers, demonstrating a lead-by-example effect. However, the degree of influence leaders have on followers varies between the mechanisms. The correlation between the leader and follower contributions was positive and significant in *VL* and in *RL-VC*, while there was weaker or no significant correlation in other treatments. A clear path of influence channel may not always be a

good thing; in *VL*, the presence of multiple leaders strongly signals cooperation from the leaders, but the overall average contribution is the lowest. The difficulty in inferring followers' cooperative intentions may dilute the leader's influence and help conceal the true inclination to cooperation.

Finally, endogenous leadership mechanisms (*VL* and *RL-VC*) that allow multiple candidates tend to induce more selfish leaders than mechanisms with a single candidate (e.g., *VL-RC*). A typical bystander effect (Darley & Latané, 1968) does not explain the difference in the probability of becoming a leader between *VL* and *RL-VC*. It turns out that there is another layer of *conditional* free-riding incentive in *VL* as follows: the existence of multiple candidates incentivizes candidates to free-ride and not to lead by example. In *RL-VC*, becoming a candidate means that only one subject is eligible to become a leader. When there are multiple leaders, followers in these treatments often base their contributions on the least cooperative leader, suggesting that the quality of leadership, rather than the quantity, drives group outcomes.

The rest of the paper is organized as follows. Section 2 reviews the literature. Section 3 describes the experimental design, Section 4 presents the results, and Section 5 concludes the paper. We attach the experimental instructions in Appendix A. Appendix B includes supplemental analysis and results.

2. Literature Review

Research on leadership in the economics literature is pioneered by Hermalin (1998). Using a game-theoretical approach, Hermalin (1998) focuses on what a leader does to induce a following, either by signaling through information or through costly first-mover actions. Meidinger and Villeval (2002) experimentally tests two forms of leadership in Hermalin (1998), as follows: leading by example and leading by sacrifice. In leading by example, the leader makes the decision first, and then, the rest follow. Meidinger and Villeval (2002) finds that leaders expect reciprocity and that pure signaling does not work. In leading by sacrifice, the leader can choose to give up a part of their payoff. The results show that sacrifice functions only when it is lost for the follower. Using a lab experiment, Potters et al. (2007) shows that leading by example works through signaling rather than reciprocity, by comparing contributions when the return from contributions is privately known to the leader with the scenario when the information is publicly known.

The literature moves on to investigate how the leadership selection mechanisms affect leadership performance. Güth et al. (2007) considers the performance of a rotated exogenous leadership mechanism with exclusion power. The role of the leader is either fixed throughout the experiment or rotated among the group members. In the other dimension, the leader may or may not be empowered with the right to exclude some group members from the next-round play. Results show that the exclusion power is remarkably effective in promoting public goods contributions, while whether the leader is fixed or rotated makes no significant difference. Rivas and Sutter (2011) finds that group contributions are closer to the socially optimal level under voluntary leadership than random selection leadership. However, such evidence is not found in Arbak and Villeval (2013), who use a similar experimental design. Haigner and Wakolbinger (2010) finds that groups with voluntary leaders outperform groups with involuntary leaders, regardless of whether the leader contributes before or after the other group members do. Leaders can also be chosen via specific voting rules (Güth et al., 2007; Levati et al., 2007). Using a field experiment approach, Jack and Recalde (2015) emphasizes the legitimacy of leadership and finds that authority induces greater contribution than randomly selected leadership. Berger et al. (2020) propose a partly random selection mechanism that combines

competitive selections with lotteries. The novel mechanism succeeds with a higher quality of relationships between leaders and followers.

Another stream of the literature considers what types of leaders induce more group contributions. Kumru and Vesterlund (2010) finds that leaders of higher social status attract more donations. Préget et al. (2016) finds conditional cooperators are more likely to volunteer to be leaders. Chemin (2021) finds that groups with appointed leaders who are competent and hardworking outperform groups with self-selected leaders.

The evidence from the reviewed literature regarding the assessments of exogenous versus endogenous leadership is pretty mixed. More importantly, systematic comparisons between different real-world-based leader selection mechanisms are limited. The leadership selection mechanisms studied in this paper are motivated by the observations in charitable fundraising. Some celebrities spontaneously and simultaneously publicly contribute to charities to spur additional donations, establishing voluntary leadership *VL*. However, in some cases, the procedure is set exogenously by a third party, such as a fundraiser, who considers announcing the initial contributions to those who follow (Vesterlund, 2003). This mechanism is closer to *RL* and *RL-VC*. More often, the fundraiser can send requests to potential donors but still preserve their right to refuse, thus corresponding to the *VL-RC* mechanism. Some other examples include the execution of global climate policies where one or multiple nations may decide to be the first to take an environmentally progressive action (*VL* or *RL-VC*) or that the superior authority can impose real requirements on a nation first, either in a hard or soft way (*RL* or *VL-RC*, Czap & Czap, 2011).

We contribute to the literature by providing a comprehensive comparison between exogenous leadership and endogenous leadership, focusing on how the selection procedure shapes the incentives of group members. Arbak and Villeval (2013) test the differences between randomly selected leadership (*RL*) and randomly selected leadership from voluntary candidates (*RL-VC*). Dannenberg (2015) implemented a similar method of installing a leader to the proposed *VL-RC* mechanism. However, there are two differences as follows: First, in her design, the installation way is not treated as a specific leader selection mechanism comparable to the random selection mechanism, but rather a rule to divide the groups between groups without a leader (treatment *En-Base*) and groups with a leader leading by example (treatment *En-Lead*) or leading by word (treatment *En-Pledge*) so that the comparison is made at the decision level of the randomly selected candidate, while out analysis makes the comparison at the mechanism level. Second, in Dannenberg (2015), a subject becomes the leader once and for all periods, resulting in a quite low incidence rate of voluntary leadership, while we allow a new leader to be chosen in each period.

Our study complements He and Zheng (2024). The paper uses a random-matching fixed-pairing design, while we use a random-matching random-pairing design. The random-pairing design induces a key difference. Unlike in fixed-pairing design, subjects in our design have no history of play to condition on. Thus, subjects are more directed to focus on the one-shot game structure, and the explanation for the results avoids the multiple equilibria concerns typical in repeated games with incomplete information. For instance, we only found that *VL-RC* outperforms *VL* and did not find that *VL-RC* also outperforms *RL* and *RL-VC*, which was the finding of He and Zheng (2024).

In addition, we give a complete characterization of the differences among the four leadership selection mechanisms, including the attributes and effects regarding the willingness to lead by group members under different scenarios, which gives the foundations for our hypotheses and predicts that *VL* performs the worst and *VL-RC* performs the best within the endogenous leadership selection mechanism considered.

