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**MAJORITY RULE OR DICTATORSHIP? THE ROLE OF  
COLLECTIVE-CHOICE RULES IN RESOLVING SOCIAL  
DILEMMAS WITH ENDOGENOUS INSTITUTIONS**

By

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# Majority rule or dictatorship? The role of collective-choice rules in resolving social dilemmas with endogenous institutions

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## Abstract

Collective-choice rules aggregate individual choices into a group choice. This study addresses the role of collective-choice rules in a social dilemma situation in which group members can repeatedly choose a combination of institutions to achieve self-governance. Specifically, we investigate three collective-choice rules: majority voting, dictatorship and rotating dictatorship. We identify a direct and an indirect channel through which collective-choice rules may affect groups' behavior and performance in the game. Our main findings are: (1) In terms of the direct effects, there is no evidence of a "democracy premium" (i.e., cooperation level is higher under the institutions chosen via a democratic rule than when the same institutions are chosen via a non-democratic rule). (2) In terms of the indirect effects, institutional choices produced by a fixed dictator are more stable than produced by rotating dictators. (3) Overall, groups with a fixed dictator earn the highest payoffs.

Keywords: collective decision-making; social dilemma; institutions; majority rule; dictatorship; cooperation

JEL codes: C92; D02; D71

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# 1 Introduction

In social dilemmas where there is a conflict between individual interests and collective interests, human beings often appeal to institutions, which range from household cleaning schedule to public policies, to sustain cooperation and achieve self-governance. A growing body of experimental research looks into the endogenous formation of institutions where groups of participants are allowed to establish or remove certain institutions collectively (Bischoff, 2007; Potters et al., 2005; Sutter et al., 2010; Guillen et al., 2007; Gürerk et al., 2009; Fehr and Williams, 2013; Ertan et al., 2009). In deciding on the institutions, groups apply an explicit or implicit collective-choice rule to aggregate individual preferences over institutions into a collective decision. In this paper, we explore whether and how collective-choice rule would affect groups' behavior and performance in the context of social dilemma with endogenous institutions.

Specifically, we look at three types of collective-choice rules: majority voting, a single decision-maker or a dictatorship (fixed dictatorship) and single decision makers on a rotating basis (rotating dictatorship henceforth). These rules are natural candidates for a study on collective-choice rules because they are simple, representative and widely used in real world.

Collective-choice rules can affect groups' performance in social dilemma through two channels: a direct channel and an indirect channel. Collective-choice rules may directly influence behavior through the perceived legitimacy and procedural justice of the collective-choice rules. Castore and Murnighan (1978) argues that the decision process is one of the factors that determine group members' support for a group decision, partly due to the procedural utility Frey et al. (2004) derived from the collective-choice rule per se. Bartling et al. (2014); Fehr et al. (2013) show that indeed people value decision rights. Some studies on endogenous institutions find an "endogeneity premium" in the sense that policies chosen by the subjects are more effective than if they are selected randomly by the computer or imposed by the experimenter (Arbak and Villeval, 2011; Bó et al., 2010; Casari and Luini, 2009; Kamei, 2016; Markussen et al., 2013; Rivas and Sutter, 2011; Tyran and Feld, 2006). In this study, we further explore whether there exists a "democracy premium". That is, given that the institutions are chosen endogenously, do people behave more pro-socially under the same institutions produced by a democratic rule than by a non-democratic rule? If the procedure argument holds true, majority voting and rotating dictatorship are expected to have a positive direct effects on cooperation compared with fixed dictatorship.

Collective-choice rules may also indirectly influence behavior through their influence on the collective choice over institutions. Collective-choice rules are social

choice functions that define mappings from individual preferences to a collective decision, and institutions can be viewed as the policy outcomes. In social choice theories and political science, the comparison between simple majority voting and dictatorship has long been an important subject. The intransitivity and instability of simple majority rule captures significant attention, following Arrow's pioneering work. Arrow (1950) proves that under certain conditions, non-dictatorial rules fail to satisfy unanimity and independence of irrelevant alternatives at the same time. Plott (1967); McKelvey (1976); Schofield (1978) showed that the condition for the existence of an equilibrium rarely occurs and that you can almost always identify a deviation from the current social choice which is supported by a majority. As Plott (1967) put it, "it would only be an accident (and a highly improbable one) if an equilibrium exists at all". An implication of these theories is the instability and the fragility of majority rule outcomes (Riker, 1980). As instability in policies or institutions can be detrimental to social well-being (Dixit, 2009), non-dictatorial collective-choice rules might impact cooperation levels by producing unstable institutions over time.

The context of our study is a social dilemma where groups are motivated to achieve self-governance and benefit from higher cooperation levels. We use a repeated standard public goods game as the basic game. Every 3 rounds, subjects can collectively choose institutions as additional rules to the basic game and play under the modified public goods game for 3 rounds. In each treatment, we impose a different collective-choice rule on the collective decision process of groups and hence employ a between-subjects design.

A distinct feature of our experiment is that we provide participants with a menu of institutions from which they can choose. The items on the menu are communication, punishment, and reputation. Groups can choose any combination of the three items as their institutional choice. We select these institutions according to two principles. First, there has to be at least three institutions such that any institutional choice is a multi-dimensional policy outcome and therefore Arrow's impossibility theorem can be applied. Second, subjects should have no problem understanding the nature of the available institutions. Even better, the institutions should come naturally to the subjects. Rockenbach and Wolff (2016) show that when people can create any institutions they prefer, their creations are often limited to a handful of institutions including communication, sanction, information feedback or some kind of redistribution. Also, communication, punishment and reputation are among the mostly studied institutions in economic experiments and have been shown to be effective in promoting cooperation in the lab.<sup>1</sup>

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<sup>1</sup>E.g. Isaac and Walker (1988); Ostrom et al. (1992); Bochet et al. (2006); Bischoff (2007); Koukoulis et al. (2012); Ostrom (1990); Kosfeld et al. (2009); Fehr and Gächter (2000); Carpenter

Additionally, we take into consideration the fact that the institution itself has the property of being a public good. Running and maintaining an institution typically entails costs. Once an institution is established and made to work, each group member can benefit from increased cooperation regardless of whether she pays for it or not. A second-order social dilemma is thus formed. For example, punishing someone else typically entails costs for the punisher, while other group members can benefit from enforced cooperation without paying any additional cost.<sup>2</sup> Therefore the successful establishment of an effective institution calls for agreement on the burden of institutional costs. Subjects need to decide collectively on how to divide the costs for each institution they would like to establish through the given collective-choice rule.

To our knowledge, this paper is the first to investigate the role of collective-choice rules in self-governance in a controlled environment. We aim to identify the effects of collective-choice rules on behavior through the two fore-mentioned channels and preferably the overall effects on groups' performance in a social dilemma.

Our main findings are as follows. First, we do not find evidence of the "democracy premium". On the contrary, fixed dictatorship has a positive direct effect on contribution behavior compared with majority voting or rotating dictatorship, provided that communication is used. Second, institutional choices generated by rotating dictators are significantly more unstable than those generated via majority voting or fixed dictatorship. Third, overall, groups in fixed dictatorship treatment achieve higher cooperation level, spend less on institutions and hence earn more than those in rotating dictatorship. With regard to endogenous institutions, we also find evidence of subjects' active and strategic usage of institutions to resolve the social dilemma.

## 2 Related literature

As our paper builds on and contributes to experimental studies on endogenous institutions in social dilemma situations, we will focus on relevant studies on this. More specifically, we will concentrate on two dimensions of institutions that are varied in most of the existing experimental literature: the set of available institutions and the choice rule.

The set of available institutions can vary from small, large to unlimited. In

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et al. (2004); Milinski et al. (2002). Kroll et al. (2007) shows that non-binding voting on how much to contribute to a public good is not effective in itself unless combined with punishment.

<sup>2</sup>Related literature finds that people suffer as much from higher order social dilemmas as from first-order social dilemma (Sigmund et al., 2010; Zhang et al., 2014). Fehr and Gächter (2002) claim that this can only be solved if sufficient agents are willing to "altruistically" provide the second-order public good.

the simplest case, the institution set contains two elements: no institution and an exogenously given institution. Subjects face a take-it-or-leave-it offer. In Guillen et al. (2007), for example, subjects choose whether they want to keep a central sanction mechanism or not after several rounds of experience. Similarly, in Kosfeld et al. (2009), participants choose whether to implement a sanction stage. Potters et al. (2005) let two players decide unanimously whether to apply a sequential structure in a voluntary contribution mechanism.

Some scholars expand the institution set to study variations of a certain category of institution. For instance, Sutter et al. (2010) provide subjects with three institutions to choose from: standard voluntary contribution mechanism (VCM), VCM with punishment, and VCM with reward. Markussen et al. (2013) distinguish informal sanction and formal sanction in their institution set. Fehr and Williams (2013) offers four communities with different forms of a punishment system to choose from, including one without punishment. In these studies, comparisons are made among various modifications of a sanction system.

Very few studies set virtually no limits to the institution set. For example, in Rockenbach and Wolff (2016), subjects are empowered to invent any institutional setting for a public good game and repeatedly improve their design. The authors then decompose the subjects' rule sets into rule components and classify these components along different categories. Their study finds that subjects usually combine two or more rule components, rather than use exclusively a single category of institution.

Along the first dimension of literature on endogenous institutions, our study lies between small and unlimited. We enlarge the institution set and allow subjects to select from and combine different categories of institutions. Since institutional choices are made repeatedly, we are able to observe subjects' strategic usage of different types of institutions, depending on timing, their own preferences and the behavior of their opponents.

On the second dimension of endogenous institutions, studies vary the different collective-choice rules they apply. The most commonly observed rules are unanimity, majority voting, and voting with feet. An example of using unanimity in a group of two people is Potters et al. (2005). Majority voting is a simple rule, which is very often implemented, see for instance Bó et al. (2010); Ertan et al. (2009); Markussen et al. (2013); Sutter et al. (2010); Tyran and Feld (2006). Voting with feet is typically implemented by allowing subjects to move between communities with various institutions (Gürerk et al., 2009; Fehr and Williams, 2013; Botelho et al., 2005; Ramalingam et al., 2014). Note that an important difference between these papers and ours is that they usually take focus on one specific collective choice rule, while one of our main interests is to look at the difference between

collective-choice rules and their potential influence.

## 3 Experimental design and procedure

### 3.1 The endogenous institution game

We use what we call an “Endogenous institution game” to represent a social dilemma environment where groups of people can explore the possibility of establishing institutions, and use them. The main body of the Institution game is a standard public goods game. The standard game can be modified by using institutions that change the rules of the game. Groups choose institutions via a given collective-choice rule. Therefore different choices of institutions pin down a personalized version of a modified public goods game for each group. As explained in the introduction, the main aim of this study is to examine whether, and to what extent, collective-choice rules affect cooperation behavior in such a social dilemma situation. In particular, we study three collective-choice rules: majority voting (MV), fixed dictatorship (FD), and rotating dictatorship (RD). More details on the basic game, the institutions and the collective-choice rules are provided in the next subsections.

#### 3.1.1 Standard public goods game

The main body of the Institution game is a standard three person public goods game which is widely used in studies into social dilemmas (Ledyard, 1994). The public goods game is repeated for 18 rounds, which are divided into 6 terms. In every round group members are assigned ID numbers as their temporary identity; ID numbers change every round. The three participants form a fixed group (partner matching). To avoid abusing notation, we use subscript  $i \in 1, 2, 3$  to denote individual level decisions and subscript  $j$  to denote group level decisions or outcomes. In every round, all group members receive an endowment  $e = 20$  tokens and they decide simultaneously how much to invest in a public project. Every token invested into the project yields a return  $\alpha = 0.5$  to each group member. Tokens that are kept in private remain unchanged. The payoff function of player  $i$  in round  $t$  if he chooses to invest  $x_i$  into the public project is then:

$$\pi_{it} = 20 - x_{it} + 0.5 * \sum_k^3 x_{kt}$$

The marginal per capita return  $\alpha = 0.5$  ensures that there is a conflict between group interest and individual interest since  $0.5 < 1$  while  $3 * 0.5 > 1$ . That is, there



are incentives to achieve a higher cooperation level; full cooperation gives every group member 30 while fully selfish group members earn 20. After contributions have been made, group members receive feedback information on their own payoff in the current round. They can also see the contributions and payoffs of the other two group members together with their respective temporary IDs in the current round (except for the case where the reputation institution is in office, see below).

