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ORIGINAL PAPER

An experimental study of leadership institutions in collective action games

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Abstract We investigate the effectiveness of two leadership institutions in each of two games: a weakest link and a linear public good game. An "Exemplar" leader is a first mover who commits to a level of contribution; a "Manager" is a first mover who makes cheap talk suggestions to the team members. Our results show that both leadership institutions reduce coordination failures as compared to a simultaneous move, baseline scenario with no leader. Although the Manager treatment seems to be slightly more effective at the outset, both leadership institutions significantly and equally improve contributions in the coordination game over time. According to our results none of the leadership institutions seem effective in the linear public good game. This may be due to the fact that our marginal per capita return is rather large, keeping the contribution levels high regardless of the treatment. Subjects who choose to free ride continue to do so with or without leaders, and subjects who choose to be cooperative do not become discouraged by others' lack of cooperation.

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These results both replicate earlier findings and allow direct comparison across similar games.

Keywords Leadership institutions · Coordination failure · Free riding · Weakest link public good game · Linear public good game

JEL Classification C7 · C92 · M12

1 Introduction

Free riding and coordination failures are two common problems in collective action. Economists have emphasized leadership as a viable solution to such collective action problems, and recent experimental research has explored the effectiveness of leadership in improving cooperation and coordination. We construct parallel standard linear and weakest-link public good games, and examine the effectiveness of two common leadership institutions: leading by example, where a leader moves first and is observed by others; and leading by suggestion, where a leader makes a "cheap talk" suggestion of a choice for each member of a group.

Much of the extensive research in economics on leadership can be categorized based on four important characteristics. First is the set of actions that the leader may take. Some leaders lead by making a costly commitment such as their own participation as a first mover in the project (Hermalin 1998; Vesterlund 2003; Potters et al. 2005, 2007; Komai et al. 2007; Komai and Stegeman 2010). In most cases, these leaders are simply first movers with observable actions (Moxnes and van der Heijden 2003; Bardsley and Sausgruber 2005; Guth et al. 2007; Levy et al. 2011; Gächter et al. 2012; Jack and Recalde 2015).[1] Others lead by sending their followers a cheap talk signal such as making a simple suggestion (Wilson and Sell 1997; Levy et al. 2011; Houser et al. 2014). In a typical experiment these messages are sent by a leader, who is also a participant in the game; strategies (such as contribution levels) are chosen both by the followers and the leader herself after the signals are sent.

A second characteristic is the type of collective action in question. Most papers focus on leadership in linear public goods games, most using the voluntary contribution mechanism, in which free-riding is the dominant strategy (e.g., Guth et al. 2007). A number of papers, however, address leadership in coordination games (e.g., Brandts et al. 2007). Several have designed games that simultaneously capture both the free-riding problem and coordination failures (e.g., Komai and Stegeman 2010; Komai et al. 2011).

Third is the way in which leaders are selected. In most research in experimental economics, leaders are randomly-selected players who occupy the leadership position. However, selecting the leader, whether by a transparent procedure (Kumru and Vesterlund 2010; Eckel et al. 2010), by volunteering (Arbak and Villeval 2013; Rivas and Sutter 2011), or by election (Brandts et al. 2014; Grossman and

[1] See also: List and Rondeau (2003), Andreoni (1998, 2006), Brandts et al. (2007), Levati et al. (2007), Komai and Grossman (2009), Komai et al. (2011), Kulas et al. (2013) and Grossman et al. (2015).

Baldassarri 2012; Jack and Recalde 2015) substantially improves the leader's effectiveness. In our study, leaders are selected according to their score on a 10 question trivia quiz, thus enhancing the legitimacy, and perhaps effectiveness, of the leader.[2]

A fourth characteristic is the information structure in which the leader operates. The leader may have no informational advantage, in which case he serves primarily as a role model or coordination device (as in Moxnes and van der Heijden 2003); or he may have access to information that the followers do not (as in Potters et al. 2005, 2007; see Footnote 1 for additional studies). Our study focuses on the first condition, and does not consider the very important issue of informational advantage.