3. Experimental Design

3.1. Treatments

The basic game is the voluntary contribution mechanism (hereafter, VCM), where groups of four subjects are randomly matched in each period and interact for 10 periods. In each period, the subjects are endowed with 20 tokens. Each subject allocates the tokens either to the private account or to the public account. Tokens allocated to the private account remain the same. Each token contributed to the public account yields 1.6 tokens.[2] Tokens in the public account are evenly distributed to four group members. Let c_{it} denote the individual's contribution to the public account in period t, restricted to an integer satisfying $0 \leq c_{it} \leq 20$. Let π_{it} denote individual i's earnings from their private account and the public account in period t, given the contributions of all group member $\{c_{it}\}_{i=1}^{4}$, as follows:

$$\pi_{it} = 20 - c_{it} + \frac{1.6 \times \sum_{j=1}^{4} c_{jt}}{4}$$

The experiment includes a baseline treatment and four distinct leader selection mechanisms as follows:

1. ***Control* (Baseline Treatment)**. All subjects play the standard *VCM*. They independently and simultaneously choose the contributions to the public account.
2. ***RL* (Randomly Selected Leadership)**. One individual is randomly selected as the group leader and chooses the contribution first. The followers perfectly observe the leader's contribution and then contribute simultaneously
3. ***VL* (Voluntary Leadership)**. Group members first volunteer to be the leaders. All volunteers automatically become leaders. Each leader observes the number of leaders and then simultaneously chooses a contribution. The followers (if there are any) perfectly observe the contributions of the leaders and then simultaneously choose the contributions.
4. ***RL-VC* (Randomly Selected Leadership from Voluntary Candidates)**. Group members first volunteer to be the leaders. Unlike *VL*, only one volunteer is randomly selected to be the leader. The leader does not know how many volunteers they compete with and choose the contribution. The followers perfectly observe the leader's contribution and then simultaneously choose the contribution.
5. ***VL-RC* (Voluntary Leadership by the Randomly Selected Candidate)**. One individual is randomly selected and decides whether to be the leader. If the individual volunteers to be the leader, then, they contributes first, and the rest follow after observing their contribution. If the individual does not want to be the leader, all group members contribute simultaneously.

In all treatments, subjects anonymously receive feedback on group members' roles, contributions, and payoffs at the end of each period. In stark contrast to the fixed-pairing design of He and Zheng (2024), subjects are randomly re-matched after each period. In a fixed-pairing design, subjects are paired with the same individuals throughout the experiment. Behaviors in previous periods have a lasting impact on future periods. Such a design is useful for understanding the dynamic interactions of the subjects, how subjects coordinate to some equilibrium profile, and the reputation effect of the leadership selection mechanisms. In contrast, in a random pairing design, subjects are paired with new teammates in each period. Subjects effectively played a series of independent one-shot games, because subjects have no history of play to condition on when devising strategies in each period. Compared with He and Zheng (2024), our design avoids the concerns of multiple equilibria, typical in repeated games with incomplete information. Our design also eliminates the contamination whereby subject behaviors may condition on the divergent

beliefs of other participants' cooperative type due to history of play. Our design makes the one-shot interaction within each leadership selection mechanism the play's focus and generates more independent observations than fixed-pairing design.

3.2. Treatment Effects

Similarly to what Hermalin (1998) finds under a game-theoretic framework in public goods games with leadership, we believe leaders increase the provision of public goods through the behavioral force of signaling and reciprocity. We conjecture that what really differentiates the effectiveness of four leadership mechanisms theoretically is how *informative* the leadership selection mechanism is in communicating the average degree of generosity of group members to followers through the leaders' (in)actions.

We perceive a leadership selection mechanism as a signaling device. The state of the world is the average degree of generosity of group members. A leadership selection mechanism is a family of distributions of signals conditional on the average degree of generosity. A signal is the contribution level of a leader. Upon observing the contribution levels, followers update their beliefs about the average degree of generosity of their group members. Then, reciprocity kicks in as follows: followers reward cooperation and punish free-riding.

Table 1 summarizes the properties of the four leader selection mechanisms. We first explain the properties and then connect these properties to the signaling power of leadership selection mechanisms.

Table 1. Summary of differences in the leader selection mechanisms.

	RL	***VL***	***RL-VC***	***VL-RC***
F1. Possibility of multiple leaders	No	Yes	No	No
F2. Possibility of no leader	No	Yes	Yes	Yes
A1. Respecting individual willingness to lead	No	Yes	No	No
A2. Respecting individual willingness not to lead	No	Yes	Yes	Yes
A3. Respecting group willingness to lead	—	Yes	Yes	No
E1. Free riding incentive among multiple leaders	No	Yes	No	No
E2. Strong willingness to lead by the leader	No	Yes	Yes	Yes
E3. No willingness to lead in case of no leader	—	Yes	Yes	No

We first discuss the treatments' facts regarding the number of leaders. *VL* is the only treatment allowing multiple group leaders (Fact F1). *RL* is an *exogenous* leader selection mechanism and the only treatment where a leader always exists. *VL*, *RL-VC*, and *VL-RC* are *endogenous* leader selection mechanisms; a group member becomes a leader only if he or she is willing to lead, and there could be groups without a leader (Fact F2).

A mechanism *respects individual willingness to lead* (Attribute A1) if any group member willing to lead is selected as a leader. Such a mechanism may have multiple leaders (A1 implying F1). When there are multiple leaders, they have incentives to free-ride on each other (Effect E1).

A mechanism *respects individual willingness not to lead* (Attribute A2) if any group member unwilling to lead is not selected as a leader. Such a mechanism may potentially have no leader (A2 implying F2). By revealed preference, those who volunteered are willing to lead (Effect E2).

A mechanism *respects group willingness to lead* (Attribute A3) if a leader exists when and only when a group member is willing to lead. This attribute distinguishes *VL-RC* from *VL* and *RL-VC*: In *VL-RC*, the group member willing to lead may not be the randomly selected leader candidate. Given that one player's decision determines the leadership structure in *VL-RC*, we cannot rule out the possibility of other members' willingness to lead in the leaderless group (Effect E3).

The different effects of the leader selection mechanisms shed light on the channels through which leadership may operate. First, in the absence of the "*free riding incentive among multiple leaders*" (E1), leaders in *RL*, *RL-VC*, and *VL-RC* should contribute more than their counterparts in *VL*. A leader in *VL* might feel that the other leaders will take care of the group and then lower their contribution.

