Institutional Choice and Cooperation in Representative Democracies: An Experimental Approach

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Abstract

It is examined whether an institution has a differing impact on cooperation if it is introduced by a representative of the affected parties rather than autocratically imposed. The experimental design is able to control for selection effects arising from the democratic policy choice. I find evidence of a large *endogeneity premium* in the sense that endogenously implemented institutions lead to higher cooperation than exogenous policies. Especially the subjects who initially did not prefer the policy comply highly if it was brought about by an elected representative. This result cannot be explained with conventional economic theory and has important implications for policy recommendations and the analysis of decision-making processes.

Keywords: Laboratory Experiment, Representative Democracy, Collective Decision-Making, Social Dilemma

1 Introduction

The central argument for ceding authority from citizens to the state is to overcome the social dilemma that economists typically model as a prisoners' dilemma. It is characterised by the conflict between maximizing individual payoffs versus overall welfare. As a consequence, societies are shaped by institutions that punish free-riding behaviour in order to attain a more efficient outcome for every citizen. Examples range from taxation authorities and court systems to international agreements to contend climate change and anticompetitive firm behaviour.

That a central authority can effectively improve cooperation has been shown in manifold economic experiments. Recently, additional interest in endogenous institutions which do not "fall from heaven" but are introduced by the affected parties themselves is growing. The process that leads to an institutional setting might well influence the extent to which it can fulfill its societal purpose. This study sheds light on the question how institution formation influences cooperation levels in an indirect democracy. A law that potentially fosters

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cooperation is democratically introduced into a prisoners' dilemma and it is examined whether the policy's effectiveness differs if it is autocratically imposed.

Dal Bó, Foster, and Putterman (2010) develop an experimental approach to quantify the impact that democratic procedures have on cooperation levels in a direct democracy. I extend the experiment by including the election of a representative. The modification is a robustness test for the authors' findings under very common circumstances: nations, firms and clubs typically delegate at least parts of their decision-making processes to representatives.

The experiment has two stages. The first consists of a repeated prisoners' dilemma. Subsequently, subjects form preferences about the introduction of a formal institution that penalizes unilateral free-riding. This institutional change is modeled by a transformation of the payoff structure to a coordination game that makes cooperation incentive-compatible. A vote for a representative follows, whose preference about payoff modification becomes binding for the group, but is only considered with some probability. If it is not considered either the coordination game or prisoners' dilemma is randomly assigned to each group for the second stage. Cooperation rates before and after the vote are analysed conditional on individual modification preferences and the outcome of the random intervention.

Dal Bó et al. (2010)'s claim is that a democratically introduced institution has an intrinsic behavioral effect that goes beyond the pure policy impact. The question of my study is whether the influence of an institution in a representative democracy is different if it is endogenously implemented. This influence is measured in terms of differences in cooperation rates between subjects with comparable preferences. The central hypothesis is that the endogenous introduction of a policy leads to increased cooperativeness. The topic of the behavioral effects of endogenous institutions in general and in representative democracies in particular is of relevance for the evaluation of experimental treatment effects in which subjects are assigned to different institutions. If the way an institution is implemented has quantifiable behavioral consequences this has to be accounted for in the analysis. The findings are also of interest for policy-makers. Can a law that was observed to be effective in one instance also be prescribed in other situations? Consider for example the progressing European integration. Is a reform introduced in Greece as effective when it is de facto prescribed from an external authority such as the "Troika" as if it was introduced directly by the national government? These questions extend economic theory, which is outcome-oriented and does usually not consider utility derived from processes and contextual phenomena.

The main shared result with Dal Bó et al. (ibid.) is that the institutional change significantly fosters cooperation and even more so when introduced by a group representative instead of the computer. This holds true even when controlling for information and individual characteristics to eliminate self-selection biases. In contrast to Dal Bó et al. (ibid.) I find that especially those subjects who initially did not prefer the coordination game respond strongly to a democratic payoff modification with an increased willingness to cooperate. A decomposition of cooperation rates in the different outcomes of the vote stages gives evidence of a large democracy premium beyond the pure policy effect of the modified

payoffs. 78 percent of the total policy impact can be attributed to this endogeneity effect. Self-selection of cooperative players into the policy is a smaller factor than expected.

The remainder of the study is structured as follows. Section 2 reviews the most closely related literature with a focus on the effects of endogenous institutions in experiments. Section 3 presents the design of the experiment. In section 4, I briefly discuss the relevant theory and derive testable hypotheses. Section 5 reports the analysis and results including the findings on the relation between indirect democracy and cooperation. Section 6 discusses these results and concludes.

2 Related Literature

Institutions[1] are henceforth defined according to North (1990, p.3) as "the rules of the game in a society, [...] the humanly devised constraints that shape human interactions". Hodgson (2006, p.2) adds that institutions create stable expectations by both constraining and enabling this behaviour. The focus of this paper lies on formal institutions, e.g. laws, that are publicly designed and enforced, as opposed to informal sanctions which are privately implemented and often self-enforcing (Groenewegen et al., 2010, p.25).

A central result from previous experiments is that direct democratic participation rights increase subjects' contributions to a public good, ceteris paribus. These insights cannot be explained with the outcome-oriented standard economic theory. In such a setting, an endogeneity premium of democratic institutions is not reasonable if the institution that is implemented and the information provided remain the same. However, Frey et al. (2004, p.379) introduce *procedural utility* allowing for the possibility that people have preferences about the process that leads to instrumental outcomes.

A concept from political theory that can be related to the study of endogenous institutions is input legitimacy, meaning that an institution is responsive to citizens' needs by allowing them to participate in the decision-making process (Schmidt, 2013).

2.1 Democratic Policy Selection in Public Goods Games

Dal Bó et al. (2010) build on the rapidly growing empirical literature including field and lab experiments exploring the key factors that influence cooperative behaviour in democratic societies. This body of research suggests that the process of the implementation of an institution matters in addition to the institutional design itself. The current evidence about the influence of participation rights on cooperation levels is mainly based on public goods experiments, [2] where democratic structures are implemented into the policy selection

[1] Literature investigating the importance of democratic institutions dates back to authors of the 19th century such as Schmoller, Menger, Veblen, and de Tocqueville (Scott, 2013, pp.2-7). Acemoglu et al. (2001) emphasize the importance of institutions for the development of an economy: differences in institutions are able to explain a great share of differences in development and economic growth across countries. But which specific institutional design and implementation can be recommended is disputed (Aghion, 2006).

[2] Neoclassical economic theory assuming rational and selfish individuals predicts under-provision of public goods since these are non-rival and non-excludable (Varian, 2007). They represent a variant of the prisoners' dilemma (Kagel and Roth, 1995, p.23). But if public good provision is simulated in lab experiments, it is often found that players do not completely free-ride. For surveys of the vast literature on public goods experiments see Ledyard (1997) and Chaudhuri (2011).

process by allowing participants to directly vote on different proposals.

Tyran and Feld (2006) produce evidence that an endogenously chosen non-deterrent law reduces free-riding behaviour in public good provision. The authors vary the severity and enaction of a monetary punishment on free-riding. The treatments involve no, mild (i.e. non-deterrent), and deterrent law, which is implemented endogenously or exogenously. In the endogeneity treatment subjects vote on whether to enact a given law and then play a public goods game with the chosen institution. In the exogenous treatment the game is played with a given ordering of the institutions (ibid., p.142). Any contribution under the mild law is in contradiction to game theoretic predictions.

The authors give two explanations why compliance is achieved through the endogenous implementation of non-deterrent law: First, once subjects voted for a law they feel committed to it. Second, the referendum in favour of a law works as a signal to the affected parties, alters their expectations about others' behaviour, and activates the social norm of conditional cooperation[3]. In addition, any law, be it exogenous or endogenous, can serve as a reminder to citizens about the desired behaviour (ibid.). It is found that under exogenous law the mild version does not significantly increase compliance compared to the game without law, while the severe punishment deters free-riding as predicted. In the endogenous treatment, individuals mostly accept mild law and the contribution rate is significantly higher than without law which contradicts the game-theoretic prediction of full free-riding (ibid.). It can be seen that yes-voters comply highly under accepted mild law, but have low contribution rates if the mild law is rejected. This is evidence against a *pure* selection effect, because in this case unconditionally cooperative players contribute similarly under both circumstances (ibid., p.150). However, the mechanism does not allow to isolate a *democratic dividend*. We cannot be sure that the result is not mainly driven by conditional cooperation where players adjust their behaviour in response to the other players' signal.

A study by Sutter et al. (2010) of a public goods game presents additional evidence that participation rights enhance cooperation in groups. The authors employ an experiment in which participants can vote for a decentral punishment or reward mechanism. It is found that for any given institution, endogenous choice is associated with higher contributions compared to an identical mechanism implemented through an external authority (ibid.). Given the experimental design, it is not directly possible to separate the effects of self-selection and endogenous choice. In the exogenous treatment subjects are simply told about the predetermined institution (ibid.). This means that players cannot form substantiated expectations about their fellow players' intentions ex ante. On the other hand, the vote stage in the endogenous treatment reveals information about the group composition and their members' preferences. Conditionally cooperative players are likely to respond to this and adjust their behaviour accordingly. Sutter et al. (ibid., p.1563) note that the voting procedure in small groups entails a non-negligible signalling component and can be interpreted as "implicit communication". Further research is needed to disentangle the

[3] Axelrod (1986) defines social norms as implicit rules in a society to which its members feel compelled to adhere to. The specific norm of conditional cooperation requires someone to cooperate if others also cooperate and is frequently observed in experiments (Tyran and Feld, 2006).

different channels through which endogenous institutional choice influences behaviour.

Markussen et al. (2014) contrast informal and formal sanctions in a public goods game. Informal sanctions turn out to be more popular than formal ones because they are more cost-effective in the experimental setting (ibid.). The authors compare endogenous and exogenous regimes to estimate a *democratic dividend*. It is found, just as in Tyran and Feld (2006), that the efficiency of non-deterrent formal sanctions is higher if they are chosen (Markussen et al., 2014, p.303). But again the increased contributions can also be attributed to an information or signalling effect.