In this paper, we compare, under complete information, the effectiveness of two leadership institutions in two different collective action settings: a linear public good game (Isaac and Walker 1988) in which the dominant strategy of a selfish player is to free ride on others by contributing zero, and a weakest link coordination game (Van Huyck et al. 1990), in which the optimal strategy of any player depends on the actions of others. The games are repeated for 20 periods in stable groups. We consider an "Exemplar" leadership institution in which a first mover makes a commitment in the form of an actual contribution: This institution is known as "leading by example". A second institution introduces a "Manager" in which a first mover makes cheap talk suggestions to the team members before contributions are selected: This institution could be termed, "leading by suggestion". The two games are parallel. Free riding in the linear public good game and coordination failures in the weakest link public good game limit efficiency. Ours is the first paper (to our knowledge) that brings together two different leadership styles in directly comparable linear public goods and weakest link games.

Results in the weakest link game reveal strong coordination failure in the absence of leadership. Both leadership institutions significantly reduce coordination failure. Leading by suggestion seems more effective than leading by example in the first period but it loses its advantage over time. Results in the linear public good game also show strong evidence of free riding in the absence of leadership. The free riding problem in the linear public good game, however, does not seem as severe as the coordination failures in the weakest link game; in the sense that in the absence of a leader total contributions in the weakest link game are much smaller than those in the linear public good game. According to our results neither of the leadership institutions seem effective in the linear public good game. Subjects who choose to free ride continue to do so with or without leaders and subjects who choose to be cooperative do not get discouraged by others' lack of cooperation.

Section 2 explains our public good games. Section 3 presents our experimental procedure. Sections 4 and 5 present our results. Section 6 concludes the paper and discusses the replication of previous studies.

[2] Erkal et al. (2011) show that high earners in a real effort task give lower amounts to other group members. This suggests that real effort tasks may in fact select selfish leaders, if leaders know that scoring high will put them in a position to exploit others.

2 The games

The experiment includes two games that are frequently used as experimental models of a situation involving public goods. These two games are illustrated in Table 1.

2.1 The weakest link public good game

A team of six subjects undertakes a "weakest link" public good game. Each subject $i \in \{0, \ldots, 6\}$ chooses a contribution level $c_i \in \{0, \ldots, 9\}$. Subject i's payoff function is as follows:

$$\pi_i(c_i, c_{-i}) = 1.25\, Min\{c_i, c_{-i}\} - 0.25c_i,$$

where c_{-i} is the minimum contribution of subject i's team members. The strategy profiles $(c^*)_{i \in I}$ where all players choose the same contribution level are the pure strategy Nash equilibria. These Nash equilibria are Pareto ranked: the highest contribution equilibrium is the most efficient, and thus is the most desirable outcome. This outcome, however, may not be achieved in this game due to coordination failure.[3] Table 1 shows the payoff structure of the game, where subject's earnings depend only on the smallest contribution level.

2.2 The linear public good game

A team of six subjects undertakes a linear public good game. Each subject $i \in \{0, \ldots, 6\}$ chooses a contribution level $c_i \in \{0, \ldots, 9\}$. Subject i's payoff function is:

$$\pi_i(c_i, c_{-i}) = 1.25 \frac{\sum_{i=1}^{6} c_i}{6} - 0.25c_i,$$

where c_{-i}. denotes the contribution of subject i's team members. The Nash equilibrium of this game is the strategy profile $(c^*)_{i \in I}$ where all players choose their dominant strategy, which is to free-ride. In equilibrium, efficient cooperation cannot be achieved as a result of the incentive to free ride. Table 1 again illustrates the game, where payoffs depend on own contributions as well as the average contributions of others.[4]

[3] Van Huyck et al. (1990) provide experimental evidence on coordination games with multiple, Pareto-ranked equilibria.

[4] Note that this game has a marginal per capita return of 5/6, which is rather large compared with most of the literature. The closest that we are aware of is Isaac and Walker (1988), where a MPCR of 0.75 produces contributions of about 60 % of endowment in the first round, deteriorating to about 25 % after ten rounds.