Second, with the "*strong willingness to lead by the leader*" (E2), leaders in *VL*, *RL-VC*, and *VL-RC* should contribute more than their counterparts in *RL*. Randomly selected leaders in *RL* may not be intrinsically motivated to unite the team and set a good example. In contrast, self-motivated leaders in the endogenous leader mechanisms intend to promote group contributions.

Third, with the "*no willingness to lead by group members in case of no leader*" (E3) in effect, group members in *VL* and *RL-VC* should contribute less than their counterparts in the *VL-RC* when there is no leader. In *VL* and *RL-VC*, no leader occurs only when all group members refuse to engage in leadership. The unanimous reluctance strongly signals that group members want to free-ride. Thus, groups without a leader can hardly achieve cooperation.

We hypothesize the rankings of the four leader selection mechanisms in raising public goods contribution. First, the three effects are all positive for the *VL-RC* mechanism, making it the most effective. Although a reluctant leader in *RL* may contribute nothing, observing such inaction does not give information about other members' inclinations to cooperate. In contrast, no leader in *RL-VC* strongly signals that group members want to free-ride. *RL* suffers the negative effect of E2, and *RL-VC* suffers the negative effect of E3. *RL* and *RL-VC* are intermediately effective. Last, the three effects are all negative for the *VL* mechanism, making it the least effective mechanism.

3.3. Procedure

One hundred and sixty college students from Tsinghua University participated online between April and July 2020. We assigned 32 students to each treatment and ran two sessions per treatment. In each session, 16 subjects were randomly assigned to groups of four and re-matched after each period.

Subjects received an electronic version of the instructions and were required to complete the task independently in a quiet place without being disturbed. The experimenter guided the subjects through the details in the instructions by organizing an online meeting and encrypted their true identities to minimize the possibility of any communication between them. Any further questions from the subjects were privately answered.

The experiment was programmed and conducted using the software z-Tree (version 4.1.6) (https://www.ztree.uzh.ch/en.html) (Fischbacher, 2007). Each session lasted approximately 20 min. The earnings were accumulated across the 10 periods with the conversion rate of 1 token = CNY 0.05. The average payment received was about CNY 23.597 per subject (including a CNY 5 show-up fee), comparable to standard online payment levels in mainland China.

4. Results

In this section, we report our experimental results. First, we compare the average contributions by treatment. Next, we compare the average contributions between groups with and without a leader. Then, we compare the leader–follower interactions by treatment. Lastly, we focus on the free-riding incentives in endogenous leadership selection mechanisms.

4.1. Comparison of Average Contributions

Result 1. Introducing leadership selection mechanisms did not significantly increase public goods contributions. There was no significant difference in average contributions among *Control*, *VL-RC*, *RL*, and *RL-VC*. *VL* is the least effective in raising contributions.

Table 2 lists the average contributions of all treatments. In none of the leadership treatments did the contribution levels significantly exceed those in the baseline treatment (Wilcoxon rank-sum test, *RL* vs. *Control*: $p = 0.098$; *VL* vs. *Control*: $p < 0.001$; *RL-VC* vs. *Control*: $p = 0.216$; *VL-RC* vs. *Control*: $p = 0.229$). The average contribution in *VL* is significantly lower than that in *Control*, *RL*, *RL-VC*, and *VL-RC*. Further 0.341 ($p < 0.001$), indicating a significant difference between the two. The comparison between *RL* and *VL* shows an effect size oanalysis is provided in Appendix B, Table A1. The effect size between the *Control* and the *VL* is 3.341 ($p < 0.001$), indicating a significant difference between the two. The comparison between *RL* and *VL* shows an effect size of 5.106 ($p < 0.001$, confidence interval [3.672, 6.541]), further demonstrating that the contribution in the RL group is significantly higher than in *VL*. Notably, the comparison between *VL*-RC and *VL* reveals an effect size of −4.619 ($p < 0.001$, confidence interval [−5.995, −3.243]), indicating that the contribution in *VL-RC* is significantly higher than in *VL*. This result highlights the significant advantage in contributions of *VL-RC*, showing a marked improvement over *VL*. The average contributions in *RL* and *VL-RC* are significantly greater than that in *VL* and are similar to or slightly greater than the average contribution in the *Control*.[3]

Table 2. Average contribution separated by treatment.

	Control	***RL***	***VL***	***RL-VC***	***VL-RC***
Contribution	6.066	7.831	2.725	6.013	7.344
	(3.587)	(5.700)	(3.220)	(5.498)	(5.392)

Notes: The unit of observation is the group. Standard deviations are in parentheses.

Figure 1 depicts the average contributions over periods by treatment. Contributions in the *VL* are consistently lower than those in the baseline treatment across most periods (Wilcoxon matched-pairs signed-rank test, *VL* vs. *Control*: $p < 0.001$). Besides, the temporal patterns of contributions for the *Control*, *RL*, *RL-VC*, and *VL-RC* are pretty similar (Wilcoxon matched-pairs signed-rank test, *RL* vs. *Control*: $p = 0.050$; *RL-VC* vs. *Control*: $p = 0.604$; *VL-RC* vs. *Control*: $p = 0.121$).

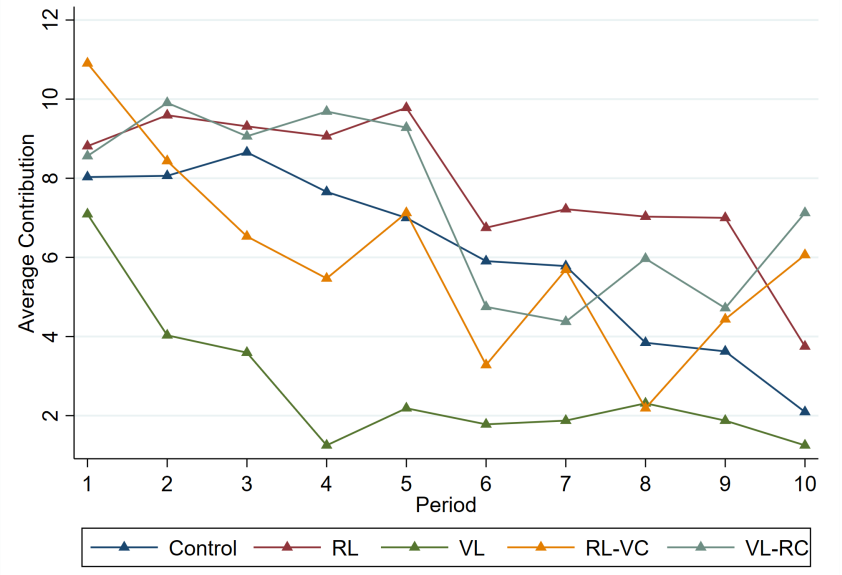


Figure 1. Average contributions over periods by treatment.