### 3.1.2 Institutions

In the experiment several institutions can be established to extend the rules of the basic game. As mentioned before, the basic public goods game is repeated for 18 rounds. The 18 rounds are divided into six terms of 3 rounds each. At the beginning of each term, groups can choose the institution(s) to be implemented in this term. We provide a menu with three available institutions: communication, reputation, and punishment. Subjects can choose any combination of these three items from the menu, or none of the institutions. Hence there are 8 possible institutional choices. To avoid connotation, in the experiment, these institutions are referred to as mechanism A, B and C, respectively. For each group, the individual choices are aggregated to determine if an institution will be implemented in a term. How individual choices are aggregated depends on the collective choice rule, i.e. on the treatment.

One property of institutions is that they are typically costly to establish and/or to maintain. To capture this characteristic in the experiment, the establishment of an institution in a group costs 3 points per round, and these costs will be shared equally among group members in the three rounds of the term. On top of that, every time the function of an institution is executed, a variable cost arises. As will be described in more detail below, variable costs depend on the institution chosen, and they can be shared equally among group members or burdened by the individual who initiates it, depending on the cost-sharing rules chosen by the group members. Table 1 summarizes the fixed costs and variable costs for each institution. This table was also presented in the instructions. We will now elaborate on the details of the institutions.

With communication (mechanism A), group members can send messages by posting on a “blackboard” simultaneously and before making a contribution decision. The content of the message is semi-specified, and participants are required to fill in the blank before they send the message. Every message they send entails a variable cost of 1 point. They can choose one or more from the following three messages:

- “I propose we invest X points in the project.”

- “I propose we use mechanism A/B/C/none.”
- “I propose we share the variable costs of mechanism A/C/none.”

Reputation (mechanism B) makes a person’s history tractable and known to all group members. To achieve this, we simply fix the ID numbers that have been assigned to group members for this term and provide them with a record of contribution and payoff information of each group member. Therefore, subjects can see at least one (in the first round of this term) and at most three (in the last round of this term) contribution and payoffs outcomes for each group member. Unlike the other two institutions, reputation does not incur any variable cost. Once it is constituted (at fixed costs of 3 per round), it keeps working for the entire term of three rounds without any further costs.

The last institution, punishment (mechanism C), enables group members to directly reduce others’ payoffs at some costs after they have been informed of every member’s contribution and payoffs. The fine-to-fee ratio is 3 in this experiment. That is, it costs one point to reduce another individual’s payoff by 3 points, a standard punishment mechanism in public good experiments (Nikiforakis and Normann, 2008). Subjects are only allowed to punish those who contribute less than them, ruling out anti-social punishment behavior.<sup>3</sup>

Subjects are informed of the above information in the instructions they receive (see Appendix B).

Table 1: Overview of costs (in points) per treatment

Institution	Fixed Cost per round	Variable Cost per use
Communication	3	1 per message
Punishment	3	1/3 per unit of deduction
Reputation	3	-

### 3.1.3 Treatments: Collective-choice rules

Our experiment consists of three treatments, which only differ in the collective-choice rules employed to translate individual preferences into one collective decision: majority voting (MV), fixed dictatorship (FD), and rotating dictatorship (RD). The rules of the basic game and the institutions explained in previous sections apply to all treatments.

<sup>3</sup>Anti-social punishment widely exists when punishment is possible (Fehr and Gächter, 2000; Herrmann et al., 2008). We forbid antisocial punishment in order to keep the function of the “punishment” institution straightforward and to avoid inducing more complicated motives and interactions.

In the beginning of each term, subjects need to indicate their preferences over the institutions and the corresponding cost-sharing rules of each institution. For each item (or institution) on the menu, participants answer two questions individually and simultaneously: (1) whether they want this institution to be established with fixed costs that will be shared by all group members and (2) whether they would like to share the potential variable cost of that institution, if it's put into use.

In the MV treatment, whether an institution will be established depends on if the majority of the group votes yes or no concerning question (1). If the majority votes yes, the cost-sharing rule will be also determined by majority rule according to their answers to question (2).

In the FD treatment, one of the group members will be randomly chosen as the decision maker (fixed dictator) and remains the decision maker throughout the game. In the very first round, all group members are asked to answer questions (1) and (2) without knowing whether they are the decision maker or not. After the voting phase in the first round, each subject knows whether he is assigned as the decision maker or not. Nevertheless, and to minimize procedural differences between the treatments, at the beginning of each term, non-dictators are still required to privately indicate their preferences over institutions, even though their choices do not affect the institutional outcome.

In the RD treatment, participants take turns to be the decision maker (rotating dictator) and the order is randomly determined by the computer. All group members answer questions (1) and (2) in all six terms without knowing whether they will be assigned as the decision maker in that term. Only after the voting phase will they be informed of whether their choices have been selected and implemented or not. Since there are six terms and hence six institutional choices, it is known to the subjects that only two times will their decision(s) be actually implemented as the collective-choice. Therefore, if one group member has been selected twice as the decision maker, she can conclude that her institutional choice would not matter anymore in later terms.

## **3.2 Procedure**

The experiment was conducted at CentERlab at Tilburg University, and was programmed using zTree (Fischbacher, 2007). Participants were recruited via the UvTlab system of Tilburg University. In each session only one treatment (i.e. collective-choice rules) was conducted, and we used a between-subjects design. Per treatment we implemented two sessions, for a total of six experimental sessions. Participants could only participate in one experimental session.

We start the experiment by reading aloud instructions. In the instructions, first the standard public good game is described, as described in section 3.1.1. A test of subjects' understanding of the public good game is performed before entering the next stage of instruction. Then we introduce institutions to the subjects, as in section 3.1.2. Finally, we explain to them the collective-choice rule that has been imposed on them. Subjects can ask questions, which are answered privately. There is no practice round before the experiment starts. The complete procedure of the game is presented in Appendix A.

In each treatment, people are randomly matched in fixed groups of three (partner matching). There are in total 18 rounds, which were divided into six terms of 3 rounds each. In round 1, 4, 7, 10, 13, 16, groups play a full endogenous institution game that consists of two phases: a collective decision phase and a simultaneous contribution phase. In all other rounds participants skip the collective decision phase and only make contribution decisions. Every round participants will be randomly (re)assigned an ID number 1, 2 or 3 (except for the case where they have established reputation institution).

In the collective decision phase, group members make a collective choice over what institution(s) they would like to implement in the next three rounds. After having answered the two questions on the establishment and cost sharing of each institution individually, the decisions are aggregated, based on the collective-choice rule (treatment). At the end of the collective decision phase, successfully established institutions along with their respective cost-sharing rules are displayed on the screen and hence known to all group members. No information about individual votes is revealed to keep the anonymity of voting.

Then follows the second phase of simultaneous contribution. Participants play a standard public game with potentially additional rules that they have chosen themselves, via the institutions. The first stage of the contribution phase is the communication stage. Only groups that have chosen the communication institution are eligible to participate in this stage. Participants of eligible groups can choose and fill in the messages that they would like to convey to his/her group members. Not sending anything is also possible. Messages from each member are shown on the group's blackboard. In the second stage, participants play the standard public good game and make their contribution decisions simultaneously. In the succeeding stage, individual contribution and payoffs of this round are shown to all group members. The fourth potential stage is the punishment stage. If the punishment institution is established, participants indicate whether they wish to punish someone in their group and if so, how many punishment points they want to assign. These decisions are individually and simultaneously made. In the final stage, punishment and final payoffs of each group member in this round are shown

on the screen. Groups that have chosen reputation can identify contributions and payoffs of the group member in a term; without reputation this information cannot be linked to individual group members (only to random IDs).

The monetary payoff of each participant in the experiment is determined by the sum of private tokens earned in all of 18 rounds plus a show-up fee of 3 euros. 100 tokens are translated into 3 euros.

In total 114 subjects participated in the experiment (39 in MV (13 groups), 36 in FD (12 groups), and 39 in RD (13 groups), of whom 43% are women. In the questionnaire conducted at the end of the experiment, around 74% of the subjects claimed that they had participated in a “similar” experiment. This suggests that these participants generally have a good understanding of the game, or at least they believe so. On average, subjects earned 16.9 euros in about 1 hour 15 minutes.

### 3.3 Definitions and hypotheses

The experiment generates rich data on subjects’ behavior and strategies in the game. Although there is a great deal of potential interesting things to look at, the focus will be on two testable hypotheses regarding the direct and indirect effects of collective-choice rules. We will also explore the general behavior of subjects in the game, but with the main aim to provide necessary background information for the analysis of collective-choice rules.

To better demonstrate the direct and indirect effects and formulate our hypotheses, we put forward a simple formal framework. A set  $P \subset \mathbb{R}^3$  contains all the available institution combinations. Each element in set  $P$  is an ordered triple in a 3-dimensional Euclidean space  $\mathbf{p} = (p_{COM}, p_{REP}, p_{PUN})$ , with  $p \in \{0, 1\}$  representing the individual or group choice on the establishment of one institution. For example,  $\mathbf{p}_{it} = (1, 0, 1)$  indicates that the institutional choice of individual  $i$  in term  $t$  is communication and punishment. Let  $C = \{MV, FD, RD\}$  be the set of collective-choice rules. An element in  $C$  is a function  $c : \times_{i \in \{1,2,3\}} P_i \rightarrow P$  that aggregates individual choices over institutions into a collective choice.

An individual  $i$ ’s institutional choice in round  $t$  depends on her own type  $\mu_i$ , where  $\mu_i$  is a stochastic term with mean zero and it’s assumed to be fixed for an individual over the period of our experiment.  $\mu_i$  includes any individual characteristics that might be correlated with her contribution behavior and institutional choice. The individual institutional choice is also affected by a group specific effect: the group “morale”  $\epsilon_{jt}$ .  $\epsilon_{jt}$  includes the unobserved group characteristics influencing the willingness to cooperate and further the dynamics of the game, such as the belief about the permutation of different types of individuals in the group. Assume that group morale is built up at the end of each round. It might change and ac-

cumulate over time as group members interact and learn more about each other. The individual makes an institutional choice:

$$\mathbf{p}_{it} = \mathbf{p}(\mu_i, \epsilon_{j,t-1})$$

where  $t$  can only take the value of  $\{1, 4, 7, 10, 13, 16\}$ . Note that we allow the institutional choice in the current round to be influenced by the group morale in the last round, hence the subscript of  $\epsilon_{j,t-1}$ . In the first round before group morale is built up, institutional choice depends solely on individual characteristics

$$\mathbf{p}_{i,1} = \mathbf{p}(\mu_i).$$

Then an individual enters the modified public goods game according to the collective choice of her group. In a similar vein, we assume that her contribution may depend on her type as well as the group morale, and furthermore on the institutions and the collective-choice rule through which the institutions are determined. Thus we may write the average per round total contribution to the public good of group  $j$  in round  $t$   $X_{jt}$  as the sum of all individual contributions to the public good

$$X_{jt}(C_j, \mathbf{p}_{jt}, \epsilon_{j,t-1}) = \sum_i^3 x_{it}(C_j, \mathbf{p}_{jt}, \mu_i, \epsilon_{j,t-1}).$$

Direct effects of collective-choice rules are the influence of collective-choice rules on contribution behavior after controlling for institutions. Our first hypothesis is derived from people's preference for fairness or equality in decision power. In terms of equality of opportunity, all of the three collective-choice rules can be regarded as fair since everyone's chance of being decisive is the same. But equality of opportunity does not necessarily lead to equality of outcome, which is the case in the FD treatment. As long as people value equality of outcome to some extent (Almås et al., 2010; Cappelen et al., 2007; Dawes et al., 2007; Sutter, 2007), MV and RD may be considered as fairer than FD. We hypothesize that the cooperation level is higher under a given institution, if the institution is chosen via a collective-choice rule that is perceived as fairer.

**Hypothesis 1.** *(Direct effects). Conditional on the same institution combination, contributions to the public good are greater in MV and RD than in FD.*

Our second hypothesis regards the stability of institutional outcomes under different collective-choice rules. Based on the implications of Arrow (1950); Plott (1967); McKelvey (1976); Schofield (1978), we hypothesize that institutional choices produced by a dictatorial collective-choice rule are more stable than those generated via majority voting. And since individuals take turns to choose their favored

institutions under rotating dictatorship, it follows naturally that rotating dictatorship produces the most unstable institutional outcomes.

