

An Experimental Investigation of Electoral Delegation and the Provision of Public Goods

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How effectively do democratic institutions provide public goods? Despite the incentives an elected leader has to free ride or impose majority tyranny, our experiment demonstrates that electoral delegation results in full provision of the public good. Analysis of the experimental data suggests that the result is primarily due to electoral selection: groups elect prosocial leaders and replace those who do not implement full contribution outcomes. However, we also observe outcomes in which a minimum winning coalition exploits the contributions of the remaining players. A second experiment demonstrates that when electoral delegation must be endogenously implemented, individuals voluntarily cede authority to an elected agent only when preplay communication is permitted. Our combined results demonstrate that democratic delegation helps groups overcome the free-rider problem and generally leads to outcomes that are often both efficient and equitable.

Social scientists have long recognized individuals' strong incentives to "free ride" on the contributions of others when public goods are provided through decentralized, voluntary institutions (Dawes 1980; Hardin 1968; Lindahl 1919; Olson 1965; Samuelson 1954). As a result of such individual incentives, society will tend to underproduce public goods and will sometimes even fail to produce them at all.

A classic justification for the role and legitimacy of the state is that citizens cede or delegate decision making to a centralized authority, which solves the free-rider problem by using its coercive power—this is Hobbes' Leviathan. Indeed, governments provide a variety of public goods ranging from security (national defense, antiterrorism, police services), to public spaces (libraries and parks), to infrastructure (roads and highways). However, in contrast

to Hobbes' ideal vision of an absolute sovereign, decision makers in modern democratic governments wield their power temporarily, subject to popular approval, and regular elections give citizens the opportunity to select new leaders.

We explore the extent to which delegation through repeated elections can solve the free-rider problem by conducting two laboratory experiments that investigate the effects of delegation and elections on the provision of public goods. Our first experiment contrasts a *decentralized* institution in which individuals independently decide how much to contribute to the public good over several rounds (the canonical "voluntary contribution mechanism") with an *electoral delegation* institution in which in every round a group selects one of its members to make allocation decisions on every individual's behalf.

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In our second experiment, membership in the electoral institution is *endogenous*, which introduces a second-order free-rider problem.

Our design captures two essential features of modern delegated democracies.¹ First, once elected, a government official is not bound to take any particular action or choose any particular policy. Thus, there is the possibility that an official may act opportunistically for his or her own personal gain at the expense of the public at large. Second, an official's power is held only temporarily and continues only if the public collectively chooses to reelect the official. Although repeated elections may sometimes provide sufficient incentives for officials to act in the public interest rather than in their own private interest (Barro 1973; Ferejohn 1986), there are also strong incentives for majority tyranny—for the official to exploit a minority of the group for the benefit of a minimum winning coalition (Bueno de Mesquita et al. 2003; Riker 1962). Our work therefore bridges two disparate research literatures on collective action and democratic accountability.

The parameters of our experiment ensure that we observe significant levels of free riding under decentralization and that the incentive to free ride persists under electoral delegation. However, the latter institution surprisingly yields outcomes very close to the socially optimal level of the public good. Groups in our experiment typically achieve the socially optimal outcome under delegation by identifying the most “socially oriented” individuals (who voluntarily contribute the most when delegation is not possible) and granting them the power to determine collective outcomes. When allocators attempt to exploit their position by forcing others to contribute fully while contributing nothing themselves (consistent with a pure dictatorship outcome as in the unique equilibrium of the one-period game), they are almost always removed from office in the next period. Thus, elections help to produce socially desirable outcomes primarily through the selection of prosocial allocators, and the removal of those who attempt to exploit their power. However, we also observe instances of majority tyranny, so electoral delegation may yield potential social costs as well as benefits.

In our second experiment, we turn to the question of whether individuals will voluntarily cede the right to make individual decisions, allowing the degree of centralization to arise endogenously. This is an important

¹We use the term “delegated democracy” to include both delegation to a single individual or executive as well as to a legislative body in order to distinguish it from “representative democracy,” which typically refers to the latter. In contrast, a “direct democracy” involves citizens proposing and voting directly on proposals and does not involve any form of delegation.

question because the voluntary decision to submit to a centralized political institution presents a second-order free-rider problem. We introduce *endogenous delegation* in which subjects first choose to opt in or opt out of centralized decision making in each period.² We find that when subjects cannot communicate prior to making decisions in the endogenous delegation institution, few agree to delegate and contributions converge to zero just as in decentralization. However, when preplay discussion is possible, half of the groups voluntarily opt for the delegation institution and sustain outcomes close to full efficiency. Communication appears to work in conjunction with endogenous delegation because it provides a means for coordination and fosters trust, which encourages individuals to cede the right to make independent decisions to an elected allocator. While we also find that communication yields higher levels of initial contributions under decentralization, it is not nearly as effective at producing or sustaining full contributions as when electoral delegation is possible.

Related Literature

There is a vast experimental literature on collective action, including the provision of public goods and closely related problems of social dilemmas and common pool resources, throughout the social sciences (e.g., Andreoni 1988; Dawes et al. 1986; Fehr and Gächter 2000; Ostrom, Walker, and Gardner 1992).³ Much of this literature is focused on understanding why collective action emerges in decentralized environments as well as why punishment is used to enforce cooperation, as neither behavior should be observed when individuals are rational and egoistic (Ostrom 1998, 2000).

Our focus is different. We are interested in the effects of democratic institutions and decision making and in the effects of electoral delegation in particular. Very few public goods experiments involve either voting or delegation, and none directly investigate the dynamics of electoral delegation in a group setting. Walker et al. (2000) and Kroll, Cherry, and Shogren (2007) find that direct democracy increases public good provision

²See Kosfeld, Okada, and Riedl (2009) and Guillen, Schwieren, and Staffiero (2006) for other examples of endogenous institution formation, but in the context of a sanctioning institution rather than an electoral institution. Dal Bó, Foster, and Putterman (2010) show that cooperation is higher in an endogenously chosen coordination game than when the game is exogenously imposed.