4.2. Comparison of Average Contributions Between Groups with and Without a Leader

Result 2. The barrier to becoming a leader amplifies the signaling effect of self-chosen leadership in endogenous leadership treatments. For groups without a leader, the average contribution in endogenous leadership treatments is significantly lower than in the baseline treatment. For groups with a leader, *RL-VC* and *VL-RC* outperform *RL*, and *RL* outperforms *VL*.

To understand the gaps in raising public goods contribution among the mechanisms, we first examine the leadership performance by comparing groups with and without leaders, as shown in Table 3. In every endogenous leader selection mechanism (*VL*, *RL-VC*, and *VL-RC*), groups without a leader contribute much less compared to groups with leaders (Wilcoxon rank-sum test, $p < 0.001$ for all pairwise comparisons). Groups without a leader contribute at an average of around 54.2% of the level of groups with leaders, comparable to treatments in the study of Güth et al. (2007)[4].

Table 3. Average contribution separated by group leadership.

	Control	*RL*	*VL*	*RL-VC*	*VL-RC*
Groups without a leader	6.066	—	1.121	1.700	3.829
	(3.587)		(1.899)	(2.335)	(3.425)
Groups with a leader	—	7.831	3.972	7.450	11.038
		(5.700)	(3.493)	(5.506)	(4.555)
Percentage of groups with a leader (%)	0	100	56.25	75	48.75

Notes: The unit of observation is the group. Standard deviations are in parentheses.

In endogenous leadership treatments, self-chosen leadership serves as a signaling device. When there is no leader, the structure of the subgame is essentially the same as that in the control treatment. The subjects who avoid an early contribution are perceived to be more uncooperative than when a simultaneous move is the only option (Stanc et al., 2009). The average contribution in groups without a leader in the three treatments is significantly lower than in the *Control* (Wilcoxon rank-sum test, $p < 0.001$ for all pairwise comparisons, further details can be found in Tables A2 and A3).

Furthermore, the barrier to becoming a leader matters in fostering group contributions. *VL-RC* only allows one group member to be a leader. When the randomly selected candidate refuses to lead, subjects are still not sure about the followers' willingness to cooperate. In contrast, *VL* and *RL-VC* allow multiple group members to be candidates. When there is no leader, group members perceive others as not cooperative. We find average group contribution when no leader exists in *VL-RC* is significantly higher than that in *VL* or in *RL-VC*. (Wilcoxon rank-sum test for the group without a leader, *VL* vs. *RL-VC*: $p = 0.169$; *VL* vs. *VL-RC*: $p < 0.001$; *RL-VC* vs. *VL-RC*: $p = 0.026$).

Restricting attention to groups with a leader, we compare the average group contributions of the endogenous leader selection mechanisms against that of *RL*. We find that *VL-RC* outperforms *RL*, while *VL* performs significantly worse (Wilcoxon rank-sum test for groups with a leader, *RL* vs. *VL-RC*: $p = 0.002$; *RL* vs. *VL*: $p < 0.001$; *RL* vs. *RL-VC*: $p = 0.651$). Among the three endogenous leadership treatments, *VL-RC* significantly outperforms *RL-VC* and *VL*; *RL-VC* significantly outperforms *VL* (Wilcoxon rank-sum test, $p < 0.001$ for all pairwise comparisons).

In all three endogenous leader selection mechanisms, we find "*reluctance to lead*". The average vacancy rate of voluntary leadership is around 40%. The leader's presence is the greatest in *RL-VC* and the lowest in *VL-RC*. On the other hand, more groups with leaders do not always translate to greater average contributions. *VL* allows multiple leaders, leading to a diffusion of responsibility among them, which could limit the increase in contributions.

4.3. Comparison of Leader–Follower Interactions

Result 3. Leaders lead by example, and followers follow. Within the endogenous leader selection mechanisms, the leader's influence is more pronounced if the barrier to becoming a leader is lower. There is a significant positive correlation between leader and follower contributions in *VL* and in *RL-VC*, and a weak or no correlation in the other treatments.

In this subsection, we seek to understand the leader's role modeling effect (or lack thereof) by examining leaders' cooperative behavior and followers' reciprocity.[5] In aggregate, leaders contribute more and effectively foster greater follower contribution. Table 4 presents the average contributions by role at the individual level, conditional on having group leaders. Regardless of treatment, leaders contribute significantly more than followers (Wilcoxon rank-sum test, $p < 0.05$ for all pairwise comparisons, further details can be found in Tables A4 and A5).[6]

Table 4. Average contributions by role in groups with a leader.

	RL	*VL*	*RL-VC*	*VL-RC*
Leader	11.225	8.214	12.667	16.231
	(7.286)	(6.412)	(7.191)	(5.905)
Follower	6.7	2.056	5.711	9.308
	(6.999)	(3.783)	(6.974)	(7.672)

Notes: The unit of observation is the individual. Standard deviations are in parentheses.

Table 5 presents the average follower contributions in endogenous leader selection mechanisms. The contribution levels of followers in groups with a leader are significantly greater than those in groups without a leader (Wilcoxon rank-sum test, $p < 0.001$ for all pairwise comparisons, further details can be found in Tables A5 and A6).

Table 5. Average follower contributions in endogenous leader selection mechanisms.

	VL	*RL-VC*	*VL-RC*
Has a leader	2.056	5.711	9.308
	(3.783)	(6.974)	(7.672)
No leader	1.121	1.700	3.829
	(3.370)	(3.584)	(6.299)

Notes: The unit of observation is the individual. Standard deviations are in parentheses.

Failure to become a leader dampens volunteers' willingness to contribute. The average contribution of the volunteers who failed to become a leader in *RL-VC* (mean = 11.136) is between that of the leaders (mean = 12.667) and that of the members who did not volunteer (mean = 3.861).

The barrier to becoming a leader also matters in coordinating leader–follower contributions. Figure 2 depicts the average contributions over periods made by leaders and followers at the group level and the average contribution of groups without a leader. Spearman's rank correlation analyses reveal mixed results, with a significant positive relationship observed in the *VL* and in *RL-VC*, while other treatments show weak or no significant correlation between leader and follower contributions.[7]

In *VL*, all volunteers become leaders. Observing more leaders making greater contributions gives followers a clear signal of cooperative play. A cooperative, forward-looking leader is confident that the followers will reciprocate the favor. *RL-VC* is a weakened version where followers observe the contribution level of only one leader.