**Hypothesis 2.** (*Indirect effects*). *Institutional choices generated in FD groups are the most stable among the three collective-choice rules, and those generated in RD are the least stable.*

To measure the magnitude of change in institutions more formally, we compute the linear distance between the institutional choices in the current round and in last round and denote it as the *instability index*  $index_{jt} = \|\mathbf{p}_{j,t-1}, \mathbf{p}_{j,t}\|$ . The overall degree of instability of a group’s institutional choices over time is defined by  $instability_j = \sum_{t \in \{2, \dots, 18\}} \|\mathbf{p}_{j,t-1}, \mathbf{p}_{j,t}\|$ .<sup>4</sup> An instability index can also be computed at the individual level, since all individuals are asked to indicate their institutional choices in every term. The focus will be, however, at the group (in)stability.

## 4 Results

We first present some general results on subjects’ behavior in the public goods game, including the performance in resolving social dilemma, contribution behavior and institutional choices. Bearing these results in mind, we will then proceed to investigate the direct and indirect effects of collective-choice rules.

### 4.1 General behavior

#### 4.1.1 Performance

The main outcome variable we are interested in is the “performance”. Performance is defined by the earnings of an individual or a group in the game: subtracting the costs related to the establishment and usage of institutions from the total profits made in the public goods game. Performance is the materialized individual or social welfare. For a group, performance is also a net measure of cooperation level, broadly considered. It increases as group members contribute more to the public good, and it decreases as the group achieves that cooperation level at greater costs.

As a benchmark, if a group never establishes any institution and all group members contribute nothing to the public good, an individual in this group will earn 360 experimental points over the 18 rounds of the game. Full contributions without any costs of institutions would yield maximum individual earnings of 540

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<sup>4</sup>As institutional choices can only change when a new term starts (not within a term),  $\|\mathbf{p}_{j,t-1}, \mathbf{p}_{j,t}\|$  can only differ from zero at  $t = 4, 7, 10, 13,$  and  $16$ . The maximum value of  $index_{jt}$  is thus  $\sqrt{3}$  and the maximum value of  $instability_j$  is  $5\sqrt{3}$ .

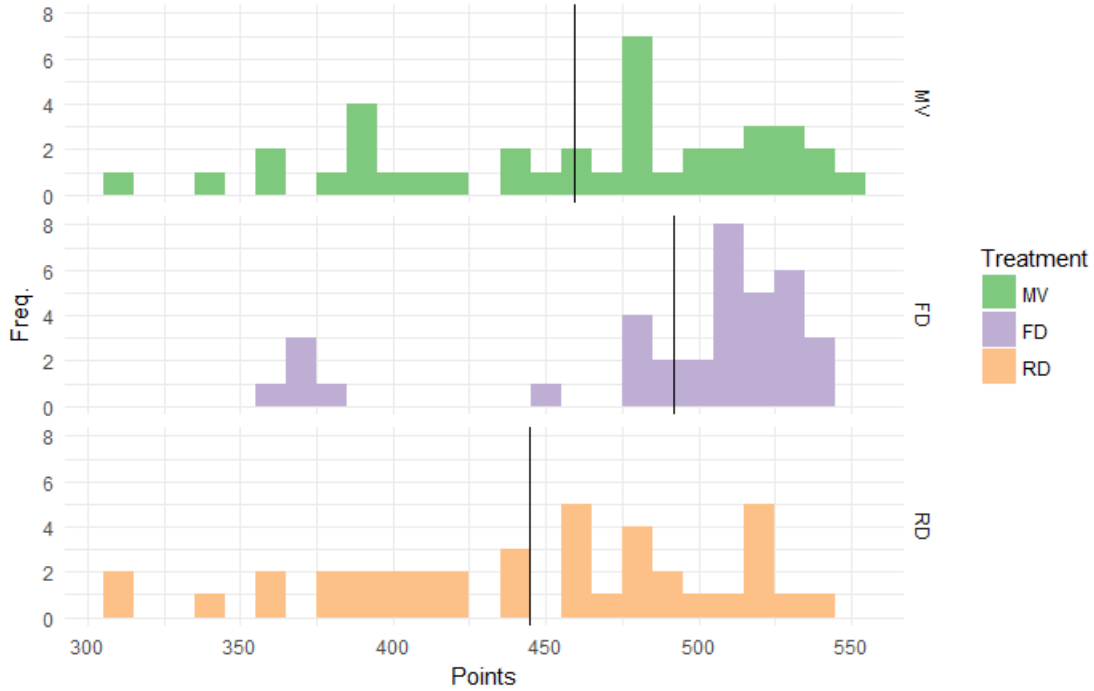


Figure 1: Distribution of individual earnings

points. Figure 1 presents the distributions of individual accumulated earnings (in experimental points) in each treatment, where the vertical lines are drawn at the mean value. On average, subjects earn 483.2 points, more than the benchmark 360 points.

The average earnings of subjects are the highest in the FD treatment and the lowest in the RD treatment. The variance of individual earnings in the FD treatment is smaller than in the other two treatments. Using independent observations at group level, Mann–Whitney U tests confirm that average group earnings in FD are significantly higher than in RD at the 5% significance level ( $p=0.034$ ,  $n=25$ ), but not significantly higher than in MV ( $p=0.211$ ,  $n=25$ ). MV and RD do not differ significantly from each other ( $p=0.457$ ,  $n=26$ ).

**Result 1.** *Groups in FD perform significantly better than those in RD in terms of final earnings.*

To see the trend of performance over time, we present the average group performance over time of different treatments in Figure 2. The benchmark group earnings are 60 points per round. Figure 2 shows that on average, groups in all treatments manage to earn more than the benchmark in all rounds. In MV and RD, there are ups and downs over time with no clear trend or sign of convergence. In FD, the group performance follows a hump-shape pattern. Groups in FD on average outperform those in MV and RD in most of the rounds.

Note that group performance can be decomposed into three parts: the profits



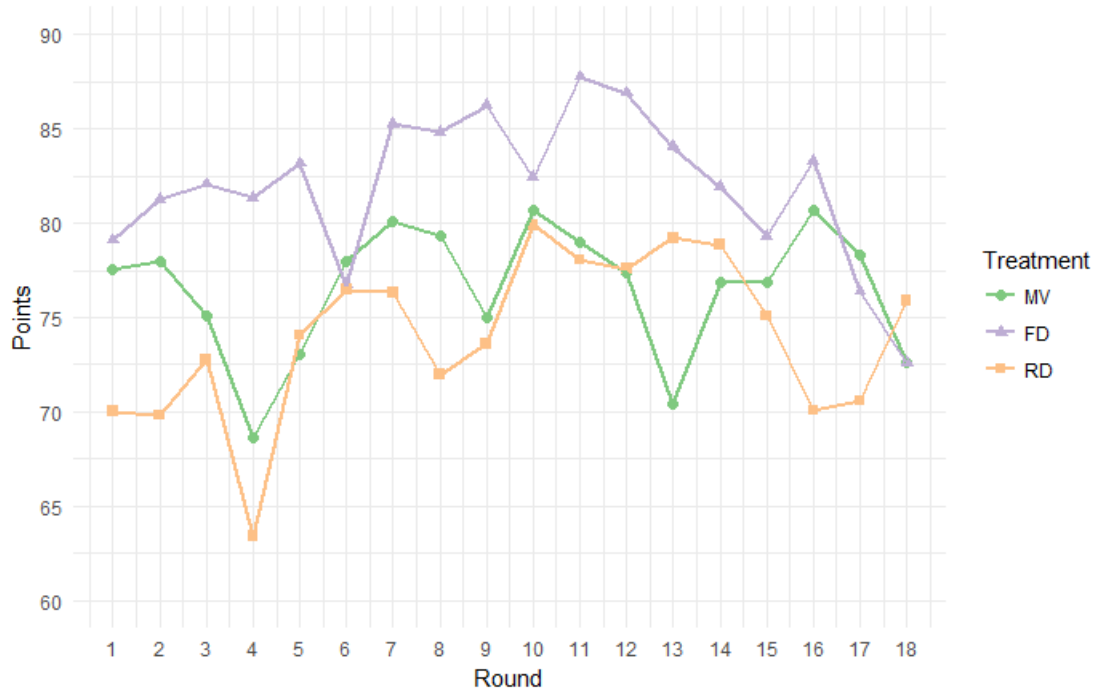


Figure 2: Group earnings over rounds

from contribution decisions, the fixed and variable costs of institutions, and the loss from punishment. Figure 3 and Table 2 give more detailed information on these three parts. In Figure 3, the dots are located at the mean of per round group contribution, group institutional costs and punishment across terms of the three treatments respectively, with tails covering one standard deviation. The box-and-whisker plot shows the distribution of group earnings in each treatment across terms.<sup>5</sup>

The profits from contribution decisions play a decisive part in determining the group performance while the cost part, including the fixed and variable costs of institutions and the loss from punishment are relatively small in magnitude. However, both sources contribute to the differences between treatments. For instance, Table 2 shows that FD groups on average earn 7.83 more points than RD groups, of which 4.19 points come from the profit side and 3.64 come from the cost side.

In the subsequent sections, we look into contribution behavior and institutional choices more closely.

#### 4.1.2 Contribution behavior

For each treatment, the average group contribution over 18 rounds is shown in Figure 4. Per round group contribution to the public good is between 28 and 59

<sup>5</sup>The bold line in the box represents the median earnings. The end of the box shows the first and the third quartiles. The extreme lines shows the highest and lowest earnings excluding outliers.

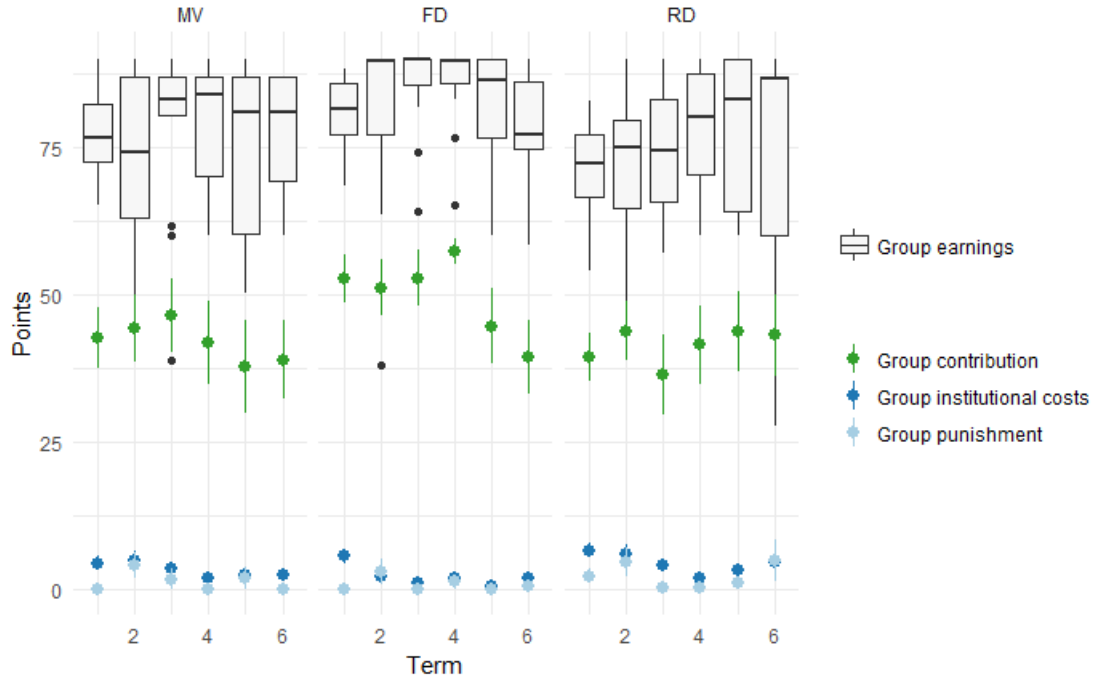


Figure 3: Per round group earnings, contribution, institutional costs and punishment over terms

points, with an average group contribution of 44.18 points, which is approximately 73.6% of the group endowment. Groups manage to sustain cooperation at a rather high level in all three treatments. In the FD treatment, cooperation even seems to be climbing up until round 12. But in the very last term, we observe a sharp falling of group contribution in FD and MV, which suggests that cooperation might be more of a strategic play rather than purely driven by social preferences.