Kamei et al. (2015) further develop Markussen et al. (2014)'s experiment by allowing subjects to decide on the parameters of the formal sanctioning regime themselves. They find that endogenous sanctions are slightly more effective in inducing contributions to the public good than exogenous sanctions, but again self-selection cannot be excluded.

Various authors have taken the search for effects of endogenous institutions in public goods games to the field. Cavalcanti et al. (2010) find that public deliberation increases the willingness of participants to contribute to projects for the management of common resources among Brazilian fishermen. The findings emphasize the importance of communication and public participation in institution formation to establish trust and coordinate on cooperation. Deliberation fosters perceived fairness and legitimacy independent of outcome, a phenomenon that can serve as one explanation for the existence of a *democratic dividend*. Other studies such as Bonin et al. (1993), Bardhan (2000), Black and Lynch (2001), and Fearon et al. (2011) find similar results in vastly different settings ranging from irrigation rules in rural India to workplace decisions of manufacturing businesses in the USA: participation rights increase compliance, productivity, and satisfaction. Grossman and Baldassarri (2012) find that subjects electing leaders contribute more to public goods than subjects who were assigned leaders through a lottery.

2.2 Representative Democracies

Hamman et al. (2011) find that repeated electoral delegation is a useful tool to overcome the free-rider problem in a social dilemma situation via selection. As groups largely choose pro-social representatives, delegation leads to a higher provision of a public good compared to decentralized decision-making. Other experiments find that leadership by example can reduce free-riding and thus improve overall welfare, but is seldom chosen endogenously (Rivas and Sutter, 2011).

Field experiments comparing cooperation under direct and indirect democratic decision-making processes are especially interesting for an assessment of the potential robustness of Dal Bó et al. (2010)'s results when the setting is transferred to a representative democracy. The main finding of Olken (2010) is that when compared to a representative system, direct participation in political decision making increases the satisfaction of participants even when the outcome is not changed. He conducted a randomized field experiment in Indonesian villages, where decisions about the implementation of a project with the character of a public good are either reached through a direct plebiscite or a representative-based meeting. The problem with the latter institution is that it is prone to capture by lo-

cal elites, thereby losing its legitimacy (Olken, 2010, p.243). The results confirm that a plebiscite leads to higher satisfaction of the citizens, increased willingness to contribute to the public good, better knowledge about the projects, and a higher perceived legitimacy of the decision. The study shows that satisfaction increases even when the outcome of the political process is unaffected, thereby lending support to the findings of Dal Bó et al. (2010)'s experiment in a substantially different setting.

A vast number of experiments investigate tax compliance as a representation of contribution to public goods. Pommerehne and Weck-Hannemann (1996), Frey and Feld (2002), Frey and Torgler (2007), and Feld and Frey (2007) show that institutional quality and tax morale are positively correlated. Moreover, the first two studies find that compliance is higher in direct democratic cantons of Switzerland as compared to parliamentary cantons.

2.3 Novel Experiments on Democracy and Cooperation

Dal Bó et al. (2010) further develop the work of Tyran and Feld (2006). In the first part of the experiment, subjects play a prisoners' dilemma in small groups. They are then allowed to vote on whether to change the payoff into a coordination game. This turns cooperation into an additional Nash equilibrium besides mutual defection and can thus increase efficiency. The decision is reached through a simple majority vote. However, with some probability not the referendum but the computer randomly decides on the modification of payoffs. The subjects are informed both about the choice of game for the last stage and how this decision was reached: democratically or by the computer. They then play their respective game. Dal Bó et al. (2010, p.2217) find that when comparing behaviour under endogenous versus exogenous modification, an effect of democratic institutional formation beyond the instrumental effect through the policy choice itself is present.

The innovative experimental mechanism avoids a self-selection bias in investigating the effect of democracy. Even when controlling for selection, endogenous and exogenous payoff modification have a differing impact on cooperation in Dal Bó et al. (ibid.)'s study. The authors find evidence of a *democratic dividend*. The results support the hypothesis that the endogeneity of institutions itself affects individuals' behaviour and has to be considered when making policy recommendations. There seems to be an effect of democratic institutions that goes beyond the instrumental effect of the policy choice. Dal Bó et al. (ibid.) have two hypotheses as to why this could be the case. First, the endogenous modification choice reveals to a subject that their group members are likely to have preferred modification. Second, the endogeneity of the institution as such can influence cooperation. The knowledge that the policy was introduced by the subjects can reinforce cooperation norms or work as an equilibrium selection device. After controlling for information effects in a slightly modified experiment, Dal Bó et al. (ibid.) conclude that the second claim is more likely to hold true.

Sutter et al. (2010) run an experiment in addition to the presented study, with a mechanism that is very similar to Dal Bó et al. (2010)'s experiment: a group's preferred institution is only chosen in 50 percent of the cases. Otherwise, another institution is implemented at random (Sutter et al., 2010, p.1561). When regressing individual con-

tributions on several control variables it is found that whether the vote was considered has no significant influence. From this Sutter et al. (2010) conclude that the institutional design itself influences behaviour and not its democratic nature, which is in contrast to the findings of Dal Bó et al. (2010). At the same time, it is evidence against self-selection as the driver of results (Sutter et al., 2010). The authors conclude that "letting subjects vote is not sufficient for achieving higher contribution levels. [...] Keeping it open whether the vote will really count is detrimental to cooperation" (ibid., p.1563). This would imply that the uncertainty involved in Dal Bó et al. (2010)'s design lowers cooperation. Thus, the true effect of democracy might be even larger than in Dal Bó et al. (ibid.).

2.4 Research Question

It is studied if a given policy that is introduced to a community through an indirect democratic process has a stronger effect on cooperation than an exogenous policy. This *democratic dividend* is isolated by controlling for the instrumental effect of the reform itself, potential selection biases, and information effects from the implementation. There are two central questions: Are subjects willing to introduce a policy that incentivises cooperative behaviour in a social dilemma? And is cooperation influenced by the way the policy is implemented? On top of that the experiment sheds some light on the relationship between the group members in the role of citizens and their representatives.

The addition of a representative democracy introduces important features of political processes typically present in larger communities. I believe this to be relevant for two main reasons. First, it gives important insights into the external validity and scope of Dal Bó et al. (ibid.)'s results. Further light is shed on the channels through which institutions influence cooperation. Conditional cooperation by observation of compliance is easier in small groups compared to larger communities (Tyran and Feld, 2006, p.139). For the latter expectations play an important role which in turn are influenced by the perceived legitimacy of an institution. Second, the results are of relevance for politicians. To make policy recommendations insights into the interdependence between institutions and behaviour, not only for small Polis-style groups but also for communities that operate on a larger scale, are crucial. These societies typically use an indirect democratic system. Hence, following Kagel and Roth (1995, p.22)'s categorisation, I consider this work to be both *speaking to theorists* as well as *whispering in the ears of princes*.

3 The Experiment

The chosen method to shed light on the research question established in the previous section is a lab experiment in which subjects participate anonymously. Computerized economic experiments make it possible to measure the effect of policies under conditions that control the incentives and information structure. Neutral language is used throughout as is common practice in experimental economics to minimize the psychological effect of the institution.[4] The experiment was programmed with the z-Tree software by Fischbacher

[4] The original instructions can be found in the appendix.

(2007). The procedure consists of two stages, the details of which are explained in the following.[5]

Both the experiment conducted by Dal Bó et al. (2010) as well as the extension presented here are based on the prisoners' dilemma game. Payoffs are calculated according to Table 1. This game has a strictly dominant strategy and hence a unique and symmetric Nash equilibrium in which both players defect.[6]

		Player 2	
		C	D
Player 1	C	50, 50	30, 60
	D	60, 30	40, 40

Table 1: Initial Payoffs – Prisoners' Dilemma

The group size is n = 4. Groups are randomly formed at the beginning of the experiment and remain together over the entire session. In the first stage, ten rounds of the prisoners' dilemma are played with random rematching of pairs within each group. When players make the decision to cooperate or defect in each round, they do not know against which group member they are playing. However, to make the voting decision in the second stage of my experiment meaningful, the opponent's player ID – a number which is randomly assigned and kept over the entire session so that group members can identify each other over the course of the different stages – is shown on the screen of each subject together with the earned points at the end of every round. Additionally, I show the actions of the other pair in the group. By doing this, it is ensured that all group members have identical information about the behaviour of the other players in the group. Direct reciprocity among group members is excluded, but it is possible to establish a reputation as a cooperator or "trustworthy partner" (Tyran and Feld, 2006, p.143). However, maintained anonymity of subjects' true identities should rule out the fear of informal sanctions.

The second stage begins with a vote. Instructions for this stage are handed out after the end of the first in order not to influence behaviour previous to the vote. Subjects are asked whether they want to change the payoff matrix of their small group into a coordination game that has an additional – and more efficient – Nash equilibrium than mutual defection, namely cooperation by both players. The possible modification to the payoff structure is shown in Table 2 and can be understood as introducing a penalty on unilateral defection (Dal Bó et al., 2010, p.2207).

		Player 2	
		C	D
Player 1	C	50, 50	30, 48
	D	48, 30	40, 40

Table 2: Modified Payoffs – Cooperation Game

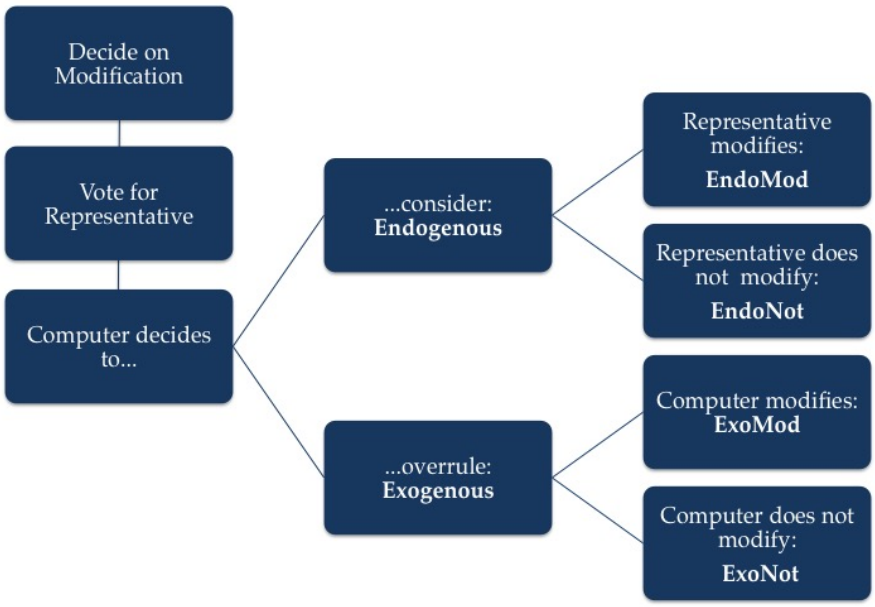
[5] The experiment was first developed in collaboration with Julia S. Wolffson for a course taught by Prof. Dr. Dr. Lydia Mechtenberg at Hamburg University in 2014.

