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Preface

Cooperation is a powerful tool to reach Pareto improvements compared to pure self-serving behavior. How to achieve cooperation is therefore a key question for everybody who is interested in promoting the general welfare.

This dissertation presents several institutional arrangements to improve cooperation in experimental settings. The work is based on the now standard public goods game: Subjects are matched into a group and get an initial endowment. Each individual can allocate the endowment either to his own private account or to the public account. Allocations to the public account are multiplied by a factor larger than 1 and the public account is subsequently distributed equally to all group members. This setup creates a social dilemma: each individual maximizes his payoff by contributing nothing, even though full contribution by all group members would maximize the total payoff for all group members. The three chapters of the dissertation present different institutional arrangements to alleviate this dilemma. The first chapter introduces an additional costly mandatory contribution mechanism, the second chapter discusses the effect of giving one group member allocation power over the group account and the third chapter discusses the introduction of religious and pro-social primes before the allocation decision.

For the analysis I mainly use the frameworks developed by Fehr and Schmidt (1999) and Charness and Rabin (2002). Both are based on the insight that individuals do not care solely about their own payoff but also take the payoffs of the other group members into account. Fehr and Schmidt (1999) emphasize a general distaste for inequality. Individuals like neither being better off nor being worse off than other group members. Charness and Rabin (2002) assume that subjects care about their own payoff and, additionally, the minimum payoff in their group and the sum of all payoffs. The results in this dissertation are approximated quite well by predictions from these two frameworks.

The dissertation proceeds as follows:

The first chapter "Tax or trust: a public goods game with enforceable and voluntary contributions" presents a modified public goods game. In the modified game, there are two funding mechanisms for a public account – a costly tax mechanism and a cost-free voluntary contribution mechanism. The tax mechanism is controlled by a voting of all group members. After the tax payment is established, each group member can voluntarily contribute to the public account. The public account is multiplied by an efficiency factor larger than one and distributed equally among all group members.

I provide four main empirical results: First, the additional funding mechanism leads to higher average profits than in the appropriate control treatments in which there is only one funding mechanism each. Second, the negative time trend that occurs in the standard voluntary contribution mechanism also exists in the modified game with two funding mechanisms. Third, the voting and contribution decisions are strongly influenced both by the behavior of group members in the current period and the experience with different group members in earlier periods. Fourth, subjects who cast the decisive vote in the first stage contribute more in the second stage.

The second chapter “The team allocator game: allocation power in public goods games” is joint work with Martin Kocher and Dominik Matzat. The chapter also presents a modified public goods game. In our team allocator game, each team member can contribute to a public account. The sum of contributions is multiplied by an efficiency factor larger than one, but – in contrast to the standard public goods game – the public account is not distributed equally among all team members. Rather, the team allocator receives the entire amount and has full discretionary power over the allocation of the revenues from the account within the team.

We provide three main empirical results: First, we find that the level of contributions in the team allocator game is significantly higher than in an appropriate control treatment in which there is no team allocator, but one team member is forced to contribute her entire endowment. Second, we find that it is the team allocator’s distribution behavior that influences together with the time horizon of the team interaction the development of contributions. Contributions increase in the returned amount, i.e. the reward channel is most effective in sustaining high levels of cooperation. Third, although there is some heterogeneity among the team allocators, on average, team allocators return remarkably high amounts to ordinary team members that invest into the public account. Non-contributors, however, are excluded from the benefits from cooperation. Hence, team allocators generate strong contribution incentives.

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The third chapter “How to make people generous and credulous: religious and pro-social primes in a public goods game” presents a classic public goods game with religious, pro-social and neutral primes. Participants solve a scrambled sentence task – they have to form a four-word sentence out of five given words – filled with religious, pro-social or neutral keywords, before making decisions in a standard public goods game.

I provide three main empirical results: First, both the religious and the pro-social prime increase the average contribution in the public goods game. Second, the subjective importance of the other group members’ payoff and the expectation of the other group members’ contribution positively influence the own contribution. Third, both the religious and the pro-social prime increase the subjective importance of the other group members’ payoff, the pro-social prime also increases the expectation of the other group members’ contribution.

Each of the three chapters has its own introduction and appendix. You can therefore read each chapter independently from the other chapters.

Chapter 1: Tax or trust: A public goods game with enforceable and voluntary contributions

1.1. Introduction

Consider a group setting in which a public good is funded by a combination of two different mechanisms. The first mechanism can enforce identical contributions by all group members but its implementation is costly. The second mechanism is costless, but the contributions are entirely voluntary without enforcement. The mechanisms are organized sequentially, first the group members determine the forced contribution and then every group member decides on his voluntary contribution. The group faces the classic social dilemma in the second mechanism: it is individually rational for a selfish group member to contribute nothing, even though full contribution by all group members would be socially optimal. Additionally, the group members face a further dilemma when they decide about the forced contribution. They can implement a large forced contribution to hedge against free-riding. However, such a decision might actually crowd out exactly these voluntary contributions, resulting in a welfare loss due to the costs of the first mechanism.

There are two interpretations of this setting, both are equally valid. First, you can consider this as a community that has the ability to tax[1] its members, who can also voluntarily contribute to the public good. In real life, a large scale example for this is the funding of universities – a combination of public funds raised by taxation and private donations. For a small scale example you can think of a tennis club that has to keep its courts in good shape, by a combination of costly outside workers paid by the membership fees and a reliance on its members to keep the courts in good shape – a cheap but voluntary mechanism.

Second, you can consider this a team production, in which individual effort levels in the team are easily observable, but the verification of them is costly. This can be represented by a small work team that works on a joint project and whose team members

[1] This can also mean the ability to determine a membership fee.

can document their individual contribution only with a lot of time and effort. The work team can choose a high level of documentation – thus ensuring contributions but creating additional costly activities – or a low level of documentation – thereby freeing resources but making individual contributions effectively voluntary.

To my best knowledge, this is the first work providing a rigorous empirical test of the (behavioral) incentive effects of such a group structure. I analyze a modified public goods game theoretically and implement it experimentally in the laboratory. In the main treatment, called TAX/VCM[2], group members vote for a forced contribution – basically a tax payment – in stage 1. The total tax payment minus the taxation costs goes to the public account. The marginal tax costs increase with the tax payment.[3] In stage 2, each group member can make an additional voluntary contribution to a public account. The sum of contributions from both stages is multiplied by an efficiency factor larger than one, and distributed equally among all group members.

It is straightforward to show that in such a setting, group members with standard preferences have no incentive whatsoever to contribute to the public account in stage 2, and will therefore agree on a large tax payment that ensures maximum profit in absence of voluntary contributions. The experimental results, however, show that groups typically choose lower tax payments and voluntarily contribute substantial amounts. I show that contribution levels depend on individual preferences, observed past action of the other group members and separately formed expectations about future action of the other group members. I provide theoretical evidence that such behavior could be caused by other-regarding preferences such as inequity aversion (Fehr and Schmidt, 1999) or a combination of maximin-preference and general efficiency concern (Charness and Rabin, 2002).

In addition to the main treatment, I analyze two control treatments. The first control treatment – called TAX – implements only the forced contribution mechanism. The second control treatment – called VCM – implements only the voluntary contribution mechanism.

There are several studies analyzing the effects of tax schemes and institutional arrangements in public goods settings. This chapter sheds light on some additional and previously unanswered questions: (i) Does an endogenously chosen tax amount result in

[2] In this treatment, both a tax mechanism and a voluntary contribution mechanism are implemented, hence TAX/VCM.
[3] This modelling choice is motivated by disproportionately increasing tax evasion and monitoring costs in applicable real world situations.

full, partial or no crowding out of voluntary contributions? (ii) Will the “optimal tax rate” be chosen if a) there is an additional VCM or b) only the tax mechanism is available?

In the 1980’s several high-profile papers theoretically explored the relationship between taxation and voluntary contributions to public goods. Warr (1982) and Roberts (1984) postulate that costless lump-sum taxation financing of public goods crowds out voluntary contribution dollar for dollar. Consequently, financing public goods via taxation can only increase provision of the public good after crowding out all voluntary contributions. Bergstrom et. al. (1986) argue that if taxed individuals differ in their propensity to contribute to a public good, the average crowding out effect will be less than dollar for dollar. Even if taxation crowds out contributions of voluntary contributors dollar for dollar, people who do not contribute voluntarily are forced to contribute via taxation. Bernheim (1986) argues that a generalized version of these results would mean that virtually all government taxes and transfers would be neutral. He concludes that the underlying assumption that individuals are only interested in the aggregate supply of the public good should be scrutinized. Andreoni (1990) does just that and offers the theory of warm-glow giving: Voluntary contributions to a public good offer utility (a warm glow) to the contributor, the size of the effect is positive in the size of the voluntary contribution. This additional assumption leads to only partial crowding out of the tax financed contributions of the public good.

It was also Andreoni (1993) who did the first experimental test of the relationship between tax financed contributions and voluntary contributions for public goods. Building on his warm-glow model he develops a public goods game with an endowment of seven tokens in which both the Pareto optimal contribution – six tokens – and the Nashequilibrium contribution – three tokens – are interior solutions. Andreoni compares the result of a simple voluntary contribution mechanism to a treatment that implements an exogenously forced contribution of two tokens. He finds that the implementation of the tax does partially crowd out contributions – in other words: it increases the sum of forced and voluntary contributions. However, his results should be taken with a grain of salt, because his observed average contribution in the no-tax treatment is below even the Nashequilibrium contribution.

Chan et. al. (2002) as well as Gronberg et. al. (2012) vary the payoff functions but keep the general framework of Andreoni (1993): A public goods game with an interior Nashequilibrium as control treatment and a main treatment with an additional exogenously implemented tax or forced contribution below the Nashequilibrium. Both articles report incomplete crowding out or rather increased total contributions in the main treatment.

To my knowledge, the work of Sutter and Weck-Hannemann (2004) is the only previous experiment that implements an endogenous choice about a tax prior to a voluntary contribution mechanism public goods game. The paper replicates the setup of Andreoni (1993) and adds a third treatment in which subjects decide via a simple majority vote whether to implement the tax of two tokens or not. Differing from Andreoni's paper, Sutter and Weck-Hannemann do not find a difference in total contributions between the no-tax and the exogenous-tax treatments. The total contributions in the endogenous-tax treatments are significantly lower than in the exogenous-tax treatment. This stems from significantly lower contribution in groups that reject the implementation of a tax. The vote in the first stage has predictive value for the contribution in the second stage, subjects who vote 'No' contribute less whether the tax is implemented or not.

While the experimental literature on taxes and voluntary contribution in public good games has followed in Andreoni's warm glow footsteps, the general discussion about causes of cooperative behavior in public goods settings has broadened. Fehr and Gächter (2000a) and Falk and Fischbacher (2006) argue that people act reciprocal and mimic the intentions of other people. Kind actions are rewarded and unkind actions are punished. Fehr and Schmidt (1999) argue that people prefer equal outcomes and are willing to alter behavior to avoid inequality, especially if they get less than other people. Charness and Rabin (2002) argue that besides their own well-being people care about general efficiency and about the least well-off in society.

Another related topic is endogenous institutional choice. Sutter et al. (2010) run an experiment in which group members can vote on supplementing their public goods game with a reward or punishment mechanism. They find that endogenous choice of the additional mechanism leads to significantly higher contribution in the VCM phase. Although the subjects in my setting do not decide on the existence of a tax mechanism, there is a clear similarity. The group members jointly decide on the institutional environment of the voluntary contribution setting.

My work adds to the existing literature in two main ways. First, I expand the analysis of taxes and voluntary contributions to other-regarding preferences. The focus is especially on the models of Fehr and Schmidt (1999) and Charness and Rabin (2002). Second, prior experiments had to implicitly impose an exogenous limit to the feasible taxation to avoid the trivial solution of just implementing the Pareto optimal tax rate. I introduce a distinction between costly financing through taxes and costless financing through voluntary contributions. This creates an endogenous limit to the positive effects of taxation.

The remainder of the chapter proceeds as follows: In Section 2 I present the experimental design and describe the procedures of the experiment. Section 3 derives theoretical predictions for all treatments. Section 4 reports the experimental results and compares them to the theoretical predictions, and Section 5 discusses my findings and concludes the chapter.

1.2. Experimental design and procedures

In this section I describe the basic experimental setup (Section 2.1) and the details of the experimental procedure (Section 2.2).

1.2.1 Basic setup of the game

Let $I = \{1, 2, \dots, n\}$ denote n subjects who interact in T periods. Each period $t \in \{1, 2, \dots, T\}$ consists of three stages. In stage 0, each individual $i \in I$ receives an endowment E. In stage 1 the endowment can be allocated via a tax mechanism to the public account. The tax payment of individual i to the public account in period t, denoted $p_{i,t}$, must satisfy $0 \leq p_{i,t} \leq E$, and must be equal for all members $(p_{i,t} = p_{j,t})$. Let P_t be the sum of all group members' tax payment in period t (i.e. $P_t = n * p_t$) and K_t the convex cost function of implementing the tax mechanism. In stage 2, each individual can allocate the remaining endowment either to his own private account or to the public account. The contribution of individual i to the public account in period t, denoted $c_{i,t}$, must satisfy $0 \leq c_{i,t} \leq E - p_t$. Let C_t be the sum of all group members' contributions in period t (i.e. $C_t = \sum_{j=1}^{n} c_{j,t}$). Let R_t be the revenue for the public account in period t (i.e. $R_t = (P_t - K_t) + C_t$). In order to retain the public goods nature R_t is multiplied by a factor γ, which satisfies $1 < \gamma < n$.

At the end of each period the amount γR_t is automatically distributed evenly among the group members. Formally, the returned amount is denoted by $d_t = \gamma R_t / n$.

Individual group member i's payoff in period t, $\pi_{i,t}$, is then given by the sum of his remaining endowment and his share of the public good

$$\pi_{i,t} = E - p_t - c_{i,t} + d_t. \quad (1)$$

1.2.2 Experimental procedures

24 subjects participated in each experimental session. At the start of each experimental session, the subjects were divided into four matching groups of six subjects each. All subjects only interacted with subjects of their own matching group during the experiment. To ensure that they would treat each period as a (quasi) one-shot game, the subjects were not informed that there were four matching groups per session.

The experiment implements three treatments: (i) treatment *TAX/VCM,* (ii) treatment *TAX* and (iii) treatment *VCM*. TAX/VCM is a treatment according to the setup laid out in Section 2.1 with the following parameters: number of subjects $n = 3$, number of periods $T = 15$, number of groups $G = 2$, endowment per period $E = 25$ points (the experimental currency unit)[4], and revenue multiplier $\gamma = 2$.

The tax payment p_t is chosen separately for each period t by each group via a median voting mechanism. All members of the group are asked to vote for their preferred tax payment $v_{i,t}$, the implemented tax payment $p_{i,t}$ is the median of all (three) $v_{i,t}$. I will refer to $v_{i,t}$ as the vote and to p_t as the tax in the remaining chapter.

TAX and VCM are two control treatments for TAX/VCM. Both implement just one of the stages 1 and 2. TAX implements only stage 1, so there is only the tax mechanism but no voluntary contribution. VCM is a standard voluntary contribution mechanism. Both TAX and VCM are otherwise identical to TAX/VCM.

Information conditions are as follows: After stage 1, each individual is informed about the vote $v_{i,t}$ of the other two members within his group and the resulting tax $p_{i,t}$. After stage 2, each individual is informed about the contribution $c_{i,t}$ of the other two members within his group. At the end of each period, each individual is informed about his remaining endowment $E - p_{i,t} - c_{i,t}$, his returned amount from the public good $d_{i,t}$ and his payoff $\pi_{i,t}$. No further information about decisions of other players or results of other groups is given.

[4] At the end of the experiment earned points from all periods are summed up and converted into euro using the following exchange rate: 40 points = 1 euro.

The experimental sessions started with instructions on the experiments (the full text is in Appendix A). The instructions gave complete information about the basic setup of the game and the relevant parameters.[5] Instructions were read aloud to ensure common knowledge of the rules, and subjects were given plenty of time to ask questions in private before the start of the first period.

The computer-based sessions were conducted at the experimental laboratory MELESSA of the University of Munich in August 2009 using the experimental software z-Tree (Fischbacher, 2007) and the organizational software Orsee (Greiner, 2004). A total of 144 subjects, mostly undergraduate students from all disciplines, participated in six sessions with 24 participants each. Two sessions each implemented treatments TAX/VCM, TAX and VCM. The six sessions provide 8 statistically independent observations (matching groups) for each of the three treatments. The sessions lasted up to 90 minutes including everything from the instructions to final payments, and the average earnings were 16.80 EUR, including a show-up payment of 4.00 EUR. No participant was allowed to take part in more than one session, and the assignment of subjects into treatments was random. Decisions were taken anonymously in cubicles, and communication among participants was prohibited.

1.3. Theoretical predictions

In this section, I present theoretical predictions for all treatments. First, we look at predictions given by the homo oeconomicus model with the assumptions of purely selfish and rational decision makers ("standard preferences"). Second, I present theoretical predictions for two well-known models that include other-regarding preferences, namely models based on Fehr and Schmidt (1999) and Charness and Rabin (2002). Finally, I present a simplified model of the TAX/VCM game.

In the rest of this section, I will discuss different equilibria based on the three mentioned models. For the voting behavior in stage 1 the term "equilibrium" will refer to a trembling hand perfect equilibrium based on Selten (1975).[6]

[5] With the exception described at the beginning of this sub-section.
[6] The trembling hand perfect equilibrium takes into account that there is a small chance that other group members might make mistakes – defined as choosing an unintended strategy. In my setting this is necessary to avoid equilibria with dominated voting behavior. Example: If all group members strictly prefer a desired tax d, then $v_3 = r$ is an equilibrium for all $r \in \{0, 1, 2, \dots, E\}$ if $v_1 = v_2 = d$, although subject 3 strictly prefers $p = d$ over all other outcomes. However, $v_3 = d$ is the only trembling hand perfect equilibrium,

1.3.1 Predictions based on standard preferences (homo oeconomicus model)

We can look at all three treatments as (almost pure[7]) repeated one-shot experiments. First, let us look at the treatments with one decision stage. In the VCM, each participant will always contribute zero to the public account, because an increase of the contribution by 1 will lower his remaining endowment by 1 and will increase his share of the public good by just 2/3, resulting in a net loss of 1/3. In the TAX, each participant will always vote for 16. As you can see in Table 1, a tax of 16 maximizes the payoff for each participant. The relationship of the tax and the payoff has a single peak at 16. Combined with the median voting mechanism this ensures that a vote of 16 is optimal regardless of the votes of the other group members.[8]

Now we can look at TAX/VCM and the two decision stages in this treatment. Assuming common knowledge of rationality and selfishness and using backward induction, each participant will vote for 16 in the first stage and contribute nothing in the second stage:

In the second stage, the logic used in the discussion of the VCM holds regardless of the tax in the first stage, resulting in a contribution of zero. Therefore, the first stage can be treated like the TAX treatment above, resulting in a vote of 16.

Proposition 1. *Under standard preferences, participants a) contribute zero in the VCM and the second stage of TAX/VCM and b) vote for 16 in the TAX and the first stage of TAX/VCM.*

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because now subject 3 assigns a small probability to the outcome were subjects 1 or 2 mistakenly do not vote for d. Assuming that mistakes are possible in this setting also makes sense in practice because subjects type their choices into keyboards.

[7] See also Fehr and Gächter (2000a), footnote 3. Even if future periods play a role in the decision making, the predictions are unchanged.

[8] We can proof this by looking at all possible combinations of the votes of the other two group members:

a) If at least one of the other two group members votes 16, a vote of 16 implements the optimal tax of 16.
b) If one of the two members has a vote strictly higher than 16 and the other member has a vote strictly lower than 16, a vote of 16 implements the optimal tax of 16.
c) If both other group members have a vote strictly below 16, a vote of 16 implements the tax that equals the higher vote of the other group members. Because the payoff is strictly increasing in the tax as long as the tax is below 16, this is the best result that is achievable given the other votes.
d) If both other group members have a vote strictly above 16, a vote of 16 implements the tax that equals the lower vote of the other group members. Because the payoff is strictly decreasing in the tax as long as the tax is above 16, this is the best result that is achievable given the other votes.

Table 1: Tax payments, taxation costs, public good payments and remaining endowments in stage 1

Tax payment (p)	Total tax payments (P)	Marginal costs per subject	Total costs of taxation (K)	R = P - K	d	Remaining endowment	Payoff d + RE
0	0	0	0	0	0	25	25
1	3	0.03	0.09	2.91	1.94	24	25.94
2	6	0.06	0.27	5.73	3.82	23	26.82
3	9	0.09	0.54	8.46	5.64	22	27.64
4	12	0.12	0.90	11.10	7.40	21	28.40
5	15	0.15	1.35	13.65	9.10	20	29.10
6	18	0.18	1.89	16.11	10.74	19	29.74
7	21	0.21	2.52	18.48	12.32	18	30.32
8	24	0.24	3.24	20.76	13.84	17	30.84
9	27	0.27	4.05	22.95	15.30	16	31.30
10	30	0.30	4.95	25.05	16.70	15	31.70
11	33	0.33	5.94	27.06	18.04	14	32.04
12	36	0.36	7.02	28.98	19.32	13	32.32
13	39	0.39	8.19	30.81	20.54	12	32.54
14	42	0.42	9.45	32.55	21.70	11	32.70
15	45	0.45	10.80	34.20	22.80	10	32.80
16	48	0.48	12.24	35.76	23.84	9	32.84
17	51	0.51	13.77	37.23	24.82	8	32.82
18	54	0.54	15.39	38.61	25.74	7	32.74
19	57	0.57	17.10	39.90	26.60	6	32.60
20	60	0.60	18.90	41.10	27.40	5	32.40
21	63	0.63	20.79	42.21	28.14	4	32.14
22	66	0.66	22.77	43.23	28.82	3	31.82
23	69	0.69	24.84	44.16	29.44	2	31.44
24	72	0.72	27.00	45.00	30.00	1	31.00
25	75	0.75	29.25	45.75	30.50	0	30.50

1.3.2 Predictions based on other-regarding preferences

We focus on two prominent models that both belong to the class of outcome-based social preference models: the inequity aversion model by Fehr and Schmidt (Fehr and Schmidt, 1999) and the welfare-oriented model by Charness and Rabin (Charness and Rabin, 2002).

1.3.2.1 Fehr and Schmidt (1999) preferences

The model by Fehr and Schmidt (1999) assumes that subjects suffer from inequity within their reference group. More precisely, a subject i benefits from his own payoff π_i but compares it with the payoff of the $n-1$ other members in his reference group. The corresponding utility function is the following:

$$U_i(\pi) = \pi_i - \alpha_i \frac{1}{n-1} \sum_{j \neq i} \max\{\pi_j - \pi_i, 0\} - \beta_i \frac{1}{n-1} \sum_{j \neq i} \max\{\pi_i - \pi_j, 0\} \qquad (2)$$

The vector $\pi = (\pi_1, \ldots, \pi_n)$ denotes the monetary payoffs and α_i and β_i represent subject i's individual attitude towards inequity. The two weights are restricted to $\beta_i \leq \alpha_i$ and $0 \leq \beta_i < 1$. They control for the impact of utility losses from disadvantageous inequity (α_i) and advantageous inequity (β_i), respectively.[9]

In the VCM, for given j and k, the utility maximizing contribution is $(c_i) = (\min\{c_j, c_k\})$ if $1/3 \leq \beta_i$ and $(c_i) = 0$ if $\beta_i < 1/3$. The monetary loss of a positive contribution is 1/3 per contributed point. If the maximum utility loss by advantageous inequality represented by β_i is below this threshold, a contribution of zero is maximizing utility – subject i is a free-rider. If this utility loss is above the threshold, subject i can increase his utility by contributing positive amounts up to the minimum contribution of the other group members. In this case, subject i is a weak conditional cooperator. However, he will never want to contribute more than this minimum, because the gain of decreasing advantageous inequality with the high contributor will at least be canceled out by the loss of increasing disadvantageous inequality with the low contributor ($\beta_i \leq \alpha_i$).

There are two types of equilibria: If $1/3 \leq \beta_i$ holds for all group members, then every combination of identical contributions ($c_i = c$ for all i) is an equilibrium. If $\beta_i < 1/3$ holds for at least one group member, the only equilibrium is the contribution of zero ($c_i = 0$ for all i) by all group members.

[9] Note that for $\alpha_i = \beta_i = 0$ the model collapses into the case of standard preferences.

In the TAX, the Fehr and Schmidt preferences case collapses into the standard preferences case with an optimal vote of 16. There is no inequality, because by design all group members pay the same tax and get the same payoff. Therefore, payoff maximization is the optimal strategy. Consequently, the only equilibrium is $v_i = 16$ for all group members.

Now we get to the TAX/VCM. For any given tax in stage 1, the discussion above about the VCM holds for stage 2. If $1/3 \leq \beta_i$ holds for all group members, then every combination of identical positive contributions ($c_i = c$ for all i) and identical votes up to 23[10] ($v_i = v \leq 23$ for all i) is an equilibrium, as long as the payoff for each subject is above the threshold of 32.84 (tax of 16, no contributions). If $\beta_i < 1/3$ for at least one group member, all group members contribute nothing in the VCM stage as shown above. Therefore, the first stage can be played as if there is no second stage. By backwards induction, the only equilibrium is the contribution of zero ($c_i = 0$ for all i) and identical vote of 16 ($v_i = v = 16$) for all i) by all group members.

Proposition 2. *With Fehr and Schmidt (1999) preferences, subject i is willing to contribute positive amounts in the VCM if $\beta_i \geq 1/3$. If $\beta_i \geq 1/3$ for all group members identical contributions ($c_i = c$ for all i) is an equilibrium, else ($c_i = 0$ for all i) is the only equilibrium. In the TAX ($v_i = 16$ for all i) is the only equilibrium. In the TAX/VCM there are multiple equilibria.*

1.3.2.2 Charness and Rabin (2002) preferences

Charness and Rabin (2002) assume that subjects care about their own individual well-being and about social welfare. Their model includes a subject's own payoff and, additionally, two components of social welfare: the minimum payoff in a group (the "Rawlsian" motive) and the sum of all group members' payoffs (the efficiency concern). More precisely, the utility function in their general model (see their Appendix 1) with only outcome-based components looks as follows:[11]

$$U_i(\pi) = (1-\lambda_i)\pi_i + \lambda_i[\delta_i \min(\pi_1, \dots, \pi_n) + (1-\delta_i)(\pi_1 + \pi_2 + \dots + \pi_n)] \qquad (3)$$

[10] $v > 16$ can be considered an impractical equilibrium, because it requires that a welfare loss in stage 1 is compensated by an increasing contribution in stage 2.
[11] Note that we consider here only the outcome-based version of the model and neglect the role of intentions as the more complex model with intentions does not seem suitable for deriving specific predictions in my setup.

The vector $\pi = (\pi_1, \dots, \pi_n)$ denotes the monetary payoffs within the group of n subjects and λ_i and δ_i are individual weights (i.e. $\lambda_i, \delta_i \in [0, 1]$). The first weight, λ_i, captures how much an individual cares for social welfare relative to his own payoff.[12] The second weight, δ_i, controls for the influence of the "maximin"-aspect relative to the general efficiency concern.