**Result 2.** *With endogenous institutions, groups contribute on average more than half of their endowment. In all of the three treatments, contributions to the public good do not demonstrate a declining trend over time.*

Interestingly, a declining trend within terms can be observed in the MV and RD treatment, which mirrors the stylized fact of declining cooperation found in repeated public goods experiments (Ledyard, 1994; Neugebauer et al., 2009). Subjects contribute significantly less in the third round of a term than in the first round of that term ( $p < 0.00$ ), which can be viewed as a “draining” effect. And they contribute significantly more upon entering a new term, compared with their contribution in the last round of the last term ( $p < 0.00$ ), which can be called a “boosting” effect. When we construct an indicator of whether the institution has changed between the two terms, we find that a change in the institutions is positively correlated with the boosting effect as well as the draining effect. That is, if a group enters the next term with a new set of institutions, their willingness to cooperate

Table 2: Decomposition of group performance

	Profits			Costs			Earnings		
	MV	FD	RD	MV	FD	RD	MV	FD	RD
Term 1	81.28	86.36	79.65	4.41	5.55	8.78	76.88	80.81	70.87
Term 2	82.14	85.57	81.88	8.92	5.14	10.57	73.23	80.43	71.32
Term 3	83.29	86.39	78.18	5.18	0.94	4.20	78.12	85.45	73.98
Term 4	80.86	88.69	80.73	1.85	2.99	2.21	79.01	85.70	78.52
Term 5	78.87	82.33	81.88	4.18	0.58	4.15	74.69	81.76	77.73
Term 6	79.49	79.71	81.56	2.26	2.28	9.38	77.23	77.44	72.18
Avg.	80.99	84.84	80.65	4.46	2.91	6.55	76.53	81.93	74.10

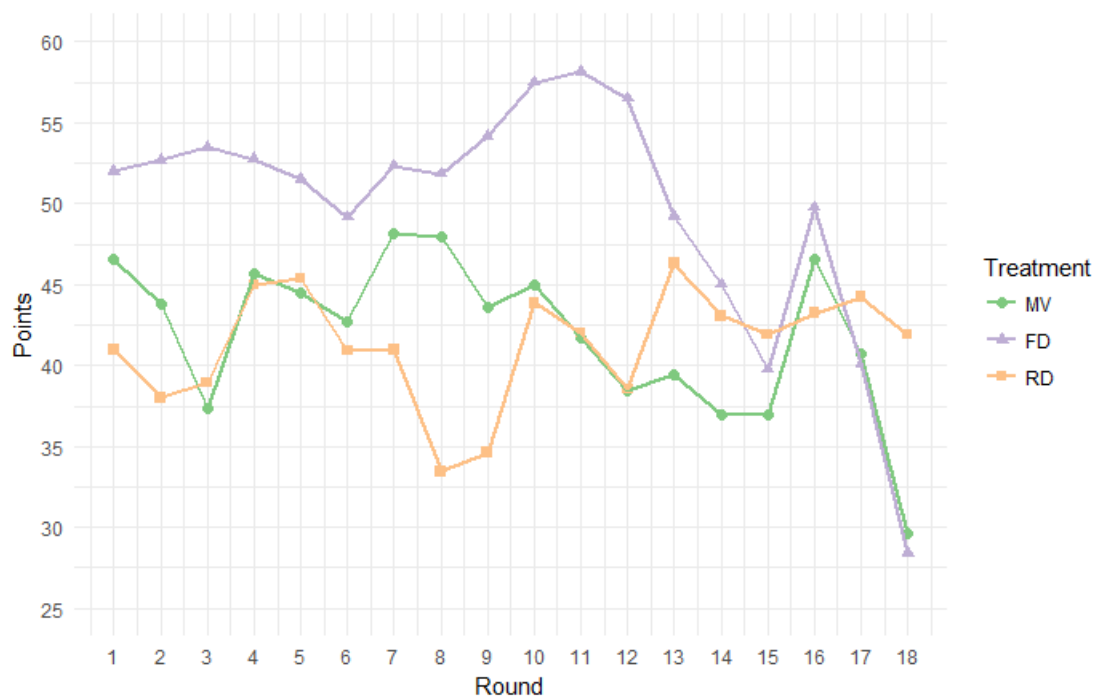


Figure 4: Group contribution over rounds

will be boosted to a greater extent than if the institutions do not change while the cooperation level will drain to a greater extent too. This suggests that the boosting effect, although partially due to the restart of the game, is more than a pure “restart effect”.<sup>6</sup>

Now we turn to the differences across treatments. As can be seen from Figure 4 groups in the FD treatment constantly and consistently enjoy a higher cooperation level than MV and RD groups with the exception of some of the last rounds. As a result, average group contributions in the FD treatment are about 20% higher than in the other two treatments. Table 3 shows the average group contribution per term, as well as the results of pairwise two sample Mann–Whitney U tests comparing group contributions per term between treatments. The results confirm that subjects in FD contribute more than those in RD in earlier terms although not all differences are significant. The contributions in FD are also consistently higher than those in MV, but the differences are not statistically significant (all p-values > 0.1).

Table 3: Group contribution over terms

	Group contribution		
	MV	FD	RD
Term 1	42.56	52.72 <sup>‡</sup>	39.31 <sup>‡</sup>
Term 2	44.28	51.14	43.77
Term 3	46.59	52.78 <sup>†</sup>	36.36 <sup>†</sup>
Term 4	41.72	57.39 <sup>†</sup>	41.46 <sup>†</sup>
Term 5	37.74	44.67	43.77
Term 6	38.97	39.42	43.13
Avg.	41.98	49.69 <sup>‡</sup>	41.30 <sup>‡</sup>

*Notes.* Two-sided Mann-Whitney U tests. <sup>†</sup> Significant difference (p<0.1) between FD and RD. <sup>‡</sup> Significant difference (p<0.05) between FD and RD.

**Result 3.** *Groups in FD contribute significantly more than those in RD in early terms.*

<sup>6</sup>Andreoni (1988) unexpectedly announced a restart after subjects had played ten rounds of a public good game. He found that subjects in the partner treatment returned to a high level of cooperation in round 11 and the restart effect seems to be lasting. In the current experiment, the new terms were not unexpected but announced ex ante, which may reduce the effect

### 4.1.3 Institutional choices

We will first look at the overall institutional choices in all 6 terms. The frequency of each institution combination chosen is displayed in Figure 5. Summing up all treatments, of in total 228 group institutional choices (38 groups x 6 terms), 51.32% of the group outcomes are no institution. The most frequently selected institutions are (only) punishment (14.9%) and (only) communication (11.4%). Then it follows with the combination of punishment and communication (8.3%) and the combination of all three institutions (6.6%). Participants show little interest in reputation, neither alone nor combined with other institutions. The reason could be that reputation in this experiment is rather weak while still costly.<sup>7</sup>

FD and RD slightly diverse in their institutional choices. FD use institutions less frequently (24 times) than RD groups (47 times). Less institution usage means smaller institution related costs, which contributes to the better performance of FD groups, as was shown in the previous section.

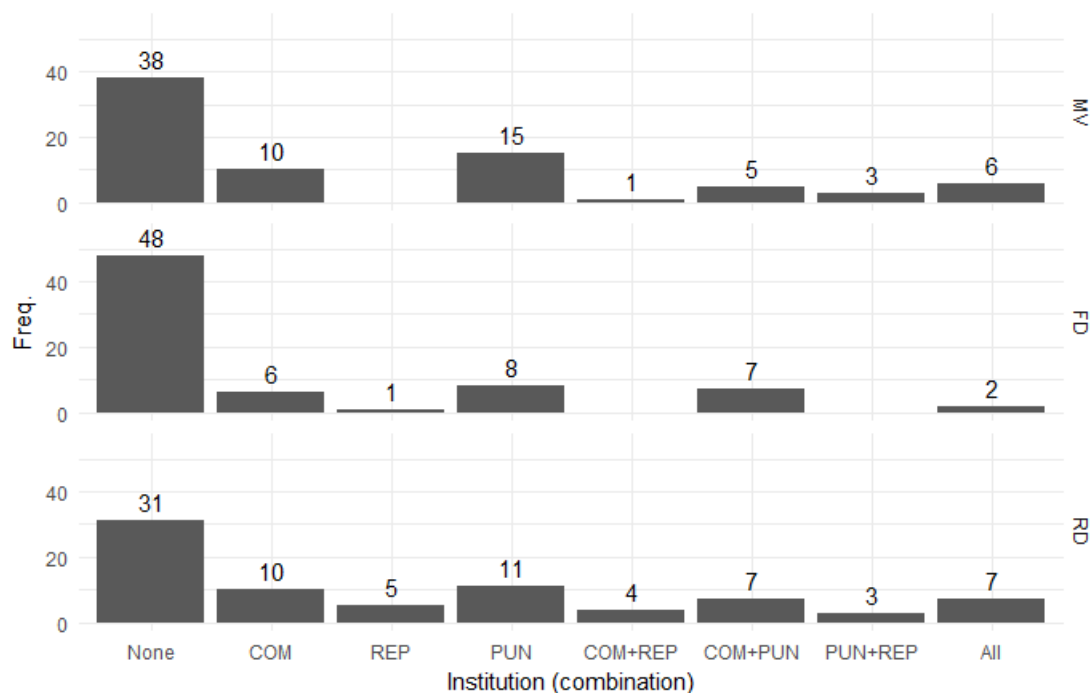


Figure 5: Group institutional choices over 6 terms

To see whether and how collective-choice rule influences the preferences over institutions, we compare the first round institutional choices across treatments since they are made individually and simultaneously before any form of interaction and contributions have taken place. Figure 6 shows that the individual institutional choices made in all three treatments are not very different. The re-

<sup>7</sup>Rockenbach and Wolff (2016) find that institution designers tend to provide aggregate contribution information, and leave individual information vague. Our findings do not conflict theirs.

sults of a Fisher's exact test confirms that the initial preference of subjects over institutions does not differ significantly across treatments ( $p=0.412$ ,  $n=114$ ).

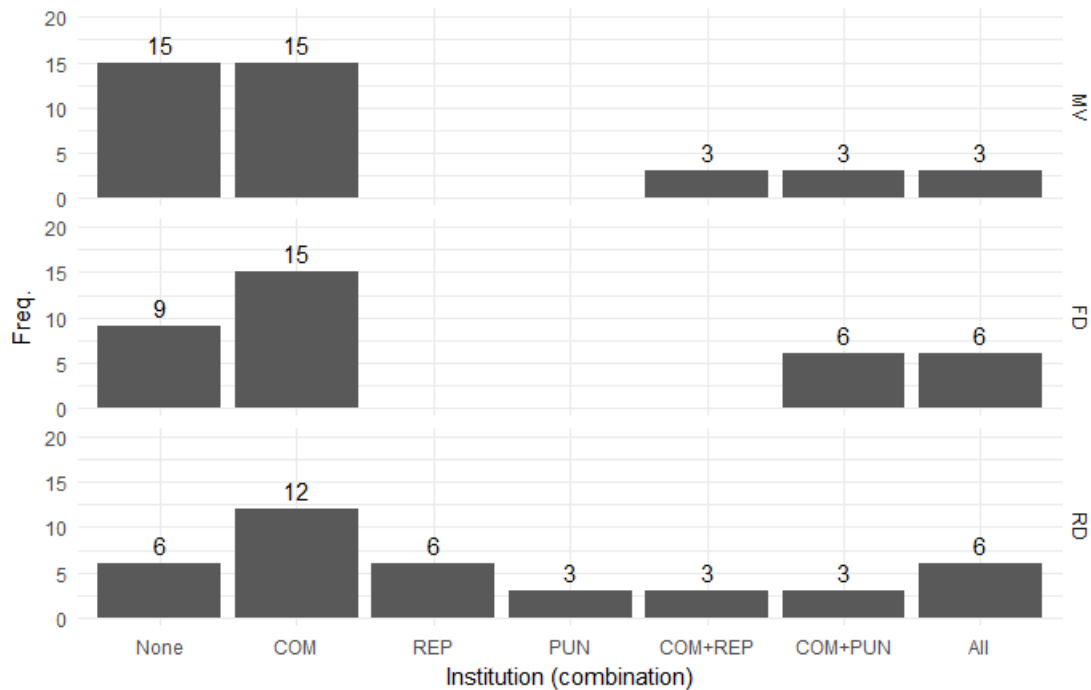


Figure 6: First round individual institutional choices

We also look at choices over cost-sharing rules, i.e whether group members are willing to share the variable costs of institutions. In the first round, 60.5% of subjects vote for sharing the variable costs of communication but only 36.8% choose to share the variable costs of punishment. There is no significant difference in the individual votes on cost-sharing rules across treatments however ( $p=0.714$ ,  $n=114$  for communication;  $p=0.549$ ,  $n=114$  for punishment). Therefore we find no evidence showing that different collective-choice rules might induce different preferences over institutions.