Table 1 Games

Weakest Link Game: Payoffs

		Smallest Contribution Level									
Your Contribution		**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
	9	**9.00**	7.75	6.50	5.25	4.00	2.75	1.50	0.25	-1.00	-2.25
	8		**8.00**	6.75	5.50	4.25	3.00	1.75	0.50	-0.75	-2.00
	7			**7.00**	5.75	4.50	3.25	2.00	0.75	-0.50	-1.75
	6				**6.00**	4.75	3.50	2.25	1.00	-0.25	-1.50
	5					**5.00**	3.75	2.50	1.25	0.00	-1.25
	4						**4.00**	2.75	1.50	0.25	-1.00
	3							**3.00**	1.75	0.50	-0.75
	2								**2.00**	0.75	-0.50
	1									**1.00**	-0.25
	0										**0.00**

Linear Public Good Game: Payoffs

		Average Contribution Level									
Your Contribution		**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
	9	**9.00**	7.75	6.50	5.25	4.00	2.75	1.50	0.25	-1.00	-2.25
	8		**8.00**	6.75	5.50	4.25	3.00	1.75	0.50	-0.75	-2.00
	7		8.25	**7.00**	5.75	4.50	3.25	2.00	0.75	-0.50	-1.75
	6		8.50	7.25	**6.00**	4.75	3.50	2.25	1.00	-0.25	-1.50
	5		8.75	7.50	6.25	**5.00**	3.75	2.50	1.25	0.00	-1.25
	4		9.00	7.75	6.50	5.25	**4.00**	2.75	1.50	0.25	-1.00
	3			8.00	6.75	5.50	4.25	**3.00**	1.75	0.50	-0.75
	2			8.25	7.00	5.75	4.50	3.25	**2.00**	0.75	-0.50
	1			8.50	7.25	6.00	4.75	3.50	2.25	**1.00**	-0.25
	0			8.75	7.50	6.25	5.00	3.75	2.50	1.25	**0.00**

3 Experimental design and procedure

We consider three different treatments under which each game is played in order to test the impact of the two different leadership institutions, giving a 3 × 2 factorial design. In all games the subjects are randomly assigned to groups of six, and the game is repeated for 20 rounds in stable groups. For the leadership treatments, the leader is selected using scores on a set of ten trivia questions: the high-scoring person in the group is assigned to the leader position and subjects are aware of this (see Kumru and Vesterlund 2010 or Eckel et al. 2010 for similar procedures). This is to confer legitimacy on the leader. The leader is then described to the other players as "Player A".[5] In all games the payoff structure is common knowledge. A detailed

[5] All subjects are given private identity numbers and are seated separately in front of computer screens. Players' roles appear on their computer screens to preserve the anonymity of the leader.

comparison of the treatments can be found in the online Supplementary Material, Table B1. Full instructions are also available there.

3.1 The Baseline treatment

Subjects choose a contribution level simultaneously in private.

3.2 The Exemplar treatment

A subject is chosen based on a score on a set of ten trivia questions to be the Exemplar. The Exemplar leads by example by pre-committing to a contribution level. Other players observe this commitment and then make their contribution decisions simultaneously in private without being forced to conform to the Exemplar's commitment.

3.3 The Manager treatment

A subject is chosen based on a score on a set of ten trivia questions to be the Manager. The Manager makes suggestions to each of the team members privately. Other subjects observe their suggestion and then all subjects make their contributions simultaneously in private without being forced to commit to the Manager's suggestion.

A total of 480 subjects were recruited from the student populations at Virginia Tech (252 subjects) and University of Texas at Dallas (228 subjects) via email and posters. Subjects were paid a show up fee of $3 at Virginia Tech and $5 at UT Dallas, reflecting standard practices at the respective labs at the time the experiments were conducted.[6] There were 12 participants in each session, randomly grouped in two groups of six subjects. In total, there were 8 groups in each of the Baseline treatments, and 16 groups in each of the Exemplar and Manager treatments for the weakest link and linear public good games. Each subject was given a private identity number that was used to collect earnings at the end of the experiment. Subjects were seated separately at computers, and were instructed not to talk to each other during the experiment. After signing the consent forms, instructions were read aloud and subjects could follow them on their computer screens; the instruction phase included a comprehension test to make sure that subjects understood the game and the payoff structure.