As in the previous part, I start with a look at the treatments with one decision stage. In the VCM the optimal contribution for subject i depends on λ_i *and* δ_i. If subject i strongly cares about general efficiency and $\lambda_i \geq 1/(4 - 4\,\delta_i)$ he wants to contribute everything. I refer to these subjects as strong cooperators. If subject i strongly cares about the maximin-aspects and $1/(4 - 4\,\delta_i) > \lambda_i \geq 1/(4 - \delta_i)$ he wants to contribute as much as the higher contribution of the other two group members. These subjects are strong conditional cooperators. If subject i cares mostly about his own payoff and $1/(4 - \delta_i) > \lambda_i$, he wants to contribute nothing and is labeled as a free-rider.

Intuitively, an increase of c_i by 1 decreases π_i by 1/3, increases $(\pi_1 + \pi_2 + \cdots + \pi_n)$ by 1, and increases $\min(\pi_1, \dots, \pi_n)$ by 2/3 if another group members contributes more but decreases $\min(\pi_1, \dots, \pi_n)$ by 1/3 if no other group member contributes more.

As a result, there are different equilibria based on the distribution of λ_i *and* δ_i. All possible equilibria are shown in Table 2.

In the TAX, the Charness and Rabin preferences case collapses into the standard preferences case with an optimal vote of 16. There is no inequality, because by design all group members pay the same tax and get the same payoff. As a result, the "maximin"-aspect does not matter. Since the general efficiency concern is perfectly correlated with the individual payoff, individual payoff maximization is the optimal strategy. Consequently, the only equilibrium is $v_i = 16$ for all group members.

In the TAX/VCM it is obvious via backwards induction that for any given tax in stage 1, the discussion above about the VCM holds for stage 2. Different distributions of λ_i *and* δ_i lead to a wide variety of equilibria in stage 1:

[12] For $\lambda_i = 0$, the Charness and Rabin (2002) model nests standard preferences.

Table 2: Distribution of λ_i and δ_i and resulting equilibria in VCM with Charness and Rabin (2002) preferences

Distribution of λ_i and δ_i	Resulting equilibria
$\lambda_1 \geq 1/(4-4\,\delta_1)$, $\lambda_2 \geq 1/(4-\delta_2)$, $\lambda_3 \geq 1/(4-\ \delta_3)$	$c_1 = E, c_2 = E, c_3 = E$
$\lambda_1 \geq 1/(4-4\,\delta_1)$, $\lambda_2 \geq 1/(4-\delta_2)$, $1/(4-\ \delta_3) > \lambda_3$	$c_1 = E, c_2 = E, c_3 = 0$
$\lambda_1 \geq 1/(4-4\,\delta_1)$, $1/(4-\delta_2) > \lambda_2$, $1/(4-\ \delta_3) > \lambda_3$	$c_1 = E, c_2 = 0, c_3 = 0$
$1/(4-\delta_1) > \lambda_1$, $1/(4-\delta_2) > \lambda_2$, $1/(4-\ \delta_3) > \lambda_3$	$c_1 = 0, c_2 = 0, c_3 = 0$
$1/(4-4\,\delta_1) > \lambda_1 \geq 1(4-\delta_1)$, $1/(4-4\,\delta_2) > \lambda_2 \geq 1(4-\delta_2)$, $1/(4-\ \delta_3) > \lambda_3$	$c_1 = c_2,\ c_3 = 0$
$1/(4-4\,\delta_1) > \lambda_1 \geq 1(4-\delta_1)$, $1/(4-4\,\delta_2) > \lambda_2 \geq 1(4-\delta_2)$, $1/(4-4\,\delta_3) > \lambda_3 \geq 1(4-\delta_3)$,	$c_1 = c_2 = c_3$

First, if all group members care enough about maxi-min and general efficiency consideration to be strong cooperators, they will contribute their entire remaining endowment in stage 2. Because contributions in stage 2 are more efficient than tax payments in stage 1 (due to the costs of implementing the tax mechanism), the resulting equilibrium is $v_i = 0$ for all group members (Table 3, line 1).

Second, if individual preferences within groups are polarized – meaning that some group members are free-riders who contribute nothing and some group members are strong cooperators who contribute the entire remaining endowment in stage 2 – this will be reflected in the votes. In Line 2 you can see the case in which the first two group members contribute everything. The third group member now prefers a tax rate of zero, because he wants to profit from the full contribution of the first two group members in stage 2. However, the first two group members prefer a non-zero tax rate because they want to force subject 3 to at least pay some taxes. Line 3 shows the case in which only the first group member contributes the full remaining endowment. Similar to the case above, the second and third group member contribute nothing and are therefore interested in a lower tax rate. Note that they nevertheless prefer a non-zero tax rate because they gain more by forcing each other to pay taxes than they cost themselves by having to pay them.

Third, if all group members are free-riders, they will not contribute anything in stage 2. Therefore the resulting equilibrium is identical to the equilibrium in TAX, $v_i = 16$ for all group members (Table 3, line 4).

In the previous cases, groups are dominated by a majority of a combination of strong cooperators and free-riders. As a result, all group members contribute either everything or nothing in stage 2. These cases predict a clear negative relationship between tax payments and contributions. From line 1 to 4 the tax payment goes up while the share of contributors and consequently the contributions go down. Counterintuitively, within a group, these cases predict a positive relationship between votes and contributions (lines 2 and 3).

Finally, if the strong conditional cooperators form a majority, there can be many equilibria for each combination of λ_i *and* δ_i. We can see this in lines 5 and 6. I will illustrate the intuition based on the case in line 6, where all group members are in the intermediate category. Because all group members contribute the same amount in stage 2, all members will get identical payoffs. Therefore, the maximization of the individual payoffs maximizes the utility. Now most possible tax payments can be supported as an equilibrium. Examples:

If $c_1 = c_2 = c_3 = RE$ for all p, then $p = 0$ is an equilibrium, $v_1 = v_2 = v_3 = 0$.

If $c_1 = c_2 = c_3 = r$, $r \in \{16 - s, 16 - s + 1, \ldots, 25 - s\}$ for all $p \leq s < 16$ and $c_1 = c_2 = c_3 = 0$ all $p > s$, $p = s$ is an equilibrium, $v_1 = v_2 = v_3 = s$.

If $c_1 = c_2 = c_3 = 0$ for all p, then $p = 16$ is an equilibrium, $v_1 = v_2 = v_3 = 16$.

If $c_1 = c_2 = c_3 = RE$ for $p = n$ and $c_1 = c_2 = c_3 = 0$ for $p \neq n$ and $n \leq 23$, $p = n$ is an equilibrium, $v_1 = v_2 = v_3 = n$. For all $n > 16$, this type of equilibrium can be considered an impractical equilibrium, because it requires that a welfare loss in stage 1 is compensated by an increasing contribution in stage 2.[13]

[13] In other words, lowering taxes while maintaining the contribution increase the welfare for everybody.

Table 3: Distribution of λ_i *and* δ_i and resulting equilibria in TAX/VCM with Charness and Rabin (2002) preferences

Line	Distribution of λ_i *and* δ_i	Resulting equilibria in stage 2 (VCM)	Resulting equilibria in stage 1 (TAX)	Resulting tax payment
1	$\lambda_1 \geq 1/(4-4\,\delta_1)$, $\lambda_2 \geq 1/(4-\delta_2)$, $\lambda_3 \geq 1/(4-\ \delta_3)$	$c_1 = RE$, $c_2 = RE$, $c_3 = RE$	$v_1 = 0$, $v_2 = 0$, $v_3 = 0$	$p = 0$
2	$\lambda_1 \geq 1/(4-4\,\delta_1)$, $\lambda_2 \geq 1/(4-\delta_2)$, $1/(4-\ \delta_3) > \ \lambda_3$	$c_1 = RE$, $c_2 = RE$, $c_3 = 0$	$v_1 = 5-8$, $v_2 = 5-11$, $v_3 = 0-0$,	$p = 5-8$
3	$\lambda_1 \geq 1/(4-4\,\delta_1)$, $1/(4-\delta_2) > \ \lambda_2$, $1/(4-\ \delta_3) > \ \lambda_3$	$c_1 = RE$, $c_2 = 0$, $c_3 = 0$	$v_1 = 11-16$, $v_2 = 5-11$, $v_3 = 5-11$	$p = 5-11$
4	$1/(4-4\,\delta_1) > \ \lambda_1$, $1/(4-\delta_2) > \ \lambda_2$, $1/(4-\ \delta_3) > \ \lambda_3$	$c_1 = 0$, $c_2 = 0$, $c_3 = 0$	$v_1 = 16$, $v_2 = 16$, $v_3 = 16$	$p = 16$
5	$1/(4-4\,\delta_1) >$ $\lambda_1 \geq 1/(4-\delta_1)$, $1/(4-4\,\delta_2) >$ $\lambda_2 \geq 1(4-\delta_2)$, $1/(4-\ \delta_3) > \ \lambda_3$	$c_1 = c_2$, $c_3 = 0$	$v_1 = 0-23$, $v_2 = 0-23$, $v_3 = 0-23$,	$p = 0-23$
6	$1/(4-4\,\delta_1) >$ $\lambda_1 \geq 1(4-\delta_1)$, $1/(4-4\,\delta_2) >$ $\lambda_2 \geq 1(4-\delta_2)$, $1/(4-4\,\delta_3) >$ $\lambda_3 \geq 1(4-\delta_2)$,	$c_1 = c_2 = c_3$	$v_1 = 0-23$, $v_2 = 0-23$, $v_3 = 0-23$,	$p = 0-23$

Proposition 3. *With Charness and Rabin (2002) preferences, in the VCM subject i is willing to contribute his full endowment if $\lambda_i \geq 1/(4 - 4\,\delta_i)$ and up to his full endowment based on the other group members if $\lambda_i \geq 1/(4 - \delta_i)$. In the TAX ($v_i = 16$ for all i) is the only equilibrium. In the TAX/VCM there are multiple equilibria, in stage 1 tax payments vary between 0 and 16, in stage 2 contribution vary between zero and the full remaining endowment. Tax payments in stage 1 and contributions in stage 2 tend to be negatively correlated, votes in stage 1 and contributions in stage 2 tend to be positively correlated.*

All models predict the same behavior for the TAX treatment, because by design the payoffs are equal for all group members and self-regarding and other-regarding preferences are perfectly correlated. For the VCM treatment, standard preferences predict contribution of zero but other-regarding preferences can support positive contributions. In this case the contribution of a single player can be influenced by the contribution of the other players. For the TAX/VCM treatment, standard preferences collapse into a simple combination of unrelated TAX (payoff maximization) and VCM (zero contribution) treatments. Other-regarding preferences can support different equilibria with lower tax payments and higher contribution compared to the standard preferences.

1.3.2.3 A simple model of a basic TAX/VCM game

With both Fehr and Schmidt (1999) as well as Charness and Rabin (2002) preferences, there are several equilibria in which individuals want to contribute as much as other group members. For these conditional cooperators their contribution in the second stage crucially depends on their expectation of the other’s contributions. To shed some light on the possible impact of this feature let us look at a simplified model of the TAX/VCM game:
Consider first a VCM game with three players. Each player simultaneously determines his contribution, either the high contribution $\bar{c}$ or the low contribution $\underline{c}$. There are two types of players. Both types are conditional coordinators, but they differ in their expectations on the behavior of other players. Players of type H expect other players to contribute $\bar{c}$, while players of type L expect others to contribute $\underline{c}$. Let p be the fraction of players from type H. The payoffs are identical for both types and are given by Table 4.

It is obvious that the share of players who will contribute $\bar{c}$ is p, the others (1-p) will contribute $\underline{c}$.

Table 4: Payoffs in the basic game

		Contribution of others			
	player 2	high	high	low	low
	player 3	high	low	high	low
Own contribution	high	3	0	0	0
	low	1	1	1	1

Now consider an extension to a two stage game with three players. In stage 1, a majority decision determines one of two tax payments, either the high tax $\bar{t}$ or the low tax $\underline{t}$. In stage 2, the VCM game is played. If $\bar{t}$ is chosen, all players get an additional payoff of 1 and have to choose $\underline{c}$ in the VCM game, therefore everybody gets a payoff of 2. If $\underline{t}$ is chosen, the VCM game as described above is played in stage 2 and determines the payoffs.

Players of type H expect a payoff of 3 from the VCM game and accordingly vote for $\underline{t}$; players of type L expect a payoff of 1 from the VCM game and accordingly vote for $\bar{t}$. Let us further assume that players learn from the behavior of others and change their belief (and their type) if they observe that both other players act in accordance with the other belief.

This setup leads to following results: The share of groups that go for $\underline{t}$ and consequently contribute $\{\bar{c}, \bar{c}, \bar{c}\}$ is ($3p^2 - 2p^3$), the other groups choose $\bar{t}$. The contribution in the groups is polarized, either all members contribute $\bar{c}$ or everybody contributes $\underline{c}$. The relation of contributions of $\bar{c}$ between the VCM game and the TAX/VCM game depends on p. If 1 > p > 1/2, the introduction of the tax stage raises the share of contributions of $\bar{c}$, if 1/2 > p > 0 the introduction of the tax stage lowers the share of contributions of $\bar{c}$.

In summary, this model predicts that if the share of votes for high taxes in the TAX/VCM is above 1/2, there are more low contributions in the TAX/VCM than in the VCM. If the share of votes for high taxes in the TAX/VCM is below 1/2, there are more high contributions in the TAX/VCM than in the VCM. Despite the global relationship between votes and contributions, the model also predicts that within a group the vote in stage 1 does not have predictive power for the contribution in stage 2.

1.4. Experimental results

In Section 1.4.1 I start with a comparison of votes, tax payments, contributions and profits between the three treatments. Finally, analysis on the behavior on the individual level in the TAX/VCM is presented in Section 1.4.2. The analysis on the matching group level is discussed in the Appendix B.1.

Let me define the variables discussed in this section.

Vote: The preferred tax chosen by subject i in period t.

Tax payment: The implemented tax in a group in period t.

Contribution: The voluntary contribution by subject i in period t.

Profit: The difference between the realized payoff for by subject i and the endowment E in period t.

Total expenditures: The sum of the implemented tax payment and the voluntary contribution by subject i in period t.

1.4.1 Votes, tax payments, contributions and profits

Let me start with a look at the aggregate result for votes, tax payments, contributions and profits in Table 5. The first two rows show the mean votes and the mean tax payments for TAX and VCM/TAX. The votes and tax payments in TAX/VCM are lower than in TAX. The difference is both large (more than 7 points on average) and highly significant ($p < 0.001$, Mann-Whitney U-test, $N = 16$)[14] for both votes and tax payments. The profits – defined as the total payoff minus the initial endowment – for both treatments are shown in the third row. The profits in the TAX/VCM are higher, again the difference is large (about 4 points on average) and highly significant ($p < 0.001$, Mann-Whitney U-test, $N = 16$). The next two rows compare VCM and TAX/VCM. In row 5 you can see that the contributions are quite similar, the difference is just 0.22 on average and not significant ($p = 0.46$, Mann-Whitney U-test, $N = 16$). The sixth row shows that the profits in TAX/VCM are higher than in VCM by more than 4 points on average and that the difference is weakly significant ($p < 0.1$, Mann-Whitney U-test, $N = 16$).

[14] All tests in this chapter are two-sided tests unless it is explicitly stated otherwise.

Table 5: Mean votes, tax payments, voluntary contributions and profits (in points) by treatment

	VCM	TAX	TAX/VCM
Votes	-	16.11	8.96***
Tax payments	-	16.03	8.40***
Profits	-	7.82	11.74***
Total expenditures	-	16.03	15.51***
Voluntary contributions	7.32	-	7.10
Profits	7.32	-	11.74*
Total expenditures	7.32	-	15.51

Note: Difference between TAX/VCM and other treatment significant at: *** 1% level; ** 5% level; * 10% level.

The fourth and last rows illuminate the causes of the higher profits in the TAX/VCM by listing the mean average total expenditure for the public good in all treatments. The total expenditure in the TAX/VCM is higher than in the VCM, as the former adds tax expenditures to the similar contributions. The total expenditure in the TAX/VCM is not significantly different (but a tad lower on average) from the total expenditure in TAX. However, nearly half of the total expenditure in TAX/VCM comes in the form of costless contributions that are more efficient than the additional costly tax expenditures in TAX.[15]

Although the average profit in TAX is a little higher than in VCM, the significance of the difference to the average profit in TAX/VCM is way higher. This is caused by the fact that the variance in the profits for VCM (mean: 7.32, std. dev.: 3.50) is a lot higher than in TAX (mean: 7.82, std. dev.: 0.04) and the variance in TAX/VCM is also sizeable (mean: 11.74, std. dev.: 3.61).

The results for the size and significance of the differences in tax payments, contributions and profits between the treatments in the OLS regression in Tables 7, 8 and 9 is similar to the non-parametric tests above. Model 1 in each Table shows a simple OLS regression that includes a dummy variable that is 1 for the TAX/VCM treatment and 0 for the respective other treatment.

Result 1. *Mean profits in TAX/VCM are significantly higher than in TAX and VCM. The total expenditures for TAX/VCM are higher than in VCM and more efficient than in TAX.*

[15] This effect is pronounced because the voluntary contributions effectively replace the very costly contributions just below the threshold of 16.

Table 6: Contributions in TAX/VCM (OLS regression)

	Dependent variable: contribution
	Model 1
Tax up to 16	-0.766***
	(0.047)
Tax over 16	0.086
	(0.077)
Constant	13.180***
	(0.565)
# Observations	720
R^2	0.33

Notes: *** Significant at 1% level; ** significant at 5% level; * significant at 10% level. Robust standard errors in parentheses.

The average contribution in TAX/VCM is basically identical to the average contribution in VCM, the difference is just 0.22. The average tax payment in the TAX/VCM is 8.40, resulting in an average crowding out of below 3%. However, that does not mean that there is no marginal crowding out. Table 6 reports a simple regression for all 720 individual contribution decisions in the TAX/VCM.

I divide the tax payments into two variables. The first variables includes all tax payments up to 16, the second variable includes all tax payments over 16. Because tax payments over 16 are dominated by tax payments of 16 if contributions are constant, the effect of marginally increased tax rates above 16 might be different.

The results show a highly significant negative marginal impact of the tax up to 16, resulting in a marginal crowding out of 77%. Tax rates over 16 do not have a significant effect on contributions. The contribution for a tax rate of zero (the constant in the regression) is 13.18, about 5.86 points higher than the average contribution in the VCM. This implies that there are two opposing effects. The existence of the tax mechanism increases contributions while taxation has a negative marginal effect on contributions. According to the regression result, a tax of 7.65 would result in a contribution of 7.32, the average in the VCM. The average tax rate in the TAX/VCM is a little higher – 8.40 – resulting in just a small net effect of taxation on contributions.

A possible effect of the introduction of an additional tax mechanism is the creation of a focal point, a “clue to co-ordination”, following Schelling (1960). A natural focal point for the total expenditure is 16, the optimal tax rate in the TAX.

Figure 1: Frequency of total expenditures in TAX/VCM (720 total)

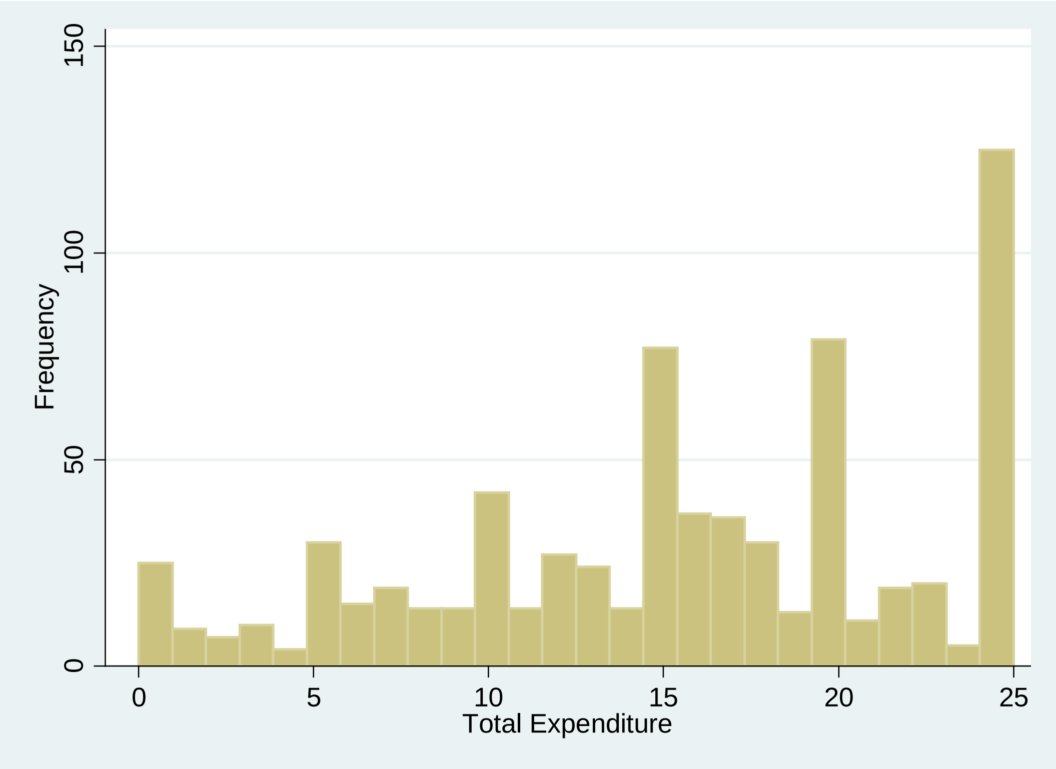


Figure 2: Frequency of contributions in TAX/VCM and VCM (720 total each)

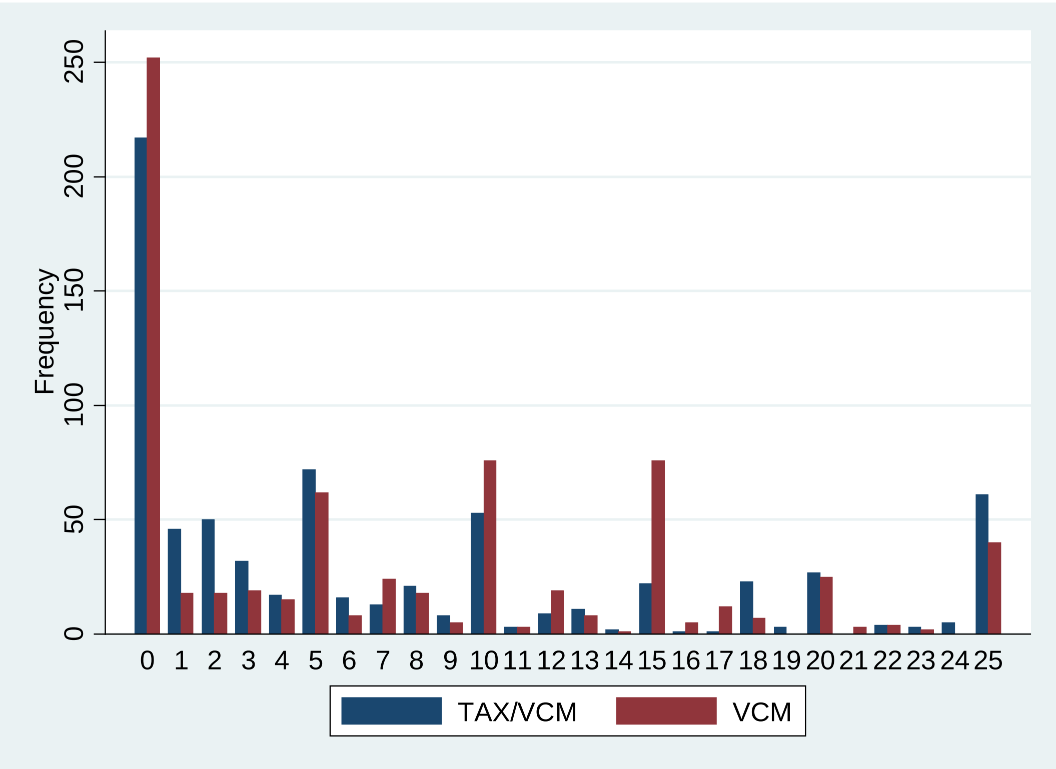


Figure 1 shows the frequency of total expenditures in the TAX/VCM. There is no strong focal point effect that leads to total expenditures of 16. (There seems to be a strong focal point effect for all numbers that are multiples of 5, see also Figure 2).

We can also look at the distribution of contributions in the TAX/VCM and VCM. Figure 2 shows the frequency of different contributions. There are more zero contributions in the VCM (252 of 720) than in the TAX/VCM (217 of 720)[16]. The difference is significant ($p < 0.05$, Pearson's chi-squared test).

There are about three times as many contributions of the full remaining endowment in the TAX/VCM (122 of 720)[17] as in the VCM (40 of 720). The difference is highly significant ($p < 0.001$, Pearson's chi-squared test). Even if we restrict the analysis to the maximum possible contribution of 25, we can find more of them in the TAX/VCM (61 of 720) than in the VCM (40 of 720), although there are only 147 instances of a tax of zero that permits a maximum contribution. The difference is significant ($p < 0.05$, Pearson's chi-squared test).

The tax mechanism in stage 1 leads to more full and maximum and less zero contributions. More than 75% and therefore substantially more than 1/2 of the total votes in stage 1 of the TAX/VAM are cast for a tax payment below 16. Therefore, the change in the contribution pattern in stage 2 is exactly as predicted by the simple model in 1.3.2.3.

Result 2. *The implementation of the additional tax mechanism results on average in just a negligible crowding out of voluntary contributions. This is caused by the combination of a positive level effect and a negative marginal effect of taxation.*

The next step is to analyze time trends in the different treatments. Figure 3 shows the mean tax payments for the TAX and TAX/VCM treatments over time. The graph for the TAX treatment is very flat at about 16, while the TAX/VCM graph is more volatile and hovers between 7 and 10, albeit without an obvious time trend. The regressions in Table 7 support this conclusion. There is neither a general time trend (model 2) nor a difference between time trends between both treatments (model 3).

[16] Note that there is one group that implements a tax of 25, resulting in zero remaining endowment in the contribution stage. I count these group members as contributing zero.
[17] Note that there is one group that implements a tax of 25, resulting in zero remaining endowment in the contribution stage. I do not count these group members as contributing the full remaining endowment.

Table 7: Tax payments in TAX and TAX/VCM (OLS regressions)

	Dependent variable: tax payment		
	Model 1	Model 2	Model 3
TAX/VCM dummy	-7.621***	-7.621***	-7.199***
	(1.955)	(1.897)	(2.410)
Period	-	-0.059	-0.032
		(0.073)	(0.023)
Period * TAX/VCM dummy	-	-	-0.053
			(0.146)
Constant	16.025***	16.495***	16.284***
	(0.072)	(0.583)	(0.148)
# Observations	16	240	240
R^2	0.52	0.45	0.45

Notes: *** Significant at 1% level; ** significant at 5% level; * significant at 10% level. Robust standard errors in parentheses (clustered on matching group level for model 2 and 3).