**Result 4.** *There is no evidence that initial preferences over institutions differ given different collective-choice rules.*

Do institutional choices display strategic concerns? The effectiveness of institutions might depend on the timing. In early rounds, communication is a powerful tool to build up group morale and mutual trust, it seems, but it may gradually lose its position to punishment because punishment is more of a credible threat than cheap talk. Figure 7 shows some evidence on this “carrots first, then the sticks” strategy by comparing choices of institutions in the first term (top panel) and last term (bottom panel). Among other things, Figure 7 shows that in the first term 25 out of 38 groups (66%) establish communication, either alone or combined with

other institutions, while 26.3% of the groups choose punishment. In the last term, however, only 6 out of 38 groups (15.8%) choose communication and 17 groups (45%) use punishment. Also, in the first term, 60.5% of the groups choose to share the variable costs of communication while only 28.2% of the groups do the same for punishment. But when they are in the last term, only 15.8% of the groups still share the variable costs of communication while the percentage increases to 42.1% for punishment. The reverse in their attitudes towards communication and punishment suggests that subjects indeed prefer different types of institutions out of strategic considerations. The correspondence between the establishment and the cost sharing rules of an institution suggests that people are only willing to pay for the institutions they vote for. Summarizing, this gives the following result:

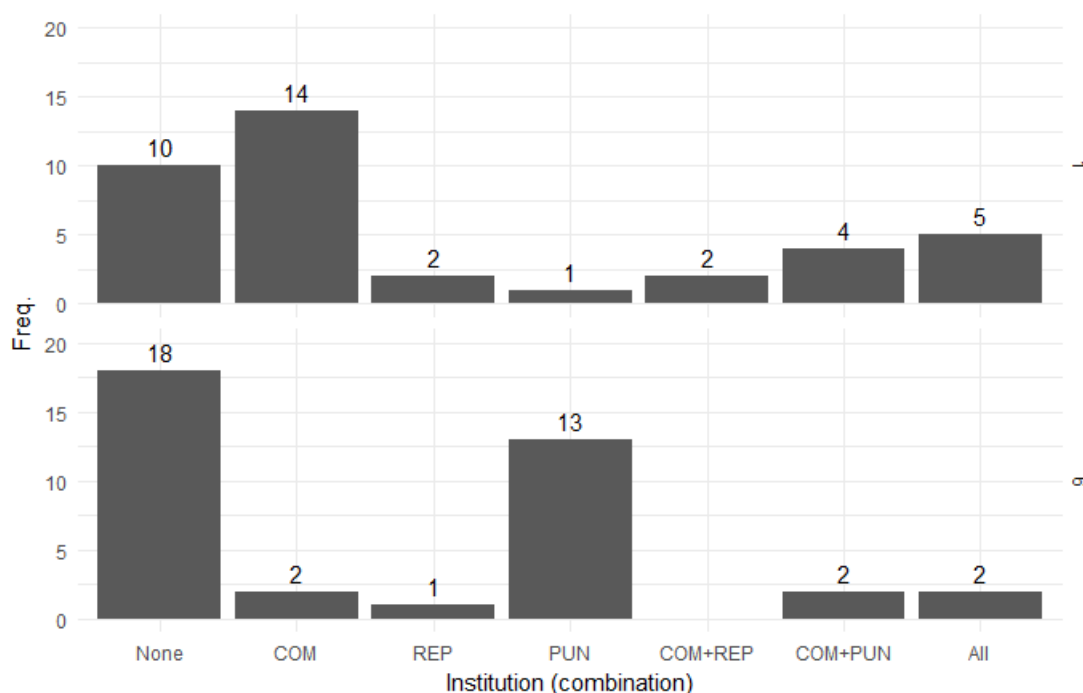


Figure 7: Group institutional choices in term 1 and term 6

**Result 5.** *Groups prefer communication in the beginning of the game, then turn to punishment when they approach the end of the game.*

Finally, we present a complete and detailed picture of how institutions evolve over time in each group of the three treatments in Figures 8, 9 and 10. On each graph, each sub-plot shows the institutional choices of one group over 6 terms. The color of dots denotes the instability index of the institutional choice in a term (see section 3.3). A red dot suggests that institutions have changed a lot from previous term while a blue dot is a sign of stability.

Visual inspection shows that institutional choices in groups of FD treatment are the most "stable" as the graph of FD looks more blue. Seven out of 12 groups

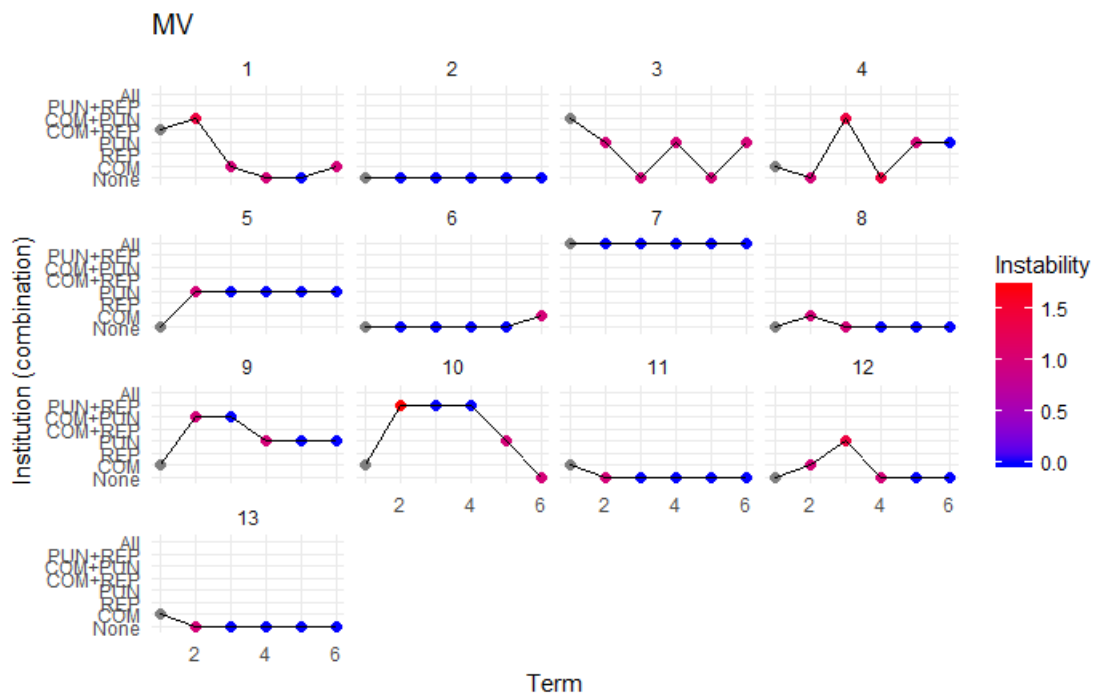


Figure 8: Evolution of institutions in MV

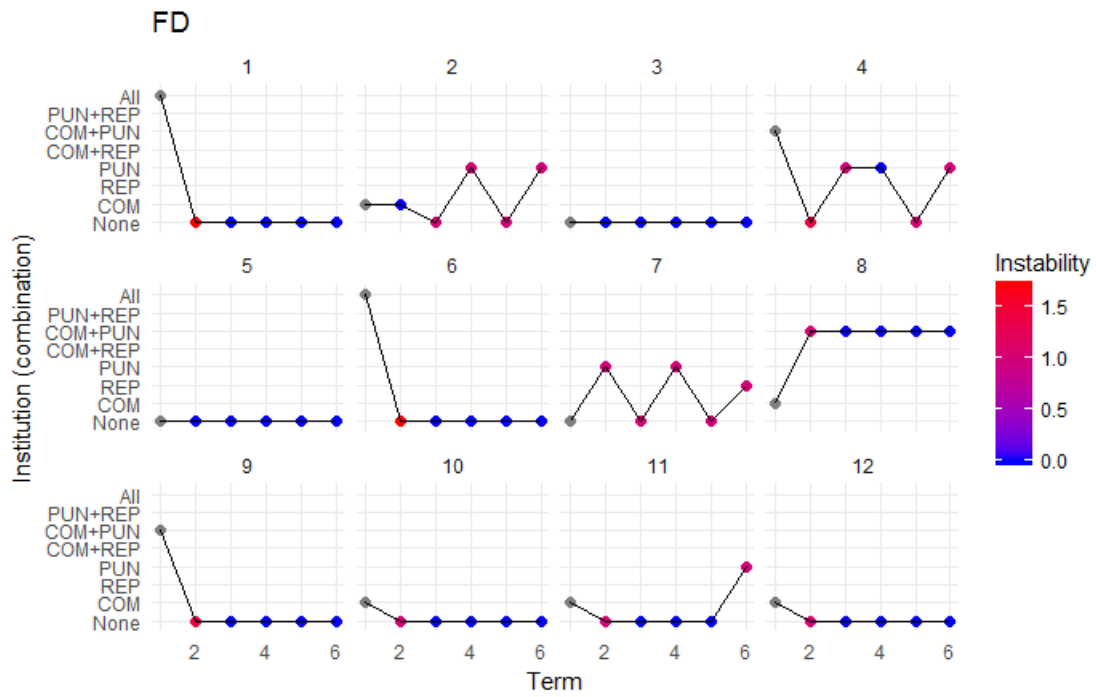


Figure 9: Evolution of institutions in FD



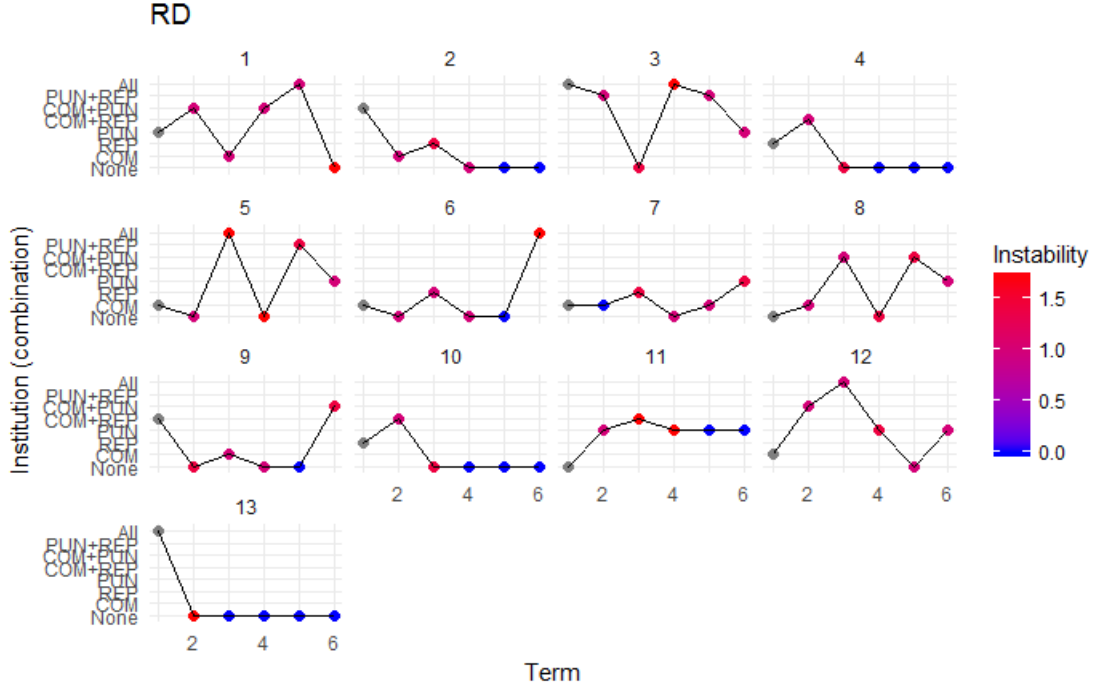


Figure 10: Evolution of institutions in RD

in FD converge to no institutions immediately after the second term. In sharp contrast, groups in RD treatment seem to be struggling with picking out the best institutions for their group. There is frequent and seemingly random switching among different institution combinations and no sign of convergence even after several terms. What happens in MV is somewhere in between the case of FD and RD.

To evaluate the magnitude of change in institutions between two consecutive rounds/terms more formally, we use the measure constructed in section 3.3: *instability index* $_{jt} = \|\mathbf{p}_{j,t-1}, \mathbf{p}_{j,t}\|$ . Taking the average of the instability index over all rounds gives us a measure of the overall degree of instability of a group's institutional choices over time:  $instability_j = \sum_{t \in \{2, \dots, 18\}} \|\mathbf{p}_{j,t-1}, \mathbf{p}_{j,t}\|$ . Conducting Mann-Whitney U tests on these average degree of instability confirms that institutional choices in FD and MV are more stable than in RD (both differences are significant with  $p < 0.01$ ) while the difference between FD and MV groups is not significant. Note that this is not a direct test of our second hypothesis regarding the stability of collective-choice rules, which will be discussed in the next section.