Each session consisted of 20 rounds of a single treatment. At the end of each round, the lowest contribution (average contribution), level of production, and subjects' earnings were announced on individual computer screens in the weakest link (linear public good) game. Subjects then calculated their earnings and moved to the next round. At the end of each session subjects filled out a survey and then were paid in private using their codes. Subjects earned an average of $5.87 and $13.23 in

[6] For both games, half of the Exemplar and Manager sessions were conducted at each location. For the Weakest-link public good game, one-third of the baseline sessions were conducted at UTD and the rest at Virginia Tech. For the linear public good game, half of the baseline sessions were conducted in Virginia Tech and the other half at UTD.

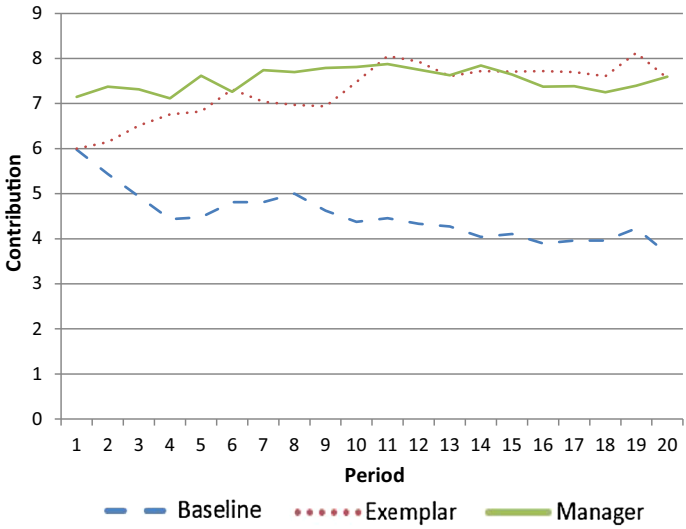

Fig. 1 Weakest link game—average contributions—all members

the Baseline treatment, \$13.83, and \$14.13 in the Exemplar treatment, and \$13.23 and \$14.05 in the Manager treatment for the weakest link and linear public good game respectively.

4 Empirical results: the weakest link game

Figure 1 shows the average contributions of the subjects over all 20 rounds in the weakest link game. Contribution levels (out of a possible 9), averaged over all rounds, are 4.49 in the Baseline treatment, 7.15 in the Exemplar treatment, and 7.53 in the Manager treatment. We conducted Mann–Whitney rank sum (henceforth MW) tests applied to group level data (there are 8 groups in the Baseline Treatment and 16 groups in the Manager and Exemplar treatments each). The test results show that, in both the Manager and the Exemplar treatments, contributions are significantly higher than in the Baseline ($p = 0.000$ and 0.002 respectively), but they are not significantly different from each other ($p = 0.82$).[7] In addition, in the first period, there is no significant difference between contributions in the Exemplar treatment and the Baseline ($p = 0.95$). The Manager treatment, however, produces marginally higher first-period contributions compared to the Baseline ($p = 0.07$).[8]

We further analyze the leadership treatments by investigating leaders and followers separately. For the leaders, the average contribution is 7.67 in the Exemplar treatment, and 7.47 in the Manager treatment; the difference is not

[7] Note all reported p-values are two-sided.

[8] We conduct regression analysis to investigate whether subjects' contributions differ across treatments. Our regression results are consistent with the MW rank sum tests and Fig. 1. Please see online Supplementary Material for details.

Table 2 Leaders' contributions

Leaders' contributions[a]	Weakest link game			Linear public good game		
	OLS	Tobit	RE GLS	OLS	Tobit	RE GLS
Constant	7.1631* (0.194)	7.1330* (0.227)	7.2940* (0.089)	7.1380* (0.263)	7.1031* (0.285)	7.0687* (0.235)
Period	0.0471* (0.010)	0.0472* (0.010)	0.0425* (0.012)	0.0028 (0.020)	0.0021 (0.022)	−0.0064* (0.020)
Manager	−0.1981 (0.935)	−0.1713 (0.963)	−0.2266 (0.915)	−0.2724^{+} (0.142)	−0.2695^{+} (0.145)	−0.1993 (0.445)
Above min/ above ave[b]	0.0143 (0.100)	0.0140 (0.102)	−0.0481 (0.0459)	0.3452* (0.063)	0.3559* (0.068)	0.0787* (0.002)
R^2	0.01		0.01	0.10		0.08
Pseudo R^2		0.003			0.02	
Observations	639	639	639	639	639	639
Uncensored observations		624			610	