Table 8: Contributions in VCM and TAX/VCM (OLS regressions)

	Dependent variable: contribution		
	Model 1	Model 2	Model 3
TAX/VCM dummy	-0.218	-0.218	-1.545
	(2.343)	(2.273)	(3.028)
Period	-	-0.267***	-0.350**
		(0.089)	(0.128)
Period * TAX/VCM dummy	-	-	0.166
			(0.173)
Constant	7.322***	9.460***	10.124***
	(1.236)	(1.646)	(2.007)
# Observations	16	240	240
R^2	0.00	0.05	0.05

Notes: *** Significant at 1% level; ** significant at 5% level; * significant at 10% level. Robust standard errors in parentheses (clustered on matching group level for model 2 and 3).

Figure 4 depicts the contribution in VCM and TAX/VCM over time. The two graphs are overlapping and show an obvious decreasing trend. The graphs start between 8 and 10 in the first periods and fall to around 5 for the final periods. The regressions presented in Table 8 show that there is a highly significant time trend of about -0.3 points per period (model 2) and that there is no significant difference for the time trend between the treatments (model 3).

Table 9: Profits in TAX, VCM and TAX/VCM (OLS regressions)

	Dependent variable: profit			
	Model 1	Model 2	Model 3	Model 4
TAX/VCM dummy	3.926*** (1.225)	3.926*** (1.226)	5.666*** (1.385)	5.666*** (1.385)
VCM dummy	-0.497 (1.185)	-0.497 (1.186)	2.307 (1.986)	2.307 (1.986)
Period	-	-0.189*** (0.056)	0.000 (0.002)	-0.217 (0.065)
Period * TAX/VCM dummy	-	-	-0.218*** (0.065)	-
Period * VCM dummy	-	-	-0.350** (0.126)	-0.133 (0.142)
Period * TAX dummy	-	-	-	0.218*** (0.065)
Constant	7.819*** (0.012)	9.332*** (0.449)	7.817*** (0.012)	7.817*** (0.012)
# Observations	360	360	360	360
R^2	0.25	0.29	0.32	0.32

Notes: *** Significant at 1% level; ** significant at 5% level; * significant at 10% level. Robust standard errors in parentheses (clustered on matching group level for model 2 and 3).

The development of tax payments and contribution over time is reflected in the development of profits that you can see in Figure 5. The profits in TAX are flat while the profits for VCM and TAX/VCM are falling over time – parallel to the contributions in these treatments. Consequently, profits in TAX are better relative to the other two treatments in later periods. The profits in VCM are higher than in TAX in each of the first five periods and lower starting from period 6. The profits in TAX/VCM start more than five points higher than in TAX during the early rounds but are just one to three points above for the last rounds. The OLS regressions in Table 9 confirm these points. Profits fall on average (model 2). However, this result is entirely driven by decreasing profits in VCM and TAX/VCM (model 3), profits in TAX remain nearly constant over time. The difference between the negative time trends in VCM and TAX/VCM is not significant (Model 4).

Result 3. *Contributions decrease over time in both the VCM and TAX/VCM. Tax payments do not show a time trend in TAX and TAX/VCM. Correspondently, profits in VCM and TAX/VCM fall over time whereas profits in TAX are steady.*

Figure 3: Evolution of mean tax payments in TAX and TAX/VCM

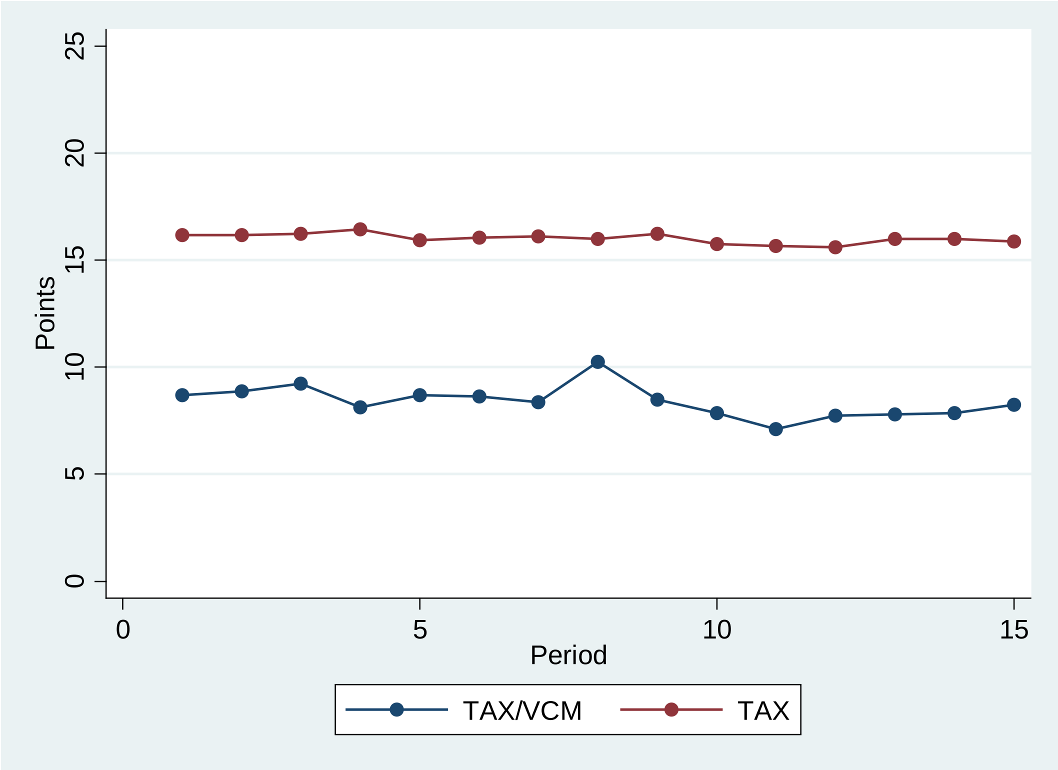


Figure 4: Evolution of mean contributions in VCM and TAX/VCM

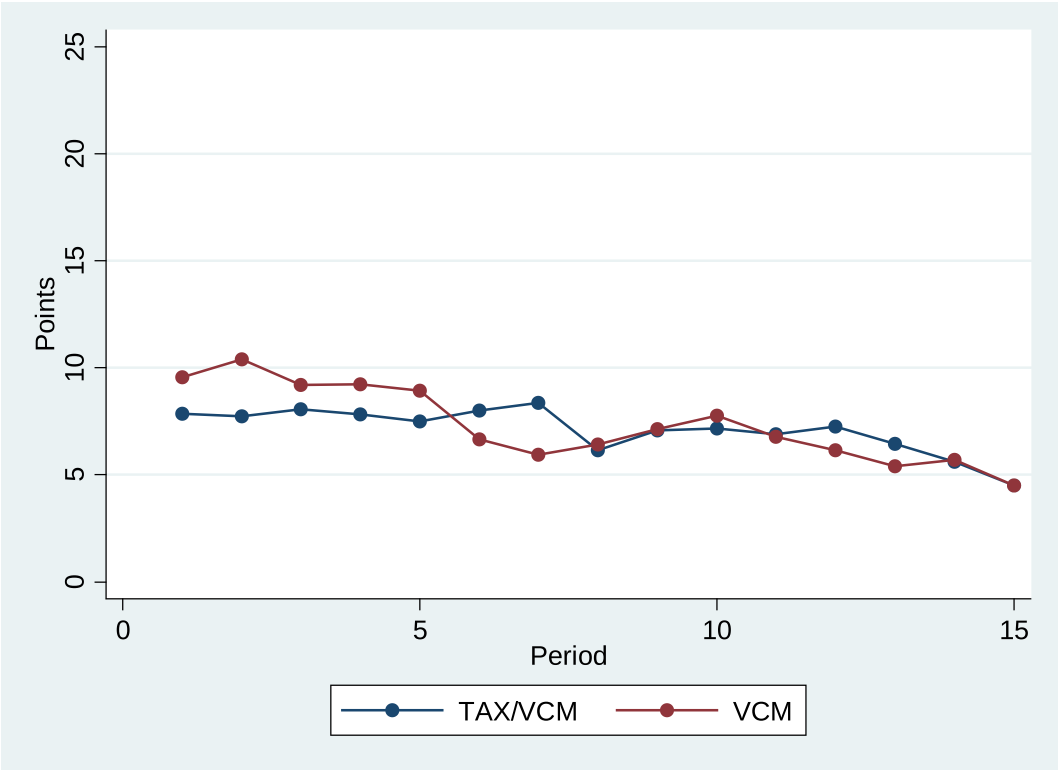
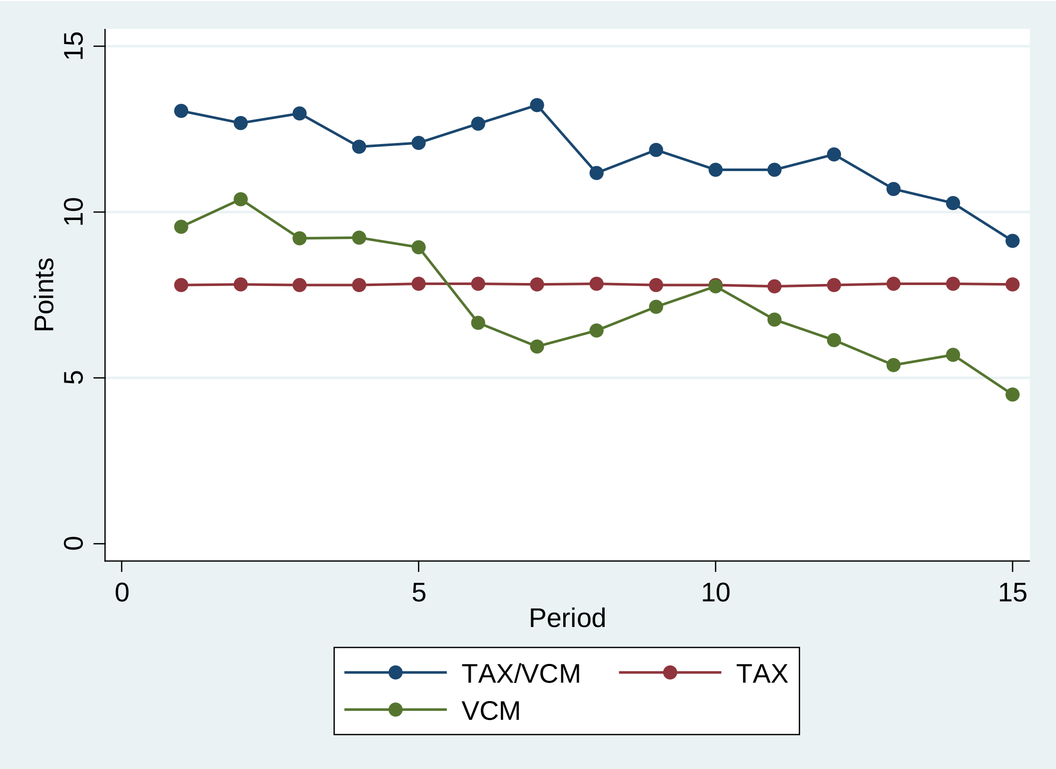


Figure 5: Evolution of mean profits in TAX, VCM and TAX/VCM



1.4.2 Analyzing behavior in the TAX/VCM on the individual level

To get a better idea what exactly is happening in the TAX/VCM, Table 10 presents analysis on the individual behavior of subjects. Subjects have to make two decisions per period, one about the vote and one about the contribution. The OLS regression considers the available information from the current and the preceding period.[18] The regression is therefore limited to periods 2-15.

The vote is significantly influenced by three variables: The vote in the previous round, the tax payment in the previous round and the contribution by the other group members in the previous round. The significantly positive impact of the own previous vote indicates that there are stable underlying preferences for the voting decision. The positive influence of the previous tax payment can be interpreted as an (Bayesian) adjustment to the (assumed) preferences of the other subjects. The negative impact of the average contribution of the other group members in the previous rounds supports the idea of strategic voting to give the other group members more or less room for their contributions. The regression does not show a significant time trend.

[18] Considering additional preceding periods does not qualitatively change the results.

The contribution of a given period is influenced by both the preceding period and the results during stage 1 of the current period, as you can see in the second column of Table 10. The largest impact comes from the own contribution of the previous period. This result is in line with the prediction from the Charness and Rabin (2002) model that stable underlying preferences strongly influence the decision making. The average contribution of the other group members and the tax payment in the previous period also have a highly significant positive effect on the contribution. This conforms to the notion of both weak conditional cooperators from Fehr and Schmidt (1999) and the strong conditional cooperators from Charness and Rabin (2002), if one assumes that prior observed contributions of other group members positively influence the expectation of future contributions. The results of stage 1 also impact the decision in stage 2. The tax payment – both for taxes up to 16 and for taxes above 16 – has a strong negative influence on the contribution, as predicted by Charness and Rabin (2002). The own vote does not have a direct statistical impact on the contribution, in accordance with the simple model but different from the prediction from the Charness and Rabin (2002) model.

The most interesting result from a behavioral view is that subjects who cast the decisive vote in stage 1 contribute significantly more during stage 2.[19] The effect is worth nearly a full point, as you can see in the first regression on the contribution in Table 10. There are several conceivable explanations for this effect. One reasonable explanation is that subjects increase their contribution to compensate for their responsibility for lower profits via the tax mechanism. This explanation is supported by the data. In the second contribution regression I have added the "difference to tax maximization" variable. This variable captures for all subjects with decisive votes the positive difference between their own vote and their hypothetical vote that would have resulted in the highest profit from the tax mechanism.[20] You can find analysis of further conceivable explanations for this behavior in Appendix B.2.

[19] This result is also in line with result 6 in Sutter at. al. (2010), p. 1557.

[20] Examples:
If the own vote is 10 and the high vote of the other group members is 10, the difference to tax maximization is 0.
If the own vote is 10 and the high vote of the other group members is 15, the difference to tax maximization is 5.
If the own vote is 10 and the high vote of the other group members is 20, the difference to tax maximization is 6, because a tax of 16 maximizes the payoff from the tax mechanism.
If the own vote is 20 and the high vote of the other group members is 25, the difference to tax maximization is 0.

Table 10: Votes and contributions in TAX/VCM (periods 2-15, OLS regressions)

	Dependent variable:		
	Vote	Contribution, Model 1	Contribution, Model 2
Period	-0.030 (0.048)	-0.091* (0.045)	-0.084* (0.045)
Tax up to 16	-	-0.419*** (0.068)	-0.392*** (0.068)
Tax over 16	-	-0.442*** (0.142)	-0.428*** (0.143)
Vote	-	-0.015 (0.043)	-0.004 (0.042)
Tax payment=Vote dummy	-	0.926** (0.407)	0.312 (0.374)
Difference to tax maximization	-	-	0.165** (0.070)
Vote (t-1)	0.545*** (0.060)	-	-
Contribution (t-1)	-0.072 (0.044)	0.591*** (0.061)	0.596*** (0.060)
Avg. contribution of other group members (t-1)	-0.092** (0.046)	0.249*** (0.055)	0.251*** (0.056)
Tax payment (t-1)	0.155** (0.071)	0.356*** (0.081)	0.348*** (0.080)
Constant	4.220*** (0.951)	1.920 (1.483)	1.515 (1.496)
# Observations	672	672	672
R^2	0.52	0.64	0.65

Notes: *** Significant at 1% level; ** significant at 5% level; * significant at 10% level. Robust standard errors in parentheses (clustered on subject level).

1.5. Discussion and conclusion

In this chapter I present a modified public goods game and analyze the results of the implementation in a laboratory setting. In the modified game, there are two funding mechanisms for a public account – a costly tax mechanism and a cost-free voluntary contribution mechanism. The tax mechanism is controlled by a voting of all group members. After the tax payment is established, each group member can voluntarily contribute to the public account. The public account is multiplied by an efficiency factor larger than one and distributed equally among all group members.

I provide four main empirical results: First, the additional funding mechanism leads to higher average profits than in the appropriate control treatments in which there is only one funding mechanism each. Second, the negative time trend that occurs in the standard voluntary contribution mechanism also exists in the modified game with two funding mechanisms. Third, the voting and contribution decisions are strongly influenced both by the behavior of group members in the current period and the experience with different group members in earlier periods. Fourth, subjects who cast the decisive vote in the first stage contribute more in the second stage. The results clearly refute predictions based on standard preferences. They are, however, largely in line with models of heterogeneous preferences inequity aversion (Fehr and Schmidt, 1999) or a combination of maximin-preference and general efficiency concern (Charness and Rabin, 2002).

A natural extension to this work is the explicit test for the impact of endogenous and exogenous choice of the tax payment. This could be achieved by running the TAX/VCM as described in this chapter in combination with a treatment that exogenously implements the same group composition and tax rate from the TAX/VCM treatment.

Appendix

A. Experimental instructions (originally in German)

A.1 Experimental instructions for the TAX/VCM treatment

Welcome to the experiment and thank you very much for your participation!

From now on, please do not talk to the other participants

General information

This experiment is done to study decision behavior. You can earn money. This money will be paid at the end of the experiment.

During the experiment you (and the other participants) will be asked to make decisions. Your decisions as well as the decisions of the other participants determine the amount of money you earn. The exact rules will be explained in the following.

The entire experiment will last about 90 minutes. If you have any questions or if anything is unclear to you, please raise your hand. One of the experimenter will get to you and answer your questions individually.

For simplicity, we use only the masculine form to describe the experiment. The description is valid for both male and female participants.

Anonymity

During the experiment you will be matched with other participants into groups. You and the other participants will learn neither during nor after the experiment with whom you were matched in the respective periods.

Unless explicitly specified in the following, the other participants will learn neither during nor after the experiment about your decisions.

Unless explicitly specified in the following, the other participants will learn neither during nor after the experiment about your payoff.

We analyze the data from the experiment only in aggregated form and never match names with the data from the experiment. At the end of the experiment, you have to sign a receipt about your payoff. This is necessary for us to balance accounts with our funding agency. The funding agency does not receive data from the experiment

Tax or trust: A public goods game with enforceable and voluntary contributions

The experiment

General

The experiment is comprised of 15 periods.
At the start of each period, you are randomly matched with two other participants.
All periods are identical. In each period you (and the other members within your group) have to make two decisions.
Your earnings in each period depend only on your decisions and the decisions of the other members of your group in the respective period.

Experimental currency

During the experiment you work with the experimental currency EC. At the end of the experiment your earnings in EC will be exchanged to Euro and paid out to you. The exchange rate is:

40 EC = 1 Euro

Schedule of a period

In each period you start with a private endowment of 25 EC. During two stages, you can invest a fraction or all of your private funds into a joint project with the other two participants in your group.

Stage I

You and the other two group members determine via vote the mandatory contribution to the project that has to be paid by each group member. Each group member selects his preferred integer mandatory contribution between 0 and 25.
The median (second highest) selected amount is implemented as mandatory contribution for all group members.
You (and the other two group members) will be informed about the preferred amount of the other two group members and the resulting implemented mandatory contribution.

This mandatory contribution has to be paid by all group members and is subtracted from the private funds of each group member.
The collection of the mandatory contribution induces costs, therefore the project fund receives less than the sum of subtractions from the initial endowments.
You can find the exact relationship in table 1.

Stage II

After stage I you (and the two other group members) have a remaining endowment of 25 minus the mandatory contribution.
From this remaining endowment, you (and the two other group members) can provide a voluntary contribution towards the project fund.
The collection of the voluntary contribution does not induce costs. The project fund consequently receives the sum of voluntary contributions of all group members.

Earnings of a period

After stage II the project is carried out. The operation of the project creates a payment to the group members. The payment to you (and each of the two other group members) is 2/3 of the total project fund.
Your earnings in each period is the sum of the remaining endowment after stage II (25 – mandatory contribution – your voluntary contribution) and the payment from the project (2/3 of the project fund after stage II).
You can find an overview about possible earnings depending on stages I and II in table 2.

Short overview about the schedule of a period:

- Allocation of initial endowment of 25 EC
- Selection of the mandatory contribution
- Collection of the mandatory contribution from the private funds / inflow to the project fund
- Selection of the voluntary contribution
- Collection of the voluntary contribution from the private funds / inflow to the project fund
- The project is carried out
- Calculation of the earnings in the period

Payment

At the end of the experiment your total earnings will be paid out to you in cash.
The earnings of all 15 periods will be added.
The exchange rate is:

40 EC = 1 Euro

Your earning will be rounded up to the nearest 10 cent and paid out to you.

Examples

The two following examples illustrate the mechanics of the experiment:

	Participant	A	B	C
Stage I	Preferred mandatory contribution	4	23	7
	Selected mandatory contribution	7		
	Inflow to the project fund	18.48		
Stage II	Remaining private funds after stage I	18	18	18
	Individual voluntary contribution	18	0	9
	Inflow to the project fund	27		
Payment	Total project fund	45.48		
	Payment from the project	30.32	30.32	30.32
	Remaining private funds after stage II	0	18	9
	Earnings of the period	**30.32**	**48.32**	**39.32**

	Participant	A	B	C
Stage I	Preferred mandatory contribution	19	19	0
	Selected mandatory contribution	19		
	Inflow to the project fund	39.90		
Stage II	Remaining private funds after stage I	6	6	6
	Individual voluntary contribution	1	4	2
	Inflow to the project fund	9		
Payment	Total project fund	48.90		
	Payment from the project	32.60	32.60	32.60
	Remaining private funds after stage II	5	2	4
	Earnings of the period	**37.60**	**34.60**	**36.60**

Table 1

Stage I				Stage II
Mandatory contribution	Inflow to project fund	Project fund per capita	Change in project fund per capita	Remaining private funds
a)	**b)**	**c)**	**d)**	**e)**
0	0.00	0.00	-	25
1	2.91	0.97	0.97	24
2	5.73	1.91	0.94	23
3	8.46	2.82	0.91	22
4	11.10	3.70	0.88	21
5	13.65	4.55	0.85	20
6	16.11	5.37	0.82	19
7	18.48	6.16	0.79	18
8	20.76	6.92	0.76	17
9	22.95	7.65	0.73	16
10	25.05	8.35	0.70	15
11	27.06	9.02	0.67	14
12	28.98	9.66	0.64	13
13	30.81	10.27	0.61	12
14	32.55	10.85	0.58	11
15	34.20	11.40	0.55	10
16	35.76	11.92	0.52	9
17	37.23	12.41	0.49	8
18	38.61	12.87	0.46	7
19	39.90	13.30	0.43	6
20	41.10	13.70	0.40	5
21	42.21	14.07	0.37	4
22	43.23	14.41	0.34	3
23	44.16	14.72	0.31	2
24	45.00	15.00	0.28	1
25	45.75	15.25	0.25	0

Explanation of the respective columns

a) Amount of the mandatory contribution

b) Inflow to project fund

c) Project fund per capita

d) Change of c) compared to a mandatory contribution that is one point lower

e) Remaining private funds

Table 2

Earnings based on

voluntary contribution of the two other group members	**minimum**	**maximum**	**minimum**	**maximum**
and own voluntary contribution	**minimum**	**maximum**	**maximum**	**minimum**
Mandatory contribution				
a)	**b)**	**c)**	**d)**	**e)**
0	25.00	50.00	16.67	58.33
1	25.94	49.94	17.94	57.94
2	26.82	49.82	19.15	57.49
3	27.64	49.64	20.31	56.97
4	28.40	49.40	21.40	56.40
5	29.10	49.10	22.43	55.77
6	29.74	48.74	23.41	55.07
7	30.32	48.32	24.32	54.32
8	30.84	47.84	25.17	53.51
9	31.30	47.30	25.97	52.63
10	31.70	46.70	26.70	51.70
11	32.04	46.04	27.37	50.71
12	32.32	45.32	27.99	49.65
13	32.54	44.54	28.54	48.54
14	32.70	43.70	29.03	47.37
15	32.80	42.80	29.47	46.13
16	32.84	41.84	29.84	44.84
17	32.82	40.82	30.15	43.49
18	32.74	39.74	30.41	42.07
19	32.60	38.60	30.60	40.60
20	32.40	37.40	30.73	39.07
21	32.14	36.14	30.81	37.47
22	31.82	34.82	30.82	35.82
23	31.44	33.44	30.77	34.11
24	31.00	32.00	30.67	32.33
25	30.50	30.50	30.50	30.50

Explanation of the respective columns

a) Amount of the mandatory contribution

b) Earnings if all group members choose the minimum (0) voluntary contribution

c) Earnings if all group members choose the maximum voluntary contribution

d) Earnings if the other two group members choose the minimum voluntary contribution and you choose the maximum voluntary contribution

e) Earnings if the other two group members choose the maximum voluntary contribution and you choose the minimum voluntary contribution

A.2 Experimental instructions for the TAX treatment

Welcome to the experiment and thank you very much for your participation!

From now on, please do not talk to the other participants

General information

This experiment is done to study decision behavior. You can earn money. This money will be paid at the end of the experiment.

During the experiment you (and the other participants) will be asked to make decisions. Your decisions as well as the decisions of the other participants determine the amount of money you earn. The exact rules will be explained in the following.

The entire experiment will last about 90 minutes. If you have any questions or if anything is unclear to you, please raise your hand. One of the experimenter will get to you and answer your questions individually.

For simplicity, we use only the masculine form to describe the experiment. The description is valid for both male and female participants.

Anonymity

During the experiment you will be matched with other participants into groups. You and the other participants will learn neither during nor after the experiment with whom you were matched in the respective periods.

Unless explicitly specified in the following, the other participants will learn neither during nor after the experiment about your decisions.

Unless explicitly specified in the following, the other participants will learn neither during nor after the experiment about your payoff.

We analyze the data from the experiment only in aggregated form and never match names with the data from the experiment. At the end of the experiment, you have to sign a receipt about your payoff. This is necessary for us to balance accounts with our funding agency. The funding agency does not receive data from the experiment

The experiment

General

The experiment is comprised of 15 periods.

At the start of each period, you are randomly matched with two other participants.

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All periods are identical. In each period you (and the other members within your group) have to make one decision.
Your earnings in each period depend only on your decision and the decisions of the other members of your group in the respective period.

Experimental currency

During the experiment you work with the experimental currency EC. At the end of the experiment your earnings in EC will be exchanged to Euro and paid out to you. The exchange rate is:

40 EC = 1 Euro

Schedule of a period

In each period you start with a private endowment of 25 EC. You can invest a fraction or all of your private funds into a joint project with the other two participants in your group.

You and the other two group members determine via vote the mandatory contribution to the project that has to be paid by each group member. Each group member selects his preferred integer mandatory contribution between 0 and 25.
The median (second highest) selected amount is implemented as mandatory contribution for all group members.
You (and the other two group members) will be informed about the preferred amount of the other two group members and the resulting implemented mandatory contribution.
This mandatory contribution has to be paid by all group members and is subtracted from the private funds of each group member.
The collection of the mandatory contribution induces costs, therefore the project fund receives less than the sum of subtractions from the initial endowments.
You can find the exact relationship in table 1.

Earnings of a period

After collection of the mandatory contribution the project is carried out. The operation of the project creates a payment to the group members. The payment to you (and each of the two other group members) is 2/3 of the total project fund.
Your earnings in each period is the sum of the remaining endowment after stage II (25 – mandatory contribution) and the payment from the project (2/3 of the project fund after stage II).
You can find an overview about possible earnings depending on the decisions in table 2.