³See Ledyard (1995), Chaudhuri (2010), and Gächter and Herrmann (2009) for reviews.

relative to voluntary contributions, but their experiments involve collective choices about outcomes, so there is no principal-agent problem or problem of accountability. In contrast, electoral delegation involves concentrating power into the hands of one individual, where the only collective choice is to select the decision maker, who then possesses full discretion over collective outcomes.

More closely related are experiments by social psychologists Messick and Samuelson (Messick et al. 1983; Samuelson et al. 1984; Samuelson and Messick 1986), who find that individuals will sometimes voluntarily cede control of decision making to a centralized authority and that “leaders” exploit their position by taking more of the resource than they designate for other members of the “group” to use. But because their subjects never actually interact with each other, or participate in repeated electoral competition, their experiment is silent with respect to social interaction and to group dynamics that are critical to democratic accountability.

Other related experiments with leaders find that leadership by example can reduce free riding (Guth et al. 2007; Levati, Sutter, and van der Heijden 2007). An experiment by van der Heijden, Potters, and Sefton (2009) finds that a strong leader who can reallocate benefits in a team production game also reduces free riding. Our design also involves a strong leader whose decision is unilateral and binding on the entire group, but differs in that the leader is selected by the group and power is temporary.

Our study is also related to the literature on electoral accountability. An unresolved question in this area concerns the conditions under which electoral selection (Ashworth and Bueno de Mesquita 2008; Fearon 1999; Gordon, Huber, and Landa 2007) or electoral sanctioning (Ferejohn 1986) influences policy outcomes. Some evidence suggests that both mechanisms are important (Alt, Bueno de Mesquita, and Rose 2007), but other studies suggest that voters have strong tendencies for sanctioning and retrospective voting (Achen and Bartels 2004; Landa 2010; Wolfers 2002; Woon 2010).

There is also related empirical work at the intersection of democracy, institutions, and public goods that shows how leadership selection and sanctioning can have beneficial effects (Chattopadhyay and Duflo 2004; Deacon 2009; Lake and Baum 2001; Tsai 2007), but democratic institutions may not be very effective or may lead to majority tyranny in the presence of ethnic heterogeneity (Alesina, Baqir, and Easterly 1999; Habyarimana et al. 2007). Our work informs both empirical and theoretical scholarship by establishing a benchmark, using controlled laboratory experiments, regarding the effectiveness of electoral delegation.

Experiment 1: Voting and Delegation

Our first experiment involves a direct comparison of decentralized voluntary contributions with centralized decisions via electoral delegation. Electoral delegation introduces both an election stage and a centralized process for making collective allocation decisions. Since comparisons between electoral delegation and other common institutions are likely to involve varying the rules of the game along more than one dimension, we view the direct comparison to voluntary contributions as appropriate for several reasons. First, the voluntary contributions mechanism is the canonical decentralized institution in the public goods literature, so using this as a baseline allows us to compare the political institution of interest, electoral delegation, with one with well-known properties. Second, using the voluntary contributions mechanism as a baseline allows us to ensure that our parameterization and design provide strong incentives to free ride. Third, decentralized decision making is generally more prevalent in the real world compared to other possible comparison institutions such as direct democracy. Fourth, and most importantly, using voluntary contributions as the baseline enables us to hold constant important aspects of the individual choice problem facing both an individual contributor and an allocator. In particular, the individual incentive to free ride is identical, in monetary terms, across our treatments. Moreover, an allocator under electoral delegation and an individual contributor under voluntary contributions both possess complete liberty to make a decision that is not subject to approval by others (i.e., in both institutions it is individual rather than collective choice, and with identical incentives to free ride). Therefore, while comparisons between electoral delegation and other alternative institutions may be interesting, we view the comparison to decentralized voluntary contributions as an appropriate first step in its evaluation.

We also include, for each institution, communication conditions in which individuals can engage in preplay messaging at the beginning of each period, resulting in a 2×2 factorial design. We include the communication treatments for two reasons. First, we are interested in comparing the extent to which communication can enhance efficiency under voluntary contributions and under delegation. Second, the communication treatment also provides us with insight into how players make their decisions in the voting stage of the delegation treatment. For example, if we were to observe the majority tyranny outcome, the transcripts of the preplay communication might allow us to directly observe the coalition formation.

Experimental Design and Procedures

In every session, we randomly divided subjects into two groups with nine members ($n = 9$), which remained fixed throughout the experiment.⁴ Subjects were informed that the experiment was divided into two parts and that each part consisted of a series of periods. Each period in both parts of the experiment involved a linear public goods production framework. Each individual is endowed with $w = 100$ “tokens” to be divided between spending on a private good and contributions to a public good. Letting x_i denote individual i ’s allocation to the public good (subject to the restriction that $0 \leq x_i \leq w$ for all i) so that the amount $w - x_i$ is allocated to the private good, individual i ’s payoff in the period is $(w - x_i) + \frac{k}{n} \sum_{j=1}^n x_j$, where k is the marginal benefit from the public good and k/n is the *marginal per capita return* (MPCR). We set $k = 1.35$ so that the MPCR is 0.15.

Part 1 of the experiment was identical across all treatment conditions and consisted of five periods of a voluntary contributions game in which subjects simultaneously choose their individual contributions x_i . The instructions were context free and did not make any reference to “public” or “private” goods but instead to “Account A” (the private good) and “Account B” (the public good). After every period, each subject observed the results of that period, including the individual allocations made by each group member, the total amount contributed to the public good, and the subject’s own earnings from the period. Playing Part 1 allowed subjects to become familiar with the structure of payoffs and to experience the free-rider problem. It also allows us to obtain a measure of each subject’s prosocial orientation in terms of his or her willingness to contribute to the public good in a decentralized environment. Subjects also knew that there would be a Part 2, but received no information about it prior to completing Part 1. We did this to ensure that play in Part 1 would not be strategically biased by expectations about the future, thus giving us a cleaner measure of prosocial behavior.⁵

When Part 1 concluded, subjects received instructions for Part 2, which varied according to the institutional features of the treatment conditions. In every condition, however, subjects were informed that they would be playing at least 15 additional periods and that after the

15th additional period (20th overall) and any subsequent period there would be a 75% chance of continuing for another period. We used an indefinite horizon to prevent possible “endgame” effects.