In *RL*, how much the leader contributes does not generate much information about how likely other followers will contribute under our random-pairing design. In *VL-RC*, barriers to becoming a leader are higher than in *VL*, and it is more difficult to infer other followers' inclinations to cooperate.

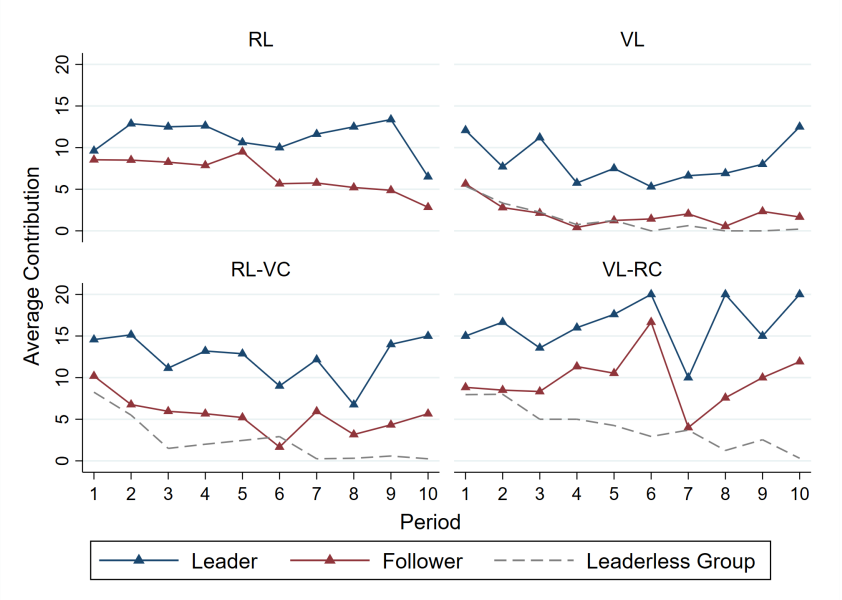


Figure 2. Average contribution over periods by role.

We observe no significant difference between the contributions of leaders in periods 1–5 and 6–10, implying that leaders exhibit stable pro-social behavior (Sahin et al., 2015). Followers in *RL* and in *RL-VC* exhibit a noticeable decline in contributions over time. Followers in other leadership treatments show no significant variation in their contributions. Members of groups without a leader in *VL*, *RL-VC*, and *VL-RC* significantly decrease their contributions over periods.[8]

4.4. Discussion of Endogenous Leadership

Result 4. Endogenous leader selection mechanisms that allow multiple volunteers induce more selfish leaders. When there are multiple leaders, the leader with the lowest contribution significantly influences the followers.

Among endogenous leader selection mechanisms, only *VL* and *RL-VC* allow multiple candidates. Followers have incentives to free-ride on other volunteers. However, Table 6 shows the difference in probabilities to volunteer between the two mechanisms (Wilcoxon rank-sum test, $p < 0.001$).

Table 6. Inclinations to volunteer and lead.

	VL	***RL-VC***	***VL-RC***
Probability of being chosen as a candidate (%)	100 by design	100 by design	25 by design
Conditioning on being a candidate, probability to volunteer (%)	17.5 (0.381)	25.625 (0.190)	48.750 (0.503)
Conditioning on being a volunteer, probability to lead (%)	100 by design	73.171 (0.446)	100 by design
Conditioning on being a candidate, probability to lead (%)	17.5 (0.381)	18.75 (0.391)	48.75 (0.503)
Unconditional probability of being a leader (%)	17.5 (0.381)	18.75 (0.391)	12.188 (0.328)

Notes: The unit of observation is the individual. Standard deviations are in parentheses.

Figure 3 also shows that the number of volunteers in *RL-VC* is higher than in *VL* for most of the experiment. In both treatments, individuals' volunteer tendencies fluctuate considerably, gradually decreasing. The average number of volunteers in *RL-VC* starts above that of *VL* and ends higher.

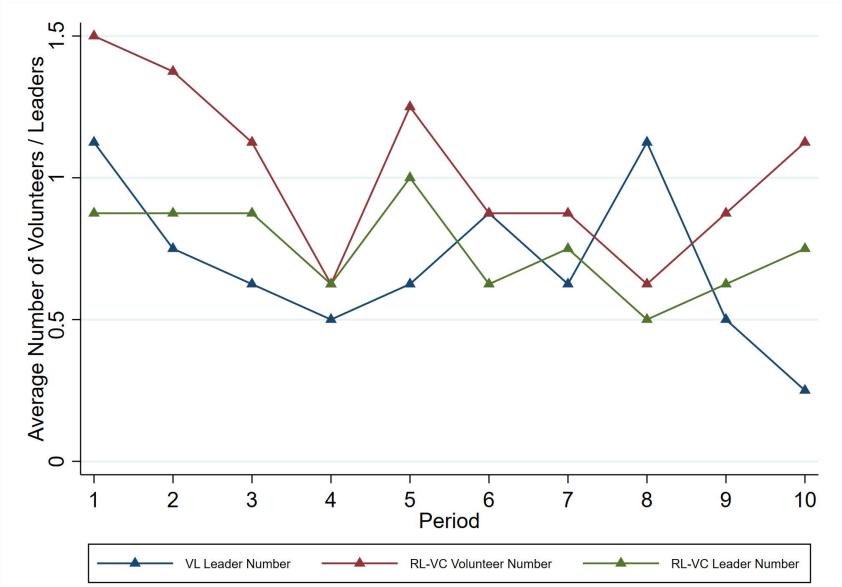


Figure 3. Average number of volunteers or leaders over periods by treatment.

We attribute the difference to another layer of bystander effect induced by the probability of becoming a leader conditional on being a volunteer. As we highlighted in the second row of Table 6, conditional on being a volunteer in *VL*, candidates are forced to be a leader; on the other hand, conditional on being a volunteer in *RL-VC*, candidates are randomly selected to be the single leader. Thus, in *VL*, volunteers have incentives to free-ride on other leaders, which dampens the incentive to become a volunteer in the first place.

We further find that mechanisms allowing multiple candidates (*VL* and *RL-VC*) induce more selfish leaders than mechanisms allowing only one candidate (*VL-RC*). Conditional on being a leader, the share of the leaders contributing no more than one-quarter of their endowment is 50% in *VL*, 28.33% in *RL-VC*, and only 7.69% in *VL-RC*, though the share of selfish leaders in the exogenous leader selection mechanism of *RL* is 31.25%.

When multiple leaders emerge, followers base their contribution levels on those made by the worst leader to a large degree. In *VL*, Spearman's rank correlation coefficient is 0.283 ($p = 0.063$) with the best leader contribution, and the coefficient is 0.419 ($p = 0.005$) with the worst leader contribution.