Tax or trust: A public goods game with enforceable and voluntary contributions

Short overview about the schedule of a period:

- Allocation of initial endowment of 25 EC
- Selection of the mandatory contribution
- Collection of the mandatory contribution from the private funds / inflow to the project fund
- The project is carried out
- Calculation of the earnings in the period

Payment

At the end of the experiment your total earnings will be paid out to you in cash.

The earnings of all 15 periods will be added.

The exchange rate is:

40 EC = 1 Euro

Your earning will be rounded up to the nearest 10 cent and paid out to you.

Examples

The two following examples illustrate the mechanics of the experiment:

	Participant	**A**	**B**	**C**
Decision	Preferred mandatory contribution	4	23	7
	Selected mandatory contribution	7		
	Inflow to the project fund	18.48		
Payment	Total project fund	18.48		
	Payment from the project	12.32	12.32	12.32
	Remaining private funds	18	18	18
	Earnings of the period	**30.32**	**30.32**	**30.32**

	Participant	**A**	**B**	**C**
Decision	Preferred mandatory contribution	19	19	0
	Selected mandatory contribution	19		
	Inflow to the project fund	39.90		
Payment	Total project fund	39.90		
	Payment from the project	26.60	26.60	26.60
	Remaining private funds	6	6	6
	Earnings of the period	**32.60**	**32.60**	**32.60**

Table 1:

Mandatory contribution	Inflow to project fund	Project fund per capita	Change in project fund per capita	Remaining private funds
a)	**b)**	**c)**	**d)**	**e)**
0	0.00	0.00	-	25
1	2.91	0.97	0.97	24
2	5.73	1.91	0.94	23
3	8.46	2.82	0.91	22
4	11.10	3.70	0.88	21
5	13.65	4.55	0.85	20
6	16.11	5.37	0.82	19
7	18.48	6.16	0.79	18
8	20.76	6.92	0.76	17
9	22.95	7.65	0.73	16
10	25.05	8.35	0.70	15
11	27.06	9.02	0.67	14
12	28.98	9.66	0.64	13
13	30.81	10.27	0.61	12
14	32.55	10.85	0.58	11
15	34.20	11.40	0.55	10
16	35.76	11.92	0.52	9
17	37.23	12.41	0.49	8
18	38.61	12.87	0.46	7
19	39.90	13.30	0.43	6
20	41.10	13.70	0.40	5
21	42.21	14.07	0.37	4
22	43.23	14.41	0.34	3
23	44.16	14.72	0.31	2
24	45.00	15.00	0.28	1
25	45.75	15.25	0.25	0

Explanation of the respective columns

a) Amount of the mandatory contribution

b) Inflow to project fund

c) Project fund per capita

d) Change of c) compared to a mandatory contribution that is one point lower

e) Remaining private funds

Table 2:

Mandatory contribution	Earnings
a)	**b)**
0	25.00
1	25.94
2	26.82
3	27.64
4	28.40
5	29.10
6	29.74
7	30.32
8	30.84
9	31.30
10	31.70
11	32.04
12	32.32
13	32.54
14	32.70
15	32.80
16	32.84
17	32.82
18	32.74
19	32.60
20	32.40
21	32.14
22	31.82
23	31.44
24	31.00
25	30.50

Explanation of the respective columns

a) Amount of the mandatory contribution

b) Earnings

A.3 Experimental instructions for the VCM treatment

Welcome to the experiment and thank you very much for your participation!

From now on, please do not talk to the other participants

General information

This experiment is done to study decision behavior. You can earn money. This money will be paid at the end of the experiment.

During the experiment you (and the other participants) will be asked to make decisions. Your decisions as well as the decisions of the other participants determine the amount of money you earn. The exact rules will be explained in the following.

The entire experiment will last about 90 minutes. If you have any questions or if anything is unclear to you, please raise your hand. One of the experimenter will get to you and answer your questions individually.

For simplicity, we use only the masculine form to describe the experiment. The description is valid for both male and female participants.

Anonymity

During the experiment you will be matched with other participants into groups. You and the other participants will learn neither during nor after the experiment with whom you were matched in the respective periods.

Unless explicitly specified in the following, the other participants will learn neither during nor after the experiment about your decisions.

Unless explicitly specified in the following, the other participants will learn neither during nor after the experiment about your payoff.

We analyze the data from the experiment only in aggregated form and never match names with the data from the experiment. At the end of the experiment, you have to sign a receipt about your payoff. This is necessary for us to balance accounts with our funding agency. The funding agency does not receive data from the experiment

The experiment

General

The experiment is comprised of 15 periods.

At the start of each period, you are randomly matched with two other participants.

Tax or trust: A public goods game with enforceable and voluntary contributions

All periods are identical. In each period you (and the other members within your group) have to make one decision.
Your earnings in each period depend only on your decision and the decisions of the other members of your group in the respective period.

Experimental currency

During the experiment you work with the experimental currency EC. At the end of the experiment your earnings in EC will be exchanged to Euro and paid out to you. The exchange rate is:

40 EC = 1 Euro

Schedule of a period

In each period you start with a private endowment of 25 EC. You can invest a fraction or all of your private funds into a joint project with the other two participants in your group.

From this endowment, you (and the two other group members) can provide a voluntary contribution towards the project fund.
The collection of the voluntary contribution does not induce costs. The project fund consequently receives the sum of voluntary contributions of all group members.

Earnings of a period

After collection of the voluntary contributions the project is carried out. The operation of the project creates a payment to the group members. The payment to you (and each of the two other group members) is 2/3 of the total project fund.
Your earnings in each period is the sum of the remaining endowment after stage II (25 –your voluntary contribution) and the payment from the project (2/3 of the project fund after stage II).
You can find an overview about possible earnings depending on the decisions in table 1.
Short overview about the schedule of a period:

- Allocation of initial endowment of 25 EC
- Selection of the voluntary contribution
- Collection of the voluntary contribution from the private funds / inflow to the project fund
- The project is carried out
- Calculation of the earnings in the period

Payment

At the end of the experiment your total earnings will be paid out to you in cash.

The earnings of all 15 periods will be added.

The exchange rate is:

40 EC = 1 Euro

Your earning will be rounded up to the nearest 10 cent and paid out to you.

Examples

The two following examples illustrate the mechanics of the experiment:

	Participant	**A**	**B**	**C**
Decision	Initial private endowment	25	25	25
	Individual voluntary contribution	25	0	12
	Inflow to the project fund		37	
Paymen	Total project fund		37	
	Payment from the project	24.67	24.67	24.67
	Remaining private funds	0	25	13
	Earnings of the period	**24.67**	**49.67**	**37.67**

	Participant	**A**	**B**	**C**
Decision	Initial private endowment	25	25	25
	Individual voluntary contribution	3	4	2
	Inflow to the project fund		9	
Paymen	Total project fund		9	
	Payment from the project	6	6	6
	Remaining private funds	22	21	23
	Earnings of the period	**28**	**27**	**29**

Table 1:

Earnings based on

voluntary contribution of other group member 1	**minimum**	**maximum**	**minimum**	**maximum**
and voluntary contribution of other group member 2	**minimum**	**maximum**	**maximum**	**minimum**
Own voluntary contribution				
a)	**b)**	**c)**	**d)**	**e)**
0	25.00	58.33	41.67	41.67
1	24.67	58.00	41.33	41.33
2	24.33	57.67	41.00	41.00
3	24.00	57.33	40.67	40.67
4	23.67	57.00	40.33	40.33
5	23.33	56.67	40.00	40.00
6	23.00	56.33	39.67	39.67
7	22.67	56.00	39.33	39.33
8	22.33	55.67	39.00	39.00
9	22.00	55.33	38.67	38.67
10	21.67	55.00	38.33	38.33
11	21.33	54.67	38.00	38.00
12	21.00	54.33	37.67	37.67
13	20.67	54.00	37.33	37.33
14	20.33	53.67	37.00	37.00
15	20.00	53.33	36.67	36.67
16	19.67	53.00	36.33	36.33
17	19.33	52.67	36.00	36.00
18	19.00	52.33	35.67	35.67
19	18.67	52.00	35.33	35.33
20	18.33	51.67	35.00	35.00
21	18.00	51.33	34.67	34.67
22	17.67	51.00	34.33	34.33
23	17.33	50.67	34.00	34.00
24	17.00	50.33	33.67	33.67
25	16.67	50.00	33.33	33.33

Explanation of the respective columns

a) Amount of the own voluntary contribution

b) Earnings if both other group members choose the minimum (0) voluntary contribution

c) Earnings if both other group members choose the maximum (25) voluntary contribution

d) Earnings if the first of the other group members chooses the minimum (0) voluntary contribution and the second other group member chooses the maximum (25) voluntary contribution

e) Earnings if the first of the other group members chooses the maximum (25) voluntary contribution and the second other group member chooses the minimum (0) voluntary contribution

B. Further analysis

B.1 Behavior on the matching group level

Figure 6 presents the average tax payment for all matching groups in TAX. The graphs for all matching groups are flat at 16 with only minor fluctuations (four of the graphs are even completely flat without any fluctuation).

- The results in VCM are more heterogeneous, as you can see in Figure 7. The matching groups can be categorized into three different types:Steady downward trend from the first to the last period (602, 603)
- Double-peaked with an initial increase from the first to second or third period, decrease until the middle periods, a short upward trend to the second peak followed by a downward trend until the end (502, 503, 504).
- Seemingly random fluctuation without a clear time trend (501, 601, 604).

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For the TAX/VCM it is necessary to look at both at the tax payment and the contribution as shown in Figure 8. There are a few matching groups with a clear pattern:

- Matching group 104 exhibits steadily increasing tax payments and decreasing contributions.
- Matching group 203 moves to a no tax payment / maximum contribution state and stays there for several periods before the contributions decay for the later periods.

However, most matching groups do not follow a readily apparent pattern.

Figure 6: Average tax payment in TAX over time by matching group

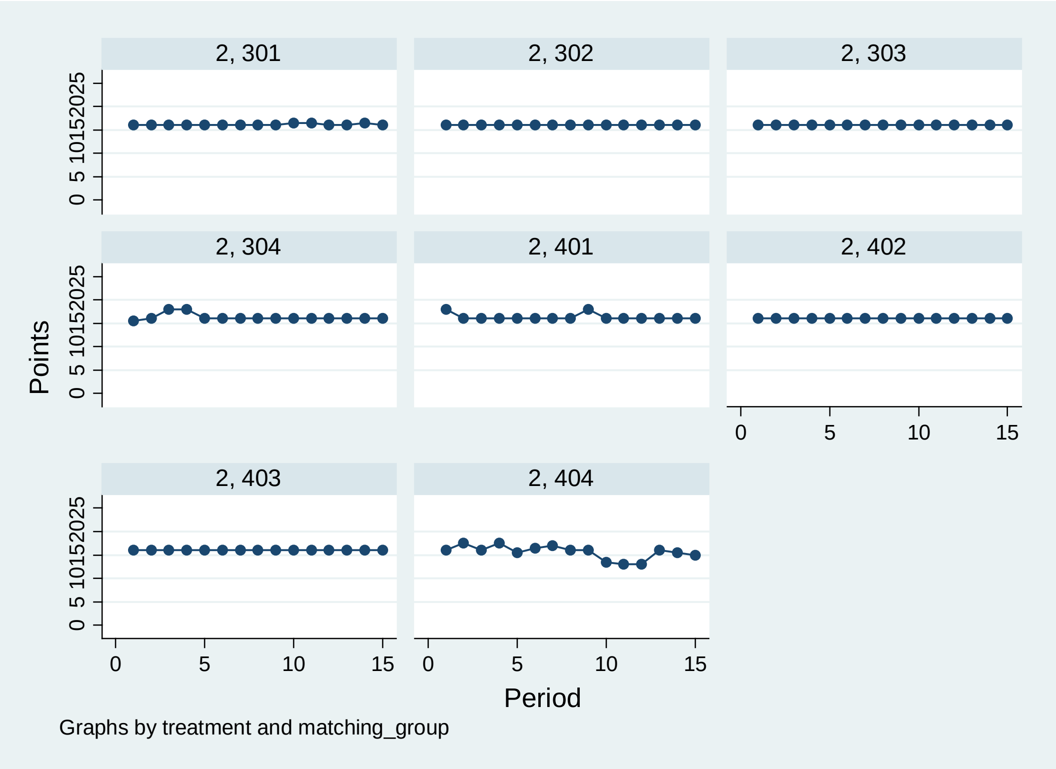


Figure 7: Average contribution in VCM over time by matching group

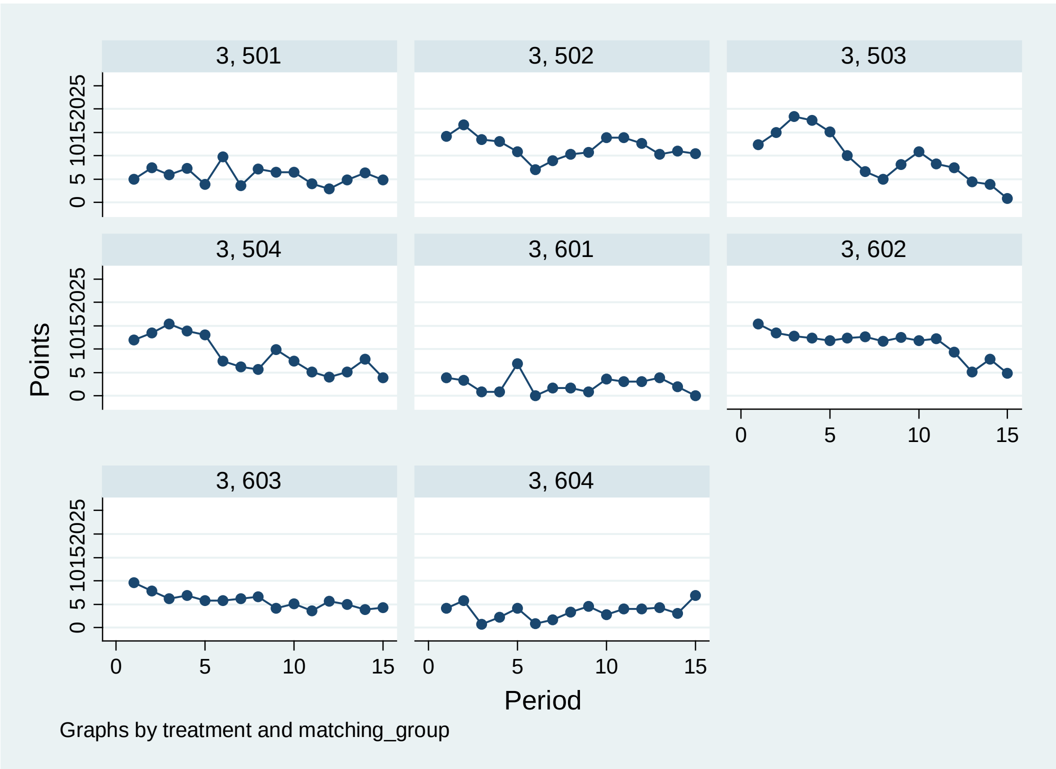
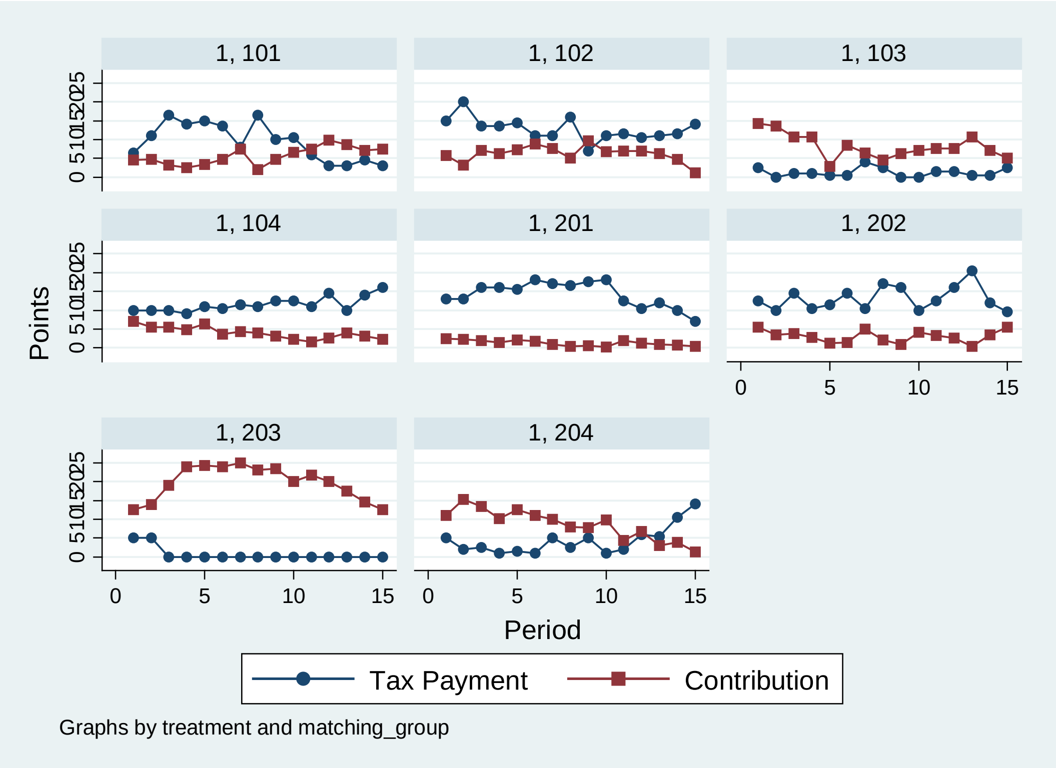


Figure 8: Average tax payment and contribution in TAX/VCM over time by matching group



B.2 Further analysis of the decisive vote effect

In this section I present additional analysis of the 'decisive vote' effect discussed in 1.4.2. In 1.4.2 I argued that the difference of the own vote to the tax maximizing vote matters because the 'vote winner' wants to compensate the loss of profit through the tax mechanism. The same motive could also be captured by the explanatory variable 'loss of tax profits' of the 'vote winner', where the tax profit is defined as the payoff from the public account minus the tax payment (d – p) for one group member. The loss of tax profits is the difference between the tax profit from the tax maximizing vote and the realized tax rate. The idea about the connection is basically the same, but with an emphasis on differences for low tax payments that have a larger potential efficiency loss.

Running the regression with the loss of tax profits (Model 3) yields similar results to Model 2, the loss of tax profits variable is positive and weakly significant, the tax payment=vote dummy loses half its value and the significance.

Table 11: Votes and contributions in TAX/VCM (periods 2-15, OLS regressions)

	Dependent variable:		
	Contribution, Model 3	Contribution, Model 4	Contribution, Model 5
Period	-0.082* (0.045)	-0.086* (0.045)	-0.085* (0.044)
Tax up to 16	-0.390*** (0.066)	-0.394*** (0.065)	-0.419*** (0.068)
Tax over 16	-0.455*** (0.140)	-0.418*** (0.133)	-0.452*** (0.133)
Vote	-0.004 (0.042)	-0.004 (0.042)	-0.017 (0.043)
Tax payment=Vote dummy	0.465 (0.362)	0.293 (0.403)	0.844** (0.415)
Majority dummy	-	-	0.428 (0.742)
Consensus dummy	-	-	-0.907 (0.930)
Difference to tax maximization	-	0.217 (0.264)	-
Loss of tax profits	0.294* (0.164)	-0.113 (0.585)	-
Contribution (t-1)	0.597*** (0.061)	0.596*** (0.060)	0.595*** (0.062)
Avg. contribution of other group members (t-1)	0.248*** (0.056)	0.252*** (0.059)	0.254*** (0.057)
Tax payment (t-1)	0.355*** (0.081)	0.346*** (0.077)	0.358*** (0.081)
Constant	1.441 (1.441)	1.570 (1.370)	1.819 (1.443)
# Observations	672	672	672
R^2	0.64	0.65	0.64

Notes: *** Significant at 1% level; ** significant at 5% level; * significant at 10% level. Robust standard errors in parentheses (clustered on subject level).

When I include both difference to tax maximization and loss of tax profits as variables (Model 4), they both lose their significance. However, the difference to tax maximization variable remains positive while the loss of tax profits variable turns negative. The former variable seems to be a better fit to describe the effect.

Two further reasonable explanations are not supported by the data. First, there could be a homogeneity effect, meaning that subjects contribute more if other group members vote the same (thus ensuring that the voted tax is implemented). Second, 'winning' the voting process could bring an utility gain which the winner wants to balance through a higher monetary payoff for the other group members.[21] Both these models imply that the number of subjects who have the winning vote in a group matters for the effect. The homogeneity effect would mean that there is only an effect if at least two subjects cast the same vote and that the effect is strongest when all three subjects choose the same vote. The 'balanced utility' would mean that the effect decreases if two subjects cast the same vote and vanishes when all three subject choose the same vote, because then there is nothing to balance. Model 5 includes a majority dummy for subjects who cast the same vote as at least one of their other group members and the consensus dummy for subjects who cast the same vote as both of their other group members. The variable for the 'vote winner' is again significant. The majority and the consensus dummies are both insignificant and they have different signs, providing no support for any of these explanations.

[21] This could be motivated with Fehr and Schmidt (1999) or Charness and Rabin (2002) preferences with the winning of the vote represented as an additional payoff for the winner.

Chapter 2: The team allocator game: Allocation power in public goods games

2.1. Introduction

Consider a team work setting with a straightforward hierarchy. There is one team member that, although contributing to the team effort, has some discretionary power to allocate gains from team production to all team members. Individual effort levels in the team are observable, but not verifiable. Hence, contracts on effort are infeasible, and the team faces a modified social dilemma: it is individually rational for a selfish ordinary team member to withhold effort, even though it would be socially optimal to provide effort. The incentives for the team member with allocation power, henceforth denoted team allocator, could be different; we shall return to this issue momentarily. In real life, we often find teams with a natural or exogenously imposed hierarchical structure that gives one team member (a team leader or manager) property rights over team output: small work teams, for instance, in consulting companies, sports teams, music bands, military units, or families readily come to mind. However, also political parties with a designated leader have a similar incentive structure when effort contributions to an election campaign are considered to have a social dilemma component.[22]

This work is the first that provides a rigorous empirical test of the (behavioral) incentive effects of such a team structure. We analyze a modified public goods game theoretically and implement it experimentally in the laboratory. From the several conceivable implementations of allocation power of a team member, we chose the most parsimonious one. In our *team allocator game (TAG)*, each team member – regardless of whether the member is an *ordinary team member* or the *team allocator* – can contribute to a public account. The sum of contributions is multiplied by an efficiency factor larger than one, but – in contrast to the standard public goods game – not distributed equally among all team members. Rather, the team allocator receives the entire amount in the public account and has full discretionary power over the allocation of the revenues from the account

[22] All these examples have in common that the team output is not a pure public good but unequally dividable among the team members. A pure public good, of course, entails no allocation power.

within the team. More precisely, she can implement any distribution of the benefits from the public account over the ordinary team members and herself.

It is straightforward to show that in such a setting, ordinary team members with standard preferences have no incentive whatsoever to contribute to the public account, whereas the team allocator will contribute her entire endowment if the public goods mechanism is linear. Our experimental results, however, interestingly show that the level of contributions in the team allocator game is significantly higher than in an appropriate control treatment in which there is no team allocator, i.e. there is an equal split of the public account, but one team member is forced to contribute her entire endowment. In other words, giving one team member dictator or allocation power leads to much higher levels of cooperation than expected. We show that team allocators' distribution behavior influences, together with the time horizon of the team interaction, the pattern of contributions. Although there is some heterogeneity in the behavior of team allocators, we find that they predominantly use the reward channel in case of high contributions, i.e. they allocate large shares of the public account to cooperating ordinary team members, but they also tend to punish non-contributors by excluding them from the benefits from the public account. Overall, the returned amounts to contributors are astonishingly high and generate strong contribution incentives for ordinary team members. We provide theoretical evidence that such a generous behavior of team allocators could be caused by other-regarding preferences such as inequity aversion (Fehr and Schmidt, 1999) or maximin-orientation (Charness and Rabin, 2002), but the repeated-game aspect plays a role as well.

In general, it seems that teams with a straightforward hierarchy – with a team member that dominates the allocation process – have an advantage over teams with members of equal standing and an automatic equal distribution of the team benefits. They are more likely to overcome the social dilemma inherent to public good provision, i.e. team effort provision. Our result is the more remarkable since the described mechanism can be implemented without any monetary costs. Other mechanisms to sustain cooperation that have been studied extensively in the literature – the most prominent one is an informal sanctioning mechanism (starting with the seminal paper by Fehr and Gächter, 2000b) – bring about substantial costs. While, for instance, an informal punishment option increases contributions dramatically, its efficiency balance depends very much on the length of the interaction among the team members (Gächter et al., 2008). On the contrary, an informal reward option can be more efficient but is typically less effective in sustaining high contribution levels. Thus, from an efficiency perspective, the implementation of hierarchy in teams seems especially positive when compared to other mechanisms.

Our work is related to the huge literature of institutional provisions in social dilemmas. This literature has, for instance, studied the effects of punishment (e.g., Yamagishi, 1986; Ostrom et al., 1992; Fehr and Gächter, 2000b; Masclet et al., 2003; Casari, 2005; Noussair and Tucker, 2005; Anderson and Putterman, 2006; Carpenter, 2007a; Denant-Boemont, et al., 2007; Sefton et al., 2007; Egas and Riedl, 2008; Gächter et al., 2008; Herrmann et al., 2008; Masclet and Villeval, 2008; Nikiforakis, 2008; Nikiforakis and Normann, 2008; Casari and Luini, 2009; Ule et al., 2009; Nikiforakis, 2010; Gächter and Herrmann, 2011), the effects of reward (e.g., Andreoni et al., 2003; Sefton et al., 2007), the effects of communication before the contribution decision (e.g., Isaac and Walker, 1988; Ostrom et al., 1994; Cason and Khan, 1999; Brosig et al., 2003; Bochet et al., 2006; Bochet and Putterman, 2009), the effects of an expulsion option from the benefits of the public good (e.g., Cinyabuguma et al., 2005), or the effects of voluntary association (e.g., Page et al., 2005; Charness and Yang, 2008) on contribution levels in and the resulting efficiency of social dilemmas. There is also a literature on the formal implementation of institutions in social dilemmas, usually by a voting mechanism (e.g., Kroll et al., 2007; Kosfeld et al., 2009).