In the baseline control condition (*voluntary contributions without communication*), subjects continued to play the same game as in Part 1. We conducted this treatment to serve as a comparison with the other institutions and to test whether the “restart” after the 5th period might substantively affect the results.⁶

In the *delegation without communication* treatment, each group selects an “allocator” at the beginning of every period. The allocator is granted complete, unilateral authority to choose a vector of contributions—that is, the allocator separately chooses an individual amount x_i for each of the n members of the group—and the allocator’s decision is binding and not subject to review by the rest of the group. Thus, the power to choose allocations to the public good is concentrated *temporarily* in a single individual. The allocator is selected by plurality rule with ties broken randomly, and subjects were informed about each member’s average voluntary contribution in Part 1 when voting. After the allocator’s decision, group members observed the allocation vector before continuing to the next period.

Two additional treatments allowed subjects the opportunity to communicate prior to every period in Part 2. In the *voluntary contributions with communication* treatment, subjects participated in up to 90 seconds of electronic written communication prior to making voluntary contribution decisions in each period. The method of communication was through an electronic “chat” program. The *delegation with communication* treatment added a similar preplay chat feature to the delegation institution. That is, prior to voting in each period, subjects participated in up to 90 seconds of electronic written communication with the same rules as above.

Our experiments were conducted at the Pittsburgh Experimental Economics Laboratory. Subjects interacted anonymously through networked computers using an application written with the software *z-tree* (Fischbacher 2007). Subjects were primarily undergraduate and graduate students at the University of Pittsburgh and Carnegie Mellon University and were recruited through an e-mail list. Total earnings were converted to cash at the rate of \$1 for every 200 tokens. In addition, each subject received a \$5 show-up fee. The experiment did not involve any kind of deception.

⁴Having two groups helps preserve subject anonymity, as no subject knew who was in his or her group.

⁵In other words, not knowing the details of Part 2 ensures that beliefs remain the same across treatments. The design involving the introduction of an institutional variation *after* playing a standard public goods or common pool resource game has been used in previous experiments (e.g., Ostrom, Walker, and Gardner 1992).

⁶The indefinite horizon also ensures that if we observe significant free riding, we can be confident that it is due to the payoff structure (i.e., low MPCR) rather than due to the finite horizon (which would make free riding more likely).

Theoretical Expectations

Classic rational choice theory does not make sharp predictions in our framework because our decision setting involves repetition between members of the same group and an indefinite horizon. Thus, a folk theorem argument implies the existence of a multiplicity of equilibria in which each member receives at least the minmax payoff.

Under voluntary contributions, the minmax payoff is w (100 tokens or \$0.50), which results from the unique Nash equilibrium outcome of the stage game in which no one contributes to the public good—that is, complete free riding. However, full contributions—which are socially optimal in terms of aggregate welfare—are also possible as an equilibrium outcome of the repeated game (which yields 135 tokens or \$0.68). Of course, when everyone else contributes there is still a strong incentive to free ride (which yields 220 tokens or \$1.10), and there is a similarly strong incentive against being the lone contributor (which yields 15 tokens or \$0.08). Previous studies of voluntary contributions involving repetition generally find that contributions start between 40 and 60% of the endowment and converge toward the zero-contribution Nash equilibrium (e.g., Andreoni 1988; Fehr and Gächter 2000; Fischbacher and Gächter 2010; Isaac, McCue, and Plott 1985; Isaac, Walker, and Thomas 1984; Neugebauer et al. 2009), with the initial level and rate of convergence depending on the MPCR.⁷ Our MPCR is extremely low, so we therefore expect substantial free riding in both Part 1 and in the voluntary contribution without communication condition.

Under electoral delegation, the minmax payoff is the lone contributor's payoff, which is *worse* than the minmax payoff under voluntary contributions. It is obtained when i is fully exploited by the other members of the group: all other members vote for some allocator other than i and the allocator decides that only i contributes to the public good while allowing every other player to free ride off of i 's contribution.

We expect that three kinds of outcomes will be focal under electoral delegation. One such outcome is that individuals will play the subgame-perfect equilibrium (SPE) of the stage game in which all players vote for themselves and the randomly determined winner of the election makes all other members contribute their full endowment while contributing nothing herself (thus free

TABLE 1 Individual Stage Game Payoffs from Focal Outcomes

Outcome and Role	General Expression	Implemented Tokens
Full contributions— every member	kw	135
Voluntary stage game Nash—every member	w	100
Delegation stage game SPE—ex post allocator	$\left(1 + \frac{k(n-1)}{n}\right)w$	220
Delegation stage game SPE—ex post nonallocator	$\frac{k(n-1)}{n}w$	120
Delegation stage game SPE—ex ante	$\frac{1+k(n-1)}{n}w$	131.1
Majority tyranny—ex post majority	$\left(1 + \frac{k(n-1)}{2n}\right)w$	160
Majority tyranny—ex post minority	$\frac{k(n-1)}{2n}w$	60

riding). Ex post and ex ante payoffs for this and other focal outcomes are described in Table 1 (in terms of their general form and the exact number of tokens in our parameterization).

The second type of outcome we expect amounts to majority tyranny, based on classic concerns about democracy suggested by Plato, Aristotle, and Madison (and many others) as well as more recent theorizing concerning minimum winning coalitions (McKelvey, Ordeshook, and Winer 1978; Riker 1962). In this outcome, a simple majority of group members vote for the same allocator in the first stage, thus forming a winning coalition. The selected allocator then selects a contribution vector such that nonmembers are forced to contribute fully to the public good and the coalition members contribute nothing, effectively free riding off of the minority. Majority and minority payoffs are summarized in Table 1. Even if the excluded members are able to coordinate on a single candidate, they will be unable to obtain a plurality and change the first-stage election outcome. The marginal per capita return is low enough so that the coalition is stable: the same allocator will be elected in each period by members of the majority coalition, whose payoffs are higher than they would be under the socially optimal outcome.⁸

⁷Previous research finds that decreasing the MPCR leads to lower contribution rates (Isaac and Walker 1988b; Isaac, Walker, and Williams 1994). These studies find contribution rates of around 20% for MPCR values of 0.3 in repeated public goods games. Falkinger et al. (2000) also find low contributions in their control group for an MPCR of 0.4, whereas Carpenter (2007) finds somewhat higher contributions for an MPCR of 0.375.