5. Conclusions

We study leader selection mechanisms in the public goods provision game. Our analysis yields four key findings. First, introducing leadership selection mechanisms does not increase contributions; voluntary leadership is the least effective and performs worse than the baseline. Second, the presence of a leader significantly increases overall contributions, and mechanisms with higher barriers (e.g., *VL-RC*) outperform those with lower barriers (e.g., *VL*). Third, leaders lead by example, and followers reciprocate, but the strength of this relationship depends on the leadership mechanism. Finally, mechanisms that allow multiple leaders (e.g., *VL* and *RL-VC*) tend to induce more selfish behavior, as the diffusion of responsibility among leaders weakens their influence.

Our study reinforced the finding of He and Zheng (2024) that voluntary leadership from a randomly selected candidate (*VL-RC*) is a promising mechanism for raising public goods contribution. Compared with He and Zheng (2024), we report average contributions by treatment and justify our experimental design through the behavioral theory of signaling and reciprocity. *VL-RC* enjoys the following three good properties: the leader, by revealed preference, is cooperative; the leader has no free-riding incentives; and no leader leaves members hoping that someone cooperative is not lucky enough to be se-

lected, increasing confidence in cooperative play. Our random-pairing design makes the subjects more focused on the one-shot game structure, highlighting the signaling effect of leadership, and reducing the concerns with multiple equilibria in repeated games with incomplete information.

Our results suggest that while leadership can enhance public goods contributions, collective leadership is not as ideal as individual leadership. Mechanisms with higher barriers to leadership are more effective in fostering cooperation, as they reduce free-riding incentives and strengthen the signaling effect of leadership. In designing the leadership selection mechanism, policymakers and organizational leaders can create barriers in selecting candidates and privately encourage the candidate who values the common good the most to lead by example voluntarily.

Although our leadership selection mechanisms are motivated by real-world examples such as fundraising and climate policies, we draw our findings from a controlled lab setting using college students as research subjects with small-stake decisions. We only study a simple form of public goods game where leaders are of equal status, and group members cannot communicate with each other. In future research, it would be interesting to see if our findings can be generalized to individuals with heterogeneous social-economic backgrounds, who are called upon to make high-stake decisions. It would also be interesting to see if a more complicated and more real-world relevant form of public goods game with multi-layered leadership hierarchies and communication between subjects would point to a leadership selection mechanism with similar properties (Hamman et al., 2011; Levy et al., 2011; Brandts et al., 2015).

Author Contributions: Authors are listed in alphabetical order and all authors contributed equally to this work. Conceptualization: J.Z.; methodology: S.X. and J.Z.; analysis: S.X. and W.Z.; data curation: W.Z. and J.Z.; writing—original draft preparation: S.X., W.Z. and J.Z.; writing—review and editing: S.X., W.Z. and J.Z.; funding acquisition: S.X. and J.Z. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Fundamental Research Funds for the Central Universities (2021QD032), the Research Achievements of "Double First-class" Major Project of Beijing Foreign Studies University (2022SYLZD001), the National Natural Science Foundation of China (72073080), and the Shandong Provincial Natural Science Foundation (ZR2024MG004).

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Tsinghua University Economic Science and Policy Experimental Laboratory (Tsinghua ESPEL) (Approval Code: 2020003 and date: 1 March 2020).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The datasets used and analyzed in this study are available on Mendeley Data. DOI: 10.17632/85p9mh3zmp.2.

Acknowledgments: We thank the editor and the three anonymous reviewers for their valuable suggestions. We thank Yunwen He for the helpful comments and Jiaye Bai for the excellent research assistance.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A. Experimental Instructions for the Leadership Treatments (Translated from Chinese)

Thank you for your participation in this experiment! Please read the following instructions carefully. If you have any questions, please feel free to ask us. Please note that you cannot communicate with other participants during the experiment.

You will be paid to complete the experiment according to the instructions. Your payoff for the experiment will be determined by your choices and the choices of other participants. At the end of the experiment the tokens that you have earned will be converted into CNY at the exchange rate of 20 tokens = CNY 1.

Appendix A.1. Matching Rules [Common to All Treatments]

There are 10 periods of games in total. At the beginning of each period, you will be randomly allocated to a group of four and carry out the experimental task anonymously with the other three participants in your group for that period. The composition of each group is randomly determined for each period of play. This means that you form a group with different participants in different periods.

Appendix A.2. Playing Rules

At the beginning of each period, every participant receives 20 tokens. Your task is to decide how you use your endowment. You have to decide how many of the 20 tokens you want to contribute to a project and how many of them to keep for yourself.

Your payoff consists of two parts:

- The tokens which you have kept for yourself (i.e., 20 tokens—your contribution to the project);
- The payoff from the project. This payoff is calculated as follows: The amount of the project equals 1.6 times the tokens invested in the project by all the four group members, which is then shared equally among the members of the group (i.e., your payoff from the project = 0.4 × the total contribution of all 4 group members to the project).

The experiment will take place in two stages chronologically, which are the **First Mover(s) Determination and Allocation Stage** and **Later Mover(s) Allocation Stage**.

Appendix A.2.1. First Stage: First Mover(s) Determination and Allocation Stage

[Specific to the treatment *RL*]

At this stage, one of the 4 group members will be randomly selected as the first mover, and the other 3 members will automatically become the later movers. The selection procedure is independent in each period.

[Specific to the treatment *VL*]

At this stage, each group member first simultaneously and independently decides whether to volunteer as the first mover. Whoever volunteers will become one of the first movers of their group. After all 4 group members confirm their decisions, they will be informed of the number of first movers in the group. Members who opt out of moving first will automatically become the later movers.

If 1, 2, or 3 of the group members choose to be the first mover, then 3, 2, or 1 of the group members will become the later mover. If all the members play the role of first mover/later mover, then the whole group will make contribution decisions simultaneously and independently at the corresponding stage.

[Specific to the treatment *RL-VC*]

At this stage, each group member first simultaneously and independently decides whether to volunteer as the first mover. When there are several volunteers, the selection of the unique first mover is made randomly among the candidates, and the other 3 members (either opting out of moving first or eliminated from the selection) will automatically become the later movers.

If none of the members want to play the role of first mover, then the whole group will make contribution decisions simultaneously and independently at the second stage.

[Specific to the treatment *VL-RC*]

At this stage, one of the 4 group members will be randomly selected as the first mover candidate. They have to decide whether to play the role of first mover. If they accepts, the other 3 members will automatically become the later movers. If they reject, the whole group will make contribution decisions simultaneously and independently at the second stage. The selection procedure is independent in each period.