All related papers on institutional provisions mentioned above share the feature that team members are equal in their personal endowments and options to implement and use the institutional mechanism. In other words, there is no hierarchy within the team. Examples of papers that study cooperation-fostering institutions with unequal team members are rare.[23] One exception that we are aware of is Reuben and Riedl (2009). The paper is, however, only loosely related to ours, because they analyze the effects of endowment differences in a public goods game on norm enforcement. Another exception, Cárdenas et al. (2009), is related more closely. They analyze a specific problem in collective water management that is modeled as a public good with asymmetric access. More precisely, in their setup there is sequential access of the team members to the benefits from the public good. The idea of sequential access is intended to capture the situation of a collective water supply with the natural feature that upstream users (farmers) can appropriate benefits from the public good before downstream users. Their main finding in

[23] There is a large literature on asymmetries in standard public goods games in the absence of norm-enforcement devices. For reasons of succinctness, we do not discuss this literature here.

terms of cooperation is that asymmetric appropriation leads to lower levels of cooperation than the usual symmetric appropriation in the standard linear public goods game (voluntary contribution mechanism).[24]

Another way of looking at our mechanism is in relation to the seminal trust game (Berg et al., 1995). Our mechanism can be viewed as a collective trust game in which the amount that can be returned by the trustee (the team allocator) depends on the collective level of trust by the trustors (the ordinary team members). Trust games with more than one trustor are for example studied in Cassar and Rigdon (2011). However, their trustees are more restricted in their allocation power as they cannot allocate benefits from one trustor's investments to another trustor.[25]

In reality, the allocation power of the team allocator is sometimes limited by law or contract, or allocation power is shared by several team members. Analytically, it makes nevertheless sense to start with a comparison of the two extremes: full allocation power by one team member versus an automatic equal distribution of the team benefits (with one team member being forced to contribute the entire endowment to keep incentives constant across the two conditions). Our study thus intends to provide a benchmark for a hierarchical social dilemma setting with allocation power. Future studies should address different contractual limitations associated with allocation power.

The remainder of the chapter proceeds as follows: In Section 2 we introduce our experimental design and describe the procedures of the experiment. Section 3 derives theoretical predictions. Section 4 reports the experimental results, and Section 5 discusses our findings and concludes the chapter.

2.2. Experimental design and procedures

In the following we describe the basic experimental setup (Section 2.1) and the details of the experimental procedure (Section 2.2).

[24] Finally, our research is also related, at least loosely, to recent contributions on leadership in public goods games. See, for instance, Güth et al. (2007), Levati et al. (2007), Rivas and Sutter (2011), or Gächter et al. (2010).

[25] For a recent meta-analysis of trust games, see Johnson and Mislin (2011).

2.2.1 Basic setup of the team allocator game

Let $I = \{1, 2, \dots, n\}$ denote a team of n subjects who interact in T periods with subject 1 being called the *team allocator (TA)* and subjects $2, \dots, n$ called the *ordinary team members (OTMs)*. Each period $t \in \{1, 2, \dots, T\}$ consists of two stages. In stage 1, each individual $i \in I$ receives an endowment E which can be allocated either to her private account or to a public account. The contribution of individual i to the public account in period t, denoted $c_{i,t}$, must satisfy $0 \leq c_{i,t} \leq E$. Let C_t be the sum of all team members' contributions in period t (i.e. $C_t = \sum_{j=1}^{n} c_{j,t}$). In order to retain the public goods nature C_t is multiplied by a factor γ, which satisfies $1 < \gamma < n$.[26]

In the second stage, the TA can freely distribute the amount γC_t among the team members (the OTMs and herself), following only two restrictions for the returned amount. Every team member has to get a non-negative amount that cannot be greater than γC_t, and the sum of all returned amounts has to be equal to γC_t. Formally, the returned amount is denoted by $d_{i,t}$, with i being the receiving team member:

$$0 \leq d_{i,t} \leq \gamma C_t \ \forall i, \quad \sum_{j=1}^{n} d_{j,t} = \gamma C_t \tag{1}$$

Individual team member i's payoff from the TAG in period t is then given by

$$\pi_{i,t} = E - c_{i,t} + d_{i,t}. \tag{2}$$

2.2.2 Experimental procedures

The experiment implements two treatments: (i) treatment *TAG* and (ii) treatment *VCM+*. TAG is a treatment according to the setup laid out in Section 2.1 with the following parameters: team size $n = 4$, endowment per period $E = 20$ points (the experimental currency unit)[27], $\gamma = 1.6$, and the number of periods $T = 10$. Returned amounts $d_{i,t}$ can have up to one decimal.[28] Experimental participants are matched randomly in teams at the beginning of the experiment and one randomly chosen team

[26] Indeed, γ could also be smaller than 1 or larger than n in the TAG without changing the incentives for OTMs. In contrast to the standard public goods game, there is no individual incentive to contribute to the public account, no matter how high γ is. The condition is just imposed to keep the setup comparable to the standard voluntary contribution mechanism. A $\gamma < 1$ changes, however, the incentives for the TA.

[27] At the end of the experiment earned points from all periods are summed up and converted into euro using the following exchange rate: 1 point = 4 euro-cent.

[28] Note that we allow for one decimal place to ensure that the entire amount of γC_t can be distributed to the team members. This also gives TAs the ability to return exactly 1.6 times the invested amount to each OTM.

member is assigned the role of TA. We use a partner design with fixed subject IDs that allows building reputation because a one-shot interaction in a team with hierarchy seems less realistic. Roles are kept over the course of the experiment. Since we are not interested in studying irrational behavior or potentially complicated signaling through contributions by the TA that are below the full endowment, we automatically enforce full contributions for a TA, i.e., $c_{1,t} = E$. This is innocuous because both a completely selfish and an other-regarding TA would want to contribute the highest possible amount.[29] All details of the setup and all parameters are common knowledge.

VCM+ is the appropriate control treatment for TAG. It is a standard voluntary contribution mechanism with identical parameters and provisions as in TAG. In order to align incentives, however, we need to randomly select one team member that is forced to contribute her entire endowment to the public account – hence, the plus in the notation.[30] The team member who is forced to contribute the entire endowment is the same in every period of the experiment and will be denoted, analogous to the denomination of the TA in the TAG, as subject 1. Note that the benefit from the public account in VCM+, γC_t, is distributed equally among all team members, just as in a standard VCM.[31]

Information conditions are as follows: In the TAG treatment, the TA receives the full vector of individual contributions within her team before deciding about the returned amounts to each team member in stage two of the game. In both treatments at the end of each period, all team members are informed about the vector of contributions within their teams, the resulting benefit from the public account, the distribution of this benefit among the team members (either equally in the VCM+ or according to the allocation decision of the TA in the TAG), and the final individual profits from this period. Hence, information conditions are identical across the two treatments.

[29] An anti-social TA would not necessarily want to contribute the highest possible amount. However, we will show later on that we do not have any anti-social TA in our experiment.

[30] Partial coercion does not change contribution incentives for unforced contributors compared to a standard VCM. This is shown in a recent study by Cettolin and Riedl (2011). They implement two coercion treatments (low and high) in which they force one randomly selected group member to contribute at least a minimum amount (approximately 25% and 75% of the endowment, respectively). The authors show that partial coercion has no influence on average contributions beyond the pure coercion effect, i.e. non-coerced subjects do not contribute significantly different amounts than subjects in a control VCM. Cettolin and Riedl argue that the lack of a cooperative intention may prevent unforced conditional cooperators from increasing their contributions.

[31] For the control treatment VCM+, the condition $1 < \gamma < n$ ensures that we have a social dilemma. See footnote 5 for a brief discussion.

An experimental session consisted of two parts (instructions can be found in Appendix A) in which the second part was either the TAG or the VCM+ treatment. In the first part we used a social value orientation questionnaire (henceforth referred to as ring test) to obtain an independent measure of an individual's social motivation (i.e. her generalized other-regarding preferences).[32] The measure from the ring test helps us to assess one of our main research questions, namely to what extent the behavior of TAs is driven by an intrinsic motivation or by opportunistic maximization behavior.

In the ring test, individuals choose 24 times between two possible pairs of payoffs for themselves and another person (see Appendix B for details). The recipient remains the same throughout the entire test and answers herself the same set of tasks (thereby, vice versa, influencing the first person's payoff). The test is fully incentivized since all 24 selected pairs are payoff relevant. However, the profit from the ring test is not revealed before the end of the second part (the VCM+ or the TAG, respectively) in order to avoid any income spill-over effects within the ring test or from the ring test to the VCM+/TAG.[33]

By calculating the sum of all 24 selected pairs, one can determine the overall amount of money allocated to the person herself (X) and the other person (Y). The ratio Y/X determines then a vector $\vec{A}$ and thus a certain angle in an X-Y-coordinate system. Dependent on this angle, subjects can be sorted into eight behavioral types (individualism, cooperation, altruism, martyrdom, masochism, sadomasochism, aggression and competition; see Figure 16 in Appendix B) which reflect their social orientation. With the 24 choices one can also measure a participant's consistency in her payoff choices. When using the data from the ring test in our analysis, we focus only on TAs with a consistency measure of at least 2/3.[34] Moreover, we concentrate on two behavioral types, *individualistic* and *cooperative* types, as there is no single TA that is classified differently by the mechanism. This is not unusual because behavioral types that consistently follow other motivations are very rare.

[32] Van Lange et al. (1997) provide a review on the use of the ring test in the psychological literature. Economic applications of this measure can, for example, be found in Offerman et al. (1996), Park (2000), Brosig (2002), van Dijk et al. (2002) or very recently in Sutter et al. (2010).

[33] A subject's recipient in the ring test could by chance be also a member of the same team in the second part of the experiment, as we used an unrestricted random draw mechanism. However, this does not create any problems, since no feedback was provided before completion of the second part.

[34] Note that there exists no standard consistency threshold in the literature. While Park (2000) classifies only subjects with a consistency measure of 75% or more, Brosig (2002) uses a remarkably low threshold of 25%. We decided to implement a relatively high threshold. However, shifting this value downwards or even including all TAs does not yield different results.

Before the start of the first part, our subjects received written instructions only for the ring test, but they knew that there would be a second part in the experiment and that this part would be unrelated to the first part. Upon completion of the ring test, subjects received instructions for the second part: either the TAG or the VCM+. Instructions of both parts were read aloud to ensure common knowledge of the rules, and subjects were given plenty of time to ask questions in private before the start of each part.

At the end of the experiment, before private cash payment, subjects finally answered a couple of questions about their decisions in the experiment and a post-experimental questionnaire, including questions regarding socio-economic variables such as gender, age and major. The computer-based sessions were conducted at the experimental laboratory MELESSA of the University of Munich between July 2010 and September 2010 using the experimental software z-Tree (Fischbacher, 2007) and the organizational software Orsee (Greiner, 2004). A total of 144 undergraduate students from all disciplines participated in six sessions with 24 participants each. Three sessions implemented treatment TAG, three sessions treatment VCM+. The six sessions provide us with 18 statistically independent observations for each of the two treatments. The sessions lasted up to 90 minutes including everything from the instructions to final payments, and the average earnings were 19.08 EUR, including a show-up payment of 4.00 EUR. No participant was allowed to take part in more than one session, and the assignment of subjects into treatments was random. Decisions were taken anonymously in cubicles, and communication among participants was prohibited.

2.3. Theoretical predictions

In the following, we formulate theoretical predictions for our two treatments. We start with straightforward hypotheses based on the assumptions of purely selfish and rational decision makers (“standard preferences”). In a next step, we then move to hypotheses based on two prominent models taking other-regarding preferences into account. Finally, we take care of the repeated interaction in our experiment by focusing on reputation formation.

2.3.1 Predictions based on standard preferences (homo oeconomicus model)

Our two treatments are finitely repeated games of perfect information. Assuming common knowledge of rationality and selfishness and using backward induction it is clear that in the TAG the TA will not return any positive amount to the OTMs in the second stage of period 10. Therefore, OTMs will not contribute anything to the public account in period 10 because any contribution would be “lost”. The same rationale holds for all prior periods. Consequently, contributing nothing to the public account is a dominant strategy for all OTMs, i.e. $c_{i,t} = 0 \; \forall i \neq 1$ and t. The TA herself is forced to contribute $c_{1,t} = E = 20$ in all periods, but she would have an incentive to do so anyway because $\gamma > 1$. Regarding the distribution of the public account we have $d_{i,t} = 0 \; \forall i \neq 1$ and t whereas the TA receives in each period $d_{1,t} = \gamma C_t = 32$.

For treatment VCM+ the standard logic of the public goods game applies. Since $1 < \gamma < n$, the marginal per capita return from investing into the public account is smaller than one. Hence, it is a dominant strategy for OTMs to contribute nothing to the public account, i.e. $c_{i,t} = 0 \; \forall i \neq 1$ and t. The forced contributor, on the other hand, has to contribute $c_{1,t} = E = 20$ in each period, and the automatic equal distribution of the public account yields $d_{i,t} = \gamma C_t / n = 8 \; \forall i$,.

Proposition 1. *Under standard preferences, OTMs contribute zero in each period, irrespective of treatment. The TA in the TAG always allocates the entire public account to herself.*

2.3.2 Predictions based on other-regarding preferences

We focus on two prominent models that both belong to the class of outcome-based social preference models (at least in the way we model them): the inequity aversion model by Fehr and Schmidt (Fehr and Schmidt, 1999) and the welfare-oriented model by Charness and Rabin (Charness and Rabin, 2002).

2.3.2.1 Fehr and Schmidt (1999) preferences

The model by Fehr and Schmidt (1999) assumes that subjects suffer from inequity within their reference group. More precisely, a subject i benefits from her own payoff π_i but compares it with the payoff of the $n-1$ other members in her reference group. The corresponding utility function is the following:

$$U_i(\pi) = \pi_i - \alpha_i \frac{1}{n-1} \sum_{j \neq i} \max\{\pi_j - \pi_i, 0\} - \beta_i \frac{1}{n-1} \sum_{j \neq i} \max\{\pi_i - \pi_j, 0\} \qquad (3)$$

The vector $\pi = (\pi_1, \dots, \pi_n)$ denotes the monetary payoffs and α_i and β_i represent subject i's individual attitude towards inequity. The two weights are restricted to $\beta_i \leq \alpha_i$ and $0 \leq \beta_i < 1$. They control for the impact of utility losses from disadvantageous inequity (α_i) and advantageous inequity (β_i), respectively.[35]

If we assume that the TA in the TAG is inequity-averse and the team is the relevant reference group, then a TA might be willing to reduce payoff differences within the team by returning positive amounts to the OTMs. Note that the weight α_i does not play any role here, because the TA will never reduce the amount allotted to herself below the level of full payoff equalization as this reduces her own payoff *and* increases inequity. Thus, only the weight β_i matters for TA's decisions. If the TA distributes one point from the public account to an OTM instead of putting it into her own pocket, she will reduce her own payoff by 1 and decrease inequity, on average, by 4/3 (regarding the receiving OTM by two points and regarding both other OTMs by one point). Thus, returning positive amounts is optimal if $-1 + \beta_1 \cdot 4/3 \geq 0$ or $\beta_1 \geq 0.75$.

This yields the following equilibria in the one-shot game: If $\beta_1 < 0.75$, the TA takes the entire public account for herself, which implies zero contributions of OTMs irrespective of whether they are selfish or whether they are other-regarding, i.e. $c_i = d_i = 0\ \forall i \neq 1$ and $d_1 = \gamma C = 32$. If $\beta_1 > 0.75$, the TA returns positive amounts to fully equalize period payoffs. All OTMs, therefore, have an incentive to contribute their full endowment, even when they are completely selfish and rational, and of course, the more so if they are other-regarding. Hence, we have $c_i = E = 20\ \forall i \neq 1$, and $d_i = 32\ \forall i$ as the only subgame-perfect equilibrium. If $\beta_1 = 0.75$, the TA is indifferent in the way she allocates the public account (as long as she is not worse off than one of the other team members). Hence, multiple equilibria exist in this case and cooperation between some or all team members may occur. Thus, TAs that are sufficiently averse to advantageous inequity ($\beta_1 \geq 0.75$) can generate full cooperation and payoff equalization in the one-shot version of the TAG. Regarding potential repeated game effects and reputation building, Section 3.2.3 will discuss details.

It is noteworthy that Fehr and Schmidt (1999) preferences can predict full cooperation in our VCM+ treatment. Using Proposition 4 of Fehr and Schmidt (1999, p. 839) it is, however, obvious that for our parameter values cooperation can only be achieved if all

[35] Note that for $\alpha_i = \beta_i = 0$ the model collapses into the case of standard preferences.

OTMs are sufficiently averse to advantageous inequity, i.e. $\gamma/n + \beta_i \geq 1$ or $\beta_i \geq 0.6\ \forall i \neq 1$. Asymmetric equilibria in the one-shot game do not exist for our setup. According to the parameter distribution given in Fehr and Schmidt (1999, p. 844), the probability of having three OTMs with $\beta_i \geq 0.6$ in one team is $0.4^3 = 6.4\%$. As Fehr and Schmidt (1999) do not provide data for a threshold of 0.75, we cannot infer the probability of meeting a TA with $\beta_i \geq 0.75$ from their paper. From all calibration results that are available, it is clear that the probability of meeting a TA with sufficiently high β_i in order to induce full cooperation is higher than the 6.4%. Hence, full cooperation in the one-shot TAG treatment is expected to be more prevalent than in the VCM+ treatment. Again, the discussion of repeated game effects is relegated to Section 3.2.3.

Proposition 2. *With Fehr and Schmidt (1999) preferences, the TA in the TAG is willing to distribute positive amounts to OTMs if* $\beta_1 \geq 0.75$, *i.e. if she is sufficiently averse to advantageous inequity. Full cooperation and full payoff equalization within the team is an equilibrium in this case. If* $\beta_1 < 0.75$, *in the one-shot game the TA will take the entire benefit from the public account for herself, and no OTM has an incentive to contribute. Full cooperation can also be an equilibrium in the VCM+ treatment; however, it requires* $\beta_i \geq 0.6$ *for all OTMs.*

2.3.2.2 Charness and Rabin (2002) preferences

Charness and Rabin (2002) assume that subjects care about social welfare. Their model includes a subject's own payoff and, additionally, two components of social welfare: the minimum payoff in a group (the "Rawlsian" motive) and the sum of all group members' payoffs (the efficiency concern). More precisely, the utility function in their general model (see their Appendix 1) with only outcome-based components looks as follows:[36]

$$U_i(\pi) = (1-\lambda_i)\pi_i + \lambda_i[\delta_i \min(\pi_1, \dots, \pi_n) + (1-\delta_i)(\pi_1 + \pi_2 + \dots + \pi_n)] \qquad (4)$$

The vector $\pi = (\pi_1, \dots, \pi_n)$ denotes the monetary payoffs within the group of n subjects and λ_i and δ_i are individual weights (i.e. $\lambda_i, \delta_i \in [0, 1]$). The first weight, λ_i,

[36] Note that we consider here only the outcome-based version of the model and neglect the role of intentions as the more complex model with intentions does not seem suitable for deriving specific predictions in our setup.

captures how much an individual cares for social welfare relative to her own payoff.[37] The second weight, δ_i, controls for the influence of the "maximin"-aspect relative to the general efficiency concern.

Again, we first look at the one-shot game and relegate any discussion regarding repeated interaction to Section 3.2.3. As a TA's choice in the TAG is purely distributional, i.e. the sum of team members' payoffs is not affected by her decision, only the "Rawlsian" motive of social welfare matters for a TA's decision. TAs compare the utility loss from a reduction in own payoff, $1-\lambda_1$, with the utility gain from increasing the minimum payoff in the team ($\lambda_1\delta_1$). This implies that TAs never return amounts to OTMs beyond the level of full payoff equalization. Note further that the number of subjects s that lie at the minimum payoff matters, because it determines by how much the minimum can be raised with one point. If there is more than one individual at the minimum, each point has to be split equally among all affected subjects to obtain the maximum increase in the minimum payoff. Thus, returning positive amounts to OTMs is optimal for a TA as long as $1-\lambda_1 \leq \lambda_1\delta_1 \cdot 1/s$ or $\delta_1 \geq s \cdot (1-\lambda_1)/\lambda_1$.

As s cannot be smaller than 1, $0.5 \leq \lambda_1 \leq 1$ is a necessary condition to ensure reasonable values of δ_1. However, $\lambda_1 \geq 0.5$ (and δ_1 sufficiently large) makes positive returned amounts to OTMs optimal, only as long as there is a single OTM with minimum earnings. Once the minimum is raised to the level of the second-lowest payoff or once there are two subjects with the same minimum earnings, the condition tightens to $\lambda_1 \geq 2/3$ (and δ_1 appropriately). Thus, in contrast to Fehr and Schmidt (1999), Charness and Rabin (2002) preferences can lead to a partial equalization of profits. Full payoff equalization in equilibrium will only obtain if λ_1 is large enough to make redistribution profitable in the case the points have to be split among all three OTMs, i.e. $\lambda_1 \geq 0.75$ (and δ_1 appropriately).

This implies the following: If $\lambda_1 \geq 0.75$ (and δ_1 appropriately), there is an equilibrium in which all OTMs contribute their full endowment even if they are completely selfish and rational and the more so if they are other-regarding, i.e. $c_i = E = 20\ \forall i \neq 1$, and $d_i = 32\ \forall i$.[38] If $\lambda_1 < 0.5$, selfish OTMs choose $c_i = 0$, while $E = 20$ is contributed by OTMs who care sufficiently about efficiency (requiring $\lambda_i \geq 0.625$ and δ_i sufficiently

[37] For $\lambda_i = 0$, the Charness and Rabin (2002) model nests standard preferences.

[38] There is, of course, indifference of the TA between distributions in case of $\lambda_1 = 0.75$. This leads to multiple equilibria sustaining also contribution levels below 20.

low[39]). If $0.5 \leq \lambda_1 < 0.75$, full cooperation will not be obtained with selfish and rational OTMs. However, partial cooperation with one or two OTMs contributing positive amounts is possible (the latter only for $\lambda_1 \geq 2/3$). Again, if all OTMs care sufficiently about efficiency, full cooperation will arise.

In the VCM+ treatment, OTMs have to care sufficiently for social welfare to have an incentive to contribute to the public account. Note that an increase in the contribution level decreases an OTM's own payoff by $1-\gamma/n$, increases the minimum payoff in the team by γ/n and increases the sum of all team members' payoffs by $\gamma-1$. Hence, contributing positive amounts is optimal if $(1-\lambda_i)(1-\gamma/n) \leq \lambda_i\delta_i \cdot \gamma/n + \lambda_i(1-\delta_i)(\gamma-1)$ or $\delta_i \leq 6-3/\lambda_i$. For δ_i to be non-negative, this requires $\lambda_i \geq 0.5$. Full cooperation by all group members will therefore only arise if all OTMs fulfill $\lambda_i \geq 0.5$ (and δ_i appropriately).

Proposition 3. *With Charness and Rabin (2002) preferences, the TA in the TAG might be willing to return positive amounts to OTMs if $\lambda_1 \geq 0.5$ (and δ_1 sufficiently high), i.e. if she is sufficiently "maximin"-oriented. However, full payoff equalization can only be achieved if $\lambda_1 \geq 0.75$ (and δ_1 appropriately). Full cooperation is also possible if all OTMs care sufficiently about efficiency. In the VCM+ treatment, full cooperation will only arise if all OTMs fulfill $\lambda_i \geq 0.5$* (and *δ_i appropriately).*

To sum up, in contrast to the case of standard preferences both models of other-regarding preferences predict (for appropriate parameter values) that TAs in the TAG return positive amounts to OTMs. Moreover, such behavior can induce full cooperation and payoff equalization within the team. Both models can also explain full cooperation in the VCM+ treatment. However, an equilibrium with full cooperation in the VCM+ requires that *all* OTMs have sufficiently strong other-regarding preferences, whereas in the TAG it is sufficient that the TA has strong enough other-regarding preferences. One noteworthy difference between the two discussed models is that in the Fehr and Schmidt (1999) model according to our parameterization, there are no asymmetric equilibria, whereas there are such equilibria for the Charness and Rabin (2002) model in both treatments.

[39] To see this, note that if a single OTM contributes one point to the public account, both the OTM's payoff and the minimum payoff is reduced by 1, whereas the sum of payoffs increases by $\gamma-1$. Thus, contributing is advantageous if $(1-\lambda_i)+\lambda_i\delta_i \leq \lambda_i(1-\delta_i)(\gamma-1)$ or $\delta_i \leq 1-1/(1.6\lambda_i)$. This implies $\lambda_i \geq 0.625$ (and δ_i appropriately). Note that the restriction on δ_i becomes weaker for further OTMs contributing one point (without changing the requirement on λ_i) as their contributions do not decrease the minimum anymore.

2.3.2.3 Heterogeneous social preferences and repeated interaction (reputation model)

In a *repeated* game with heterogeneous social preferences, the argument that TAs return positive amounts to OTMs holds a fortiori. With repeated interaction, additionally, selfish TAs have an incentive to act as if they were other-regarding, because the future stream of income created by mimicking is larger than the costs of acting non-selfishly in a specific period.[40] This is true until the ultimate or until the pen-ultimate period, in which the opportunistic TAs that mimic other-regarding TAs start appropriating the benefits from the public account. By returning positive amounts to OTMs until the last or the second-to-last period, TAs induce higher contributions by the OTMs in future periods that the TA can subsequently pocket for herself. The argument holds only for the TAG treatment and not for the VCM+ treatment, but depending on the model there might also be additional contribution incentives in the latter treatment. We refrain from characterizing all equilibria in the repeated game because the argument has been used and formalized straightforwardly in connection with trust contracts (see, e.g., Fehr et al., 2007).

Note finally that both the Fehr and Schmidt (1999) and the Charness and Rabin (2002) model, taken literally, would yield a very high number of either zero or full contributions and no intermediate contribution amounts.

Proposition 4. *With heterogeneous social preferences and repeated interaction, the TA in the TAG might change behavior across periods to profit from reputation effects. There is an incentive for completely selfish TAs to mimic the behavior of other-regarding TAs until the ultimate or the pen-ultimate period of the game.*

2.4. Experimental results

We start with a comparison of contributions and profits in the TAG and the VCM+ treatment in Section 4.1. Section 4.2 decomposes contribution behavior in the TAG further, and Section 4.3 analyzes the details of the TA's behavior as well as OTMs' optimal replies.

[40] We implicitly assume in this argument that players are not entirely sure about their opponent's type, i.e. we relax the common knowledge assumption.

Table 12: Mean contributions and profits (in points) by treatment

		VCM+	TAG
Mean contribution	OTMs	9.88**	14.95**
	Forced contributors/TAs	20	20
	All members	*12.41***	*16.21***
Mean profit	OTMs	29.98***	26.54***
	Forced contributors/TAs	19.86***	39.30***
	All members	*27.45***	*29.73***

Note: Difference between VCM+ and TAG significant at: *** 1% level; ** 5% level; * 10% level.

2.4.1 Contributions and profits in TAG and VCM+

Table 12 provides a first upshot of our main results regarding average contribution levels and average profits. It is immediately apparent that the TAG elicits higher contribution levels and, hence, leads to higher profits than the control treatment VCM+. Since there is always one team member that is forced to contribute the entire endowment, the difference between the treatments is solely driven by the contributions of the OTMs. The first row of Table 12 shows that mean contribution levels of OTMs differ by five points or 25% of the endowment. This difference is clearly significant ($p < 0.05$, Mann-Whitney U-test, $N = 36$).[41]

Significance can also be shown by an OLS regression on contributions (cf. model 1 in Table 13) where only the treatment dummy *TAG* is included ($p < 0.01$, standard errors clustered on the team level).[42] The significant difference in OTMs' contributions, by the nature of the game, translates into a significant difference in overall profits. In contrast to the prediction based on standard preferences, the TAG is thus more efficient than the VCM+.

[41] All non-parametric tests that we use in this chapter are two-sided tests.