⁸It is not necessary for members to elect the same allocator in every period as long as the majority coordinates their votes for the allocator, which allows for a variant in which members of the majority rotate in office.

Previous research with distinct but related institutions involving majority rule that also allow for distributional considerations suggests that some form of majority tyranny is not merely hypothetical but does, in fact, arise with substantial frequency in laboratory settings. Walker et al. (2000) find that minimum winning coalition allocations accounted for 42% of proposals adopted under direct democracy. Legislative bargaining experiments also find evidence that subjects both propose and accept benefits that accrue to a minimum winning coalition, often accounting for 60–70% of outcomes (Diermeier and Gailmard 2006; Diermeier and Morton 2005).⁹

The third type of outcome we expect involves the socially efficient outcome of full contributions ($x_i = w$ for all i). This occurs when the elected allocator ensures that the full amount of each member's endowment goes toward the public good. This outcome is consistent with evidence from experiments that individuals may be motivated by efficiency, equality, and social welfare rather than pure self-interest (Charness and Rabin 2002; Fehr and Schmidt 1999), although it is worth emphasizing that there is substantial inequality in the majority rule voting and legislative bargaining experiments we review above.

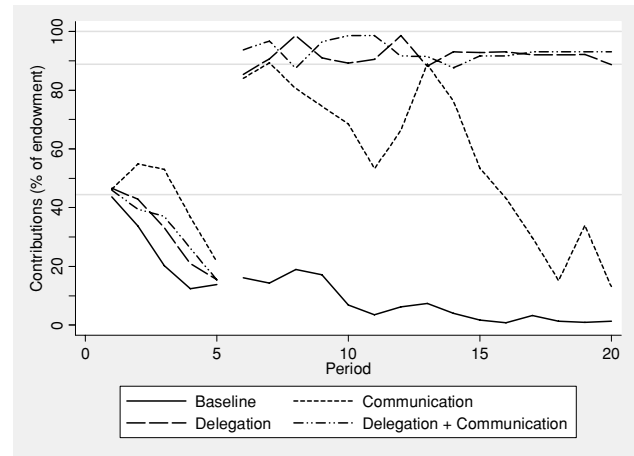
Regarding the effects of communication, since communication prior to voting or selecting contributions is “cheap talk,” it does not change the incentive structure of the game. Nevertheless, previous studies found that pre-play communication can increase the rate of voluntary contributions (e.g., Dawes, McTavish, and Shaklee 1977; Isaac and Walker 1988a), but such improvement does not always occur and can depend on characteristics of the public goods games such as payoffs and the mode of communication (Bochet, Page, and Putterman 2006; Brosig, Weimann, and Ockenfels 2003; Isaac and Walker 1988b; Wilson and Sell, 1997). We expect that communication might increase contributions, but because the specific payoffs we use in our experiment yield a low marginal per capita return from the public good, the strong incentives to free ride may outweigh any beneficial effects of communication. With electoral delegation, we expect that communication may make it easier to coordinate on a candidate in elections under the delegation institution or to coordinate on one of the focal outcomes, such as encouraging majority tyranny.

Results

We conducted 12 sessions involving 216 subjects, for a total of 24 groups. There were four groups in *voluntary*

⁹Frechette, Kagel, and Lehrer (2003) also find that play converges toward minimum winning coalitions over time.

FIGURE 1 Average Group Contributions to the Public Good in Experiment 1



contributions without communication, four groups in *voluntary contributions with communication*, eight groups in *delegation without communication*, and eight groups in *delegation with communication*. Each subject participated only once in the experiment.

Aggregate Outcomes and Allocations

Figure 1 presents the average group allocation to the public good over time by treatment.¹⁰ The results from the voluntary contributions game without communication in Part 1 of the experiment (periods 1–5) are consistent with findings in the literature. The average contribution in each condition began around 45% of the endowment and steadily declined to around 15% in period 5, with no substantive differences between conditions. The rate of decline appears to be somewhat faster than in previous studies, which suggests how strong the incentive to free ride is in our experiment.

In Part 2 of the baseline condition, where subjects continued to play the voluntary contributions game without communication as in Part 1, average contributions declined even further—to about 1%—by period 20, the last guaranteed period.¹¹ This gives us confidence that our parameter values provide strong incentives for free riding despite the possibility that greater cooperation is an equilibrium outcome.

¹⁰Figure 1 shows only the 20 guaranteed periods (5 from Part 1, 15 from Part 2) in order to show the average across periods while holding the groups constant.

¹¹It is interesting to note that we do not observe the “restart” effect found in other studies (e.g., Cookson 2000).

We find that both delegation and communication significantly increase public goods contributions to levels close to the social optimum, at least initially.¹² In period 6, average contributions in each (nonbaseline) treatment range from 84% to 93% of the endowment, and of the 20 groups in these three conditions 14 achieve the social optimum of full contributions.¹³ However, groups in the voluntary plus communication treatment cannot sustain the high level of contributions to the public good, as contributions fall to about 13% by period 20.¹⁴ In contrast, the high level of contributions to the public good is sustained throughout the guaranteed periods in both delegation treatments, with the treatment average always remaining above 85%.

To provide a clearer picture of outcomes in the delegation periods, we also determined whether each allocation vector was consistent with one of our three hypothesized focal outcomes. *Full contribution* vectors account for 72.8% of all delegation allocations. *Stage game* vectors where the allocator free rides off of the rest of the group (the allocator's contribution is 0 while the other players' contributions are each 100) account for 6.9% of all allocations. *Minimum winning coalition* vectors (the allocator assigns four group members to contribute 100 while five members, including him- or herself, contribute 0) account for only 3.4% of allocations.¹⁵

Group-Level Outcomes. Figure 2 shows the amount allocated to the public good over time by each group in Experiment 1. The results are striking. Under electoral delegation, two groups achieve socially optimal full contributions in *every* period (D1, DC2) and six more groups achieve it in all but one or two periods. Only one group with delegation (D2) fails to achieve the socially optimal

outcome at all. The delegation results stand in stark contrast to the voluntary contributions conditions. In the absence of communication, the social optimum is never achieved and with communication it is achieved in only a handful of periods.