[6] For neutrality, in the instructions and throughout the experimental sessions the actions cooperate and defect are denoted A and B.

Every individual privately announces her preference whether to implement the modification or not. This decision will only matter if she is elected as group representative. This speaker is elected in a voting directly after the modification preference is registered. In order to do so, players are asked to privately announce another group member's ID without knowing her preference for modification explicitly. The idea behind this is that players gained some experience in the first stage and can infer the other group members' preferences for cooperation from their behaviour in the prisoners' dilemma game. I expect that a cooperative player has a preference for modification and therefore votes for another member that behaved in a cooperative way. The player who is named most often in a group is then elected as speaker – the computer randomly breaks a tie when it arises – and the speaker's choice of payoff matrix from now on constitutes the whole groups' decision about modification. Analogous to Dal Bó et al. (2010), the speaker's choice is considered with probability $\frac{1}{2}$. In the other cases the computer arbitrarily decides whether the group plays the prisoners' dilemma or coordination game in the second stage (see figure 1).

Subjects are informed about the outcome of the second vote (the player ID of the elected representative), the preference of the speaker (modify payoffs or not), whether this preference was considered (endogenous or exogenous choice) and consequently the game their group is facing in the second stage (prisoners' dilemma or cooperation game). This game is played for another ten rounds, analogous to the first stage, i.e. with random matching within groups and information on the opponent's identity at the end of each round. To summarize, there are four potential outcomes: payoff modification through the group (EndoMod) or the computer (ExoMod), and an unmodified game either chosen endogenously (EndoNot) or exogenously (ExoNot).

Figure 1: Overview over Vote Stage



The main confounding factor of experiments investigating endogenous institutions is self-selection, because when a policy is introduced "from within" participants predominantly self-select into the treatment. It is only natural that players select into the treatment that best fits their preferences if they are given the choice between different policies. This makes it difficult to compare the impact of institutional designs, since the assignment is not random. Dal Bó et al. (2010) claim that selection leads to an overestimation of the effect of endogenous policy selection since the voting decision and behaviour are positively correlated. In order to eliminate the effect randomization and control for underlying characteristics are introduced into the experiment. This design holds the advantage that the results of groups that voted in the same way and ended up with the same game, but through a different mechanism, can be compared. Dal Bó et al. (ibid.)'s idea is that groups with an identical distribution of votes for and against modification also have identical preferences about modification and thus cooperation, and if their behaviour differs this is attributed to the way the modification was implemented.

The second confounding factor which I control for in the presented design is information. Sutter et al. (2010)'s as well as Dal Bó et al. (2010)'s main experiment involve instructing subjects about their group's choice only in the endogenous case, thereby straining the ceteris paribus assumption: not only the implementation of the institution differs between endogenous and exogenous outcomes but also the information provided. One can argue that this information is an essential part of an endogenous institution and the asymmetry between the outcomes should not be erased. However, in my experiment subjects are told about the representative's choice in the endogenous as well as in the exogenous case. This choice is not perfectly informative about the group's composition but hints at the preferences of the majority. Furthermore, the choice of game of the representative is a credible signal. This holds the available information constant across outcomes and means that observed differences can be attributed to the intrinsic difference between democratically and authoritatively introduced policies. I consider this an estimate of the lower bound of a *democratic dividend* because many factors that are inherent to democratic processes are controlled for.

4 Hypotheses

This section establishes theoretic reflections concerning the previously outlined experimental design. I refrain from using Dal Bó et al. (ibid.)'s theoretical considerations as their identification strategy relies on a simplified model without the first experimental stage before the election. This would imply that the representative in my study is appointed at random. Instead, I consider game-theoretic predictions and results from Dal Bó et al. (ibid.) as well as earlier studies in the light of the research questions to develop testable hypotheses for the analysis in the next chapter.

4.1 The Prisoners' Dilemma in Theory and Practice

The initial game used in the experiment is the classic prisoners' dilemma as illustrated in the payoff matrix in table 1. A Pareto-improvement for all players is possible compared to the Nash equilibrium of mutual defection but individual incentives are stacked against it. For the repeated prisoners' dilemma backwards induction tells that defecting is still the unique best response since the game is played for a finite amount of rounds. Thus, the prediction is mutual defection in each round (Gibbons, 1992). However, it can be shown that if there exists uncertainty about the other player's type or preferences – she could e.g. be generally altruistic or play a tit-for-tat strategy which prescribes cooperation if the opponent cooperated in the previous round and vice versa – then cooperation can be part of a payoff-maximizing strategy (Kreps et al., 1982). The sequential equilibrium strategy of every player would be to build a reputation for being altruistic and then defect towards the end of the game (Andreoni and Miller, 1993). This reputation hypothesis has been confirmed to some extent by experiments with the finitely repeated prisoners' dilemma (ibid.). Due to the anonymous re-matching in every round of my experiment, there exists no incentive for a player to build a reputation.

Even if the prediction for a one-shot game of prisoners' dilemma, i.e. mutual defection, is said to be valid in this case due to the finite repetition and random re-matching, I expect some cooperative behaviour in the beginning of the first stage as this is almost always found in experiments. After an initially quite high rate of cooperation, typically a steady increase in defection is observed over time, be it as part of an equilibrium strategy or simply due to experience (Selten and Stoecker, 1986; Andreoni and Miller, 1993; Dal Bó et al., 2010). The "endgame effect" of a sudden spike in defection is typically observed before a pause in the experiment (here the vote) and occurs again more markedly at the very end of the experiment (Rapoport and Dale, 1966).

Regarding individual characteristics, Ortmann and Tichy (1999) show gender differences in behaviour in the prisoners' dilemma: women cooperate significantly more in the first rounds than men. This topic is not inherently related to my research question but relevant for the interpretation of my other findings, as subject pool effects potentially bias all other experimental results (ibid., p.328). To investigate gender and other influential characteristics the analysis will predominantly focus on cooperation in round one, before any other learning or group effect influences behaviour.

4.2 The Vote

The payoff modification introduces another Nash equilibrium in pure strategies. Now both (C,C) and (D,D) are equilibrium outcomes, with the former being the social optimum. Dal Bó et al. (2010) note for the optimal choice of payoffs that it depends on the players' expectations about what the others will do in the coordination game. If subjects expect to achieve mutual cooperation under the modification, they should vote in its favour; whereas they are indifferent between the two games if they expect mutual defection in the coordination game. Dal Bó et al. (ibid.) discuss off-equilibrium reasoning as well: A player whose strategy is to always defect could oppose modification as it decreases the

deviation profit she obtains every time she faces a cooperating partner. But she could hope to increase others' willingness to cooperate through the modification thereby making it more likely to harvest the (albeit lower) deviation profit. Of course in this case it would be even better for her to cooperate herself.

As the modification of payoffs makes the Pareto-superior cooperation equilibrium more attainable I expect both unconditionally as well as conditionally cooperative players to favour modification. Dal Bó et al. (2010) find that only slightly more than half the sample wants to modify. This is a phenomenon worth investigating. One explanation is that it takes some amount of logical reasoning to grasp the influence of the modification on the (equilibrium) behaviour of one's group members such that players with a higher cognitive ability are more likely to vote for modification. Dal Bó et al. (ibid.) test a variant of this hypothesis by comparing whether more intelligent subjects are more responsive to an endogenous modification, as they are more likely to update their beliefs about group members' willingness to cooperate. However, they find no evidence of this information hypothesis (ibid., p.2222).

Hypothesis 1.a *A subject who is more cooperative in part one is more likely to have a preference for payoff modification.*

Hypothesis 1.b *Higher cognitive ability is associated with an increased preference for payoff modification.*

Since subjects only learn about the vote after the first stage is completed, and the election is held without further interaction possibilities, I do not consider electoral competition. I expect subjects with a preference for cooperation to vote for a group member that cooperated as well. Conditionally cooperative individuals are likely to be in the majority in the sample (Fischbacher et al., 2001). These would anticipate another player with a preference for cooperation to want to modify as well and consequently vote for this player. Hamman et al. (2011) find that groups typically elect the most cooperative subject as representative.

Hypothesis 2 *Cooperative players are more likely to be elected.*

4.3 The Coordination Game

For the coordination game presented in table 2 both (C,C) and (D,D) are equilibria in pure strategies. An equilibrium in mixed strategies consists of each player cooperating with probability $\frac{5}{6}$ and defecting with probability $\frac{1}{6}$. I expect more players to choose option C under the modified payoffs compared to the prisoners' dilemma as this action is not strictly dominated there. Since there is no unique best response anymore, coordination between players is crucial to realise one of the symmetric equilibria, as the name of the game already suggests. Following Harsanyi and Selten (1988) mutual cooperation can be classified as payoff-dominant as it is Pareto-superior to all other Nash equilibria. On the other hand, mutual cooperation risk-dominates mutual cooperation as the opportunity cost of unilateral deviation are higher.