[42] Note that we present OLS rather than tobit regressions for contributions because they are more straightforward to interpret and they avoid the difficulties associated with interpreting interaction effects in nonlinear models (see Ai and Norton, 2003). Qualitatively, tobit regressions yield the same results.

Table 13: Contributions of OTMs (OLS regressions)

	Dependent variable: Contributions of OTMs	
	Model 1	Model 2
TAG dummy	5.069***	-0.520
	(1.834)	(1.727)
Period	-	0.404
		(0.529)
Period²	-	-0.107**
		(0.044)
Period * TAG	-	2.096***
		(0.757)
Period² * TAG	-	-0.154**
		(0.064)
Constant	9.881***	11.786***
	(1.501)	(1.284)
# Observations	1080	1080
R^2	0.088	0.158

Notes: *** Significant at 1% level; ** significant at 5% level; * significant at 10% level. Robust standard errors in parentheses (clustered on team level).

By looking at profits in more detail (see Table 12, rows 4-5), distributional issues become apparent. TAs in the TAG earn about 1/3 more than OTMs. However, OTM's average profit of 26.54 lies clearly above the endowment level, indicating that profits are more balanced than one might have expected according to standard theory. On the contrary, in the VCM+ treatment OTMs earn about 1/3 more than the forced contributors who only roughly earn their endowment level. A comparison between treatments, not surprisingly, shows that TAs in the TAG earn significantly more than forced contributors in the VCM+ (indeed, twice as much) ($p < 0.01$, Mann-Whitney U-test, N = 36). In contrast to this, OTMs in the TAG earn significantly less than OTMs in the VCM+ ($p < 0.01$, Mann-Whitney U-test, N = 36). However, this does not tell the entire story. Without any voluntary cooperation, OTMs would earn 20 in the TAG and 28 in the VCM+. We therefore can compare the profits to this baseline and get the actual gains by cooperation in the different treatments. The OTMs' gains of cooperation are, on average, 6.54 in the TAG and 1.98 in the VCM+, the difference is significant ($p < 0.01$, Mann-Whitney U-test, N = 36).

Result 1. *Mean contributions and profits are significantly higher in treatment TAG than in VCM+. In the TAG, TAs earn about 1/3 more than OTMs. OTMs' earnings lie clearly above the endowment level and the gains of cooperation are significantly higher than in VCM+.*

Figure 9 delineates average contributions of OTMs over time for both treatments. While average contributions are around 12 points and roughly the same in period 1 in the two treatments, from period 2 on, the difference between the two treatments becomes apparent. In the TAG, average contributions increase until they reach a level of almost 18 in period 4. Afterwards, average contributions decline slowly and remain still at a level of 14 in period 9, before they finally drop to 9 in period 10 due to a strong endgame effect. On the contrary, in the VCM+ average contributions decline almost linearly over time and end at a level of 4.5 in period 10.[43] This pattern suggests that TAs win OTMs' trust quickly by implementing appropriate first period decisions. They seem to be able to stabilize contributions on a high level in contrast to the VCM+, in which cooperation decays over time just as it is usually observed in standard VCMs.

In the regression of model 2 in Table 13 we not only include the variable *TAG* but add four variables capturing time trend differences between the two treatments. In addition to *Period* and *Period²* we use the two interaction terms *Period * TAG* and *Period² * TAG*. Results show that the treatment dummy becomes completely insignificant once we control for the time trend. For VCM+, we observe *Period* to be insignificant while *Period²* has a significantly negative sign. Hence, there is no evidence for a quadratic time trend in the VCM+ treatment. However, if we run a regression for VCM+ using *Period* only, this variable is highly significant ($p < 0.01$), indicating a clear decrease in cooperation over time. For the TAG, we have to consider the joint effect with the interaction terms. Note that both of them are significant. By adding up *Period* and *Period * TAG* as well as *Period²* and *Period² * TAG* we get the expected signs of a quadratic specification. Moreover, if we test for the combined effects to be zero, both null hypotheses can clearly be rejected (Wald tests, $p < 0.01$ in both cases). This confirms that treatment differences rely on differences in the time trend of contributions.

[43] A Mann-Whitney U-test shows that contribution differences in period 1 are indeed not significant ($p = 0.54$, $N = 108$). Significant differences, however, exist for periods 3-9 ($p < 0.05$, Mann-Whitney U-tests, $N = 36$).

Figure 9: Evolution of OTMs' average contributions across treatments

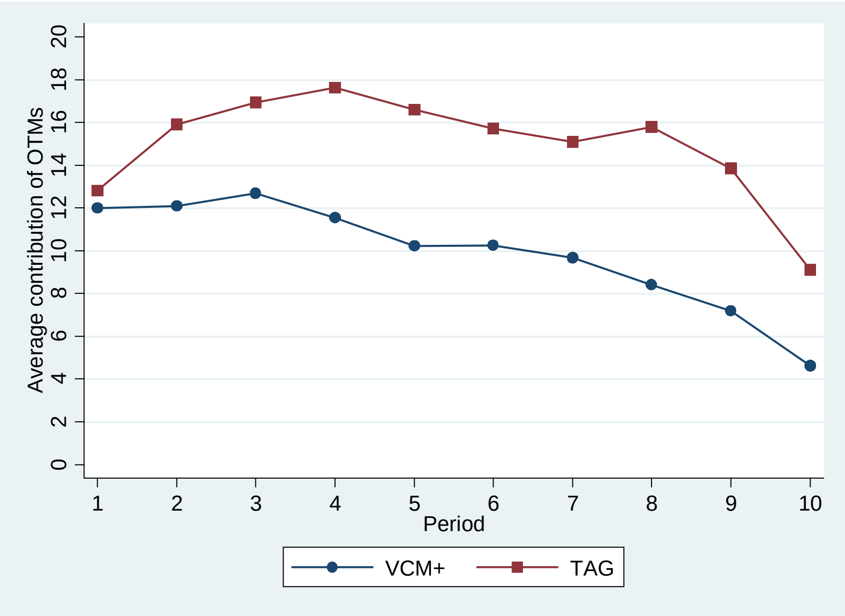
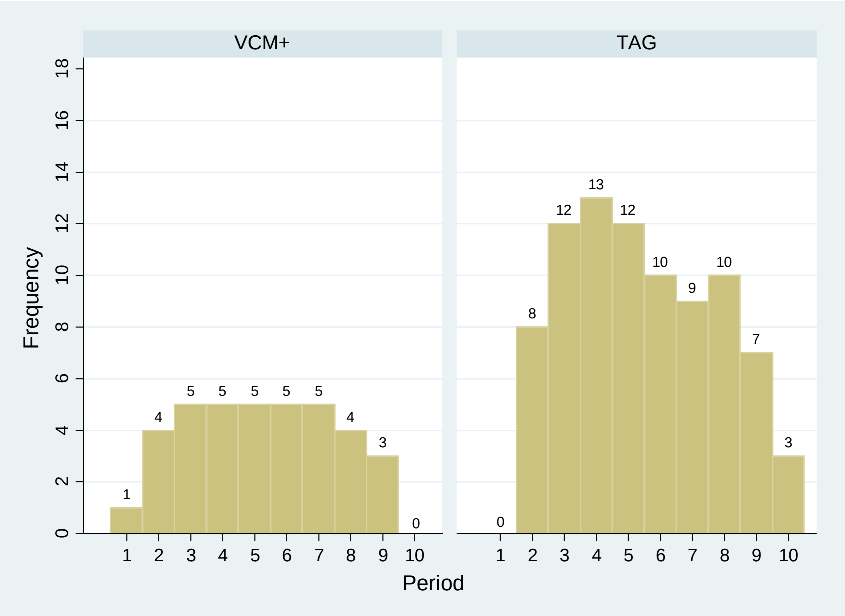


Figure 10: Evolution of the number of teams with full cooperation across treatments



Result 2. *There is no significant difference in contributions between the two treatments in period 1. But from period 2 on, contributions in the two treatments develop differently. While contributions decline almost linearly in the VCM+ treatment, there is a quadratic time trend in the TAG that leads to higher contributions in all subsequent periods.*

Figure 10 compares the number of teams with full cooperation in both treatments over time. It is clearly visible from period 2 on that the number of fully cooperating teams is roughly twice as high in the TAG than in the VCM+. This confirms the prediction from the Fehr and Schmidt (1999) model that full cooperation is easier to achieve in the TAG treatment. In fact, up to 2/3 of all teams manage to cooperate completely in intermediate periods of the TAG.

2.4.2 Explaining contribution behavior in the TAG

The OLS regressions in Table 14 concentrate on the TAG treatment and provide deeper insights into the dynamics that drive cooperative behavior of OTMs. All models contain only the periods 2-10, because first period contributions are not influenced by TA's decisions.[44]

In model 1 we include *Period* and *Period²* and add both individual i's contribution in the previous period $c_{i,t-1}$ (*Contribution (t-1)*) and the amount returned to i by the respective TA in the previous period $d_{i,t-1}$ (*Returned amount (t-1)*). Both lagged variables are highly significant and show a positive effect on next period's contributions. Especially, higher returned amounts, holding contributions constant, yield higher contributions in the subsequent period. This means that a more generous distribution decision by TAs increases future cooperation of OTMs. Interestingly, the quadratic time trend observed in Table 13 is not significant in this model and its coefficients are close to zero. We can show that this is not caused by the exclusion of period 1 as both time variables are large and highly significant ($p < 0.05$ each) in the absence of further covariates. Hence, we add model 2 in which we replace the quadratic trend by a linear one. Results reveal that contributions significantly decrease by about 0.5 points per period. Controlling for the lagged variables, therefore, turns the quadratic time trend into a linear one. This suggests that previous decisions by the TA cause the initial increase in contributions in the TAG.

Model 3 takes care of the fact that OTMs are not only informed about their own returned amount but also about the contributions and the returned amount of their team members. We control for social information by adding the lagged average contribution of the two other OTMs within the team (*Avg. contribution other OTMs (t-1)*) and the lagged average returned amount to these OTMs (*Avg. returned amount other OTMs (t-1)*). Results

[44] Tobit and random effects specifications yield very similar results.

show that the latter variable has a significantly positive effect indicating that OTMs do not only take into account their own returned amount but also what TAs return to the other two team members.

From the specifications of models 1-3 we can conclude that contribution changes in the TAG depend on two main aspects: previous period's return behavior of the TA and the respective period. While the former carries information about the TA's type the latter seems to reflect a general belief about a slightly decreasing trustworthiness of TAs towards the end of the interaction, which could be explained by an anticipation of mimicking behavior of opportunistic TAs.[45]

Result 3. *Contributions of OTMs in the TAG depend negatively on period and positively on TA's previous period's returning behavior.*

Finally, we present an alternative approach by only focusing on subjects that contribute positive amounts to the public account to be able to apply a relative measure of the benefits from an investment. Figure 11 shows mean contribution levels in period $t + 1$ for different categories of the individual return rate by the TA in period t. Note that the individual return rate r is defined as $r_{i,t} = d_{i,t}/c_{i,t}$. Not surprisingly, we find that OTMs contribute little in period $t + 1$ if they do not get any return in the preceding period t. Increasing the returned amount to a rate of 1.6 clearly raises subsequent average contributions of OTMs and a return rate of 1.6 is nearly always followed by an OTM contributing the entire endowment. Interestingly, we find a negative effect for return rates larger than 1.6. Extraordinarily high *relative* returns, i.e. returns that exceed the amount generated by the respective investment, tend to decrease contribution levels in the subsequent period.[46] Such "over-generous" behavior seems to raise OTM's suspicion regarding the TA, but the number of observations is comparatively low.

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[45] Note that both *Period* and the TA's previous period's return behavior stay highly significant once we include higher lags into the models. Significant effects can also be obtained by a fixed effects estimation. Finally, note that we also tried a linear, dynamic panel-data estimation method (Arellano and Bond, 1991). This method has the drawback that we cannot cluster on the team level and that we lose one further period. Nevertheless, we also find a significant influence of the two main aspects mentioned above.

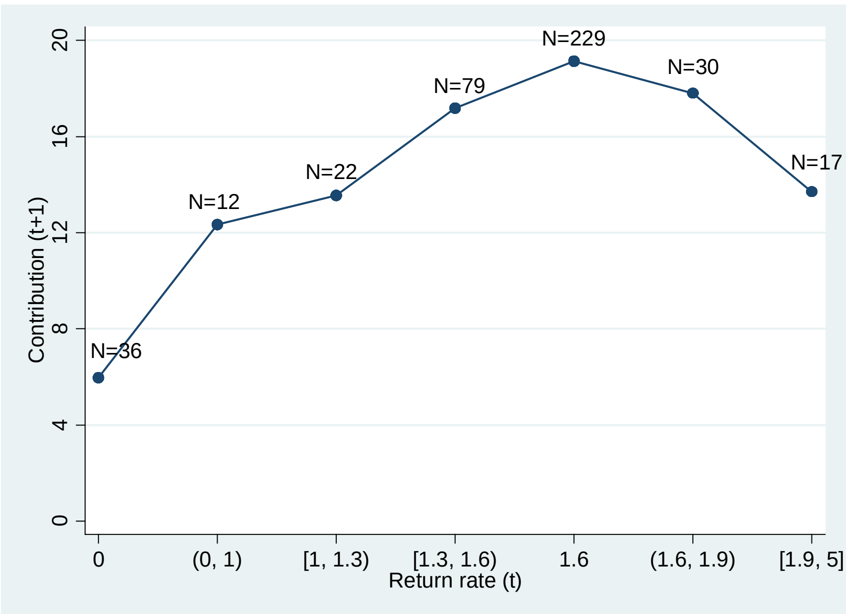
[46] A significant negative effect can also be shown by inserting a squared expression for the lagged returned amount in model 2 of Table 14. However, due to the small number of observations the decreasing effect is less robust when we introduce such a variable in estimation approaches such as fixed effects or the Arellano-Bond estimator.

Table 14: Contributions of OTMs in TAG (OLS regressions)

	Dependent variable: Contribution of OTMs in TAG, periods 2-10		
	Model 1	Model 2	Model 3
Period	0.035 (0.663)	-0.568*** (0.100)	-0.534*** (0.088)
Period²	-0.050 (0.057)	-	-
Contribution (t-1)	0.205** (0.073)	0.208*** (0.071)	0.271*** (0.061)
Returned amount (t-1)	0.325*** (0.047)	0.329*** (0.046)	0.186*** (0.025)
Avg. contribution other OTMs (t-1)	-	-	-0.075 (0.109)
Avg. returned amount other OTMs (t-1)	-	-	0.239*** (0.043)
Constant	6.531*** (2.166)	7.898*** (1.703)	5.685*** (1.366)
# Observations	486	486	486
R^2	0.557	0.556	0.611

Notes: *** Significant at 1% level; ** significant at 5% level; * significant at 10% level. Robust standard errors in parentheses (clustered on team level).

Figure 11: Contributions in the next period for different categories of the individual return rate



Result 4. *For maximizing contributions in the subsequent period, it is the best strategy to return exactly 1.6 times the contributed amount. Higher individual return rates tend to decline contributions in the next period.*

2.4.3 Behavior of the TA and consequences for OTMs

Figure 12 gives a descriptive overview of the dynamics within each team in the TAG. It displays the average contribution levels of OTMs alongside with TAs' average returns to the team members.[47] The abbreviation on top of each panel indicates session (1-3), team (a-f) and provides information on the behavioral type of the TA according to the ring test in parentheses. The letter "I" indicates an individualistic TA, "C" represents a cooperative TA, and an "X" is displayed whenever the TA cannot be categorized by the ring test because of failing to meet the consistency standard. We have twelve individualistic, four cooperative and two non-classifiable TAs.[48]

As it can be discerned easily from Figure 12, no team starts with full cooperation in the TAG. OTMs seem to contribute cautiously in period 1, testing the reaction of their respective TA. However, first period behavior of TAs already leads to full cooperation in period 2 in eight out of 18 teams (44.44%). This number increases even a bit further and stays around 50-60% until period 8. While seven teams still cooperate fully in period 9, three teams even manage to cooperate fully until period 10 (see also Figure 10). Remarkably, only three teams (1e, 2b, 2c) never reach full cooperation in any of the ten periods.

We classify the teams in *high contribution* teams (1a, 1b, 2a, 2c, 2d, 2e, 2f, 3a, 3b, 3d, 3e), *low contribution* teams (1c, 1e, 3c, 3f), and *mixed contribution* teams (1d, 1f, 2b). *High contribution* teams are teams that show either average contribution levels of OTMs above ten (50% of the endowment) in each intermediate period 2-9 or that have a significantly increasing contribution pattern ending above 50% in period 9 (spearman rank correlation coefficient, $p < 0.05$). *Low contribution* teams are obtained by reversing the classification, while *mixed contribution* is the remaining category.[49]

[47] Appendix C provides a similar graph showing average contribution levels of OTMs in the VCM+ treatment.

[48] The ring test provides evidence that there is no anti-social TA in our experiment. Hence, forcing the TA to contribute her full endowment is innocuous, in line with the discussion in Section 2.2 (see footnote 8).

[49] Note that we observe only few teams in the *low contribution* category. This is different from what we usually observe in standard public goods games and also different from VCM+. Appendix C shows that the frequency of categories is significantly different between TAG and VCM+.

Do TAs in *high contribution* teams behave differently than TAs in the other categories? If we look at average returns of TAs (consider the squared lines in Figure 12), it is obvious that the returned amounts in *high contribution* teams are indeed very high and a closer look at the data reveals that in almost all cases full cooperation goes along with equal profits for all team members. Six out of these eleven TAs (1a, 2a, 2d, 2e, 3b, 3e) return in each period, on average, more than the invested amount to their OTMs. Moreover, there is one TA (in team 2f) who does the same in all periods 1-9 but faces a zero average contribution of OTMs in period 10.[50] The other four TAs (1b, 2c, 3a, 3d) also return large amounts but appropriate the entire public account in the last or a late period.

On the contrary, TAs in teams with *low* or *mixed contribution* levels return either relatively low amounts in general (1c, 1e, 2b) or they return large amounts in the beginning, until full cooperation is achieved, but then take a large share of the public account for themselves already around period 5, thereby destroying cooperation in the subsequent period (1d, 1f, 3c, 3f). Interestingly, three of the latter TAs (1d, 3c, 3f) return large amounts in the following periods, presumably in order to re-increase OTMs' contributions.

All three of them, finally, take the chance to appropriate a large share of the cooperation benefits a second time. Hence, TAs in *high contribution* teams allocate indeed differently than TAs in the other teams.

To sum up, four types of TAs appear in our data: TAs returning large amounts in each period (type 1), TAs returning large amounts except for a late period (or periods) where they take the entire public account for themselves (type 2), TAs taking a large share of the public account twice, precisely in a period around period 5 and a late period (type 3) and TAs returning small amounts in general (type 4). While the first two types generate high and stable levels of cooperation, the third type creates ups and downs in contribution levels and the fourth type generates a decrease in contributions, just as we usually observe in standard public goods games.

[50] Hence, we do not know whether this TA would also have returned more than the invested amount in the last period. We therefore carefully sort her into the category of type 2 in Figure 13 (see below), although she could also be of type 1.

Figure 12: Average contributions of and returns to OTMs in TAG over time by team

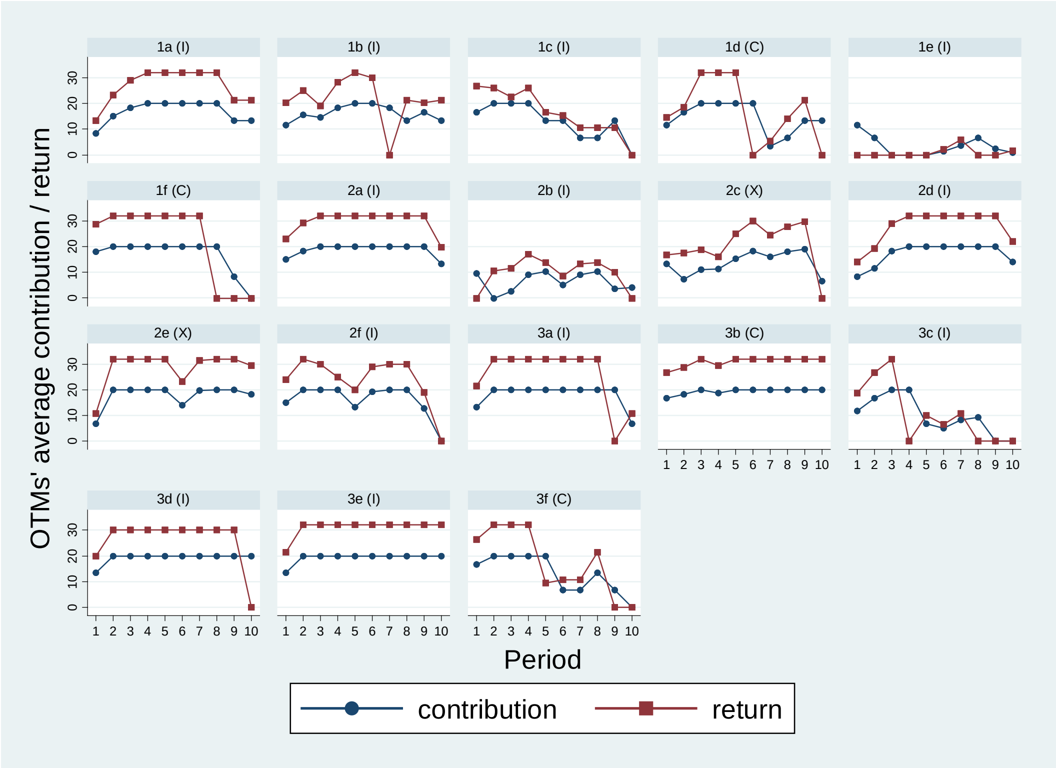
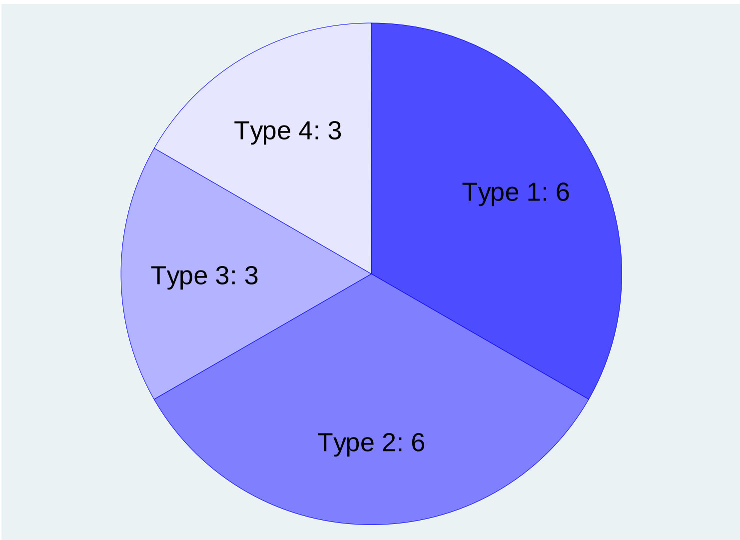


Figure 13: Types of TAs in TAG



Note that both type 2 and type 3 behavior is in line with mimicking strategies of selfish TAs (see our theoretic arguments in Section 3.2.3), while type 4 is selfish without mimicking cooperativeness. Figure 13 shows the distribution of types that we observe in our experiment.[51] Six of our 18 TAs belong to type 1.

Looking at mean profits of TAs, the TA in team 1d performs best (an average of 50.6 points per period), followed by the TAs in teams 3c (47.5), 3d (46.8), 1f (45.6), and 1e (45.1). It is apparent that both TAs in teams 1d and 3c are of the third type. Thus, the strategy of appropriating the entire public account twice and returning large amounts in the other periods seems to be the most successful one in terms of maximizing the TA's profit. The TAs in teams 3d and 1f take the public account only once. Interestingly, the TA in team 1e, who returns almost nothing over all ten periods, earns the fifth largest amount, but nevertheless five points less, on average, than the best performing TA. However, if we compare overall team profits, team 1e clearly performs poorest with an average profit of only 24.5 points per team member. On the contrary, in the best performing teams 3b, 3d and 3e, team members earn, on average, 31.7 points per period. The latter teams have in common that their TAs are either of type 1 or 2.

Result 5. *Heterogeneity between teams in terms of OTMs' contribution levels is caused by TAs' returning behavior. Most of the teams show high levels of cooperation because of the large fraction of TAs being either of type 1 or 2, i.e. returning large amounts until (almost) the end of the interaction. This is remarkable since it is not a TA's profit maximizing strategy from an ex post perspective.*

Can we explain the heterogeneity between TAs by social orientation? If we consider our ring test classification, it becomes obvious that only one of our four cooperative TAs (3b) resists the temptation of taking the entire public account until the end of the interaction. Thus, we cannot claim that being *cooperative* as a TA is a good indicator for non-exploitation of team members' trust. In addition, four of the six TAs returning more than invested in each period are classified as *individualistic*. Hence, there are individualistic TAs that are not just mimicking cooperative TAs but that become in fact trustworthy when put in the role of the TA. In line with this, the aggregated return rate for

[51] Note that the TA in team 1f is of type 2, although she creates only a mixed contribution pattern, according to the contribution classification of teams.

OTMs, defined as $\bar{r}_{OTM,t} = \frac{1}{3}\sum_{i=2}^{4} d_{i,t} \Big/ \frac{1}{3}\sum_{i=2}^{4} c_{i,t}$ [52], is, on average, even slightly higher if the TA is individualistic than if she is cooperative (1.42, N = 112 vs. 1.35, N = 38) and this holds also for the last period. Hence, we do not find any descriptive evidence for a more trustworthy behavior of cooperative TAs. This result is confirmed by a cluster-robust OLS regression explaining a TA's relative appropriation of the public account by her social motivation as it yields insignificant results for the ring test dummy, both over all periods and for the last period.[53] This confirms that social orientation, surprisingly, does not matter for TA's decisions.

Result 6. *Surprisingly, heterogeneity in TA's distribution behavior cannot be explained by social orientation. Many individualistic TAs behave cooperatively even in the last period once they are responsible for the distribution of the public account.*

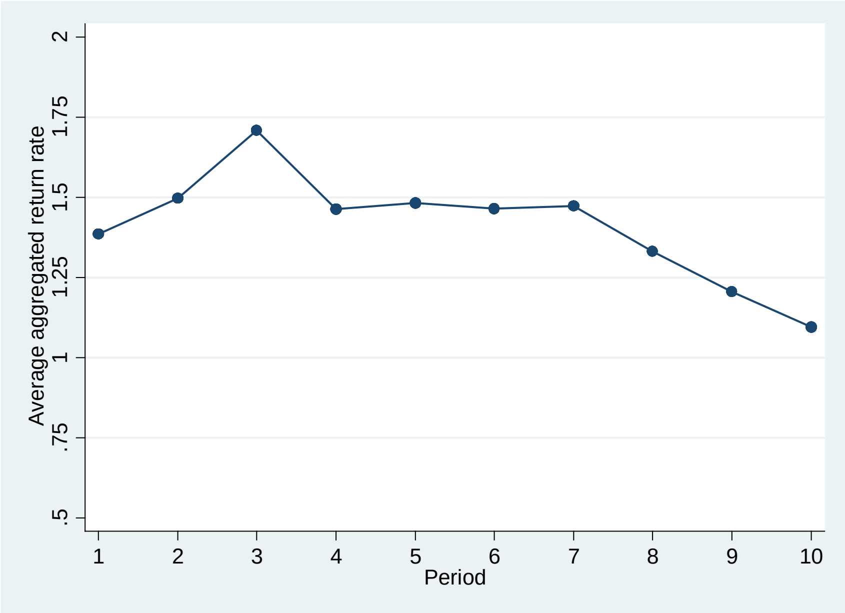
Overall, the average aggregated return rate is 1.42. This value is astonishingly high compared to predictions based on standard theory. Figure 14 shows that the mean of the aggregated return rate varies over time and, especially, decreases in the last three periods. However, even in period 10, it is slightly above one, indicating that TAs return more, on average, than OTMs contribute. Combining Figure 14 with the regression results in Tables 13 and 14, we can finally explain why we find a significant quadratic time trend in contributions in the TAG:

While the increase in cooperation in the first half of the ten periods is caused by TAs' high and even increasing return rates, the decrease is due to a decrease in aggregated return rates from period 8 on (see Figure 14) *and* due to OTMs' beliefs about a decreasing trustworthiness of TAs (see the significant influence of *Period* in Table 14).