In terms of the other hypothesized outcomes under electoral delegation, we observe that allocators in a majority of groups (10 out of 16) implement the stage game outcome at least once.¹⁶ For five of these groups, the stage game (SG) outcome is observed only once. But for the group that never achieves full contributions (D2), stage game vectors are the modal outcome (34.8%) and minimum winning coalition (MWC) vectors are the next most frequent (13%). Only one other group implements the minimum winning coalition vector: it is the modal outcome (42.1%) for the group that implements the fewest full contribution outcomes (DC1). Interestingly, Figure 2 shows that this group starts at or near full contributions in period 6 but then drops to the MWC amount in period 12. The chat transcript shows that the elected allocator explicitly proposes to tyrannize the minority by implementing the MWC allocation: "I HAVE AN IDEA. . . It would turn us against each other though. . . I have 5 ppl give 0. . . and 4 give 100 and screw them. . . hahaha. . . and I would always be leader because the vote is 5-4." Four other participants agreed to go along with the proposed plan, resulting in several periods of the precise majority-tyranny outcome that we hypothesized.¹⁷

Overall, it appears that electoral delegation generally yields a very high frequency of socially optimal outcomes. Even though the allocator has an incentive to force others to contribute while contributing nothing, similar to the free-riding incentive in the baseline, the stage game delegation outcome arises infrequently. However, in the two groups that least frequently obtain the socially optimal outcome (D2 and DC1), we observe regular occurrences of both the individually self-interested (SG) outcome and the majority tyranny (MWC) outcome.

Allocator Behavior, Selection, and Sanctioning. To better understand why most groups achieve the socially optimal outcome under delegation while some exhibit selfish behavior, we focus on the two mechanisms of electoral accountability emphasized in the literature: selection and sanctioning (e.g., Fearon 1999). More specifically, we investigate whether groups in the delegation treatments

¹²See the Supporting Information for statistical analysis of the data that support our interpretations.

¹³The Mann-Whitney statistic for the difference in contribution levels in period 6 between voluntary contributions and electoral delegation is $z = -2.60$ ($p = 0.01$).

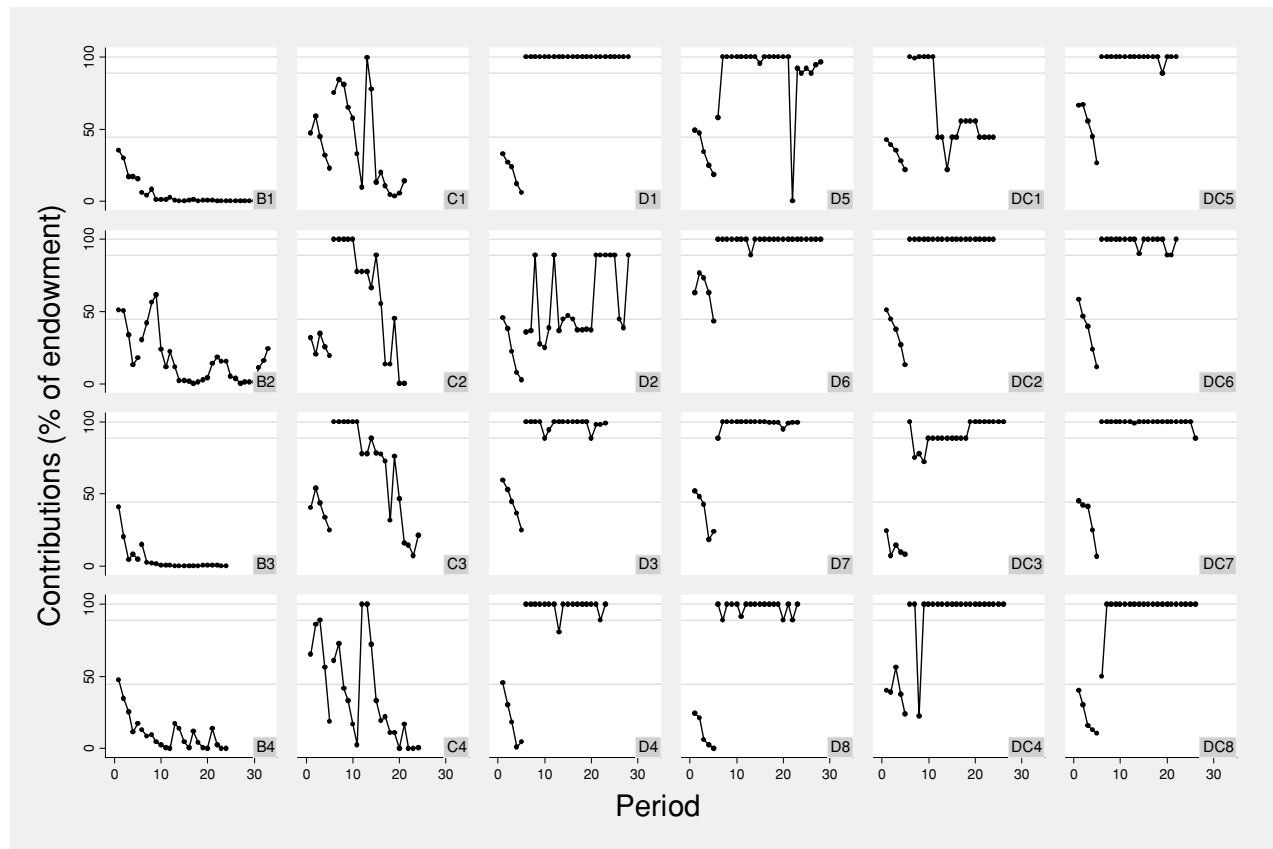
¹⁴This is somewhat surprising since Bochet, Page, and Putterman (2006) find that chat room communication can sustain cooperation. We attribute the failure of sustained cooperation to the strong free-riding incentives created by the low MPCR.