**Result 6.** *Groups in the FD and MV treatments produce significantly more stable institutions over time than in in the RD treatment.*

## 4.2 Direct and indirect effects of collective-choice rules

We now test our hypotheses regarding the direct and indirect effects of collective-choice rules.

### 4.2.1 Direct effects

As a reminder, direct effects of collective-choice rules can be captured by measuring the influence of these rules on contribution behavior after controlling for institutions. We use only the first round information to test whether there is difference in group contribution between democratic rules and non-democratic rules (MV versus FD and RD versus FD), given the same institution:

$$E[X_{j1}|MV, \mathbf{p}_{j1}] - E[X_{j1}|FD, \mathbf{p}_{j1}]$$

$$E[X_{j1}|RD, \mathbf{p}_{j1}] - E[X_{j1}|FD, \mathbf{p}_{j1}].$$

The problem with focusing only on the first round contributions is that for most institutions (combinations) the number of observations is not sufficient to perform statistical tests; only the combinations  $p_{j1} = (0, 0, 0)$  ("no institution") and  $p_{j1} = (1, 0, 0)$  ("only communication") have enough observations. In the case without any institutions, individual contributions do not differ between the three treatments. With only communication, groups in FD contribute significantly more than those in MV (Mann–Whitney U test,  $p=0.054$ ,  $n=10$ ) and those in RD (Mann–Whitney U test,  $p=0.007$ ,  $n=9$ ).

**Result 7.** *FD has a positive direct effect on contribution behavior compared with MV and RD, provided that communication is used. When there is no institution, we do not find any direct effects of collective-choice rules.*

Our first hypothesis is thus not supported. We do not find positive direct effects of democratic collective-choice rules on cooperation. On the contrary, direct effects, if any, work in the opposite direction as predicted.

### 4.2.2 Indirect effects

In section 4.1.3, we demonstrated that institutional choices in FD groups and MV groups tend to be more stable than those in RD groups:

$$E[\text{instability}_j|FD] < E[\text{instability}_j|RD],$$

$$E[\text{instability}_j|MV] < E[\text{instability}_j|RD].$$

However, this is not a direct proof of the inherent instability of collective-choice rules. A change in institutions might stem from group members' dissatisfaction with their cooperation level, and this might in turn hurt group morale and lead to even less cooperation. Instability could be the product of amplified initial difference in cooperation level among groups, rather than the indirect effects of collective-choice rules per se. Ideally, we want to control for all factors that could possibly affect institutional choices, such as group performance and group morale, and compare the overall instability index when collective-choice rule is the only thing that varies. More formally, we want to test if

$$E[\textit{instability}_j|FD, \epsilon_j] - E[\textit{instability}_j|MV, \epsilon_j] < 0,$$

$$E[\textit{instability}_j|MV, \epsilon_j] - E[\textit{instability}_j|RD, \epsilon_j] < 0$$

Again, we can use the measure constructed in section 3.3 to evaluate the magnitude of change in institutions between two consecutive terms:  $\textit{instability index}_{jt} = \|\mathbf{p}_{j,t-1}, \mathbf{p}_{j,t}\|$ . The key to testing the indirect effects is to construct counterfactual group institutional choices aggregated using a different collective-choice rule for each group, such that only collective-choice rules varies while group performance and group morale are controlled for. Here we may exploit the fact that every subject is asked to indicate her institutional preference in each term, regardless of whether she is the dictator or not. For each group, counterfactual MV institutional choice is the result of aggregating individual choices in each term by majority rule. Of course, this counterfactual MV institutional choice coincides with the actual institutional choice in MV treatment. Counterfactual FD outcome is simply a copy of each individual's institutional choice over 6 terms, as if this individual were the dictator. So we will have 3 counterfactual FD indices for each group. To obtain a counterfactual RD index, we generate all possible permutations of random dictators according to our rotating rule specified in section 3 and take the average of the resulting instability index as the counterfactual RD index.

Notice that we believe that this exercise only makes sense if we use **incentivized** individual choices. Every individual institutional choice in MV treatment is incentivized since every group member plays a pivotal role in determining their group institutional choice. This does not hold for the FD and RD treatments, however. In the FD treatment, non-dictators know immediately after the first voting stage that they are not the dictators and that their institutional choices do not matter. In the RD treatment, subjects were informed that each group member will be the dictator exactly twice. Once an individual has become the dictator twice, she will know that her institutional choices will not count afterwards anymore.<sup>8</sup>

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<sup>8</sup>More accurately, only the subject who was assigned as the dictator in the last term would make

Therefore, it's not legitimate to construct counterfactual MV and RD indices for the FD and RD treatments. For the current analysis we use only the data of the MV treatment.

We do not find evidence suggesting any difference in stability of majority voting and dictatorship (Wilcoxon signed-rank test,  $p > 0.844$ ). But there is strong evidence showing that rotating dictatorship produces more unstable institutional choices than fixed dictatorship (Wilcoxon signed-rank test,  $p < 0.000$ ) or than majority voting (Wilcoxon signed-rank test,  $p < 0.005$ ).

**Result 8.** *Institutional choices generated by rotating dictators are significantly more unstable than those generated via majority voting or fixed dictatorship while the stability of institutional choices between majority voting and fixed dictatorship is not significantly different.*

Our second hypothesis is thus partially supported in the sense that certain collective-choice rules indeed have an impact on the stability of policy outcomes, or institutional choices in our setting, but not in the way social choice theory predicts. Our results suggest that as long as the decision committee is fixed during a period of time, majority voting does not seem to dampen the stability of collective decision outcomes.

## 5 Mechanisms: What drives the direct effects

Result 7 seems to contradict what the "fairness" argument predicts. In this section we try to explore why this is the case. One conjecture points to the content of communication, that is the messages subjects exchange in the communication phase may cause the difference between FD and RD. A second conjecture is that the dictators in FD treatment function as "leaders". They might take their responsibilities in promoting group cooperation by sending messages and making larger contributions than non-dictators. As a result, the whole group benefits from having a leading figure, even though they cannot identify which member is the leader. In this section, we provide some evidence supporting the first conjecture and evidence against the second.

### 5.1 The usage and the content of communication

First we run a regression to explore the determinants of individual contribution behavior in the first round. We estimate three specifications using a simple linear

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every institutional choice in an incentivized manner. This allows us to construct one counterfactual FD index for RD treatment. Adding these data do not change our results.

model and a censored tobit model, respectively. The first specification takes the form

$$x_{ij1} = \alpha + \beta C_j + \epsilon_{i1} \quad (1)$$

where  $x_{ij1}$  is the contribution to the public good of individual  $i$  in group  $j$ , round 1.  $C_j$  is a vector of two dummy variables indicating whether the individual is in treatment MV and whether the individual is in treatment RD. The benchmark treatment in the regression is FD. The second specification is identical to the first one, except that it also takes into consideration the institutional choices of a group in round 1

$$x_{ij1} = \alpha + \beta C_j + \delta \mathbf{p}_{j1} + \sigma \text{ShareVariableCost}_{j1} + \epsilon_{i1} \quad (2)$$

where  $\mathbf{p}_{j1}$  represents the establishment of the 3 available institutions in group  $j$  and  $\text{ShareVariableCost}_{j1}$  denotes whether the variable costs of an institution is shared among group members. Our last specification controls for some individual characteristics, in addition to the second specification

$$x_{ij1} = \alpha + \beta C_j + \delta \mathbf{p}_{j1} + \sigma \text{ShareVariableCost}_{j1} + \eta Y_i + \epsilon_{i1} \quad (3)$$

where  $Y_i$  includes gender and a dummy variable denoting whether the individual has experience in similar experiments.

Results are reported in Table 4. Table 4 confirms that subjects in FD contribute significantly more than those in RD and this positive effect of fixed dictatorship on contribution persists after we control for institutions, gender and a variable indicating whether subjects have participated in a similar experiment before. We also find that the establishment of communication raises the cooperation level significantly. Of the other variables only gender has a significant effect; women contribute significantly more.

Next we look into the usage and the content of communication in the first round. The first three rows of Table 5 give a summary of the usage of communication across treatments: the number of groups that have established communication, the number of individuals who send any message at all, and the number of messages sent. We detect no significant difference across treatments.

Remember that the content of a messages is semi-specified. It can be a proposal for certain amount of contribution to the public good, a proposal for the establishment of certain institution combinations or a proposal for a certain cost-sharing rule. Although there are some differences, similar types of messages are sent across treatments. However, individual contributions may not only be influenced

Table 4: Determinants of contribution in 1st round

	<i>Dependent variable:</i>					
	Contribution					
		<i>censored regression</i>			<i>OLS</i>	
	(1)	(2)	(3)	(4)	(5)	(6)
MV	-5.964 (5.269)	-3.720 (4.716)	-3.262 (4.633)	-1.795 (1.537)	-0.948 (1.405)	-0.856 (1.420)
RD	-13.183** (5.213)	-12.446*** (4.788)	-10.694** (4.657)	-3.667** (1.537)	-3.219** (1.431)	-2.845* (1.454)
Communication		16.538*** (4.028)	14.563*** (4.865)		6.054*** (1.248)	5.366*** (1.607)
Punishment		0.339 (4.557)	1.527 (5.759)		0.057 (1.438)	-0.043 (1.990)
Reputation		6.579 (4.815)	6.065 (4.956)		1.693 (1.464)	1.367 (1.543)
Share_COM			2.431 (4.957)			0.931 (1.600)
Share_PUN			-1.907 (5.860)			0.218 (2.015)
Gender			7.581** (3.727)			2.077* (1.163)
Experience			2.902 (3.840)			1.097 (1.290)
logSigma	2.889*** (0.148)	2.714*** (0.145)	2.676*** (0.145)			
Constant	31.821*** (4.548)	17.981*** (4.172)	12.094** (5.235)	17.333*** (1.109)	12.492*** (1.348)	10.560*** (1.742)
Observations	114	114	114	114	114	114
R <sup>2</sup>				0.049	0.254	0.287
Adjusted R <sup>2</sup>				0.032	0.219	0.225
Akaike Inf. Crit.	402.159	382.923	385.595			
Bayesian Inf. Crit.	413.104	402.077	415.694			

Note:

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Table 5: Usage of communication in round 1

	MV	FD	RD
NO. groups using communication	8	9	8
NO. individuals sending any message	20	21	20
NO. messages sent	39	38	33
contribution	18	19	20
institution	13	10	7
sharing-rule	8	9	6

by the type of message sent, but also by the specific proposals for contribution made; see Table 6 for the frequency of the proposed amount of contribution proposed in round 1. Indeed, Fisher's exact tests show that the proposals for contribution are significantly different between MV and RD ( $p=0.08$ ,  $n=38$ ), and between FD and RD ( $p=0.041$ ,  $n=39$ ): Less people in RD propose to contribute the full endowment to the public good.

Table 6: Frequency of individual proposed contribution in round 1

proposed amount	MV	FD	RD
0	0	0	1
3	0	1	0
5	0	0	1
8	0	1	0
10	1	0	5
15	0	1	1
20	17	16	12
N	18	19	20

Experimental literature demonstrates that a large fraction of the population can be categorized as conditional cooperator (Fischbacher et al., 2001): they cooperate only if they expect others to cooperate. The more selfish signals group members exchange, the less cooperative they are likely to be. A regression of actual contribution on the minimal proposed amount of contribution in a group suggests that one point decrease in the minimal proposed amount of contribution lowers actual contribution by 1.07 point ( $p<0.01$ ), averaged across all treatments. The fact that group members observe fewer positive signals in the RD treatment may

explain, at least partly, why RD groups cooperate less.

## 5.2 The leadership effect

To examine if some sort of leadership effect exists, and whether it is stronger in the FD treatment, we compare the behaviors of dictators and non-dictators in the FD and RD treatments.

First, over all rounds with the possibility to communication, dictators are more willing to send messages to their group members than non-dictators (Chi-square test,  $n=387$ ,  $p<0.01$ ). This holds true in both FD and RD subsamples. But dictators in FD treatment are equally willing to communicate as those in RD treatment, if not less. However, the difference between dictators and non-dictators can be attributed to self-selection: we only observe communication within groups with a dictator who has established communication in that specific term and only those who want to send messages would choose communication in the first place.

Second, we compare the proposals about contribution sent by dictators with those sent by non-dictators since the proposed amount of contribution might affect the group morale, as suggested in the last section. We find no difference whatsoever between the two roles in the FD treatment. In the RD treatment, however, dictators propose significantly higher amounts of contribution than non-dictators (Mann–Whitney U test,  $n=24$ ,  $p<0.1$ ).