The vote stage, i.e. who was elected, the speaker's decision, if it was considered, can serve as cues towards one of the equilibria. For example, a representative choosing the coordination game may make cooperation more salient (Schelling, 1960). Markussen et al. (2014) claim that a *democratic dividend* of cooperation is rationalisable with the model of inequality aversion by Fehr and Schmidt (1999). It incorporates fairness concerns into a self-interested individual utility function, such that inequalities in a subject's own payoff relative to others' payoffs are penalized (ibid., p.819).[7] According to Markussen et al. (2014, p.307) voting can then serve as an equilibrium selection device in the coordination game because it is a credible signal of an intention to cooperate that prompts inequality-averse subjects to cooperate as well.

However, in my setting, two things are known to subjects: The actions of all players in the group in the prisoners' dilemma in part one, and the policy choice of the representative. This becomes known in the exogenous as well as in the endogenous case, thereby erasing potential information differences between the conditions. This possible signalling through the representative is considered in the analysis. With regard to the differing implementation of the modification, I nevertheless expect to replicate the findings of Dal Bó et al. (2010): Endogenous policy selection leads to more cooperation than exogenously imposed institutions. This is evaluated with a between-subjects comparison of cooperation.

Hypothesis 3 *More subjects cooperate in the coordination game compared to the prisoners' dilemma.*

Hypothesis 4 *Average cooperation rates in the coordination game are higher under endogenous modification compared to exogenous modification.*

Hypothesis 5 *Cooperation rates in the coordination game are higher under endogenous modification compared to exogenous modification when controlling for voting behaviour.*

The studies presented in section 2.3, which evaluate direct and representative democratic institutions, find less cooperative behaviour in the latter and thereby point to the possibility of lower cooperation rates in my experiment compared to Dal Bó et al. (ibid.). It is likely that the effects are somewhat smaller in my study than in Dal Bó et al. (ibid.) since the indirect voting mechanism leads to a less personal decision making process and therefore potentially less influence of the vote on the perceived legitimacy of an institution.

Hypothesis 4 states that more cooperative players are more likely to be elected. In the literature it is additionally found that being elected increases a feeling of responsibility (Corazzini et al., 2014). This would mean that elected players cooperate even more if they become speaker. However, Corazzini et al. (ibid.) find that representatives increase their benevolence on a significant level only when they are given the possibility of making pre-vote promises to their electorate. As my design abstracts from any campaign prior to the election, replicating Corazzini et al. (ibid.) would mean that representatives do not

[7] Formally, in the two-player case with payoffs $x = x_i, x_j$, the utility function of player i is given by $U_i(x) = x_i - \alpha_i max\{x_j - x_i, 0\} - \beta_i max\{x_i - x_j, 0\}, i \neq j$; where the second term represents a utility loss from disadvantageous inequality and the third term a utility loss from advantageous inequality (Fehr and Schmidt, 1999, p.822).

experience an extra behavioural effect through gaining office. I nevertheless expect them to have an increased perception of the difference between the endogenous and exogenous modification. Corazzini et al. (2014, p.588) find that higher approval rates lead to higher cooperation from the representative, but I do not test this phenomenon because in the light of hypothesis 4 I expect it to be highly endogenous.

Hypothesis 6 *Players who are elected as representatives cooperate more in part two compared to part one under exogenous non-modification.*

Furthermore, the function of the representative as leader of the group is considered. The effect of the representative's decision and that of the institution's implementation have to be separated. Analogous to Markussen et al. (2014) I investigate whether the choice of the representative works as a recommending signal also in the exogenous case, e.g. for groups whose speaker wants to modify but is not considered. This is done by a within-subjects analysis. If the information and coordination aspect of the vote stage is dominant over the effect of democracy, cooperation rates are expected to be higher. Please note, however, that the specific design at hand does not allow to control for order effects in the within-analysis by randomizing which stage is played first.

Hypothesis 7 *Cooperation rates of subjects in exogenous non-modification are higher in stage two compared to stage one if the representative chose the coordination game but was overruled.*

Another potential confounding factor for the analysis is a mismatch between an individual's expectations about the representative's preferences and her actual behaviour. For instance, a conditionally cooperative player might expect another group member to be cooperative as well and to vote for modification. If this player is elected and votes against modification, but the vote is not considered and payoffs are modified nevertheless, the first player's willingness to cooperate might be decreased due to other reasons than the exogeneity of the policy. However, this phenomenon is typical for indirect democracies with free mandates and limited accountability, such that it is not feasible to aim for a complete elimination. Another possibility is that an individual prefers modification but votes for a group member that is then not elected. If the one elected instead endogenously modifies payoffs, the first individual might still perceive this as somehow exogenous.

5 Results

This section replicates the main analysis of Dal Bó et al. (2010) for a representative democracy and presents additional results to test the previously established hypotheses. The analyses of both experimental stages as well as the vote is first carried out for individual players and lastly also at the group level. For the first part of the experiment I study the determinants of cooperation in the prisoners' dilemma. Next, subjects' preferences about the payoff modification as well as the representatives' election are analysed. The results of the second part show that – while the institutional change itself is effective in

increasing cooperation in both the democratic and authoritative outcome – the way the payoff modification is implemented has strong consequences for behaviour: there is significant evidence of a democracy premium. Subjects seem to strongly respond to their representative's choice regardless of their own individual preference.

5.1 Protocol and Summary Statistics

Sessions took place at Hamburg University in January and October 2016 with a total of 164 participants. Participants were recruited using the software hroot by Bock et al. (2014) and then randomly assigned to a computer cubicle. They received the instructions in written form. Instructions for the vote and the subsequent game stage were handed out after the first ten rounds. Before each part began, every subject correctly answered a set of control questions. At the end of the session, three unpaid questions taken from the so called cognitive reflection test elicited subjects' strategic sophistication (Frederick, 2005).[8] Together with these each participant filled out a socio-economic questionnaire. Payment was made according to the outcome of two randomly chosen experimental rounds from the first and second part respectively with an exchange rate of 10 points for €1. Average individual earnings were around €9 which is in line with the mean hourly wage of €10 that the lab promises since all six sessions lasted less than an hour.

Table 3 presents the summary statistics. 60 subjects identified themselves as male, 99 as female and 5 chose the option "other or prefer not to say". The age of the participants ranged from 17 to 48 with a mean of 25 years. I use the binary variable *econ* that takes the value one if someone's subject is broadly related to economics, which is the case for 43 percent of the sample. The mean reported net monthly income is €610.A little less than one third of the subjects answered all three of the aforementioned logic questions correctly.[9]

A voluntary question asked subjects which party they had voted for in the latest election for the German parliament. Most frequently chosen were the Christian Democratic Union, the Social Democratic Party, and The Greens (table 12 in the appendix). Half of the subjects did not state any preference making it problematic to include political opinions into the analysis as answering the question should not be assumed to be random.

[8] The questions were the following: 1) A water lily on a lake doubles in size every day. If the lake is completely covered by the plant after 48 days, how many days does it take for the pads to cover half the lake? 2) If five machines produce five units in five minutes, how many minutes does it take for one hundred machines to produce one hundred units? 3) A baseball and a bat together cost €1,10. If the bat's price is one euro higher than the ball's, how expensive is the ball? (Frederick, 2005, p.27).

[9] On average female subjects gave correct answers to 1.2 questions while males answered 2.1 questions correctly (p-value < 0.01). An OLS estimate obtains that

$$\widehat{logic} = \underset{(0.607)}{1.757} + \underset{(0.022)}{0.003}\ \text{age} + \underset{(0.000)}{0.000}\ \text{income} - \underset{(0.195)}{0.793}\ \text{female} - \underset{(0.191)}{0.013}\ \text{econ}$$

n = 157, R^2=0.121, Standard errors in parentheses;

indicating that gender is the only included variable significantly correlated with the proxy for cognitive ability. This pattern of gender differences is curious but consistent with previous studies using the cognitive reflection test (ibid., p.37).

Table 3: Summary Statistics

	Total/Mean	Standard Deviation
Participants	164	
Age	25.0	4.8
Monthly Income (€)	609.5	354.7
Semester	5.7	4.4
Logic	1.5	1.2
Payout (€)	8.8	1.1
	Share	
Female	60 %	
Economics Student	43 %	
Knowledge of Game Theory	26 %	

Note: Logic gives number of questions correctly answered (out of three).

5.2 The First Stage

Table 13 gives the cooperation rates of stage one where all groups played the regular prisoners' dilemma. Average cooperation in these rounds amounts to 33 percent Overall cooperation was highest in the first round with 52 percent. Defection increased over time until only 15 percent cooperated in the last round of stage one. The difference between cooperation rates in rounds 1 and 10 is highly significant. Average cooperation rates in my sample are somewhat higher than in Dal Bó et al. (2010), but the general pattern of positive but decreasing cooperation is well-known from previous experiments (Cooper et al., 1996).

In a linear probability model of individual cooperation in the first round regressed on personal characteristics reported in columns (1) and (2) of table 4, gender appears as the most important factor.[10] Being female is associated with an increased probability of cooperation of more than 30 percentage points and highly significant. This is potentially relevant as my sample consists of twice as many women as men. The influence of logic is significant at the 10-percent level and has an effect of an increase of six percentage points for each correctly answered question, indicating a rather small influence of cognitive ability. The age of a subject is of low economic and statistical significance and neither the income nor the subject of study seem to be relevant as explanatory variables. Probit models in columns (3) and (4) of table 4 yield consistent results.

5.3 The Vote

In the beginning of the second stage subjects announce preferences about modification and elect a spokesperson for each group. Almost two-thirds (65 percent) of my sample would modify the payoffs in case they became group speaker. Dal Bó et al. (2010, p.2212) find that 53 percent of their participants voted in favour of the modification and relate this to inefficiency preferences and delayed reforms. To further investigate the phenomenon I

[10] As no further information about the subjects' gender who chose the "other" option was collected, I exclude them from the analyses of gender effects.