¹⁵Although there is no effect of communication on overall contributions in the delegation treatments (Mann-Whitney $z = -1.12$, $p = 0.26$), there are significantly more stage game vectors without communication ($\chi^2 = 6.40$, $p = 0.01$), which suggests that communication enhances the selection of allocators. Communication also appears to encourage the formation of minimum winning coalitions, but the difference is not statistically significant ($\chi^2 = 2.62$, $p = 0.11$). We suspect that the absence of a communication effect in the delegation treatments results from the high degree of contributions obtained even when communication is absent (i.e., in the delegation without communication condition).

¹⁶A detailed table of outcome classifications by group can be found in the Supporting Information.

¹⁷Interestingly, the coalition temporarily fell apart when the allocator, angered at not having received a vote of allegiance from one coalition member, attempted to punish this subject by forcing him or her to contribute.

FIGURE 2 Group Contributions to the Public Good over Time in Experiment 1



The label in each panel denotes treatment and group number (B: Baseline; C: Communication; D: Delegation; DC: Delegation + Communication)

“select good types” (allocators who choose full contributions) and if they fail to do so, whether they “sanction poor performance” by replacing poorly performing allocators with new ones.¹⁸

We divided group members into three types according to their average Part 1 voluntary contributions: highest-ranked contributors, lowest-ranked contributors, and everyone else.¹⁹ Table 2 characterizes the allocation vectors chosen by each type of allocator. The highest-ranked and middle-ranked contributors produced high levels of the public good (96.8% and 94.8% of the total endowment, respectively, with 78.4% and 84.6% being

full contribution vectors).²⁰ In contrast, lowest-ranked contributors provide the least of the public good, are the least likely to implement the socially optimal allocation, and are systematically more self-interested than other allocators (23.8% of their allocations are stage game vectors and 16.7% are minimum winning coalition vectors).²¹ Overall, the data suggest that selecting good types primarily means *avoiding* bad ones (i.e., the lowest Part 1 contributor).

In the first period of elections, most groups did in fact select good types (or avoided the bad ones). Consistent with the predicted stage game behavior, 42% of subjects voted for themselves. Of the remaining subjects, 48%

¹⁸Our claim regarding the presence of different types of allocators is similar to the literature explaining cooperation with the presence of heterogeneous motives, including “conditional cooperators” (Fischbacher, Gächter, and Fehr 2001; Herrmann and Thöni 2009; Kocher et al. 2008; Ostrom 1998, 2000).

¹⁹The exact number of subjects within each category may vary if there are ties for highest or lowest contributors. If the rank ordering of contributions is strict, then there is one high contributor, one low contributor, and seven middle-ranked contributors.

²⁰Mann-Whitney $z = 1.00$ ($p = 0.32$) for the difference in contributions between high and middle contributors’ allocations; Pearson’s $\chi^2 = 1.77$ ($p = 0.18$) for the proportion of full contribution vectors by allocator type (high and middle).

²¹The Mann-Whitney test statistic for the difference in contributions between middle and low contributors is -8.04 ($p < .01$). This difference remains if we also control for groups’ average Part 1 contribution levels, time trends, and allow for group random effects in a regression analysis (see the Supporting Information).

TABLE 2 Elected Allocator Decisions

	Allocator Part 1 Contribution Rank		
	Highest	Middle	Lowest
Contributions (% of endowment)			
Mean	96.8	94.8	69.8
S.D.	10.7	16.2	27.0
Allocation types (% of decisions)			
FULL	78.4	84.6	16.7
SG	2.0	6.9	23.8
MWC	0	3.1	16.7
N	148	130	42

Notes: Percentages are within column. The highest and lowest categories refer to individual subjects who gave the most or least in their group.

TABLE 3 Initial Allocator Selection

	Coeff. (Std. Err.)
High contributor in group	1.73** (0.61)
Low contributor in group	0.50 (0.47)
Part 1 average contribution	0.007 (0.007)
Low ID number	0.67 (0.56)
Constant	-2.13 (0.29)
Log pseudolikelihood	-33.71
N	144

*p < .05, **p < .01; probit estimates with clustered standard errors by group.

voted for the high contributor while 12% voted for the low contributor. This resulted in the election of the high contributor in 10 out of the 16 groups. Table 3 reports estimates from a probit model of electoral selection; the dependent variable is whether a particular subject was selected to be the allocator in the first period of Part 2. The statistical analysis shows that high contributors are significantly more likely to be elected than other group members. Electoral selection therefore appears to play an important part in the effectiveness of electoral delegation: groups delegated to high contributors and these allocators in turn overwhelmingly implemented full contributions.

The voting and election data, however, also suggest that electoral selection is imperfect. Table 3 also shows that low contributors are not any less likely to be selected as middle-ranked contributors. And it turns out that the two least successful groups at implementing full contributions (D2 and DC1) elected their low contributors.²²

Nevertheless, if a group is “unlucky” enough to select the low contributor, repeated elections provide a natural mechanism for rewarding good allocator behavior with reelection while sanctioning poor performance by “throwing the bums out.”²³ In all delegation groups, 93.3% of allocators who implement the full contribution vector are elected as the allocator in the next period. Of the allocators who implement minimum winning coalition vectors, 60% are elected in the next period, which suggests that the electoral coalition strategy works. But consistent with the use of repeated elections as a corrective device, allocators who implement the stage game vector are the least likely to be reelected. They are elected in only 30% of periods following the implementation of a stage game outcome.

Overall, despite occasional instances of selfish behavior and majority tyranny, the simple electoral institution in our experiment works to regularly achieve full contributions. This is primarily because it allows groups to both select good types (by avoiding low contributors) and to sanction poor performance (by replacing allocators who behave selfishly and without the support of a majority of their group).

Experiment 2: Endogenous Delegation

The results of Experiment 1 clearly show the social welfare maximizing effects of delegation. An important question is whether individuals and groups will voluntarily forego their ability to make their own choices in favor

²²These low contributors were possibly elected due to a ballot-order effect (electing the member with the lowest ID number, who always appeared at the top of the voting screen). We find evidence that subjects disproportionately voted for the lowest ID number (first on the ballot), but as Table 3 reveals, this was not enough to create a statistical relationship between low ID number and selection.