The numbers in parentheses show the standard errors of the estimated coefficients. Standard errors are clustered at the group level

* Significant at 5 %; $^{+}$ significant at 10 %

[a] Variables: period = number of rounds from 1 to 20; Manager = 1 if the treatment is Manager and 0 otherwise; above min = the difference between a subject's contribution and the minimum contribution in the previous period; above ave = the difference between a subject's contribution and the average contribution in the previous period; leaders' initiative = leaders' contribution for the Exemplar treatment and leader's suggestion for the Manager treatment

[b] Variable "above min" applies to the weakest link and "above ave" applies to the linear public good game

statistically significant (MW rank sum test, $p = 0.99$). In the first period leaders' contributions are not significantly higher in the Manager treatment compared to the Exemplar treatment either ($p = 0.13$). We conduct OLS, Random effects GLS, and Tobit regressions to investigate whether leaders' contributions differ across leadership treatments.[9] Standard errors in all regressions are clustered at the group level to control for the potential dependency of decisions within groups. The results are reported in the first panel of Table 2. Our results suggest that leaders' contributions show a slight increase over time. When leader contributions are above the group minimum, leaders do not respond by lowering their own contributions: this implies that leaders do make an effort to show leadership.

For the followers, the average contribution is 7.21 in the Exemplar treatment, and 7.50 in the Manager treatment; these are not significantly different from each other (MW rank sum test, $p = 0.83$), nor from the leader contributions. In the first period, however, the Manager treatment produces marginally more contributions compared

[9] We first conducted random effects censored panel regressions using STATA routine "xttobit" but we were unable to get an estimation due to a non-concave log-likelihood function. As an alternative we conducted Tobit together with random effect GLS regressions to see how different the estimated results are.

to the Exemplar treatment ($p = 0.09$). This is possibly due to the fact that, in the first period, the average contribution level of leaders observed by the followers in the Exemplar treatment (6.60) is significantly smaller than leaders' average suggested contribution levels in the Manager treatment (8.00).

We again conduct OLS, Random effect GLS, and Tobit regressions to investigate whether followers' contributions differ across leadership treatments. Standard errors in all regressions are clustered at the group level to control for the potential dependency of decisions within groups. The results are presented in the first panel of Table 3. In one of the three regressions, the Manager treatment seems slightly more effective (compared to the Exemplar treatment), but the pattern is not consistent across specifications. Followers' contributions show slight decrease over time. Followers reduce their contributions when they find themselves above the group minimum, and leaders' initiatives positively affect followers' contributions. In one of the three regressions, leaders' initiatives in the Manager treatment seem slightly

Table 3 Followers' contribution

Follower' contributions[a]	Weakest link game			Linear public good game		
	OLS	Tobit	RE GLS	OLS	Tobit	RE GLS
Constant	0.9644^{+} (0.541)	0.4084* (0.139)	1.3630* (0.605)	2.8251* (0.086)	2.5515* (0.452)	3.6993* (0.621)
Period	−0.0250* (0.008)	−0.0280* (0.004)	−0.0107* (0.002)	−0.0283 (0.018)	−0.0318 (0.021)	−0.0298 (0.012)
Manager	0.0365 (0.090)	0.5939* (0.214)	0.1345 (0.649)	−1.4706* (0.105)	−1.8568* (0.052)	−1.2149 (0.008)
Leader's initiative	0.8888* (0.067)	0.9585* (0.017)	0.8006* (0.095)	0.5253* (0.005)	0.5550* (0.030)	0.4010* (0.064)
Manager*leader's initiative	0.0062 (0.011)	−0.0602* (0.026)	−0.0048 (0.073)	0.1825* (0.001)	0.2301* (0.052)	0.1450 (0.149)
Above min/above ave[b]	−0.3470* (0.079)	−0.3463* (0.014)	−0.2059* (0.026)	−0.0074 (0.014)	0.0068 (0.016)	0.0054 (0.005)
R^2	0.67		0.67	0.16		0.16
Pseudo R^2		0.24			0.03	
Observations	3159	3159	3159	3200	3200	3200
Uncensored observations		3074			2956	

The numbers in parentheses show the standard errors of the estimated coefficients. Standard errors are clustered at the group level