Table 4: Determinants of Initial Cooperation

Dependent variable: cooperation probability in round 1

	OLS		Probit	
	(1)	(2)	(3)	(4)
Logic	0.060*	0.061*	0.163*	0.180*
	(0.034)	(0.034)	(0.093)	(0.096)
Female	0.335***	0.331***	0.882***	0.921***
	(0.084)	(0.086)	(0.231)	(0.246)
Income		-0.000*		-0.000*
		(0.000)		(0.000)
Economics		-0.088		-0.242
		(0.079)		(0.218)
Age		0.016*		0.046*
		(0.009)		(0.026)
Constant	0.211**	-0.013	-0.774***	-1.489**
	(0.093)	(0.260)	(0.259)	(0.731)
N	159	157	159	157
R^2	0.093	0.137		
adj. R^2	0.082	0.109		
Pseudo R^2			0.069	0.106

Note: Logic is between 0 and 3. Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

asked subjects to give a reason for their institutional preference in the questionnaire. Two types of players emerge here, representing the trade-off between payoff- and risk-dominance introduced in section 4. Those who want to continue with the prisoners' dilemma mainly indicate that they expect to earn higher individual payoffs from this game. Almost all of those who want to modify mention fairness motives and the hope for increased earnings for all group members from cooperation as reasons for changing the game. Therefore, my data supports the claim of Dal Bó et al. (2010, p.2212) that "subjects will not necessarily vote for reforms that may make efficient behaviour incentive compatible", albeit to a smaller extent. The answers contribute to the knowledge gap insofar as it becomes clear that the reason behind the inefficiency preference of some actors are mainly risk aversion and egoistic off-equilibrium reasoning, where subjects hope to harvest the highest possible deviation payoff from a cooperating partner. In my sample the average earnings of subjects were higher in the coordination game in stage two.[11]

Table 5 shows Probit and Linear Probability Models of voting for modification regressed on variables covering experiences from stage one and personal characteristics. Own cooperation is positively related to a preference for the modification and highly significant for every specification. For instance, a player who cooperated in five of the ten rounds has a probability to favour the coordination game that is more than 20 percentage points higher than someone who did not cooperate at all in stage one, ceteris paribus.

Cognitive ability is significantly positively correlated with a preference for modification. A subject who was able to answer all three logic questions has a probability of voting

[11]The difference between a mean payout of €8.5 earned in two rounds of the prisoners' dilemma to €9 earned by those who switched to the coordination game is significant at the 1-percent level.

Table 5: Determinants of Modification Preferences

Dependent variable: preference for the coordination game

	OLS		Probit	
	(1)	(2)	(3)	(4)
Own cooperation	0.042**	0.048***	0.121**	0.142**
	(0.017)	(0.017)	(0.052)	(0.059)
Partners' cooperation	-0.028	-0.029	-0.078	-0.084
	(0.019)	(0.019)	(0.056)	(0.058)
Logic		0.091**		0.270**
		(0.038)		(0.113)
Income		-0.000		-0.000
		(0.000)		(0.000)
Female		-0.043		-0.156
		(0.094)		(0.281)
Age		-0.003		-0.009
		(0.011)		(0.030)
Economics		0.070		0.193
		(0.073)		(0.215)
Constant	0.605***	0.580*	0.272	0.227
	(0.064)	(0.300)	(0.176)	(0.850)
N	164	157	164	157
R^2	0.051	0.119		
Pseudo R^2			0.069	0.097

Note: Own and partners' cooperation range from 0 to 10. Logic lies between 0 and 3. Standard errors (in parentheses) clustered at group level. * $p < 0.10$ ** $p < 0.05$, *** $p < 0.01$.

for modification that is 27 percentage points higher compared to one who gave no correct answer.Income, gender, age and studying economics are neither statistically nor economically significant. A Breusch-Pagan Lagrange multiplier test of modification preferences with and without controls does not reject the null hypothesis of no random effects at the group level, suggesting that residuals and thus voting decisions are not correlated within groups. Overall, the data lends support to Hypotheses 1.a and b and the reported insights regarding individual modification preferences are in line with Dal Bó et al. (2010)'s observations.

Result 1 *Cooperative individuals and those with a higher cognitive ability are associated with an increased preference for the coordination game.*

Simultaneously with privately indicating their preferences about the two games, subjects were asked to name one group member other than themselves that they would like to become group speaker. Considering the reasons of the vote for the representative, nearly half of the participants (43 percent) declared they had voted for a specific group member because it had appeared cooperative in the first stage. However, some just chose randomly, e.g. because they "liked the number of the Player ID". Contradicting the subjective impression of the players there is no significant difference in behaviour in stage one between

the speakers and their electorate. If anything the representatives cooperated *less* often than the rest. Neither are there differences in modification preferences.

Result 2 *Players wish to elect pro-social speakers but in fact these do not behave more cooperatively than their group members prior to the vote.*

Table 6 shows that the speakers' decision was considered for 18 groups and overruled for another 17.[12] In the endogenous cases 12 speakers introduced the payoff modification (EndoMod) and six did not (EndoNot). In the exogenous cases the computer modified eight groups' payoffs (ExoMod) whereas nine remained in the prisoners' dilemma (ExoNot). A total of 80 subjects therefore played the coordination game and 60 the prisoners' dilemma.

Table 6: Number of Subjects per Vote Stage Outcome

	Prisoners' Dilemma	Coordination Game	Total
Implementation:			
Endogenous	24	48	72
Exogenous	36	32	68
Total	60	80	140

5.4 The Second Stage

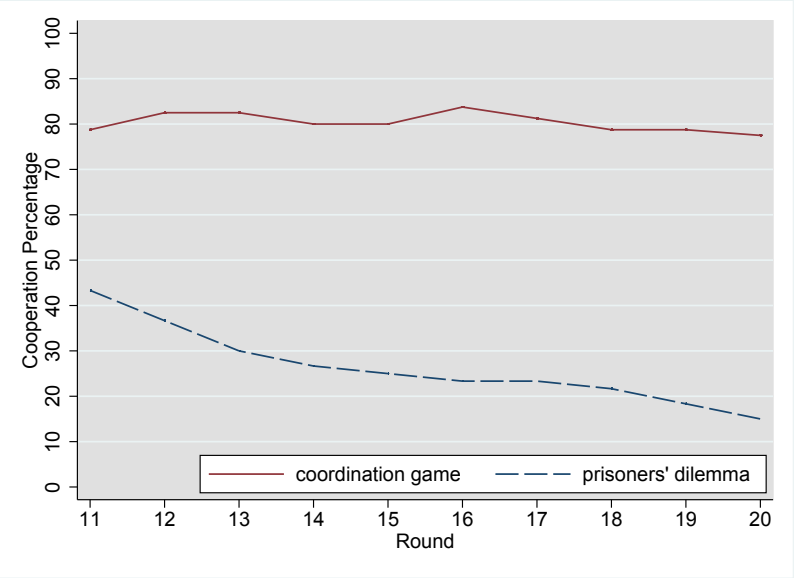
As can be seen from figure 2 and table 14, stage two began with a cooperation rate above 40 percent in the prisoners' dilemma which over time declined to less than 20 percent. It is furthermore obvious that cooperation rates were very high – over 75 percent in every round – and stable under the modified payoffs, meaning that the majority of players coordinated on the equilibrium with mutual cooperation. This shows that the institution itself is effective in fostering cooperative behaviour. The difference between the two games is large and highly significant (p-value < 0.01 for a two-sided t-test). In sum, subjects seem generally willing to cooperate, respond to the incentives of the different games and are able to coordinate on the efficient equilibrium. This gives support to hypothesis 3.

Result 3 *The change in the institutional structure is effective: cooperation is higher in the coordination game compared to the prisoners' dilemma.*

However, we have to disentangle the effect of endogenous and exogenous treatments further, since the players that ended up in the endogenously modified coordination game partly did so by choice and hence self-selection plays a role in the observed differences. Moreover, some groups were willing to modify payoffs to increase cooperation, but were overruled by the computer, which exogenously put them in the prisoners' dilemma, thereby potentially

[12] A bug in the z-Tree code confronted subjects of the first session with a confusing screen output right after the vote and their payoffs were not modified. I exclude these observations from the analysis of the second stage. This diminishes the sample to 140 subjects but is nevertheless done in order not to corrupt the results.

Figure 2: Cooperation in Stage Two



biasing the cooperation rates for the unmodified payoffs upwards. The difference between the two games is potentially biased by self-selection and obviously not informative about the effect of democratic policy selection.

The Influence of Democracy The impact of the institution and its implementation have to be isolated. Dal Bó et al. (2010) suspect subjects who play under endogenous modification to have different underlying personal characteristics than those who are under exogenous modification. The most important tool to control for a selection bias is to condition the analysis of cooperation on a subject's institutional preference. Doing so endogenous modification is assumed not to be correlated with unobserved personal characteristics anymore (ibid.).

Table 7 allows this by giving the number of observations and cooperation rates directly before and after the vote stage separated by institutional preference and vote stage outcome. The first message to take away from the topmost panel of table 7 is that selection might not be as big a factor as expected when estimating the effect of the institutional change. There is no statistical difference between the share of subjects preferring the institution in the endogenously and exogenously modified conditions (71 and 69 percent respectively). The share of yes-voters is however lower in the two unmodified conditions (46 and 58 percent respectively).

We gather from the second panel that there are significant differences in behaviour at the end of the first stage, especially that yes-voters cooperate more than no-voters (p-value = 0.03). The different group composition is therefore controlled for in the decomposition of the results in order not to overestimate cooperation rates in the coordination game. In round ten, the players that will end up in ExoMod and EndoMod display virtually identical cooperation rates. Yet one round later, after the vote took place, pronounced behavioral differences exist: compare an average cooperation rate of 85 percent if the representative modified to 69 percent if the computer modified (p-value = 0.07).