²³In theory, repeated elections might induce “good behavior” even by “bad types” if the allocator fears being punished by another allocator or being excluded from a majority coalition in future periods. Without conducting additional experiments, however, we cannot know the full extent to which allocators are influenced by such considerations. But the data suggest that future electoral considerations are insufficient to deter low contributors from selecting stage game outcomes.

of the electoral delegation institution. In Experiment 2, we allow group members to individually decide whether to make their own decision or cede their agency to an elected allocator by introducing an *endogenous delegation* condition. In each period, subjects decide whether to make individual contribution decisions or to participate in the delegation institution. An individual's access to the public good is unaffected by this choice; regardless of individuals' choices, they remain in the same group of nine for the entire experiment and receive payoffs from the public contributions of others. As in Experiment 1, we also explore the effects of communication and therefore also include an *endogenous delegation with communication* condition.

In Experiment 1, electoral delegation proved effective at overcoming the free-rider problem because it allows contribution decisions to be centrally made by socially oriented allocators. However, the endogenous decision to cede agency to such an institution creates a second-order free-rider problem: each individual player has a dominant strategy in the stage game to refuse to delegate and then to contribute nothing. Thus, we might expect public good provision under endogenous delegation that is as low as under voluntary contributions.

Experimental Design

As in Experiment 1, sessions consisted of two parts. In Part 1, each group played five periods of the public goods game with voluntary contributions. In Part 2, subjects participated in either the *endogenous delegation* treatment or the *endogenous delegation with communication* treatment (with 15 guaranteed periods and the subsequent 0.75 continuation probability as in Experiment 1). In sessions with communication, group members communicated using the same technology as in Experiment 1. We conducted three sessions (six groups) for each treatment.

At the beginning of a period in the endogenous delegation treatments, each subject decides whether to "opt in" or "opt out" of the delegation institution. By opting in, a subject voluntarily agrees to allow an elected allocator to make the contribution decision on his or her behalf, while opting out means that a subject will personally make his or her own allocation decision. If zero or only one group member opts in, the game is identical to the baseline voluntary contributions game (all subjects make their own contribution decisions), while if all group members opt in the game is identical to the delegation condition in Experiment 1 (members vote to select an allocator who makes all contribution decisions). In the intermediate cases, those who opt in to the centralized in-

stitution elect an allocator from amongst themselves and are bound by the allocator's decisions, while those who opt out of centralization make allocation decisions independently, as in the baseline. Regardless of how allocation decisions are made, the production of the public good and resulting payoffs are the same as in Experiment 1.

Results

We find that the effect of endogenous delegation depends on whether or not communication is allowed. Without communication, groups allocated only 11.4% of their endowments to the public good (with no full contribution vectors). Allowing communication prior to the "opt in" decision appears to have a positive effect: those groups allocated 60% of their endowments (with 42% full contribution vectors). Three groups sustain full contributions in a majority of periods, similar to the behavior of groups in the delegation conditions of Experiment 1.²⁴ In other groups, however, high levels of contributions are unsustainable, and the level of public goods collapses as in the decentralized voluntary contributions condition.

The regression analysis in Table 4, which compares contributions in the two treatments from Experiment 2 with the baseline and communication treatments from Experiment 1, supports these findings. The dependent variable in the analysis is the proportion of a group's endowment contributed to the public good in a period. Controlling for group-level heterogeneity (Part 1 contributions and random effects), we find that endogenous delegation alone has no significant effect on group-level allocations to the public good. However, the initial effect of endogenous delegation with communication is large and statistically significant and is statistically indistinguishable from the effect of communication on voluntary contributions. The rate of decline in contributions under endogenous delegation with communication, however, is slower (and statistically distinguishable) than the rate of decline with communication alone.

The data also suggest that communication sustains and encourages greater cooperation by encouraging group members to opt in to the delegation institution rather than through an effect of communication per se. The third column of Table 4 shows that the number of group members opting in is significantly related to the overall level of contributions to the public good and that including this variable also reduces the estimated direct effect of the endogenous delegation with communication

²⁴The Supporting Information presents group-by-group results for Experiment 2 similar to those in Figure 2.

TABLE 4 Public Good Provision in Endogenous Delegation Compared to Voluntary Contributions Baseline

	(1)	(2)	(3)
Communication	0.82** (0.16)	0.97** (0.13)	0.92** (0.12)
Endogenous	0.08 (0.14)	0.04 (0.10)	-0.14 (0.10)
Endogenous with communication	0.74** (0.14)	0.78** (0.10)	0.26* (0.11)
Period	-0.005* (0.002)	-0.005* (0.002)	-0.005* (0.002)
Communication × Period	-0.046** (0.005)	-0.046** (0.005)	-0.046** (0.004)
Endogenous × Period	-0.007 (0.004)	-0.007 (0.004)	0.001 (0.004)
Endogenous with communication × Period	-0.015** (0.004)	-0.015** (0.004)	-0.020** (0.004)
Part 1 average contribution		-0.85** (0.33)	-0.53 (0.31)
Percent of group opting in			0.77** (0.08)
Constant	0.12 (0.11)	0.33** (0.11)	0.25* (0.11)
σ_{μ}^2	0.21	0.14	0.14
σ_{ϵ}^2	0.17	0.17	0.16
R ² within	0.38	0.38	0.50
R ² between	0.74	0.81	0.86
R ² overall	0.64	0.68	0.76
Groups	20	20	20
N	370	370	370

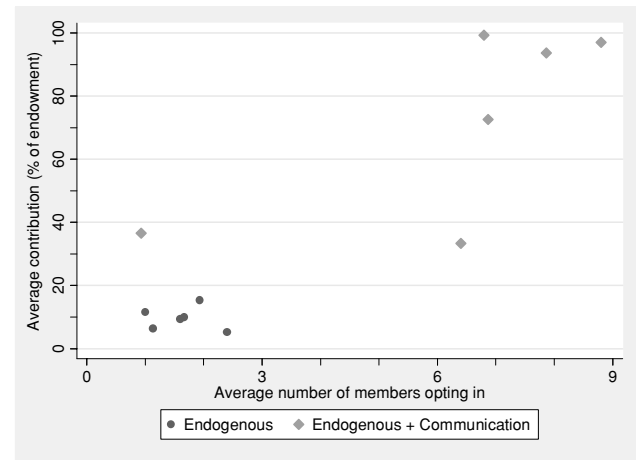
*p < .05, **p < .01; group-level random effects regression.

treatment.²⁵ Figure 3 provides further support by plotting the average endowment contributed to the public good for each group against the average number of members opting in during the guaranteed periods of Part 2. Those groups attaining the highest delegation rates achieve the highest contributions to the public good.