The first movers (if any) decide first on their contributions simultaneously, being aware of the specific number of first movers in the group. This amount can take any integer between 0 and 20, and the amount of tokens each first mover has contributed to the project will be made public to the later movers in the subsequent stage. The later movers will wait at this stage for the first movers to decide.

Appendix A.2.2. Second Stage: Later Mover(s) Allocation Stage [Common to All the Treatments]

After being informed of the contribution made by the first mover in the first stage, if any, the later movers choose simultaneously the amount of their endowment they contribute to the project, i.e., any integer between 0 and 20, at this stage. After all members have made their decisions, each one in the group is informed about the role of each member (first mover or later mover), the amount of each member's contribution, the total amount of the project and the payoff of each member for the current period. To keep anonymity, the true identity of every participant is replaced with a random drawn identification number.

Appendix A.3. Payment Rules [Common to All the Treatments]

The payoff you get in each period is the sum of the tokens which you have kept for yourself and the tokens gained from the project. The calculation formula is as follows:

$$\text{Payoff in each period} = (20 - \text{your contribution to the project}) + \frac{1.6 \times \text{the total contribution of all 4 group members}}{4}$$

The accumulated tokens that you have earned across the 10 periods will be converted into CNY at the exchange rate 20 tokens = CNY 1. We will take your payoff plus a CNY 5 show-up fee as your final earnings in the experiment. The resulting amount will be paid to you via Wechat at the end of the experiment.

If you have any questions, please contact the experimenter. If there is no problem, we will start the experiment after all participants confirm.

Appendix B. Supplemental Analysis and Results

The following tables present the effect size, *p*-value, and 95% confidence intervals (CI).

Table A1. Detailed statistical results of average contribution separated by treatment.

Comparison	Effect Size	*p*-Value	95% CI
Control vs. RL	−1.766	0.098	[−3.241, −0.290]
Control vs. VL	3.341	0.000	[2.284, 4.397]
Control vs. RL-VC	0.053	0.216	[−1.385, 1.492]
Control vs. VL-RC	−1.278	0.229	[−2.697, 0.141]
RL vs. VL	5.106	0.000	[3.672, 6.541]
RL vs. RL-VC	1.819	0.030	[0.083, 3.554]
RL vs. VL-RC	0.488	0.625	[−1.232, 2.207]
VL vs. RL-VC	−3.288	0.000	[−4.684, −1.891]
VL vs. VL-RC	−4.619	0.000	[−5.995, −3.243]
RL-VC vs. VL-RC	−1.331	0.079	[−3.019, 0.356]

Notes: *p*-value refers to the rank-sum test. As per the referee's request, CI for the *t*-test have also been included.

Table A2. Detailed statistical results of average contribution for groups with a leader.

Comparison	Effect Size	*p*-Value	95% CI
Control vs. RL	−1.766	0.098	[−9.422, 5.891]
Control vs. VL	2.094	0.001	[−2.451, 6.638]
Control vs. RL-VC	−1.384	0.385	[−9.557, 6.788]
Control vs. VL-RC	−4.973	0.000	[−12.069, 2.123]
RL vs. VL	3.859	0.000	[2.246, 5.472]
RL vs. RL-VC	0.381	0.651	[−1.490, 2.252]
RL vs. VL-RC	−3.207	0.002	[−5.106, −1.309]
VL vs. RL-VC	−3.478	0.001	[−5.204, −1.751]
VL vs. VL-RC	−7.066	0.000	[−8.823, −5.310]
RL-VC vs. VL-RC	−3.588	0.001	[−5.585, −1.592]

Notes: *p*-value refers to the rank-sum test. As per the referee's request, CI for the *t*-test have also been included.

Table A3. Detailed statistical results of average contribution for groups without a leader.

Comparison	Effect Size	*p*-Value	95% CI
Control vs. VL	4.944	0.000	[3.938, 5.951]
Control vs. RL-VC	4.366	0.000	[3.075, 5.656]
Control vs. VL-RC	2.236	0.001	[0.926, 3.547]
VL vs. RL-VC	−0.579	0.168	[−1.780, 0.623]
VL vs. VL-RC	−2.708	0.000	[−3.930, −1.485]
RL-VC vs. VL-RC	−2.129	0.026	[−3.594, −0.664]

Notes: *p*-value refers to the rank-sum test. As per the referee's request, CI for the *t*-test have also been included.

Table A4. Detailed statistical results of average leader contribution with a leader.

Comparison	Effect Size	*p*-Value	95% CI
RL vs. VL	3.011	0.011	[0.693, 5.328]
RL vs. RL-VC	−1.441	0.268	[−3.862, −0.979]
RL vs. VL-RC	−5.006	0.000	[−7.452, −2.560]
VL vs. RL-VC	−4.452	0.001	[−6.929, −1.976]
VL vs. VL-RC	−8.016	0.000	[−10.517, −5.516]
RL-VC vs. VL-RC	−3.564	0.012	[−6.161, −0.967]

Notes: *p*-value refers to the rank-sum test. As per the referee's request, CI for the *t*-test have also been included.

Table A5. Detailed statistical results of average follower contribution with a leader.

Comparison	Effect Size	*p*-Value	95% CI
RL vs. VL	4.644	0.000	[3.536, 5.752]
RL vs. RL-VC	0.989	0.154	[−0.361, 2.339]
RL vs. VL-RC	−2.608	0.002	[−4.256, 0.960]
VL vs. RL-VC	−3.655	0.000	[−4.872, −2.438]
VL vs. VL-RC	−7.251	0.000	[−8.793, −5.710]
RL-VC vs. VL-RC	−3.597	0.000	[−5.320, −1.873]

Notes: *p*-value refers to the rank-sum test. As per the referee's request, CI for the *t*-test have also been included.

Table A6. Detailed statistical results of average follower contributions without a leader.

Comparison	Effect Size	*p*-Value	95% CI
VL vs. RL-VC	−0.579	0.025	[−1.542, −0.385]
VL vs. VL-RC	−2.708	0.000	[−3.822, −1.594]
RL-VC vs. VL-RC	−2.129	0.030	[−3.373, −0.886]

Notes: *p*-value refers to the rank-sum test. As per the referee's request, CI for the *t*-test have also been included.

Notes

1 Indeed, the Nash equilibrium predicts that self-regarding decision makers have no incentive to contribute anything towards the public good. Leaders contributing to the public good commit an act of generosity, and leaders expect reciprocity, or in other words, followers' reward of cooperative behavior.