Finally, dictators behave similarly to non-dictators in terms of actual contribution to the public goods in both FD and RD treatments.

To sum up, there could be a “leadership” effect, although indistinguishable from self-selection. But there is insufficient evidence suggesting that this leadership effect is stronger in the FD treatment than in the RD treatment. The second conjecture therefore cannot account for the higher cooperation level we observed in the FD treatment compared with the RD treatment.

## 6 Conclusion

This paper addresses the role of collective-choice rules when groups can endogenously establish institutions to achieve self-governance in a social dilemma situation. In particular, we explore three basic collective-choice rules: majority voting, fixed dictatorship, and rotating dictatorship. We hypothesize that these collective-choice rules could make a difference via a direct channel (affecting contribution decisions) or an indirect channel (via the choice of institutions). Collective-choice rules might affect cooperation behavior directly, based on the argument that people derive procedural utility and they value fairness and decision rights. We do



not find a “democracy premium” in cooperation behavior of those in the MV or the RD treatments. On the contrary, groups in the FD treatment cooperate at a higher level than those in the RD treatment. The difference in contribution behavior is probably caused by the selfish signals exchanged in a few RD groups. The other channel is an indirect channel, implied by social choice theories. Collective-choice rules generate stable or unstable policy outcomes which may encourage or undermine cooperation. We find that groups in the MV and FD treatments produce significantly more stable institutional choices over time than those in the RD treatment, while no significant difference between MV and FD can be found.

Our findings have implications for the selection of collective-choice rules. It is useful to think about different channels that collective-choice rules can play a role. We provide two aspects that arguments can be reasonably based on: procedural utility and stability. In our setting with small-scale self-governing communities, majority voting and dictatorship do not display significant differences in their effects on self-governance in social dilemma. On one hand, given that the policy outcomes are endogenously chosen by their own people, group members seem to be as much willing to cooperate with a dictator as when they can democratically decide. On the other hand, the instability of majority voting implied by theories might not be so worrisome. But rotating dictators does not seem to be a good option partially because it produces more unstable policy outcomes than the other two collective-choice rules. Whether these results can be generalized to other environments remains to be investigated.

There are several other questions remaining to be answered. For example, our experiment design cannot fully explain why individuals in RD send more selfish signals than in MV and FD. There could be other psychological or cultural channels that are not fully explored. Also, we believe that the causal relationship between stability and cooperation is worth further investigation. Finally, to what extent collective-choice rules make a difference through the two channels in an environment other than our simplified abstract context requires more theoretical insights as well as empirical evidence.

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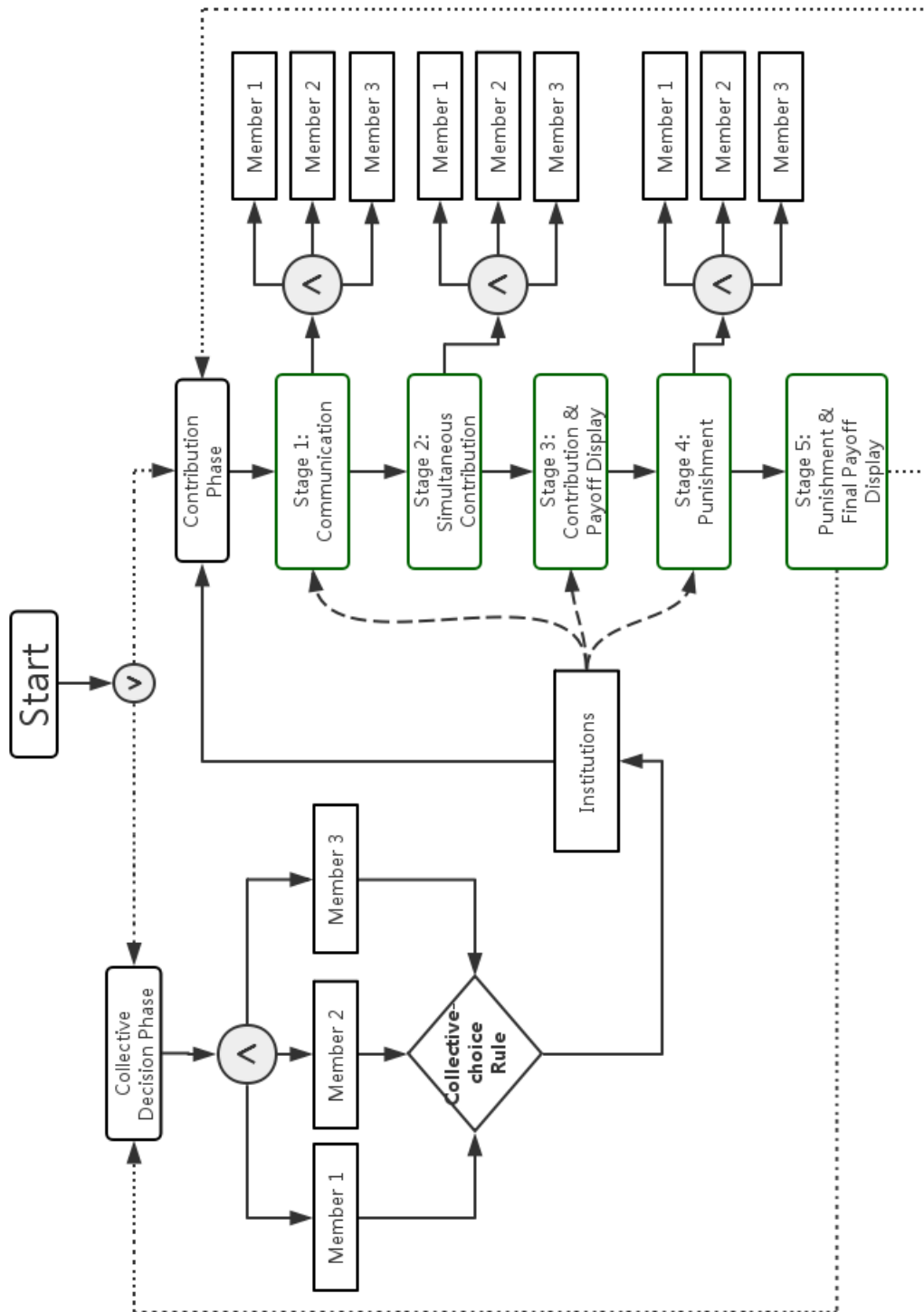
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# A Experiment Procedure



## B Instructions (MV)

Welcome and thanks for your participation. You receive €3 for having shown up on time. If you read these instructions carefully, you can earn more. Your earnings will be paid out to you in cash immediately after the experiment.

It is strictly forbidden to communicate with the other participants during the experiment. If you have any questions or concerns, please raise your hand. We will answer your questions individually.

The experiment consists of 18 rounds. It is divided into 6 terms. Each consists of 3 rounds. You will interact with two other participants. The three of you form a group that will remain the same in all 18 rounds. You will never know which of the other participants are in your group.

The sum of the 18 round payoffs will determine your final earnings. 100 points in the experiment are converted to 3 Euros: 100 points = €3.

### *Basic Game*

This is the game that you play every round. Each participant will be (re)assigned as either Member 1, Member 2, or Member 3. This identity changes every round.

In each round, each of you receive 20 points. In the following, we shall refer to this amount as your endowment. **Your task is to decide how much of your endowment you want to invest in a project.** After investment, the rest of your endowment is kept for yourself.

One POINT, no matter invested by whom, in the project gives 0.5 POINT to each member in your group. Therefore how much you earn from the project depends on both your own investment and your group members' investment. To calculate how much you earn from the project:

1. Investments into the project from the three group members are added up as the total group investment.
2. Each member in this group receives half amount of the total group investment.

The amount that you keep for yourself remains the same. Your profit is therefore the sum of the following two parts:

$$\text{Profit} = 0.5 * \text{total group investment} + \text{the amount that you keep for yourself}$$

You and your group members make this decision at the same time without knowing others' choices. The individual investments and profits of all group members will be shown to you at the end of each round.

Now please look at the screen and answer a few questions. These questions aim at making sure that you understand the game. They do not influence your earnings. If you have any questions, please raise your hand.

### ***Possible Extensions***

As mentioned, the experiment will consist of 6 terms of 3 rounds. At the beginning of each term, you are able to change the rules of the basic game by using one or more of the following three Mechanisms:

**Mechanism A:** It is used before investment. You are able to exchange messages with your group members before making your investment. There are at most three pieces of message you can send, which will be listed below.

**Mechanism B:** It is used after investment, when investments and profits are shown to you. You are able to see not only the investments and profits in the current round, but also the history of investments and profits of your group members in the previous rounds starting from this term. Your identity (Member 1, Member 2, or Member 3) will not change during this term.

**Mechanism C:** It is used after seeing your investments and profits. You are able to assign points to other group members to reduce their earnings. Each point assigned to a group member will reduce the earnings of this group member by 3 points. You can only assign points to those who invest less than you.

To be able to use these Mechanisms, you will have to pay for the fixed costs as a group. Each Mechanism costs each member of the group 3 points in this term. That is, each of you pay 1 point per round in the term in which the Mechanism is used.

Additionally, Mechanism A and C might incur variable costs, which depend on your actual usage. Within Mechanism A, the variable cost of each piece of message is 1 point. Within Mechanism C, the variable cost of each assigned point is 1 point. For example, if Member 1 assigns 1 point to Member 2, the variable cost of such action is 1 point, whereas the earnings of Member 2 will be reduced by 3 points.

Your group can choose to share the variable costs of the Mechanism A and C equally among all group members or not. If your group chooses to share the variables costs, then no matter who sends a message or who assigns points to others, the variable costs of such actions will be shared equally by all group members. Otherwise the costs of sending a message or assigning points to others will only be burdened by the member who takes the action.

The following table gives you a summary of the costs of each Mechanism.

**Your task is to decide:**



	Fixed costs	Variable costs
<i>Mechanism A</i>	3 POINTS per person	1 POINT every message
<i>Mechanism B</i>	3 POINTS per person	-
<i>Mechanism C</i>	3 POINTS per person	1 POINT every point assigned

At the beginning of each term

1. With regard to each of the three Mechanisms, would you like it to be used in your group? (Yes/No)

2. With regard to Mechanism A and Mechanism C, would you like the variable costs to be shared equally by all group members? (Yes/No)

In each round

3. (If applicable) Do you have any messages to send? If yes, what would you send?

There are three pieces of message to choose from. You need to fill in the blank before sending. You can choose more than one of them:

- “I propose that we invest \_\_\_(integer number from 0 to 20) points in the project.”
- “I propose that we later use Mechanism \_\_\_ (A/B/C/none).”
- “I propose that we later share the variable cost of Mechanism \_\_\_(A/C/none).”

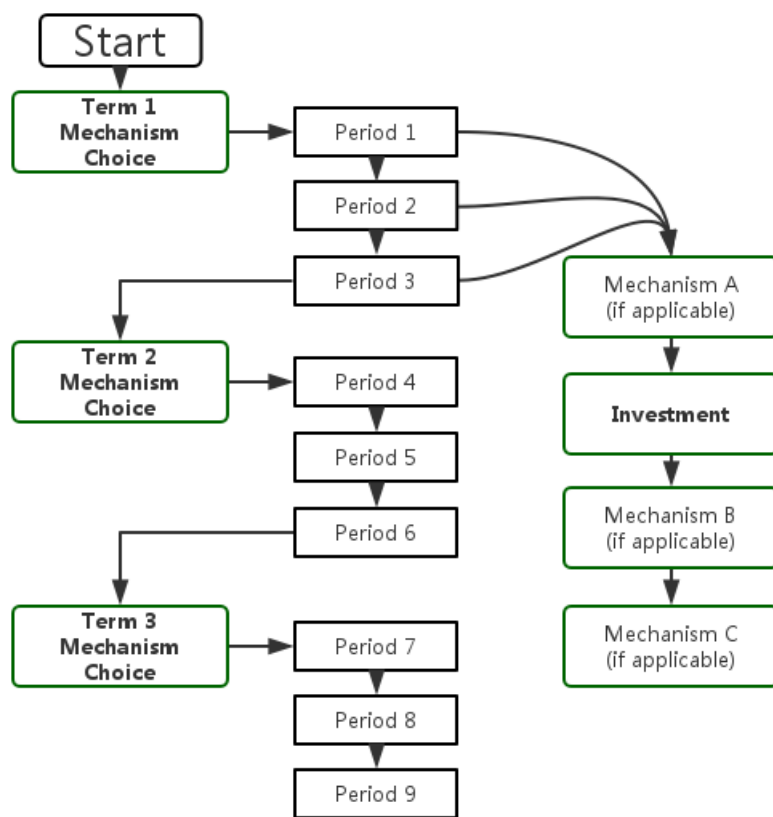
4. (If applicable) How many points you want to assign to those who invest less than you?