Examining the chat transcripts provides several insights about the way in which communication fosters delegation and high contributions. First, successful groups discuss and agree to use a contingent strategy along the lines of the “money back guarantee” in Dawes et al. (1986): if everyone opts in, the allocator should use every member’s full endowment for the public good, but if at least

²⁵Additional analysis suggests that subjects’ willingness to opt in also increases over time.

FIGURE 3 Group Opt-In and Contribution Levels in Experiment 2 (Periods 6–20)



one member opts out, the allocator should put nothing in the public good.²⁶ Indeed, after only five members of one group opted in, the allocator explicitly says, “Too many people quit. . . . I had to choose 0 for all of us.”

Second, even though communication is an important factor that contributes to delegation outcomes, successful groups only require a little bit of it, early on, in order to succeed. The number of lines of “relevant communication” (which we coded as messages involving payoffs, strategies, or behavior) is typically intense in early periods for groups that successfully provide the public good and then dies out once the group settles on the full contribution outcome. Conversely, in groups that fail to reach full allocations, relevant communication continues throughout the session as subjects struggle to convince others to opt in.

Third, groups appear to be successful when communication promotes group cohesion and discussions of collective, rather than individual, interest. When we coded whether messages are *individualistic* (involve the words “I,” “me,” or “mine”) or *collectivist* (involve the words “we,” “us,” “group,” “all,” “our,” or “everyone”), we found that opt in behavior and the successful provision of public goods are positively related to the proportion of relevant speech that is collectivist (the correlations are 0.27 and 0.29 and both are statistically significant).

Experiment 2 demonstrates that at least some groups are able to achieve high levels of public good provision

²⁶Interestingly, another group achieves full contributions without full delegation: at most seven members opt in, but while the remaining two members never delegate, they nevertheless contribute fully to the public good.

by voluntarily ceding the right to select contribution levels to an elected agent.²⁷ However, a majority of groups, including all of those operating without preplay communication, fail to obtain the potential benefits from delegation. We see communication work successfully in Experiment 2 because it facilitates group members' decisions to opt for delegation.²⁸ Thus, communication allows groups to achieve high stable contribution rates; but, rather than doing so by increasing contribution rates directly, it instead appears effective primarily because it produces high rates of opting in to the electoral delegation institution.

Conclusion

Much of the existing literature on institutions and collective action problems has appropriately focused on institutional features relevant to self-governance such as communication and enforcement (Dickson, Gordon, and Huber 2009; Ostrom, Walker, and Gardner 1992). But it is also important to understand how features of real-world democratic institutions shape the provision of public goods. Our experiment breaks new ground by providing a clear benchmark regarding the effectiveness of electoral delegation on the provision of public goods. We find that a democratic version of the Hobbesian solution to the free-rider problem indeed works to achieve socially efficient outcomes. Although the institution poses potential problems of electoral accountability, groups largely avoid selecting allocators who either free ride or impose majority tyranny.

Our experiment has implications for understanding several real-world collective action and public goods problems. For instance, a number of scholars have argued that parties produce brand names, which provide

²⁷The voting behavior in the Endogenous + Communication groups fails to offer the same clear insight as Experiment 1, where electing the highest and lowest contributing group members from Part 1 has strong differential effects on group contributions. Over the first five periods of Part 2, the high contributor from Part 1 is never elected, and only once does a group member elect the low contributor; the low contributor in EC4 refuses to contribute until the group agrees to elect him or her as the allocator in period 10. Group discussion leads group members to agree on their allocator, resulting in nearly homogenous voting behavior within groups.

²⁸To address the concern, raised by a reviewer, that the relationship between high opt-in decisions and contributions is driven by individual types who are both more willing to opt in and to contribute (in contrast with our interpretation that it is driven by access to communication), we tested whether groups with high opt-in rates have systematically different contribution levels in Part 1 and found no relationship ($p = 0.995$ from a Kolmogorov-Smirnov test).

electoral benefits to their members akin to public goods (e.g., Aldrich 1995; Snyder and Ting 2003). Even though there may be compelling logical reasons why delegating authority to an elected party leader may not be individually rational (e.g., in terms of a spatial model of policy), it may be worthwhile if the party membership selects a leader who can ensure that the cost of belonging to the party is somehow equalized across members (e.g., Jenkins and Monroe 2010).

The institutional environment in our second experiment also shares important features with international organizations and agreements, most notably regional and international trade organizations such as the WTO, supranational confederations such as the European Union, and environmental treaties such as the Kyoto Protocol. In particular, these arrangements promote the provision of international public goods even though benefits still accrue to countries that opt out of them. Our results suggest that although there is a second-order free-rider problem (equivalent to decentralization), opting out does not necessarily imply that free-riding behavior will follow: nations that opt out because they prefer to retain sovereignty may nevertheless choose policies that are consistent with the objectives of the organization.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Supporting Information A: Statistical Analysis and Tables

Table A1: Random Effects Regression Analysis of Group Contributions in Experiment 1

Table A2: Percentage of observed allocations in delegation groups (Experiment 1)

Table A3: Probit and Random Effects Probit Analysis of Opt-In Decisions (Experiment 2)

Figure A1: Public Good Contributions and Opt-In Decisions over Time in Experiment 2

Figure A2: Frequency of Full Contribution Vectors by Treatment (Periods 6–20)

Supporting Information B: Experiment Instructions

ID Screen

General Information

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Groups

Parts and Rounds

Payoffs

Description of Decision Task

Example Payoffs

Instructions Conclusion

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Part II Instructions – Voluntary contributions with communication

Part II Instructions – Voting without communication

Part II Instructions – Voting with communication

Part II Instructions – Endogenous delegation

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