2 To facilitate comparison with the existing research, we follow canonical parameter settings of experimental public goods games. See Fehr and Gächter (2000) or Fischbacher et al. (2001), for example.

3 Wilcoxon rank-sum test, *RL* / *RL-VC* / *VL-RC* vs. *VL*: $p < 0.001$; *RL* vs. *RL-VC*: $p = 0.03$; *RL* vs. *VL-RC*: $p = 0.625$; *RL-VC* vs. *VL-RC*: $p = 0.079$.

4 See Secion 4.1.1, Table 3 of Güth et al. (2007), Groups without a leader contribute on average at 8.35, while Groups with a leader contribute on average at (11.92 + 18.26)/2. The ratio is about 55.3%.

5 In fixed-pairing designs, leaders observe the same followers' actions (or a signal of actions) in the previous period. The favor (if there is any) can then be reciprocated by leaders. In random-pairing designs, leaders have no history (except experience with previous anonymous followers) to condition their decision on. Leaders' contribution is an act of unconditional cooperation.

6 $p < 0.001$ (Wilcoxon matched-pairs signed-rank test) for all pairwise comparisons if we match the average contribution of leaders with that of followers for each group.

7 *RL*: rho = −0.018, $p = 0.960$; *VL*: rho = 0.612, $p = 0.060$; *RL-VC*: rho = 0.571, $p = 0.084$; *VL-RC*: rho = 0.554, $p = 0.097$.

8 Wilcoxon rank-sum test is used. For leaders, *RL*: $p = 0.531$; *VL*: $p = 0.243$; *RL-VC*: $p = 0.376$; *VL-RC*: $p = 0.250$; For followers, *RL*: $p = 0.001$; *VL*: $p = 0.206$; *RL-VC*: $p = 0.052$; *VL-RC*: $p = 0.826$; For leaderless group members, *VL*: $p = 0.006$; *RL-VC*: $p = 0.045$; *VL-RC*: $p < 0.001$.

References

Antonakis, J., d'Adda, G., Weber, R. A., & Zehnder, C. (2022). Just words? Just speeches? On the economic value of charismatic leadership. *Management Science*, *68*(9), 6355–6381. [CrossRef]

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

Berger, J., Osterloh, M., Rost, K., & Ehrmann, T. (2020). How to prevent leadership hubris? Comparing competitive selections, lotteries, and their combination. *The Leadership Quarterly*, *31*, 101388. [CrossRef]

Brandts, J., Cooper, D. J., & Weber, R. A. (2015). Legitimacy, communication and leadership in the turnaround game. *Management Science*, *61*(11), 2627–2645. [CrossRef]

Chemin, M. (2021). Does appointing team leaders and shaping leadership styles increase effort? Evidence from a field experiment. *Journal of Economic Behavior and Organization*, *186*, 12–32.

Czap, H. J., & Czap, N. V. (2011). Donating-selling tradeoffs and the influence of leaders in the environmental goods game. *The Journal of Socio-Economics*, *40*, 743–752. [CrossRef]

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

Darley, J. M., & Latané, B. (1968). Bystander intervention in emergencies: Diffusion of responsibility. *Journal of Personality and Social Psychology*, *8*(4), 377–383. [CrossRef]

Fehr, E., & Gächter, S. (2000). Cooperation and punishment in public goods experiments. *American Economic Review*, *90*(4), 980–994. [CrossRef]

Fischbacher, U. (2007). Z-Tree: Zurich toolbox for ready-made economic experiments. *Experimental Economics*, *10*(2), 171–178. [CrossRef]

Fischbacher, U., Gächter, S., & Fehr, E. (2001). Are people conditionally cooperative? Evidence from a public goods experiment. *Economics Letters*, *71*(3), 397–404.

Gächter, S., Nosenzo, D., Renner, E., & Sefton, M. (2012). Who makes a good leader? Cooperativeness, optimism and leading-by-example. *Economic Inquiry*, *50*(4), 953–967. [CrossRef]

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

Glowacki, L., & von Rueden, C. (2015). Leadership solves collective action problems in small-scale societies. *Philosophical Transactions of the Royal Society B*, *370*, 0010.

Güth, W., Levati, M. V., Sutter, M., & Van der Heijden, E. (2007). Leading by example with and without exclusion power in voluntary contribution experiments. *Journal of Public Economics*, *91*(5), 1023–1042.

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

Hamman, J. R., Weber, R. A., & Woon, J. (2011). An experimental investigation of electoral delegation and the provision of public goods. *American Journal of Political Science*, *55*(4), 737–751.

He, Y., & Zheng, J. (2024). Promoting cooperation by leading: Leader-selection mechanisms in public goods games. *Economics Letters*, *238*, 111718. [CrossRef]

Hermalin, B. E. (1998). Toward an economic theory of leadership: Leading by example. *American Economic Review*, *88*, 1188–1206. [CrossRef]

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

Kumru, C. S., & Vesterlund, L. (2010). The effect of status on charitable giving. *Journal of Public Economic Theory*, *12*(4), 709–735.

Levati, M. V., Sutter, M., & Van der Heijden, E. (2007). Leading by example in a public goods experiment with heterogeneity and incomplete information. *Journal of Conflict Resolution*, *51*, 793–818.

Levy, D., Padgitt, K., Peart, S., Houser, D., & Xiao, E. (2011). Leadership, cheap talk and really cheap talk. *Journal of Economic Behavior and Organization*, *77*(1), 40–52.

Meidinger, C., & Villeval, M.-C. (2002). *Leadership in teams: Signaling or reciprocating?* (Working Paper 02-13, GATE). University of Lumiere.

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

Pietraszewski, D. (2020). The evolution of leadership: Leadership and followership as a solution to the problem of creating and executing successful coordination and cooperation enterprises. *The Leadership Quarterly*, *31*(2), 101299.

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

Préget, R., Nguyen-Van, P., & Willinger, M. (2016). Who are the voluntary leaders? Experimental evidence from a sequential contribution game. *Theory and Decision*, *81*(4), 581–599.

Rivas, M. F., & Sutter, M. (2011). The benefits of voluntary leadership in experimental public goods games. *Economics Letters*, *112*(2), 176–178.

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

Stanca, L., Bruni, L., & Corazzini, L. (2009). Testing theories of reciprocity: Do motivations matter? *Journal of Economic Behavior and Organization*, *71*, 233–245.

Vesterlund, L. (2003). Informational value of sequential fundraising. *Journal of Public Economics*, *87*, 627–657.

Zhou, Y., Huang, G., He, H., & Liu, M. (2015). Group leader and individual leader—An experimental study of public goods game. *Finance and Trade Economics*, *5*, 20–34.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.