Table 7: Overview of Individual Data

	Endogenous Condition		*Exogenous Condition*		
Prefer to modify	EndoMod	EndoNot	ExoMod	ExoNot	Total
Number of subjects in each outcome by preference:					
No	14	13	10	15	52
Yes	34	11	22	21	88
Total	48	24	32	36	140
Cooperation rate in round 10 (in percent):					
No	7.1	0.0	10.0	13.3	
Yes	23.5	0.0	22.7	14.3	
Average	18.8	0.0	18.8	13.9	
Cooperation rate in round 11 (in percent):					
No	64.3	23.1	40.0	46.7	
Yes	94.1	27.3	81.8	61.9	
Average	85.4	25.0	68.8	55.6	

Result 4 *Directly after the vote stage, cooperation is higher if the policy is democratically introduced than when it is exogenous.*

Table 8 reports a linear probability model of cooperativeness in the first round after the vote with the different vote stage outcomes interacted with individual behaviour as explanatory variables. Again, the endogenously modified payoffs are associated with the highest cooperation probability even when controlling for modification preferences and cooperation in part one. This is especially true among those players who preferred the coordination game over the prisoners' dilemma. A player's own cooperation rate in the rounds 1 to 10 is a significant predictor of the cooperation rate in round 11, but with a smaller effect size than the vote stage outcomes. But while each vote stage outcome on its own is significant as a regressor, a Wald test does not allow to reject the hypothesis that behaviour in round 11 is statistically identical under endogenously and exogenously modified payoffs when conditioning on institutional preference. This is in contrast with Dal Bó et al. (2010, p.2215) who find significant differences between EndoMod and ExoMod, at least for those players who preferred the payoff modification.

Dal Bó et al. (ibid.) further decompose the effect of the institution. The authors break down the total policy effect into a selection effect and the endogenous treatment effect. The latter can be further separated into an exogenous treatment effect and the endogeneity premium. This is done by using weighted averages of the individual cooperation rates and voter shares in round 11 that are provided in table 7 of this paper (see ibid., p.2218 for a formal discussion). The total effect of the policy is given by the difference between EndoMod and EndoNot and amounts to 55 percentage points in Dal Bó et al. (ibid.)'s case and 60 in mine.[13]

The selection effect – differences in the proportion of types of players in a group that lead to changes in behaviour that go beyond the differing treatment – is calculated by Dal

[13] The total policy effect in round 11 can be calculated following Dal Bó et al. (2010) from table 7: [64.3(14/48) + 94.1(34/48)] - [23.1(13/24) + 27.3(11/24)] = 60.38.

Table 8: OLS-Regression – The Influence of Democracy on Cooperation

Dependent variable: cooperation probability in round 11

	(1)	(2)	(3)	(4)
EndoMody	0.941***	0.855***	0.720***	0.837***
	(0.073)	(0.251)	(0.077)	(0.224)
EndoNoty	0.273**	0.236	0.204*	0.293
	(0.128)	(0.252)	(0.119)	(0.226)
ExoMody	0.818***	0.758***	0.599***	0.691***
	(0.091)	(0.256)	(0.093)	(0.229)
ExoNoty	0.619***	0.520**	0.415***	0.513**
	(0.093)	(0.261)	(0.092)	(0.233)
EndoModn	0.643***	0.567**	0.565***	0.688***
	(0.114)	(0.267)	(0.112)	(0.240)
EndoNotn	0.231*	0.255	0.093	0.215
	(0.118)	(0.217)	(0.108)	(0.193)
ExoModn	0.400***	0.354	0.286**	0.400
	(0.135)	(0.274)	(0.124)	(0.244)
ExoNotn	0.467***	0.349	0.269**	0.371
	(0.110)	(0.268)	(0.110)	(0.239)
Own cooperation in part 1			0.075***	0.078***
			(0.015)	(0.015)
Partners' cooperation in part 1			-0.021	-0.016
			(0.016)	0.017
Session Dummies	No	Yes	No	Yes
N	140	140	140	140
R^2	0.731	0.743	0.790	0.799
adj. R^2	0.715	0.716	0.774	0.775

Note: Independent variables are binary and indicate vote stage results. Regressors are interaction terms of vote stage results and individual preference (suffix y pro and n against modification). Own and partners' cooperation range from 0 to 10. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Bó et al. (ibid.) to account for an increase in cooperation of four percentage points. This represents the increase in average cooperation that is supposed to happen in the EndoNot condition if the share of yes-voters was the same as in EndoMod. In my case this effect is smaller and accounts for a difference of one percentage point.[14]

The endogenous treatment effect then gives the increase in cooperation that is *not* due to the different composition of groups but caused by the (democratic) policy choice. This is the difference in cooperation rates between EndoNot and EndoMod weighted with the preference structure of EndoMod. Its magnitude is found to be about 50 percentage points by Dal Bó et al. (2010) and 59 by me.[15]

The change in cooperation caused by an exogenous payoff modification is represented by the exogenous treatment effect which compares ExoNot and ExoMod. By keeping the proportion of yes- and no-voters as in the endogenous estimate and using the cooperation rates from the exogenous conditions, Dal Bó et al. (ibid.) calculate it to amount to 36 percentage points. From my results it is estimated at a much lower 12 percentage points.[16]

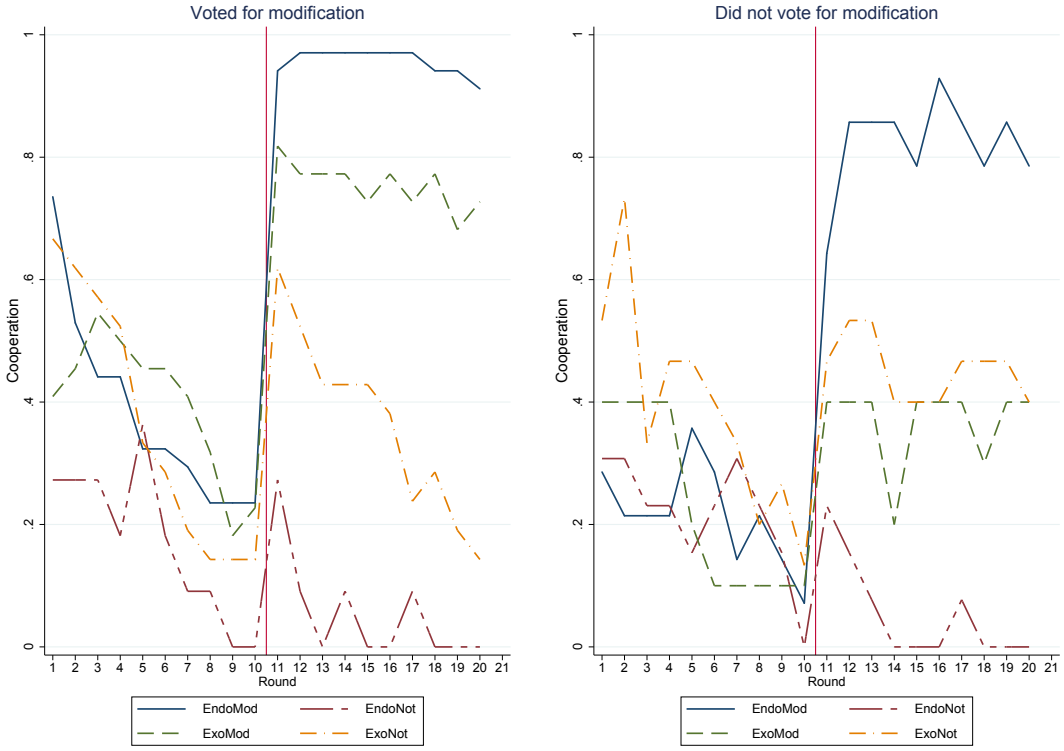
Lastly, the difference between the exogenous treatment effect and the endogenous treatment effect gives the endogeneity premium which accounts for 14 percentage points in Dal Bó et al. (ibid.) and a stunning 47 in mine.[17] This *democratic dividend* seems large and is, among other factors, driven by the pronounced increase in cooperation of the no-voters in EndoMod. The recommendation towards cooperation from the fellow group member appears to have a much stronger influence on behaviour than the modification through the computer. A more personal or more legitimate decision-making process can seemingly trigger a willingness to cooperate that was not present initially. It should, however, be kept in mind that not all the vote stage outcomes are significantly different when controlling for individual institutional preference.

I broaden the analysis to include all rounds in stage two to investigate the development of cooperation. In figure 3, the differences in behaviour between the four conditions are evident at first glance. Analogous to table 7 it presents individual cooperation for all vote stage results separated by individual voting behaviour. It can be observed from the left-hand side that for those who preferred modification the endogenous institution has a considerable effect and leads to almost full cooperation. Exogenous modification results in the second highest average cooperation. For both conditions the change of payoff structure results in a striking increase in willingness to cooperate in stage two.

The right panel shows the development of cooperation for individuals who voted against the payoff modification. Those who preferred the prisoners' dilemma but received the coordination game through their representative dramatically change their behaviour and display quite stable cooperation rates in stage two. In contrast, the effect of the exogenous policy implementation is much less pronounced and similar to that under exogenous non-modification. Behaviour exemplary for the restart effect is displayed in all conditions. This is commonly observed when after a short break in the experiment cooperation suddenly

[14] Selection effect: 23.1(14/48 - 13/24) + 27.3(34/48 - 11/24)] = 1.05
[15] Endogenous treatment effect: (14/48)(64.3 - 23.1) + (34/48)(94.1 - 27.3) = 59.33.
[16] Exogenous treatment effect: (14/48)(40.0 - 46.7) + (34/48)(81.8 - 61.9) = 12.14.
[17] Endogeneity premium: 59.33 - 12.14 = 47.19.

Figure 3: Cooperation by Vote Stage Result and Individual Vote



increases (Selten and Stoecker, 1986).

Figure 3 suggests that it is worthwhile to investigate not only round 11 as differences in behaviour become more pronounced over time. I extend the analysis to include all rounds of stage two with a special focus on the end round. However, those rounds should be treated with caution, as the experiences a player makes with her opponents are likely to influence her behaviour, which is thus not independent across rounds. If a (conditionally) cooperative player meets other cooperative individuals, cooperation can become a self-reinforcing process due to selection (Dal Bó et al., 2010).

In table 9 I test whether the differences in cooperation are significantly different across vote stage outcomes and voting preferences. The most interesting comparison is that of EndoMod and ExoMod, which is significant for both yes- and no-voters at a level of at least 10-percent. Dal Bó et al. (ibid., p.2217) find that "for subjects that voted for modification, democracy has a stable, large, and statistically significant effect on cooperative behaviour". My results substantiate this claim – at least when considering the entire second stage – and even extend to to those players that initially did not prefer the payoff modification. I conclude that democracy seems to be beneficial for cooperation, but the statistical power of the analysis does not suffice to demonstrate the existence of a dividend of democracy beyond reasonable doubt.