[52] Note that the aggregated return rate is a weighted average of OTMs' individual return rates with the weight being a single OTM's relative contribution, i.e. $c_i / \sum_{i=2}^{4} c_i$.

[53] This holds irrespective of whether we control for the size of the public account or not. Using the exact angles of the vectors as obtained out of the ring test does not change the result either.

Figure 14: Evolution of the average aggregated return rate



If we look at the distribution of aggregated return rates, see row 1 of Table 15[54], it becomes obvious that TAs return, on average, exactly 1.6 times the contributed amount in more than 50% of the cases. Moreover, in about 30% of the cases, TAs implicitly *reward* OTMs for contributing but do not return the full benefit generated by OTMs' contributions. Interestingly, it is not predominantly the case within this category that TAs return only the investment plus an increment to barely motivate contributions in the subsequent period. Indeed, aggregated return rates between 1 and 1.3 are rare and appear only eight times. More frequently, in 13 cases, we observe aggregated return rates that are even larger than 1.6, implying that TAs sacrifice parts of their own share. Overall, positive reciprocity is obtained in 151 out of the 170 cases (88.8%) where OTMs, on average, contribute positive amounts to the public account. Furthermore, the level of implicit reward is quite substantial. Implicit *punishment*, on the contrary, is seen rarely. Partial punishment is almost not existent and there are only 17 cases in which TAs take the entire share of the public account if mean contributions of OTMs are positive (plus nine cases in which the mean contribution is zero).

Concerning the distribution of profits within a team, it is noticeable that in 62 out of the 170 cases (36.47%) full payoff equalization across all team members (including the

[54] Row 1 excludes ten cases in which no OTM in the team contributes positive amounts because the aggregated return rate is not defined. Not surprisingly, TAs do usually not return positive amounts to OTMs in such a case.

TA) is achieved. All of these cases exhibit full cooperation and a return rate of 1.6 to everybody. Remember that full payoff equalization was the central prediction for certain parameter values of a TA's utility function ($\beta_1 \geq 0.75$, $\lambda_1 \geq 0.75$) in both the Fehr and Schmidt (1999)- and the Charness and Rabin (2002) model. However, if contributions between team members differ, full payoff equalization is not observed.[55] TAs overwhelmingly ensure by their returning behavior that low contributors earn less than high contributors. This happens either by returning the same individual return rate to each OTM or by raising the return rate with higher OTMs' contributions. Thus, TAs seem to follow a norm of effort-based inequity or maximin orientation once contributions differ, as the two theories predict implicitly.

Result 7. *The average aggregated return rate is relatively high but decreases from period 8 onwards. Thus, there are two reasons for the decrease in cooperation in the second half of the experiment: Subjects' beliefs about a reduced trustworthiness of TAs and an actual decrease in the aggregated return rate.*

Row 2 of Table 15 presents the individual return rates to OTMs in the TAG (defined as $r_{i,t} = d_{i,t}/c_{i,t}$). Again, we focus here on observations in which OTMs contribute positive amounts. In addition, there are 86 cases in which the contribution of an OTM is zero. However, in almost all of these cases (actually, 78), a zero contribution results in a zero return by the TA.

[55] Note that in case of unequal contributions full payoff equalization would sometimes require the usage of two decimal places for the returned amount. However, there is no single observation in our data in which payoffs are equalized except for a remainder which cannot be split equally (having size 0.2). Moreover, this design issue should not matter in later periods as an almost equalization of profits already generates strong contribution incentives and, hence, full cooperation should appear in subsequent periods.

Table 15: Frequency of return rates to OTMs on aggregated and individual level

	rate = 0	0 < rate < 1	1 ≤ rate < 1.6	rate = 1.6	rate > 1.6	*Sum*
	Full Punishment	*Partial Punishment*	*Partial Reward*	*Full Reward*	*Excessive Reward*	
aggregated return rate	17	2	48	90	13	*170*
individual return rate	45	13	103	244	49	*454*

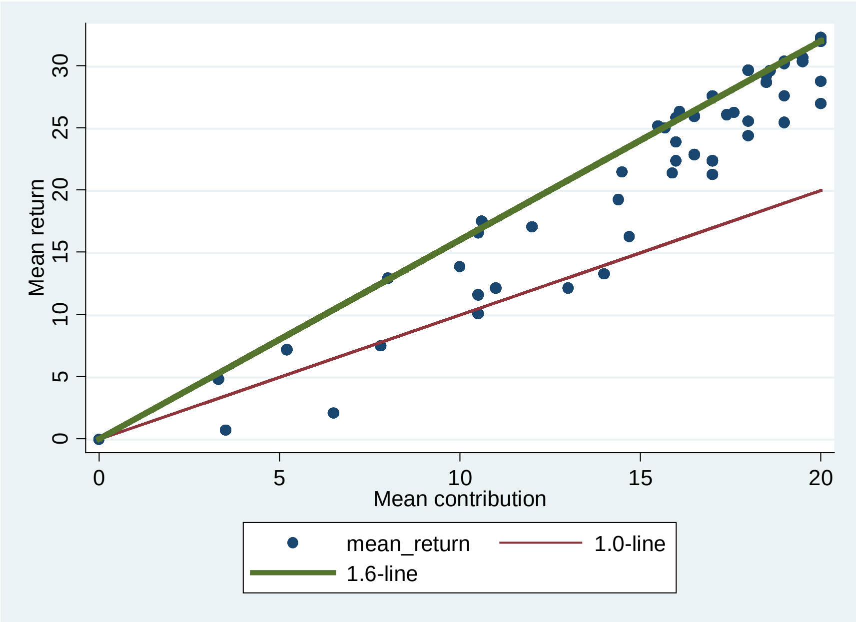
Notes: The aggregated return rate is defined as $\bar{r}_{OTM,t} = \frac{1}{3}\sum_{i=2}^{4} d_{i,t} / \frac{1}{3}\sum_{i=2}^{4} c_{i,t}$, the individual return rate as $r_{i,t} = d_{i,t}/c_{i,t}$.

In contrast, OTMs contributing positive amounts are predominantly faced by TAs rewarding their contribution behavior. In 293 cases (64.65%) the respective OTM receives the whole benefit generated by her investment or even more than that. Furthermore, if one adds the 103 observations which are below 1.6 but above or equal to 1, it turns out that the investment is profitable in about 87% of the cases. Hence, OTMs manage to benefit from their investments in almost every case. If we additionally account for the cases in which OTMs contribute zero and assume that this mistrust is justified then we find OTMs to benefit from an investment into the public account in 73% of cases. Thus, in the large majority of cases, it pays off for OTMs to contribute to the public account.

If we concentrate only on teams in which *at the same time* some OTMs contribute zero and others positive amounts we find the same picture again. TAs exclude free-riders from the benefits from cooperation since in 51 out of 56 cases they get a zero return. Thus, OTMs contributing zero cannot free-ride on their team members' contributions. At the same time, TAs implicitly reward the contributing OTMs by allocating to them a share larger than their investment (true in 82.09% of cases, N = 67). Hence, the *same* TAs use implicit punishment and implicit reward simultaneously when faced with different contributions.

Result 8. *In most of the cases, trust pays off for OTMs in the TAG. While non-contributors are excluded from the benefits from the public account, contributing positive amounts is profitable.*

Figure 15: Mean return and mean contribution for each OTM in the TAG



Finally, Figure 15 shows a scatter plot comparing mean returns and mean contributions for each OTM in the TAG over all ten periods. Two reference lines are added. The *1.0-line* captures points where the mean return equals mean contribution. Subjects on this line therefore receive on average exactly the amount they invested into the public account. In contrast, the *1.6-line* consists of all points where subjects, on average, receive 1.6 times their invested amount. In particular, if a TA returns to an OTM the complete amount generated by the respective contribution in all periods, the resulting dot will lie on the *1.6-line*. The figure shows that only two observations lie clearly below the *1.0-line*. For these OTMs it did not pay to trust the TA. Moreover, there a few points on or near to the *1.0-line*. Those subjects do not profit from their investments into the public account but they do not lose substantial amounts either. Interestingly, there is only a single observation in the origin of the graph, i.e. complete free riding is a very rare event in the TAG. In general, most of the points lie in the upper right corner near, on, or even slightly above the *1.6-line*. This shows again that over the whole course of the experiment almost all OTMs manage to gain large benefits from their investments into the public account and hence contribute large amounts.

Result 9. *Over the course of the experiment, nearly all OTMs manage to profit from investing into the public account. As a large fraction of TAs returns large amounts, many OTMs contribute, on average, almost their full endowment level.*

2.5. Discussion and conclusion

We have analyzed a modified public goods game and implemented it experimentally in the laboratory. In our *team allocator game*, each team member – regardless of whether the member is an ordinary team member or the team allocator – can contribute to a public account. The sum of contributions is multiplied by an efficiency factor larger than one, but – in contrast to the standard public goods game – the public account is not distributed equally among all team members. Rather, the team allocator receives the entire amount and has full discretionary power over the allocation of the revenues from the account within the team. More precisely, she can implement any distribution of the benefits from the public account over the ordinary team members and herself.

We provide three main empirical results: First, in contrast to theoretical predictions from standard preferences, we find that the level of contributions in the team allocator game is significantly higher than in an appropriate control treatment in which there is no team allocator, but one team member is forced to contribute her entire endowment. Second, we find that it is the team allocator's distribution behavior that influences together with the time horizon of the team interaction the development of contributions. Contributions increase in the returned amount, i.e. the reward channel is most effective in sustaining high levels of cooperation. Third, although there is some heterogeneity among the team allocators, on average, team allocators return remarkably high amounts to ordinary team members that invest into the public account. Non-contributors, however, are excluded from the benefits from cooperation. Hence, team allocators generate strong contribution incentives. Our results clearly refute predictions based on standard preferences. They are, however, largely in line with models of heterogeneous preferences and repeated interactions such as (effort-based) inequity aversion (Fehr and Schmidt, 1999) or a maximin-preference (Charness and Rabin, 2002).

The general implication of our results is that teams with a straightforward hierarchy can have an advantage over teams with equal members. They are more likely to overcome the social dilemma inherent to public good provision, i.e. team effort provision. This is the more remarkable since the described mechanism is costless: Implicit reward (and, to a much lesser degree, implicit punishment) works through the allocation process and does not bear any monetary costs such as formal or informal sanctions that have been studied widely. Allocation power in teams can, thus, be considered as a potential alternative of a sanctioning regime, because the latter is often much more efficiency-damaging.

However, it is difficult to predict how easily such a mechanism can really be implemented in a social dilemma environment. Thus, a natural extension of our setup is to implement an endogenous treatment in which subjects can vote on whether they want to have a team allocator or not. Another obvious extension would be to let subjects elect their team allocator. Recent literature on the impact of elected vs. randomly chosen leaders (e.g. Baldassarri and Grossman, 2011; Levy et al., 2011) suggests that legitimate authorities enhance team cooperation. As many real-life situations involve voting decisions on group leaders, our experiment most probably underestimates the true gain of endogenously formed hierarchies.

Appendix

A. Experimental instructions (originally in German)[56]

A warm welcome to an experiment on decision making!

Thank you for participating!

During the experiment you and all other participants will be asked to make decisions. Your decisions as well as the decisions of the participants you are matched with determine your earnings from the experiment according to the following rules.

Please stop talking to other participants from now on. If you have any questions after going through the instructions or while the experiment is taking place, please raise your hand, and one of the experimenters will come to you and answer your questions privately. In case the question is relevant for all participants, its answer is repeated aloud.

The whole experiment is computerized and will last approximately **90 minutes**. All your decisions and answers remain anonymous. You will not find out with whom you are matched in each of the experiment's parts and how much each of the other participants earns. We evaluate data from the experiment on aggregate level only and never link names to data from the experiment. At the end of the experiment, you will be asked to sign a receipt for your earnings. This has accounting purposes only.

The experiment consists of **two** parts. At the beginning of each part, you will receive the corresponding instructions for this part. The instructions will be read out loud and you will get time to ask questions. Please, do not hesitate to ask if anything is unclear to you. Your decisions in Part I of the experiment **do not** have any effects on Part II. In the interest of clarity, we will only use male terms in the instructions. They should be interpreted as being gender-neutral. For means of help, you will find a pen on your table.

While taking your decisions at the PC, there will be a clock counting down in the right upper corner of the screen. The clock serves as a guide for how much time you should need. You may exceed the time. The input screens will **not** be turned off when time has run out. However, the information screens on which no decision is required to be taken will be turned off when time has run out. Once you have taken a decision or have read through a screen, please confirm by clicking on the "OK" button.

Your earnings in the experiment will be calculated in **"points"**. At the end of the experiment, the "points" get converted into euro at the exchange rate announced in the respective part. In addition, you receive 4 euro for your arrival on time. Your total earnings from the experiment will be paid out to you privately and in cash at the end of the experiment.

[56] Baseline instructions describe treatment TAG. Differences in VCM+ are indicated by [**VCM+**].

The Team Allocator Game: Allocation Power in Public Goods Games

Part I

In Part I of the experiment all participants are randomly assigned into groups of two. Nobody will find out with whom he forms a group – not during the experiment and not after the experiment either.

You have to take 24 decisions in this part of the experiment. In each decision you can choose between 2 options, A and B. Each option allocates a positive or negative payoff (earning) in points to you and to the other person in your group. The other person answers exactly the same questions. Your total payoff from Part I depends on your decisions *and* on the decisions taken by the other person in your group.

A decision example:

	Option A	Option B
Your payoff	10.00	7.00
Other's payoff	-5.00	4.00

- If you choose Option A you receive 10 points, and the other person loses 5 points. If the other person also chooses Option A, he, too, receives 10 points and you lose 5 points. In total, you therefore earn 5 points (10 points from your choice minus 5 points from the other person's choice). The other person earns 5 points (10 points – 5 points), too.
- In case you choose Option B and the other person chooses Option A, you earn 2 points (7 points from your choice minus 5 points from the other person's decision). The other person earns 14 points (10 points + 4 points).
- The remaining combinations (you choose A and the other person chooses B, or both persons choose B) are analogous to these two examples.

Overall you take 24 decisions like the one described above. Your total payoff is computed as follows: The 24 values for "your payoff" are summed up over your decisions. The 24 values for "other's payoff" are summed up over the other person's decisions. The sum of these two sums determines your total payoff from this part and is converted into euro at the end of the experiment as follows: **25 points = 3 euro** (1 point = 12 cent). This exchange rate is valid only for Part I of the experiment.

Note that you are not receiving information on each single decision taken by the other person in your group. Rather, you will find out only the sum of your decisions for "your payoff", the sum of the other person's decisions for "other's payoff" and your total payoff from Part I at the very end of the experiment. Note that you do not get any feedback immediately after Part I.

If there are any questions, please raise your hand now. We will come to you and answer your questions privately.

The Team Allocator Game: Allocation Power in Public Goods Games

Part II

The points earned in Part II are converted into euro at the exchange rate of **25 points = 1 euro** (1 point = 4 cent) at the end of the experiment.

At the beginning of Part II, all participants are randomly assigned into groups of four. Nobody will find out with whom he forms a group – not during the experiment and not after the experiment either. Part II consists of **10 identical periods** and you remain matched with the **same persons throughout the entire Part II**.

Each participant is randomly given an **individual name** which, too, remains the same across all 10 periods, and which allows you to keep track of the behavior of your group members throughout the periods. The names are: Person 1, Person 2, Person 3 and Person 4.
Furthermore, a **member type** is assigned to each group member (A or B). Within each group there is one group member of type A and three group members of type B. The group members of type A and B differ in their decision possibilities. The type of each group member is publicly announced within the group and remains the same throughout the 10 periods.

The group member of type A is **randomly determined**. The probability of being of type A is 25 % for each group member. The remaining three group members are of type B.

Endowment and alternatives in each period
Each period consists of two stages, a **contribution stage** and a **distribution stage**

Contribution stage:

Each participant receives an initial endowment of **20 points** at the beginning of the contribution stage in each period. The 20 points are allocated to two alternatives, a group account and a private account, depending on the participant's type:

The group member of type A **is obliged** to put all of the 20 points into the group account. Thus, the group member of type A takes no decision during the contribution stage.
Group members of type B can **freely** choose how many points to contribute to the group account and how many points to contribute to the private account.

The group account:
Contributions to the group account from all group members are summed up. The sum is multiplied with 1.6 and distributed among the group members during the distribution stage (s.b.). For example, if the sum of all contributed points to the group account is 60, there are 60*1.6=96 points from the group account to be

distributed to the group members in the distribution stage. If the sum of contributed points to the group account is 20, there are 20*1.6=32 points from the group account to be distributed in the distribution stage.

The private account:
The contribution of a group member to the private account turns solely and one-to-one into direct earning of the respective individual. For example, if a group member puts 6 points into the private account, he receives exactly 6 points from the private account to his earnings. If the contribution to the private account is 17, the group member earns exactly 17 points from the private account. The other group members do not receive anything in each case.

Distribution stage:

During the distribution stage, the group account gets divided among the four group members.
The group member of **type A** is in charge of the division**.** He distributes the group account among himself and the other group members. Group members of type B do not have any influence. Values with **at maximum one decimal place** are allowed for the distribution (please use a dot to separate digits).
[**VCM+**: The distribution is done **automatically**. Each group member receives 25% of the group account.]
The following table is exemplary and shows several distributions for the case that there are 60 points to be distributed. The first three distribution settings are possible. The fourth one is not possible as there are too few points (29) that are distributed. The fifth setting is not possible either as there are too many points (120) that are distributed.

	Distribution 1	Distribution 2	Distribution 3	Distribution 4	Distribution 5
Person 1	12.6	0	15	5	45
Person 2	10	0	15	8	15
Person 3	21	60	15	2	15
Person 4	16.4	0	15	14	45
	Possible	Possible	Possible	Too few points	Too many points

Naturally, the actual distribution chosen by the group member of type A can look completely different to the exemplary distributions 1–3. Any combination of numbers that adds up to the sum to be distributed is possible.

[**VCM+**: The following table is exemplary and shows the distribution for the case that there are 60 points to be distributed.

	Distribution
Person 1	15
Person 2	15
Person 3	15
Person 4	15

]

Earnings in one period:

Your earnings per period are the sum of the amount of your private account and the amount allocated to you from the group account.

Procedure:

On the first screen you get told about your individual name (Person 1, Person 2, Person 3 or Person 4) and which Person is of type A. The other group members are automatically of type B. Afterwards, all group members of type B get asked about how much of the 20 points they would like to contribute to the group account. The remainder is automatically allocated to the private account. Saving points for later periods is thus not possible. Only integer numbers between 0 and 20 (whereby 0 and 20 are possible choices, too) can be entered. The group member of type A is obliged to contribute 20 points to the group account and, consequently, does not get an input screen.
Afterwards, all group members get informed about contributions to the group account of all group members and the resulting sum to be distributed.
The group member of type A is then asked how he wants to divide the group account among the group members. The Windows Calculator can be used to help with calculations. It can be found by clicking on the calculator symbol on the screen.
[**VCM+**: Thereafter, the group account is divided among the group members.]
At the end of the period, all group members are informed about the contributions to the group account, the allocation from the group account, the contributions to the private account as well as the earnings of all group members in this period. Subsequently, the next period starts.

This part of the experiment is finished after 10 periods. The results from all periods are summed up and converted into euro.

Afterwards we will ask you to fill in a short questionnaire on the PC. The questions on individual persons relate to the names of Part II. There are reply options given for most of the questions. Free text entry is required by some questions. For free text entry questions, please write your answers in the corresponding blue text box on the PC screen, and confirm your entry by clicking the enter button. Your text will then appear above the blue text box.

You get told your feedback from Part I after you have filled in the questionnaire. After that, payment of your total earnings in the experiment takes place.

If there are any questions, please raise your hand now. We will come to you and answer your questions privately.

B. Social value orientation questionnaire (ring test)

The social value orientation questionnaire consists of 24 different allocation tasks. In each task, a subject chooses among two payoff allocations, called options A and B (see Table 16). Each option allocates money, in experimental currency units, to the subject herself (*own payoff* x) and an anonymous recipient (*other's payoff* y). The recipient stays the same in all 24 allocation tasks and answers herself the same set of questions (thereby, vice versa, influencing the first person's payoff). It is common knowledge that both persons receive the same set of tasks. No feedback about the other person's decisions is given during the questionnaire to avoid any strategic considerations.

All used payoff allocations lie, equally distributed, on a circle with radius $r = 15$ that is centered at the origin of an x- y-coordinate system, i.e. $r^2 = 15^2 = x^2 + y^2$ holds. Note that it is possible to represent these allocations by vectors in a Cartesian plane. Tasks are designed such that subjects always decide between two adjacent payoff allocations. By assuming that subjects have a preferred motivational vector $\vec{M}$ somewhere in the Cartesian plane, it is optimal for them to always choose the allocation that is closer to $\vec{M}$.

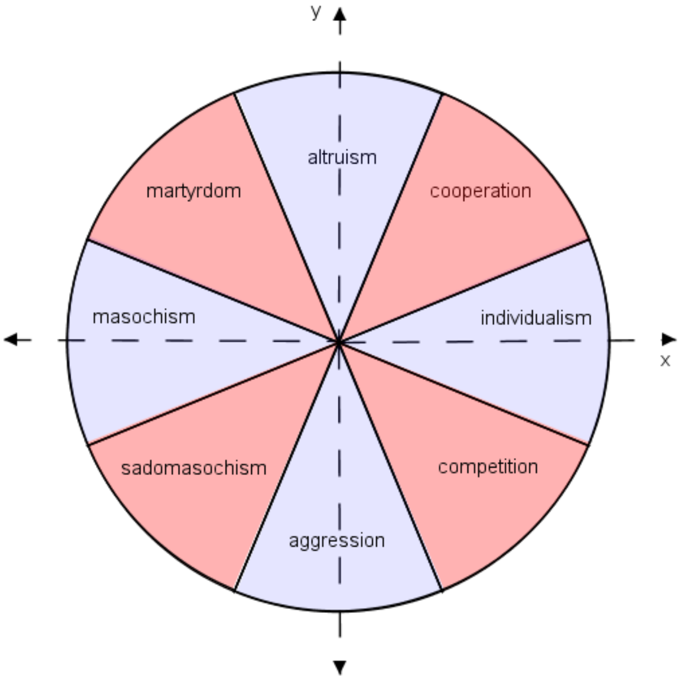
Adding up subject's x and y separately across all decisions yields a total sum of money allocated to the subject herself (X) and to the recipient (Y). The point (X, Y) determines the vector $\vec{A}$ which is used to estimate a subject's social orientation. This is done by computing the angle α between $\vec{A}$ and the x-axis using $\tan \alpha = Y/X$. The size of the angle specifies in which out of eight behavioral types a subject is sorted (see Figure 16). Subjects with an angle α between 337.5° and 22.5° are classified as individualistic, subjects with an angle between 22.5° and 67.5° as cooperative. The other categories are: altruism (between 67.5° and 112.5°), martyrdom (between 112.5° and 157.5°), masochism (between 157.5° and 202.5°), sadomasochism (between 202.5° and 247.5°), aggression (between 247.5° and 292.5°), and competition (between 292.5° and 337.5°).

Additionally, the length of vector $\vec{A}$ can be used as a consistency measure. If a subject decides consistently over all 24 allocation tasks, the length will be 30 while perfect random choice will result in a vector of zero length. The greater the length of the vector the more consistent is a subject's decision. The questionnaire is fully incentivized since subject's earnings are determined by the sum of her decisions for *your payoff* and the sum of the recipient's decisions for *other's payoff*.

Table 16: The 24 allocation tasks

	Option A		Option B	
Question number	your payoff (x)	other's payoff (y)	your payoff (x)	other's payoff (y)
1	15	0	14.5	-3.9
2	13	7.5	14.5	3.9
3	7.5	-13	3.9	-14.5
4	-13	-7.5	-14.5	-3.9
5	-7.5	13	-3.9	14.5
6	-10.6	-10.6	-13	-7.5
7	3.9	14.5	7.5	13
8	-14.5	-3.9	-15	0
9	10.6	10.6	13	7.5
10	14.5	-3.9	13	-7.5
11	3.9	-14.5	0	-15
12	14.5	3.9	15	0
13	7.5	13	10.6	10.6
14	-14.5	3.9	-13	7.5
15	0	-15	-3.9	-14.5
16	-10.6	10.6	-7.5	13
17	-3.9	-14.5	-7.5	-13
18	13	-7.5	10.6	-10.6
19	0	15	3.9	14.5
20	-15	0	-14.5	3.9
21	-7.5	-13	-10.6	-10.6
22	-13	7.5	-10.6	10.6
23	-3.9	14.5	0	15
24	10.6	-10.6	7.5	-13

Figure 16: Classification of behavioral types



C. Further results

Figure 17: Average contributions of OTMs in VCM+ over time by team

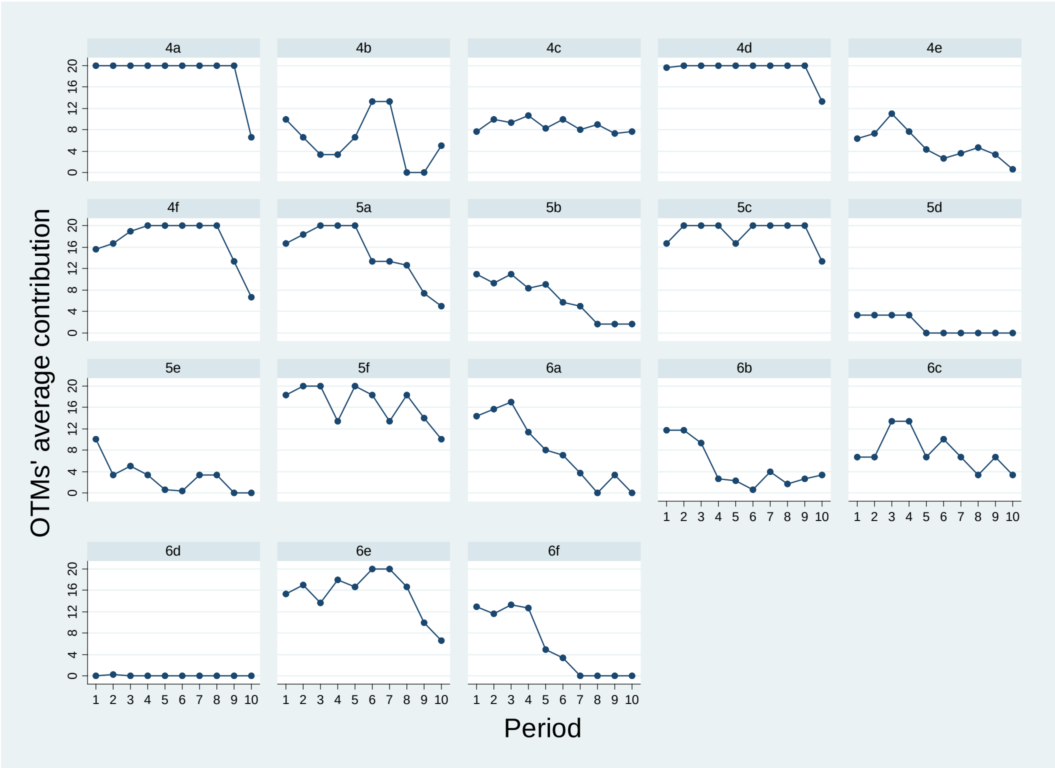


Figure 17 shows the analogous to Figure 12 for the VCM+ treatment (sessions 4-6). Team 4a characterizes team a in session 4, etc. In this treatment, only five teams (4a, 4d, 4f, 5c, 5f) can be classified as *high contribution* teams. As usual in standard public goods games, the *low contribution* teams dominate. 9 out of the 18 teams (4e, 5a, 5b, 5d, 5e, 6a, 6b, 6d, 6f) fall into this category. The four remaining teams (4b, 4c, 6c, 6e) form the *mixed contribution* category. Table 17 shows frequency of categories for the VCM+ and the TAG treatment (numbers for TAG as described in Section 4.3). Frequencies in the first two columns are significantly different using a χ^2 test ($p < 0.05$).[57]

Table 17: Frequency of teams by category and treatment

	High contribution	Low contribution	Mixed contribution
TAG	11	4	3
VCM+	5	9	4
H0: No difference between *high contribution* and *low contribution* (χ^2 test (p-value))	< 0.05		

[57] A Fisher's exact test yields p = 0.06.