* Significant at 5 %; $^{+}$ significant at 10 %

[a] Variables: period = number of rounds from 1 to 20; Manager = 1 if the treatment is Manager and 0 otherwise; above min = the difference between a subject's contribution and the minimum contribution in the previous period; above ave = the difference between a subject's contribution and the average contribution in the previous period; leaders' initiative = leaders' contribution for the Exemplar treatment and leader's suggestion for the Manager treatment

[b] Variable "above min" applies to the weakest link and "above ave" applies to the linear public good game

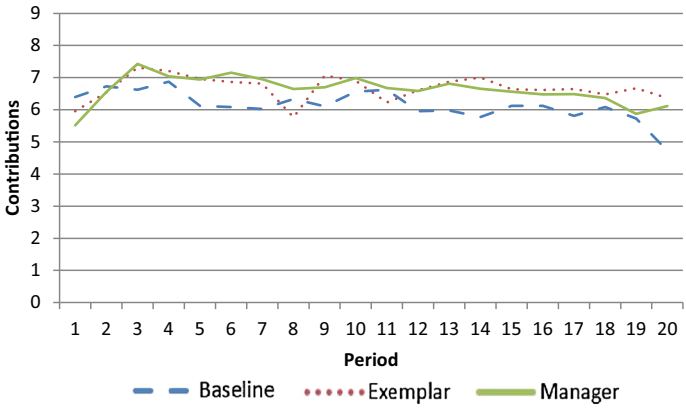

Fig. 2 Linear public good game—average contributions—all members

less effective than those in the Exemplar treatment. Controlling for socio-economic characteristic did not significantly change our results in any of our regressions.[10]

5 Empirical results: the linear public good game

Figure 2 shows the average contribution levels of the subjects over all 20 rounds in the linear public good game. Averaging across all rounds, the average contributions are 6.14 in the Baseline treatment, 6.67 in the Exemplar treatment, and 6.63 in the Manager treatment. The MW test results show no significant difference across treatments ($p > 0.40$ in all comparisons).[11]

We further analyze the leadership treatments by investigating leaders and followers separately. The leaders' average contribution is 7.74 in the Exemplar treatment, and 6.80 in the Manager treatment. The average contribution levels in the Manager and the Exemplar treatments are not significantly different from each other overall ($p = 0.13$). We conduct OLS, Random effect GLS, and Tobit regressions to investigate whether followers' contributions differ across leadership treatments. Standard errors in all regressions are clustered at the group level to control for the potential dependency of decisions within groups. The results are presented in the second panel of Table 2. Our results show no significant difference between leaders' contributions between treatments. Our results also show that a leader's contribution above average in the previous period does not discourage leaders from contributing in each round.

[10] Socio-economic variables include subjects' gender, race, marital status, relative income, academic major, GPA, number of econ classes attended, number of siblings, and frequency of attending religious services.

[11] We conduct regressions to investigate whether subjects' contributions differ across treatments. Our regression results are consistent with the MW rank sum tests and Fig. 2. Results can be found in the online Supplementary Material.

For the followers, the average contribution is 6.35 in the Exemplar treatment, and 6.59 in the Manager treatment. The average contribution levels in the Manager and the Exemplar treatments are not significantly different from each other according to MW rank sum test ($p = 0.69$). While in the weakest link game we saw no significant difference between the contribution of the leaders and those of the followers in either leadership treatment, in the linear public good game, leaders' contributions are significantly larger than those of the followers in the Exemplar treatment (MW two-tailed p value $= 0.009$). This indicates that, in the Exemplar treatment, followers effectively free ride on leaders' commitment. This difference is not observed in the Manager treatment.

We again conduct OLS, Random effect GLS, and Tobit regressions to investigate whether followers' contributions differ across leadership treatments. Standard errors in all regressions are clustered at the group level to control for the potential dependency of decisions within groups. The results are presented in the second panel of Table 3.

Contributions above the average in previous periods do not seem discouraging to followers (unlike in the weakest link game). Leaders' initiatives positively affect followers' contributions. The effect of the Manager treatment is a lower main effect (indicated by the negative, significant coefficient on Manager), but the coefficients on the manager's suggestion are positive and attain significance in two of the three regressions. Since these offset each other, the overall effect indicated by the aggregate statistics is insignificantly different from the Exemplar treatment.