Result 5 *The democracy premium accounts for a substantial increase in cooperation.*

Table 9: The Influence of Democracy on Cooperation

Dependent variable: individual cooperation				
	(1)	(2)	(3)	(4)
	rounds 11 to 20		round 20	
EndoNot = ExoNot	0.000^{***}		0.016^{**}	
EndoMod = ExoMod	0.001^{***}		0.009^{***}	
EndoMod = EndoNot	0.000^{***}		0.000^{***}	
ExoMod = ExoNot	0.036^{**}		0.002^{***}	
EndoModn = EndoNotn		0.000^{***}		0.000^{***}
ExoModn = ExoNotn		0.588		1.000
EndoModn = ExoModn		0.010^{**}		0.060^{*}
EndoNotn = ExoNotn		0.019^{**}		0.025^{**}
EndoMody = EndoNoty		0.000^{***}		0.000^{***}
ExoMody = ExoNoty		0.003^{***}		0.000^{***}
EndoMody = ExoMody		0.018^{**}		0.069^{*}
EndoNoty = ExoNoty		0.008^{***}		0.216

Note: The "y" or "n" suffix denotes the individual decision for or against modification. Reported are p-values from a Mann-Whitney-U test.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The Representative's Influence It was already found that the elected speakers were not especially pro-social in stage one. Within- and between-subjects tests show further that neither do the representatives cooperate more in stage two compared to stage one if they remain in the prisoners' dilemma, nor do they cooperate more than the rest of their group in stage two in the coordination game.[18] This is evidence against hypothesis 5.

Result 6 *Subjects elected as representatives do not change their behaviour more than other players.*

An interesting question in the light of signalling effects is whether recommendation works. Hypothesis 7 states that a speaker who is willing to modify is able to induce her group towards increased cooperation even in the exogenously installed prisoners' dilemma. There are indeed small differences in the cooperation rates of the groups in question between part one and two; but the effect is rather the opposite of what was hypothesised: average cooperation is higher in part one (28 versus 22 percent). A Wilcoxon signed-rank test does not allow rejection of the hypothesis that there is no difference. (p-value = 0.143).

Result 7 *The signal of a speaker who wants to modify does not increase cooperation rates under exogenously unmodified payoffs.*

To control for information, Dal Bó et al. (2010) ran further sessions with a design that slightly modifies their original experiment. Now subjects in the exogenous condition are informed whether there was a majority for or against modification in their group, which was also done in my experiment. Even though a part of the endogeneity premium is not explained by informational effects, Dal Bó et al. (ibid., p.2224) "cannot reject statistically the hypothesis that information plays no role". But as the authors find no difference between yes-voters in the ExoMod groups with a majority for and against modification in

[18] A Wilcoxon signed-rank test of the first statement gives a p-value of 0.13 and a Mann-Whitney-U test of the second claim a p-value of 0.36.

round 11; and a significant difference between cooperation in ExoMod and EndoMod, they conclude that there is "no evidence that information differences between endogenous and exogenous modification explain the observed difference in behaviour" (Dal Bó et al., 2010, p.2225).

Analogous to Dal Bó et al. (ibid., p.2224), table 10 is a variant of table 7 and shows that the information hypothesis should not be rejected too readily. It contains only subjects who played the coordination game in part two. I disentangle what choice the representative made for the groups who received modification. This is straightforward for endogenous modification; but in the exogenously modified condition both preferences in favour and against are present. We see that of these ExoMod speakers one chose the prisoners' dilemma (centre column) and seven the coordination game (right column). The ExoMod groups whose representatives wanted to modify start stage two with a cooperation rate below the groups whose speaker was against modification, and are only partially able to coordinate on the socially optimal equilibrium over the course of the second stage.

The average cooperation rate between EndoMod and ExoMod/Mod in period 11 is significant at the 10-percent level (Mann-Whitney U – p=0.072). When controlling for modification preferences, the difference is only significant for those who did not want to modify (p=0.083 and p=0.269).

Result 8 *The importance of information effects as key factors in explaining differences in cooperation cannot be rejected.*

Table 10: Individual Cooperation – Speaker's Choice under Modified Payoffs

	Endogenous Condition	*Exogenous Condition*	
Speaker's Choice	Modify	Not Modify	Modify
Number of subjects in each outcome by preference:			
No	14	2	8
Yes	34	2	20
Total	48	4	28
Cooperation rate in round 11 (in percent):			
No	64.3	100.0	25.0
Yes	94.1	50.0	85.0
Average	85.4	75.0	67.9
Cooperation rate in part two (in percent):			
No	63.4	20.0	41.3
Yes	91.7	10.0	82.0
Average	93.6	15.0	70.4

5.5 Group Level Analysis

In the final part, results are derived at the group level. Therefore, only one observation per group is considered in the statistical tests.[19] Analogous to Dal Bó et al. (2010, p.2212), I create the variable *voteshare* which indicates how many subjects per group wanted to modify the payoff matrix in case they were elected as speaker (see the topmost panel of table 11). This share ranges from 0 to 4 with a mean of 2.5. Note that in contrast to Dal Bó et al. (ibid.)'s direct democracy the value of voteshare here does not give a clear indication of the chosen game if it lies between 1 and 3. A majority of subjects below unanimity preferring modification can still mean that the speaker would not modify in the endogenous case.

The approach to obtaining unbiased estimates demands a comparison of groups for whom voteshare takes on the same value (ibid., p.2219). They are assumed to be of equal composition regarding cooperation preferences. The focus is put on groups with two or three votes for modification respectively. For these values of voteshare all four possible outcomes were realised in my experiment making it possible to compare groups that voted similarly but ended up under endogenous or exogenous modification.

Table 11: Overview of Group Level Data

	Endogenous Condition		*Exogenous Condition*		
Voteshare	EndoMod	EndoNot	ExoMod	ExoNot	Total
	Number of groups in each outcome:				
0	0	1	0	0	1
1	0	1	0	1	2
2	4	2	4	5	15
3	6	2	2	2	12
4	2	0	2	1	5
Total	12	6	8	9	35
	Cooperation rates in stage one (in percent):				
0		5.0			
1		2.5		95.0	
2	23.1	33.8	15.6	25.0	
3	46.3	21.3	70.0	46.3	
4	13.8		36.3	22.5	
Average	33.1	19.6	34.4	37.2	
	Cooperation rates in stage two (in percent):				
0		0.0			
1		2.8		100.0	
2	83.8	6.3	40.6	30.5	
3	95.0	8.8	75.0	36.3	
4	9.8		97.5	37.5	
Average	91.7	5.5	63.4	40.3	

Dal Bó et al. (ibid.) find little difference after the voting between the unmodified groups and do not consider these further. In contrast, average cooperation under ExoNot after the vote is significantly higher in my sample when compared to EndoNot (35 percentage points difference; p-value $= 0.011$). In the modified outcomes in stage two subjects cooperated even more than in the unmodified ones (54 percentage points difference; p-value < 0.01).

[19] The p-values reported in this section are obtained from Wilcoxon signed-rank tests for all dependent observations and Mann-Whitney-U tests for all independent observations.

A within-subjects comparison of EndoMod and ExoMod between stage one and two gives additional support to the positive influence of modification on cooperation (p-value $<$ 0.01).

Between the two kinds of groups who play the modified game Dal Bó et al. (2010) find a difference in cooperation of 8 percentage points in favour of endogenous modification in part two. But this result is not very robust: democracy is only significant at the 10 percent level if subjects who were not able to remember the vote stage result in the questionnaire are excluded from the analysis (ibid., p.2220). I find that EndoMod and ExoMod groups are very similar in stage one (p-value = 0.757), but in stage two the former display an average cooperation rate that is 28 percentage points higher (p-value = 0.077).

Result 9 *(Democratic) modification has a significantly positive effect on cooperation at the group level.*

The group level analysis therefore shows that the coordination game in general seems beneficial for cooperation and its democratic enaction even more so. These results fully support the findings from the individual analysis.

6 Concluding Remarks

The paper aims to quantify the influence that democratic decision-making processes have on the effectiveness of a policy. It extends a study by Dal Bó et al. (ibid.) who investigate how cooperation is influenced by an endogenous institutional choice via a referendum. The present experiment models a representative democracy by including the election of a group speaker who determines the policy implementation.

Small groups are presented with the possibility of changing their payoff structure from a prisoners' dilemma into a coordination game that makes cooperation incentive-compatible. This modification preference of each player is used as a proxy for unobservable personal characteristics that influence cooperative behaviour. It is tested whether the institutional change has the same influence when it is implemented by a group speaker compared to an external authority. Beforehand, this speaker is elected in each small group to simulate a representative democracy. Her choice of game is considered and implemented for the group with a 50-percent probability. If it is not considered the computer chooses between the two games with equal probability. This randomization allows for a comparison of subjects with the same preferences, information and institution who only differ in the way the institution was established. Standard economic theory would not predict a quantifiable impact of the decision-making process on behaviour and consequently efficiency. The main advantage of this design is that potentially biasing self-selection effects can be controlled for (ibid.). Information effects cannot be excluded to drive results in the studies by Tyran and Feld (2006) and Sutter et al. (2010). In these, the group's institutional choice was only revealed in the endogenous cases. My design controls for this by presenting the speaker's choice also in the exogenous outcomes.

To summarize my results, the first stage confirms the well-known phenomenon that subjects cooperate in prisoners' dilemma experiments despite defection being the best

response. Gender seems to have an influence in that women are 30 percent more likely to cooperate than men. When presented with the opportunity of payoff modification, a higher cognitive ability is associated with an increased preference for the cooperation-fostering policy. Unsurprisingly, cooperative players favour the modification more suggesting that self-selection is an issue to be concerned with as it can lead to an overestimation of the policy's effect. However, the distribution of voters in the groups with endogenously and exogenously modified payoffs is similar in the present study. Subjects try to elect pro-social representatives, but factually these do not behave significantly different than the rest of the sample in both stages. Furthermore, a cooperative speaker is not sufficient as a cue towards cooperation when payoffs are not modified.