Whether a Mechanism will be actually used depends on whether a majority in your group agree to use it. That is, if two or more group members vote yes for a Mechanism, it will be used in the following term (three rounds) and all group members will pay for its fixed costs.

For Mechanism A and C, whether the variable costs would be shared equally by all group members depends on whether a majority in your group agree to it.

***How is the game played?***

The procedure of the game is shown in the following picture. (Only the first three terms are presented).



## C Instructions (FD)

Welcome and thanks for your participation. You receive €3 for having shown up on time. If you read these instructions carefully, you can earn more. Your earnings will be paid out to you in cash immediately after the experiment.

It is strictly forbidden to communicate with the other participants during the experiment. If you have any questions or concerns, please raise your hand. We will answer your questions individually.

The experiment consists of 18 rounds. It is divided into 6 terms. Each consists of 3 rounds. You will interact with two other participants. The three of you form a group that will remain the same in all 18 rounds. You will never know which of the other participants are in your group.

The sum of the 18 round payoffs will determine your final earnings. 100 points in the experiment are converted to 3 Euros: 100 points = €3.

### ***Basic Game***

This is the game that you play every round. Each participant will be (re)assigned as either Member 1, Member 2, or Member 3. This identity changes every round.

In each round, each of you receive 20 points. In the following, we shall refer to this amount as your endowment. **Your task is to decide how much of your endowment you want to invest in a project.** After investment, the rest of your endowment is kept for yourself.

One POINT, no matter invested by whom, in the project gives 0.5 POINT to each member in your group. Therefore how much you earn from the project depends on both your own investment and your group members' investment. To calculate how much you earn from the project:

1. Investments into the project from the three group members are added up as the total group investment.
2. Each member in this group receives half amount of the total group investment.

The amount that you keep for yourself remains the same. Your profit is therefore the sum of the following two parts:

$$\text{Profit} = 0.5 * \text{total group investment} + \text{the amount that you keep for yourself}$$

You and your group members make this decision at the same time without knowing others' choices. The individual investments and profits of all group members will be shown to you at the end of each round.

Now please look at the screen and answer a few questions. These questions aim at making sure that you understand the game. They do not influence your earnings. If you have any questions, please raise your hand.

### ***Possible Extensions***

As mentioned, the experiment will consist of 6 terms of 3 rounds. At the beginning of each term, you are able to change the rules of the basic game by using one or more of the following three Mechanisms:

**Mechanism A:** It is used before investment. You are able to exchange messages with your group members before making your investment. There are at most three pieces of message you can send, which will be listed below.

**Mechanism B:** It is used after investment, when investments and profits are shown to you. You are able to see not only the investments and profits in the current round, but also the history of investments and profits of your group members in the previous rounds starting from this term. Your identity (Member 1, Member 2, or Member 3) will not change during this term.

**Mechanism C:** It is used after seeing your investments and profits. You are able to assign points to other group members to reduce their earnings. Each point assigned to a group member will reduce the earnings of this group member by 3 points. You can only assign points to those who invest less than you.

To be able to use these Mechanisms, you will have to pay for the fixed costs as a group. Each Mechanism costs each member of the group 3 points in this term. That is, each of you pay 1 point per round in the term in which the Mechanism is used.

Additionally, Mechanism A and C might incur variable costs, which depend on your actual usage. Within Mechanism A, the variable cost of each piece of message is 1 point. Within Mechanism C, the variable cost of each assigned point is 1 point. For example, if Member 1 assigns 1 point to Member 2, the variable cost of such action is 1 point, whereas the earnings of Member 2 will be reduced by 3 points.

Your group can choose to share the variable costs of the Mechanism A and C equally among all group members or not. If your group chooses to share the variables costs, then no matter who sends a message or who assigns points to others, the variable costs of such actions will be shared equally by all group members. Otherwise the costs of sending a message or assigning points to others will only be burdened by the member who takes the action.

The following table gives you a summary of the costs of each Mechanism.

**Your task is to decide:**

	Fixed costs	Variable costs
<i>Mechanism A</i>	3 POINTS per person	1 POINT every message
<i>Mechanism B</i>	3 POINTS per person	-
<i>Mechanism C</i>	3 POINTS per person	1 POINT every point assigned

At the beginning of each term

1. With regard to each of the three Mechanisms, would you like it to be used in your group? (Yes/No)

2. With regard to Mechanism A and Mechanism C, would you like the variable costs to be shared equally by all group members? (Yes/No)

In each round

3. (If applicable) Do you have any messages to send? If yes, what would you send?

There are three pieces of message to choose from. You need to fill in the blank before sending. You can choose more than one of them:

- “I propose that we invest \_\_\_(integer number from 0 to 20) points in the project.”
- “I propose that we later use Mechanism \_\_\_ (A/B/C/none).”
- “I propose that we later share the variable cost of Mechanism \_\_\_(A/C/none).”

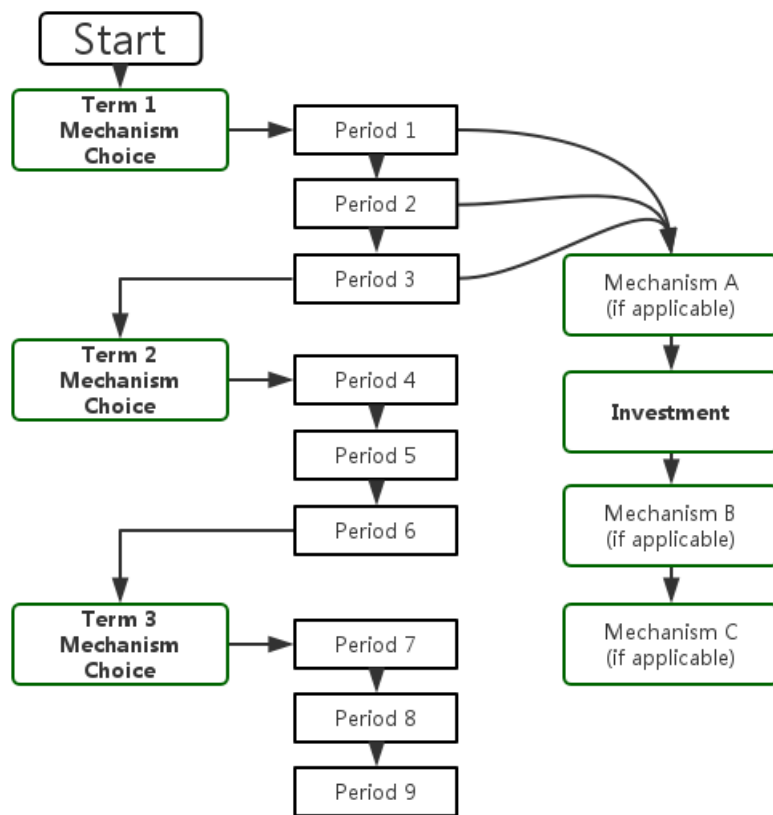
4. (If applicable) How many points you want to assign to those who invest less than you?

One of the group members will be randomly assigned the role of decision maker throughout the 6 terms. Whether a Mechanism will be actually used and whether the variable costs will be shared equally totally depend on the decision maker’s choice. You are informed of your role after all group members have made their choices regarding the Mechanisms in term 1.

If you are not the decision maker, you are still able to indicate your preferences although your choices will not affect the outcome.

***How is the game played?***

The procedure of the game is shown in the following picture. (Only the first three terms are presented).



## D Instructions (RD)

Welcome and thanks for your participation. You receive €3 for having shown up on time. If you read these instructions carefully, you can earn more. Your earnings will be paid out to you in cash immediately after the experiment.

It is strictly forbidden to communicate with the other participants during the experiment. If you have any questions or concerns, please raise your hand. We will answer your questions individually.

The experiment consists of 18 rounds. It is divided into 6 terms. Each consists of 3 rounds. You will interact with two other participants. The three of you form a group that will remain the same in all 18 rounds. You will never know which of the other participants are in your group.

The sum of the 18 round payoffs will determine your final earnings. 100 points in the experiment are converted to 3 Euros: 100 points = €3.

### *Basic Game*

This is the game that you play every round. Each participant will be (re)assigned as either Member 1, Member 2, or Member 3. This identity changes every round.

In each round, each of you receive 20 points. In the following, we shall refer to this amount as your endowment. **Your task is to decide how much of your endowment you want to invest in a project.** After investment, the rest of your endowment is kept for yourself.

One POINT, no matter invested by whom, in the project gives 0.5 POINT to each member in your group. Therefore how much you earn from the project depends on both your own investment and your group members' investment. To calculate how much you earn from the project:

1. Investments into the project from the three group members are added up as the total group investment.
2. Each member in this group receives half amount of the total group investment.

The amount that you keep for yourself remains the same. Your profit is therefore the sum of the following two parts:

$$\text{Profit} = 0.5 * \text{total group investment} + \text{the amount that you keep for yourself}$$

You and your group members make this decision at the same time without knowing others' choices. The individual investments and profits of all group members will be shown to you at the end of each round.

Now please look at the screen and answer a few questions. These questions aim at making sure that you understand the game. They do not influence your earnings. If you have any questions, please raise your hand.

### ***Possible Extensions***

As mentioned, the experiment will consist of 6 terms of 3 rounds. At the beginning of each term, you are able to change the rules of the basic game by using one or more of the following three Mechanisms:

**Mechanism A:** It is used before investment. You are able to exchange messages with your group members before making your investment. There are at most three pieces of message you can send, which will be listed below.

**Mechanism B:** It is used after investment, when investments and profits are shown to you. You are able to see not only the investments and profits in the current round, but also the history of investments and profits of your group members in the previous rounds starting from this term. Your identity (Member 1, Member 2, or Member 3) will not change during this term.

**Mechanism C:** It is used after seeing your investments and profits. You are able to assign points to other group members to reduce their earnings. Each point assigned to a group member will reduce the earnings of this group member by 3 points. You can only assign points to those who invest less than you.

To be able to use these Mechanisms, you will have to pay for the fixed costs as a group. Each Mechanism costs each member of the group 3 points in this term. That is, each of you pay 1 point per round in the term in which the Mechanism is used.

Additionally, Mechanism A and C might incur variable costs, which depend on your actual usage. Within Mechanism A, the variable cost of each piece of message is 1 point. Within Mechanism C, the variable cost of each assigned point is 1 point. For example, if Member 1 assigns 1 point to Member 2, the variable cost of such action is 1 point, whereas the earnings of Member 2 will be reduced by 3 points.

Your group can choose to share the variable costs of the Mechanism A and C equally among all group members or not. If your group chooses to share the variables costs, then no matter who sends a message or who assigns points to others, the variable costs of such actions will be shared equally by all group members. Otherwise the costs of sending a message or assigning points to others will only be burdened by the member who takes the action.

The following table gives you a summary of the costs of each Mechanism.

**Your task is to decide:**



	Fixed costs	Variable costs
<i>Mechanism A</i>	3 POINTS per person	1 POINT every message
<i>Mechanism B</i>	3 POINTS per person	-
<i>Mechanism C</i>	3 POINTS per person	1 POINT every point assigned

At the beginning of each term

1. With regard to each of the three Mechanisms, would you like it to be used in your group? (Yes/No)
2. With regard to Mechanism A and Mechanism C, would you like the variable costs to be shared equally by all group members? (Yes/No)

In each round

3. (If applicable) Do you have any messages to send? If yes, what would you send?

There are three pieces of message to choose from. You need to fill in the blank before sending. You can choose more than one of them:

- “I propose that we invest \_\_\_(integer number from 0 to 20) points in the project.”
  - “I propose that we later use Mechanism \_\_\_ (A/B/C/none).”
  - “I propose that we later share the variable cost of Mechanism \_\_\_(A/C/none).”
4. (If applicable) How many points you want to assign to those who invest less than you?

In each term, one group member will be randomly assigned the role of decision maker. Whether a Mechanism will be actually used and whether the variable costs will be shared equally totally depend on the decision maker’s choice. Each of the group members will become the decision maker exactly twice in the six terms. You are informed of your role only after all group members have made their choices regarding the Mechanisms.

If you are not the decision maker, you are still able to indicate your preferences although your choices will not influence the outcome.

### ***How is the game played?***

The procedure of the game is shown in the following picture. (Only the first three terms are presented).