6 Summary and conclusion

In the weakest link public good game, leadership of either type substantially improves coordination, consistent with earlier studies showing the power of leadership—or indeed most other types of communication—to solve the coordination problem. Leaders' initiatives, whether cheap talk or commitment, have a positive effect on followers' contributions. We not only provide strong evidence of conditional cooperation in the weakest link game, but also show that our leadership institutions overall do induce more cooperation compared to the Baseline treatment. We also see that the Manager treatment is slightly more effective at the outset; leading by suggestion seems more effective than leading by example in the first round of the game. As subjects continue playing, however, cheap talk loses its advantage over leading by example, making both institutions equally effective.

In contrast, in the linear public goods game, introducing leadership institutions does not induce more cooperation compared to the baseline. However, our results do provide some evidence that leaders matter. We see that followers' contributions increase in the leaders' choice, whether it is cheap talk or actual commitment, a result that supports the idea that subjects are conditional cooperators, but overall contributions do not increase with leadership.[12] The lack of effectiveness of leadership institutions may be due to the

[12] Many studies illustrate conditional cooperation; see for example: Keser and Van Winden (2000), Fischbacher et al. (2001) and Frey and Meier (2003). Croson (2007) discusses the tendency for subjects to "match" others' contributions.

high MPCR resulting from the setup of the game (which was designed to maintain a parallel payoff structure with the coordination game). Indeed, it is well known that a high MPCR increases donations (Isaac and Walker 1988).[13] With contributions starting at about 7 out of 9 in the first five rounds, there is little scope for leadership—especially leading by suggestion—to have an impact on contributions. A similar result is found in Eckel et al. (2014), who replicate four classic public goods experiments and find, in a population with initially quite high levels of cooperation, treatment effects that are consistently smaller than in the original studies.

The results for the weakest link game replicate earlier findings of the general effectiveness of leadership in achieving greater efficiency in a coordination game. For example, a number of authors have shown the power of even cheap talk leadership to solve simple 2×2 coordination games (e.g., Wilson and Rhodes 1997; Charness 2000; Duffy and Feltovich 2002).[14] In addition, in Van Huyck et al. (1992) the experimenter essentially plays the role of leader. Their subjects were given a public, nonbinding suggestion about which equilibrium to play in a multi-equilibrium coordination game, and this led to very high levels of coordination. Our study is consistent with these previous findings: we show that two leadership institutions, leading-by-example and leading-by-suggestion, both solve the coordination problem in the weakest-link game.

While the results in the linear public good game paint a less optimistic picture of the potential effectiveness of leadership, the results are not inconsistent with some earlier work. Several recent papers show that giving responds positively to an example set by a leader (Arbak and Villeval 2013; Gächter et al. 2012; Moxnes and Van Der Heijden 2003) others find weak or no significant difference (Potters et al. 2007; Guth et al. 2007). Similarly, the evidence on the effectiveness of cheap talk leadership in public goods settings is mixed. Levy et al. (2011) show that a leader's suggestion has a positive effect on contributions when the leader is a person, but not when it is a computer, suggesting that the commitment implicit in a cheap-talk suggestion has meaning for followers. However, Wilson and Sell (1997) find that cheap-talk communication weakens cooperation. Effective leadership may depend on the characteristics of the leader himself, as suggested by Gächter et al. (2012), who show that more optimistic, cooperative individuals make better leaders, or Eckel et al. (2010) who explore differences in the social status of leaders.

This research has a clear implication that the characteristics of the setting are more important than the leadership institution in determining the effectiveness of introducing leadership. In particular, leadership works better when coordination is required for high productivity than when self-sacrifice is required. Both types of leadership are effective in the former, but the results are mixed for the linear public goods setting and may depend on the precise characteristics of the selection mode and of the leader herself. More research is needed to fully understand the determinants of effective leadership.

[13] However, it is rare for a 20-round game to show so little deterioration in contributions, even with a high MPCR. We can only speculate about the cause, but it may have something to do with the way in which the instructions highlight the symmetric-strategy outcomes.

[14] See Crawford (1998) for a survey of cheap-talk communication in experimental games. There are far too many papers exploring various forms of communication in coordination games to cite herein.

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