The coordination game itself has a positive influence on cooperation meaning that the institution itself is effective, which is in line with theoretical considerations and previous empirical findings. Dal Bó et al. (2010) find that endogenous modification increases cooperation more than exogenous modification, especially for players who preferred the modified over the unmodified game. Directly after the vote, subjects in my experiment also cooperate more if the payoff modification is democratically introduced. Over the course of the rounds, differences between endogenous and exogenous modification become more pronounced. In contrast to Dal Bó et al. (ibid.) the impact of the democratic policy is even larger for those who initially did not want to introduce it. Using an estimation strategy of Dal Bó et al. (ibid.), which controls for different shares of player types in the outcomes, the *democratic dividend* is calculated to account for a substantial increase in cooperation. With almost 50 percentage points it is of more than triple the size of the premium that Dal Bó et al. (ibid.) find. Not enough is known about the contextual factors besides the computer intervention that cause these radical differences. It certainly does not seem to be the case that the indirect decision-making through a representative is perceived to be more exogenous per se. The strong reaction displayed by the no-voters after the endogenous modification rather points towards an exemplary function of the speaker who as an authoritative figure is able to establish cooperation as a focal point only when she is considered.

Limitations of the abstract experimental design are that many essential features of a representative democracy are excluded. There is no running for elections, no pandering and no accountability, and no rent for the elected politician. While this simplified model is undoubtedly useful when conducting a robustness check on Dal Bó et al. (ibid.), the external validity of the results should not be overrated. However, incorporating the mechanism of Dal Bó et al. (ibid.) into more complex experiments regarding representative democracies promises to be a way of obtaining unbiased estimates of various kinds of endogenous treatment effects. Possible extensions to my study are giving more power to the representative, e.g. by letting her decide on the strategies of the citizens. Repeated elections, campaigning of candidates, or lobbying for citizens with different interests are further relevant factors in representative democracies that could be included. All in all, more research needs to be done to better understand the influence of indirect democratic institutions on cooperation in societies small or large.

A Tables

Table 12: Party Preferences

Party	**Frequency**	**Percentage**
CDU	24	14.6
SPD	20	12.2
Die Grünen	18	11.0
Die Linke	16	9.8
Piratenpartei	2	1.2
FDP	2	1.2
Not answered	82	50.0
Observations	164	

Table 13: Cooperation in Stage One

Round	*Cooperation (%)*
1	51.8
2	47.0
3	41.5
4	39.6
5	36.0
6	30.5
7	25.6
8	21.3
9	18.3
10	15.2
Average	32.7

Table 14: Cooperation in Stage Two

Prisoners' Dilemma	
Round	*Cooperation (%)*
11	43.3
12	36.7
13	30.0
14	26.7
15	25.0
16	23.3
17	23.3
18	21.7
19	18.3
20	16.1
Average	26.5

Coordination Game	
Round	*Cooperation (%)*
11	78.8
12	82.5
13	82.5
14	80.0
15	80.0
16	83.8
17	81.3
18	78.8
19	78.8
20	77.5
Average	80.4

B Instructions

Herzlich willkommen im Experimentallabor. Bitte beachten Sie, dass ab jetzt bis zum Ende der Sitzung keine Kommunikation mehr gestattet ist. Wenn Sie eine Frage haben, geben Sie bitte ein Handzeichen aus der Kabine und wir kommen zu Ihnen. Während des gesamten Experiments ist das Benutzen von Smartphones, Tablets o.ä. untersagt. Bitte beachten Sie, dass eine Zuwiderhandlung zum Ausschluss vom Experiment und von sämtlichen Zahlungen führt. Alle Ihre Entscheidungen bleiben anonym und lassen sich nicht Ihrer Identität zuordnen. Bitte lesen Sie diese Instruktionen sorgfältig durch und geben Sie sie am Ende wieder ab.

Das nun folgende Experiment besteht aus zwei Teilen. Die Instruktionen für den zweiten Teil erhalten Sie nach Abschluss des ersten Teils. In beiden Teilen wird ein Spiel über zehn Runden gespielt. In den Spielen verdienen Sie Punkte. Die Anzahl der Punkte, die Sie verdienen, hängt dabei von Ihren eigenen Entscheidungen und denen Ihrer Mitspieler/innen[20] ab. Am Ende des Experiments wird jeweils eine Runde aus jedem Teil ausgelost und das in Ihr verdiente Einkommen an Sie ausgezahlt. Die Punkte werden dabei in einem Verhältnis von 10 Punkte = 1€ umgerechnet. Sie werden nun zunächst zufällig in Vierergruppen eingeteilt; diese Gruppen bleiben während des gesamten Experiments unverändert. Zugleich wird Ihnen eine zufällige Spielernummer zwischen 1 und 4 zugeteilt, die ebenfalls während des kompletten Experiments bestehen bleibt.

Beispiel: Sie haben Spielernummer 2 und bilden eine Gruppe mit den Spielern 1, 3 und 4.

Teil 1

Sie spielen nun für zehn Runden ein Spiel (**Spiel 1**) mit einem anderen Mitglied ihrer Gruppe. Dieses wird für jede Runde zufällig aus den drei anderen Gruppenmitgliedern zugeteilt und Sie erfahren erst nach Ende jeder Runde, mit welchem Gruppenmitglied Sie gespielt haben. **Sie können in diesem Spiel in jeder Runde zwischen den Optionen A und B wählen.** Gleichzeitig entscheidet sich Ihr Partner ebenfalls für eine dieser Alternativen. Sie wissen zum Zeitpunkt Ihrer Entscheidung nicht, was der jeweils andere wählt. Ihr Einkommen für eine Runde berechnet sich in Spiel 1 wie folgt:

Spielen Sie Option A und das andere Gruppenmitglied spielt ebenfalls A, so verdienen Sie beide jeweils 50 Punkte.
Spielen Sie Option A und das andere Gruppenmitglied spielt B, so erhalten Sie 30 Punkte und Ihr Partner 60 Punkte.
Spielen Sie Option B und das andere Gruppenmitglied spielt A, so erhalten Sie 60 Punkte und Ihr Partner 30 Punkte.
Spielen Sie B und das andere Gruppenmitglied spielt ebenfalls B, so erhalten Sie beide jeweils 40 Punkte.

Am Ende jeder Runde sehen Sie auf Ihrem Bildschirm eine übersicht über die gewählten

[20] Aus Platzgründen wird hier nur die männliche Form eines Wortes verwendet, in der Hoffnung, dass sich dennoch alle Geschlechter angesprochen fühlen.

Optionen Ihres Spielpartners und aller anderen Mitglieder Ihrer Vierergruppe. Tabelle 1 zeigt eine Zusammenfassung Ihres möglichen Punktegewinns pro Runde in Spiel 1:

Ihre Wahl	Wahl des Mitspielers	
	A	B
A	50	30
B	60	40

Spiel 1

Teil 2

Zu Beginn von Teil 2 findet eine Wahl statt. **Jede Gruppe wird in geheimer Wahl eines ihrer vier Mitglieder zum Sprecher ernennen. Dieser Sprecher entscheidet, welches Spiel Ihre Gruppe im zweiten Teil des Experiments für zehn weitere Runden spielt.** Dabei besteht die Wahl zwischen Spiel 1 (aus Teil 1 bekannt) und Spiel 2 (s. Tabelle 2). In Spiel 2 stehen ebenfalls die Optionen A und B zur Verfügung und Ihr Einkommen für eine Runde berechnet sich wie folgt:

Spielen Sie Option A und das andere Gruppenmitglied spielt ebenfalls A, so verdienen Sie beide je 50 Punkte.
Spielen Sie Option A und das andere Gruppenmitglied spielt B, so erhalten Sie 30 Punkte und Ihr Partner 48 Punkte.
Spielen Sie Option B und das andere Gruppenmitglied spielt A, so erhalten Sie 48 Punkte und Ihr Partner 30 Punkte.
Spielen Sie B und das andere Gruppenmitglied spielt ebenfalls B, so erhalten Sie beide jeweils 40 Punkte.

Ihre Wahl	Wahl des Mitspielers	
	A	B
A	50	30
B	48	40

Spiel 2

Zunächst müssen Sie angeben, welches der zwei Spiele Sie für Ihre Gruppe auswählen möchten, sollten Sie zum Sprecher gewählt werden. Diese Entscheidung bleibt geheim, bis die Wahl des Gruppensprechers abgeschlossen ist. Dazu müssen Sie ein Mitglied aus Ihrer Gruppe wählen (s. Abbildung 1). Sie können sich nicht selbst wählen. Das Gruppenmitglied mit den meisten Stimmen gewinnt die Wahl. Im Falle eines Gleichstands wird zufällig ein Spieler aus den meistgewählten Spielern zum Sprecher ernannt. Die hinterlegte Entscheidung über Spiel 1 oder 2 des gewählten Sprechers wird für Ihre Vierergruppe bindend. **Diese Entscheidung wird jedoch nur mit einer Wahrscheinlichkeit von 50 Prozent umgesetzt.** In den anderen 50 Prozent der Fälle teilt der Computer Ihrer Gruppe zufällig Spiel 1 oder 2 zu. **Beide Spiele sind dabei gleich wahrscheinlich**.

Sie werden nach der Wahl darüber informiert, wer gewählt wurde, welches Spiel der Sprecher ausgewählt hat, ob diese Entscheidung berücksichtigt wurde und welches Spiel Ihre Gruppe in Teil 2 spielen wird.

Sie spielen daraufhin das in der Wahlphase zugeteilte Spiel in Ihrer Gruppe für zehn Runden. Wieder sehen Sie nach jeder Runde, gegen welches Gruppenmitglied Sie gespielt haben, Ihren Punktegewinn und die Entscheidungen Ihrer Mitspieler.

Im Anschluss an das Experiment stellen wir Ihnen noch einige Fragen, die keine Auswirkungen mehr auf die Auszahlung haben, und bestimmen nach dem Zufallsprinzip die auszahlungsrelevanten Runden.

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