Chapter 3: How to make people generous and credulous: Religious and pro-social primes in a public goods game

3.1. Introduction

This chapter analyzes and compares the effect of religious and pro-social primes on voluntary contribution decisions in a public goods setting. Before the start of a standard one-shot public goods game, participants are asked to solve an unscrambling task. They get ten five-word sentences and have to drop one superfluous word in each sentence to form grammatically correct four-word sentences. There are five identical “neutral” sentences in all treatments. The five other sentences include one religious, pro-social or neutral keyword each.

This work adds to a growing literature on experimental tests of links between religious primes and cooperative behavior. To my best knowledge it is the first that (i) provides a public goods game with a comparison of a religious prime with both a neutral and a pro-social prime and (ii) rigorously tests whether the prime works through changes in selfishness and altruism, changes in the expectation of others’ behavior or through the activation of a desire to act morally correct.

I find three main empirical results: First, both the religious and the pro-social prime increase the average contribution in the public goods game. Second, both altruism and the expectation of others’ cooperation increase the own contribution. Third, both the religious and the pro-social prime increase altruism, the pro-social prime also increases the expectation of cooperation. These changes in motives and expectations explain about two thirds of the increased contributions in the religious and pro-social prime settings.

Questions about the role of religiousness for economic decision making have a long history and have gotten increased attention in the last years. Weber (1920) postulated that protestant ethics are closely related to the spirit of capitalism. Barro and McCleary (2003) find in a cross-country panel that religious beliefs increase but church attendance decreases economic growth. Gheyssens and Günter (2012) get the experimental result that in poor rural Benin people with strong religious faith tend to be extremely risk-seeking.

This chapter is closely related to an emerging body of literature on the behavioral impact of religious concepts in experimental settings. Ahmed and Salas (2008) compare the results of religious priming and neutral priming in a dictator game and a prisoner's dilemma game. They find that the religious priming increases contributions in the dictator game and cooperation in the prisoner's dilemma game for both self-described religious and non-religious participants. Anderson and Mellor (2009) run a repeated public goods experiment and compare the behavior of religious and non-religious participants. The average contribution does not differ between the two groups, but the decline of contributions over time is significantly smaller for religious participants. Benjamin et. al. (2010) test the effect of religious priming and neutral priming in several settings – including a public goods game, a dictator game and a labor market gift-exchange game. Their results show that religious priming for Protestants increases contributions to the public good, for Catholics decreases contributions to the public good but increases expectations of others' contributions to the public good, and for Jews increases labor market reciprocity. Shariff and Norenzayan (2007) find that compared to a no-prime treatment a religious prime increases contributions in a dictator game for both self-described theists and atheists. In a further experiment they compare treatments with religious priming, secular priming and neutral priming in a dictator game. Both the religious and the secular prime increase the contributions of theists and atheists, the effect of the religious priming on the theists is close to being significantly stronger. Rand et. al (2012) test the effects of an explicit prime on a diverse population in an online prisoner's dilemma game. They compare a neutral, a christian, a hinduistic and a secular prime for Christians, Hindus and atheists. Relative to the neutral prime the only effect they find is a positive influence of the christian prime on the cooperation behavior of Christians. Akay et. al. (2011) analyze the effect of a "societal" prime by comparing the behavior of muslims in a public goods game on the most religious day during Ramadan with the behavior on a normal day. They find significantly less contributions during the religious day and attribute this to the observed decreased expectation of the others' contribution.

The remainder of the chapter proceeds as follows: In Section 2 I present the experimental design and describe the procedures of the experiment. Section 3 derives theoretical predictions based on different theories. Section 4 reports the experimental results and compares them to the theoretical predictions. Finally, Section 5 discusses the results and concludes the chapter.

3.2. Experimental design and procedures

In this section I describe the basic experimental setup (Section 2.1) and the details of the experimental procedure (Section 2.2).

3.2.1 Basic setup of the game

Let $I = \{1, 2, \ldots, n\}$ denote n subjects who interact in one period. First, each individual $i \in I$ has "to unscramble 10 five-word sentences dropping an extraneous word from each to create a grammatical four-word sentence"[58]. Then, each individual receives an endowment E. Each individual can allocate the endowment either to her own private account or to the public account. The contribution of individual i to the public account, denoted c_i, must satisfy $0 \leq c_i \leq E$. Let C be the sum of all team members' contributions (i.e. $C = \sum_{j=1}^{n} c_j$). In order to retain the public goods nature C is multiplied by a factor γ, which satisfies $1 < \gamma < n$.

At the end of each period the amount γC is automatically distributed evenly among the team members. Formally, the returned amount is denoted by $d_i = \gamma C / n$.

Individual team member i's payoff, π_i, is then given by the sum of his remaining endowment and his share of the public good

$$\pi_i = E - c_i + d_i. \qquad (1)$$

After the contribution decision, subjects are asked to estimate the sum of the contributions of the other members in their group. A correct estimate is rewarded by a payoff, r_i.

3.2.2 Experimental procedures

The experiment is organized is six stages. In stage 1, subjects are primed with a scrambled sentence test. In stage 2, the public goods game is played. In stage 3, subjects fill out a questionnaire regarding their motives and expectations in the public goods game. In stage 4, subjects solve another scrambled sentence test. In stage 5, subjects fill out a questionnaire regarding some of their personal characteristics, including questions

[58] Shariff and Norenzayan (2007), p. 804

regarding their religiousness. In stage 6, subjects are informed about the results of the public goods game and their resulting payoff.

The experiment implements six treatments: (i) treatment *PRI/REL,* (ii) treatment *PUB/REL,* (iii) treatment *PRI/SOC,* (iv) treatment *PUB/SOC,* (v) treatment *PRI/NEU* and (vi) treatment *PUB/NEU.* All treatments are according to the setup laid out in Section 2.1 with the following parameters: number of subjects $n = 3$, endowment per period $E = 20$ points (the experimental currency unit)[59], revenue multiplier $\gamma = 1.5$, and reward $r = 4$. In each session 15 subjects were randomly matched into five groups to assure anonymity.[60]

The treatments differ in two dimensions. The first dimension is the information condition regarding the contribution c_i. In treatments (i), (iii) and (v) the information about c_i is private – hence the treatments are denoted PRI. In treatments (ii), (iv) and (vi) the information about c_i and the cubicle number of subject i is displayed to three other participants, who can consequently identify i but are not in the same group as i and therefore not affected by his decision. The information is public – the treatments are denoted PUB. The second dimension is the content of half the sentences in stage 1. There are five identical "neutral" sentences in all treatments. In treatments (i) and (ii) the other five sentences each include one religious keyword – these treatments are denoted REL.[61] Treatments (iii) and (iv) implement five sentences with one pro-social keyword each – these treatments are denoted SOC.[62] In treatments (v) and (vi) all ten sentences are "neutral" – these treatments are denoted NEU.

In stage 4, all sentences are "neutral" to "erase" the different primes of stage 1.

Information conditions are as follows: In stage 6, each individual is informed about the contribution c_i of the other two members within his group, his remaining endowment $E - c_i$, his returned amount from the public good d_i, his payoff $\pi_{i,t}$ and his reward r_i. No further information about decisions[63] of other players or results of other groups is given to the subjects.

The experimental sessions started with general instructions on the experiments (the full text is in Appendix A). Before each stage, instructions regarding this stage were given.

[59] At the end of the experiment earned points from all periods are summed up and converted into euro using the following exchange rate: 1 point = 2.5 euro cent.
[60] In two sessions twelve participants were matched into four groups. This was due to a high number of no-shows.
[61] The religious keywords are: pilgrim, fasting period (Fastenzeit in german), holy, god, prophets
[62] The pro-social keywords are: friend, team, helps, together, allies
[63] With the exception described for the PUB-treatments

The instructions gave complete information about the basic setup of the game and the relevant parameters. Instructions were always read aloud to ensure common knowledge of the rules, and subjects were given plenty of time to ask questions in private before the start of each stage.

The computer-based sessions were conducted at the experimental laboratory MELESSA of the University of Munich in December 2010 using the experimental software z-Tree (Fischbacher, 2007) and the organizational software Orsee (Greiner, 2004). A total of 264 students from all disciplines participated in 18 sessions with 15 participants[64] each. Three sessions each implemented treatments *PRI/REL, PUB/REL, PRI/SOC, PUB/SOC, PRI//NEU* and *PUB/NEU*. The three sessions provide me with 42 or 45 statistically independent observations for each of the six treatments. The sessions lasted up to 45 minutes including everything from the instructions to final payments, and the average earnings were 10.17 EUR, including a show-up payment of 4.00 EUR. No participant was allowed to take part in more than one session, and the assignment of subjects into treatments was random. Decisions were taken anonymously[65] in cubicles, and communication among participants was prohibited.

3.3. Theoretical predictions

In this section, I present theoretical predictions for all treatments. First, I take a look at the model based on choice norms by Benjamin et. al. (2010b). Second, I present theoretical predictions for two well-known models that include other-regarding preferences, namely models based on Fehr and Schmidt (1999) and Charness and Rabin (2002),with a special emphasis on the role of expectations in these models. Third, I discuss theoretical predictions for the impact of public decisions on the contribution decision.

3.3.1 Predictions based on choice norms

Benjamin et. al. (2010a) offer the following interpretation of the priming mechanism: "[E]ach person belongs to multiple social categories, such as religion, gender, and occupation, which each has its own set of norms. Behavior in a given moment is more powerfully affected by the norms of categories that are salient than the norms of categories

[64] Due to a high number of no-shows, two sessions – one for PUB/REL and one for PUB/NEU – were conducted with just 12 participants.
[65] With the exception described for the PUB-treatments.

that are not salient. If an environmental cue, or a "prime," makes a certain category temporarily more salient, behavior shifts towards the salient category's norm."

Benjamin et. al. (2010b) develop a decision model in which an individual wants to conform with two preferred choices – the choice in absence of identity considerations x_0 and the choice norm for the category C, x_c. If category C is made salient, the individual puts more weight on conforming with x_c. The resulting utility function is

$$U = -\big(1 - w(s)\big)(x - x_0)^2 - w(s)(x - x_c)^2, \qquad (2)$$

in which x is the action choice, $0 \leq w(s) \leq 1$ is the weight placed on the norm for social category C. It is assumed that $w(0) = 0$, $w_i'(s) > 0$ and that s has a steady state value s* but can be temporarily increased to s* + ε, with ε > 0.

Proposition 1. *Religious and pro-social primes increase contributions in the public goods game by strengthening the willingness to conform to a high-contribution choice norm.*

3.3.2 Predictions based on other-regarding preferences

I focus on two prominent models that both belong to the class of outcome-based social preference models: the inequity aversion model by Fehr and Schmidt (Fehr and Schmidt, 1999) and the welfare-oriented model by Charness and Rabin (Charness and Rabin, 2002).

3.3.2.1 Fehr and Schmidt (1999) preferences

The model by Fehr and Schmidt (1999) assumes that subjects suffer from inequity within their reference group. More precisely, a subject i benefits from his own payoff π_i but compares it with the payoff of the $n-1$ other members in his reference group. The corresponding utility function is the following:

$$U_i(\pi) = \pi_i - \alpha_i \frac{1}{n-1}\sum_{j \neq i} \max\{\pi_j - \pi_i, 0\} - \beta_i \frac{1}{n-1}\sum_{j \neq i} \max\{\pi_i - \pi_j, 0\} \qquad (3)$$

The vector $\pi = (\pi_1, \ldots, \pi_n)$ denotes the monetary payoffs and α_i and β_i represent subject i's individual attitude towards inequity. The two weights are restricted to $\beta_i \leq \alpha_i$ and $0 \leq \beta_i < 1$. They control for the impact of utility losses from disadvantageous inequity (α_i) and advantageous inequity (β_i), respectively.[66] There are two types of

[66] Note that for $\alpha_i = \beta_i = 0$ the model collapses into the case of standard preferences.

equilibria in the discussed public goods game: If $1/2 \leq \beta_i$ holds for all group members, then every combination of identical contributions ($c_i = c$ for all i) is an equilibrium. If $\beta_i < 1/2$ holds for at least one group member, the only equilibrium is the contribution of zero by all group members ($c_i = 0$ for all i).

The monetary loss of a positive contribution is 1/2 per contributed point. If the maximum utility loss by advantageous inequality represented by β_i is below this threshold, a contribution of zero is maximizing utility. If this utility loss is above the threshold, subject i can increase his utility by contributing positive amounts up to the minimum contribution of the other team members. However, he will never want to contribute more than this minimum, because the gain of decreasing advantageous inequality with the high contributor will at least be canceled out by the loss of increasing disadvantageous inequality with the low contributor ($\beta_i \leq \alpha_i$).

Proposition 2. *With Fehr and Schmidt (1999) preferences, subject i is willing to contribute positive amounts if $\beta_i \geq 1/2$. If $\beta_i \geq 1/2$ for all group members identical contributions ($c_i = c$ for all i) is an equilibrium, else $c_i = 0$ for all i is the only equilibrium. An increase of advantageous inequality aversion from $\beta_i < 1/2$ to $\beta_i \geq 1/2$ increases contributions.*

3.3.2.2 Charness and Rabin (2002) preferences

Charness and Rabin (2002) assume that subjects care about their own individual well-being and about social welfare. Their model includes a subject's own payoff and, additionally, two components of social welfare: the minimum payoff in a group (the "Rawlsian" motive) and the sum of all group members' payoffs (the efficiency concern). More precisely, the utility function in their general model (see their Appendix 1) with only outcome-based components looks as follows:

$$U_i(\pi) = (1 - \lambda_i)\pi_i + \lambda_i[\delta_i \min(\pi_1, \ldots, \pi_n) + (1 - \delta_i)(\pi_1 + \pi_2 + \cdots + \pi_n)] \qquad (4)$$

The vector $\pi = (\pi_1, \ldots, \pi_n)$ denotes the monetary payoffs within the group of n subjects and λ_i and δ_i are individual weights (i.e. $\lambda_i, \delta_i \in [0, 1]$). The first weight, λ_i, captures how much an individual cares for social welfare relative to his own payoff.[67] The

[67] For $\lambda_i = 0$, the Charness and Rabin (2002) model nests standard homo oeconomicus preferences.

second weight, δ_i, controls for the influence of the "maximin"-aspect relative to the general efficiency concern.

In my setting, the optimal contribution for subject i depends on λ_i *and* δ_i. If subject i strongly cares about general efficiency and $\lambda_i \geq 1/(2 - 2\,\delta_i)$ he wants to contribute everything. If subject i strongly cares about the maximin-aspects and $1/(2 - 2\,\delta_i) > \lambda_i \geq 1/2$ he wants to contribute as much as the higher contribution of the other two team members. If he cares mostly about his own payoff and $1/2 > \lambda_i$, subject i wants to contribute nothing. Intuitively, an increase of c_i by 1 decreases π_i by 1/2, increases $(\pi_1 + \pi_2 + \cdots + \pi_n)$ by 1/2, and increases $\min(\pi_1, \dots, \pi_n)$ by 1/2 if another team members contributes more but decreases $\min(\pi_1, \dots, \pi_n)$ by 1/2 if no other team member contributes more.

As a result, there are different equilibria based on the distribution of λ_i *and* δ_i. All possible equilibria are shown in Table 18.

Proposition 3. *With Charness and Rabin (2002) preferences, subject i is willing to contribute his full endowment if* $\lambda_i \geq 1/(2 - 2\,\delta_i)$ *and up to his full endowment based on the contributions of the other team members if* $\lambda_i \geq 1/2$.

Table 18: Distribution of λ_i *and* δ_i and resulting equilibria in VCM with Charness and Rabin (2002) preferences[68]

Distribution of λ_i *and* δ_i	Resulting equilibria
$\lambda_1 \geq 1/(2-2\,\delta_1)$, $\lambda_2 \geq 1/2$, $1/2 > \lambda_3$	$c_1 = E, c_2 = E, c_3 = 0$
$\lambda_1 \geq 1/(2-2\,\delta_1)$, $\lambda_2 \geq 1/2$, $\lambda_3 \geq 1/2$	$c_1 = E, c_2 = E, c_3 = E$
$\lambda_1 \geq 1/(2-2\,\delta_1)$, $1/2 > \lambda_2$, $1/2 > \lambda_3$	$c_1 = E, c_2 = 0, c_3 = 0$
$1/(2-2\,\delta_1) > \lambda_1$, $1/2 > \lambda_2$, $1/2 > \lambda_3$	$c_1 = 0, c_2 = 0, c_3 = 0$
$1/(2-2\,\delta_1) > \lambda_1 \geq 1/2$, $1/(2-2\,\delta_2) > \lambda_2 \geq 1/2$, $1/2 > \lambda_3$	$c_1 = c_2, c_3 = 0$
$1/(2-2\,\delta_1) > \lambda_1 \geq 1/2$, $1/(2-2\,\delta_2) > \lambda_2 \geq 1/2$, $1/(2-2\,\delta_3) > \lambda_3 \geq 1/2$,	$c_1 = c_2 = c_3$

3.3.2.3 Expectations

With both Fehr and Schmidt (1999) and Charness and Rabin (2002) preferences, the optimal contribution depends on the contributions of the other group members. With simultaneous decisions, the choice of the own contribution has to be positively based on the expectation of the other group members' contributions. Therefore, a change in the expectation leads to a change in the contribution decision. Such a change in expectations can improve or worsen the utility of the subject, depending on whether the new expectation is closer to the realized contribution of the other group members or farther away from it.

Proposition 4. *The religious and the pro-social prime can increase the contributions via an increase in the expectation of other group members' contribution.*

[68] I assume that $\lambda_1 \geq \lambda_2 \geq \lambda_3$ without loss of generality.

3.3.3 The impact of public decisions

The impact of public decision making in a public goods experiment was prominently explored by Rege and Telle (2004). They implement a standard public goods game in which all subjects write their own contribution on a blackboard. The blackboard is visible for all participants, making all contributions public. This treatment has a strong impact on the subjects' contribution decisions, full contribution is the observed mean.[69] The authors argue that participants who make high contributions receive social approval from the other participants because they conform to the social norm of giving.

The observed effect of the activation of religious concepts has previously explained by the idea that participants act differently because they are watched and judged by a god. Shariff and Norenzayan (2007) even named their article “God is Watching You”.

Because the social approval and the divine approval are both based on “observe and judge” by third parties, it is reasonable to expect a crowding out effect, meaning the effect of a religious prime should be weaker in a setting with public decisions.

Proposition 5. *Public decisions increase contributions. The effect of the religious prime is weaker in a setting with public decisions than in a setting with private decisions.*

3.4. Experimental results

In Section 4.1 I present the main treatment effects. Section 4.2 shows the independence of the religiousness variables from the primes.

3.4.1 Main results

I will start with a short analysis of the average contributions by treatment. The mean contribution by treatment range from a low of 5.93 in the PRI/NEU to a high of 10.02 in the PUB/SOC (see the first row of Table 19). The benchmark treatment for my analysis in the PRI/NEU treatment, as it represents the standard voluntary contribution mechanism used in a huge number of prior experiments. As expected, the other treatments result in higher contributions than the benchmark case.

[69] This effect would be too strong for the analysis in this chapter. Rege and Telle (2004) tested a second treatment variable for framing, but could not find a significant effect of the framing with public decisions. They explain this with a ‘ceiling effect’: The public decision pushes most contribution to 100%, leaving no room for further treatment effects. To avoid this fate, I use a weaker form of the public decision as presented in 2.2.

Table 19: Mean contributions (in points) by treatment

	Av. Con.	Diff. to PRI/NEU	Mann-Whitney	Lin. Reg.
PRI/REL	9.02	3.09	YES**	YES**
PUB/REL	8.67	2.73	YES*	YES*
PRI/SOC	10.00	4.07	YES***	YES***
PUB/SOC	10.02	4.09	YES**	YES***
PRI/NEU	5.93	-	-	-
PUB/NEU	7.81	1.88	NO	NO

Note: Difference between treatment and PRI/NEU significant at: *** 1% level; ** 5% level; * 10% level.

The differences in the mean contributions are quite large – around four points (or 20% of the endowment) for the SOC treatments, around three points for the REL treatments and around two points for the PUB/NEU treatment. I test the significance of the differences with two methods. First, I compare the distribution of contributions in the PRI/NEU with the distribution of contributions in each of the other treatment. Second, I run a linear regression on the contributions with just the five non-PRI/NEU treatment dummies as independent variables. You can see the results in the last two columns of Table 19. Both methods show highly significant differences for the PRI/REL, PRI/SOC and PUB/SOC treatments, a somewhat significant difference for the PUB/REL and no significant difference for the PUB/NEU treatment.

After establishing that the religious prime does have an effect on the contribution, we can now take look at the cause of this effect. Table 20 depicts the average contribution per treatment for two measures of religiosity. The first measure is membership in an Abrahamic religious community in columns 2 and 3. In total, 160 of 264 participants belong to an Abrahamic religious community – 150 Christians, 1 Jew and 9 Muslims.

The second measure is self-reported religiousness measured on a seven-point Likert scale, shown in columns 4-6 of the Table. The participants are grouped into three groups of about equal size. Of the 264 participants, 82 are classified as low (1 on the Likert scale), 100 are classified as medium (2 and 3 on the Likert scale) and 82 are classified as high (4-7 on the Likert scale).

Table 20: Mean contributions (in points) by treatment

	Average Contri-bution	Abrahamic Religion: Yes	Abrahamic Religion: No	Self-Religion: High	Self-Religion: Medium	Self-Religion: Low
PRI/REL	9.02	8.04 (28)	10.65 (17)	8.45 (20)	9.57 (7)	9.44 (18)
PUB/REL	8.67	8.56 (27)	8.87 (15)	9.33 (12)	6.56 (18)	11.17 (12)
PRI/SOC	10.00	9.33 (24)	10.76 (21)	10.80 (10)	10.35 (23)	8.67 (12)
PUB/SOC	10.02	10.23 (26)	9.74 (19)	8.00 (10)	11.61 (18)	9.53 (17)
PRI/NEU	5.93	5.86 (28)	6.06 (17)	6.86 (14)	6.61 (18)	4.00 (13)
PUB/NEU	7.81	7.37 (27)	8.60 (15)	7.94 (16)	6.75 (16)	9.30 (10)
All treatments	8.58	8.18 (160)	9.20 (104)	8.44 (82)	8.59 (100)	8.72 (82)

Note: Number of observations in parentheses.

The results do not show a clear relationship between religiousness and the impact of the different priming conditions. In both treatments with religious primes, the participants with a membership in an Abrahamic religious community show a lower average contribution than the participants who are not members. Also in both treatments the participants who self-identify as the lowest possible level of religiousness contribute more on average than the subjects with medium or high self-reported religiousness.

This observation is backed up by the regression analysis shown in Table 21. Contributions in the REL and SOC treatments are significantly higher compared to the baseline treatment NEU (Model 1). However, the addition of measures of religiousness does not yield explanatory power. The contributions of members of an Abrahamic religious community do not differ significantly from others (Model 2) and the interaction effect with the religious prime is also insignificant. The same result is obtained by using the self-reported religiousness as independent variable. Again, the interaction effects of high and medium self-reported religiousness with the religious prime are both negative, in the case of the medium religiousness the effect is even somewhat significant.[70]

Result 1. *Mean contributions are significantly higher for REL and SOC treatments than in the baseline treatment. The increase in the REL treatments cannot be explained by broad measures of religiosity.*

[70] Running the regressions with treatment dummies does not qualitatively change the results, see Appendix B, Table 25.

Table 21: Contributions dependent on treatment and religiousness (OLS regressions)

Dependent variable: contribution					
	Model 1	Model 2	Model 3	Model 4	Model 5
REL dummy	2.011* (1.101)	2.011* (1.100)	2.616 (1.646)	2.001* (1.112)	4.093** (1.695)
SOC dummy	3.163*** (1.097)	3.095*** (1.104)	3.119*** (1.109)	3.173*** (1.104)	3.184*** (1.107)
PUB dummy	0.508 (0.889)	0.534 (0.891)	0.532 (0.893)	0.514 (0.892)	0.739 (0.891)
Abrahamic dummy	-	-0.885 (0.926)	-0.577 (1.161)	-	-
Abrahamic * rel. prime dummy	-	-	-0.957 (1.912)	-	-
Self-Religion: High	-	-	-	0.025 (1.139)	0.818 (1.473)
Self-Religion: High * rel. prime dummy	-	-	-	-	-2.151 (2.311)
Self-Religion: Medium	-	-	-	-0.099 (1.090)	1.167 (1.350)
Self-Religion: Medium * rel. prime dummy	-	-	-	-	-4.136* (2.260)
Constant	6.594*** (0.859)	7.141*** (1.075)	6.947*** (1.181)	6.621*** (1.109)	5.745*** (1.253)
# Observations	264	264	264	264	264
R^2	0.03	0.04	0.04	0.03	0.05

Notes: *** Significant at 1% level; ** significant at 5% level; * significant at 10% level. Robust standard errors in parentheses.

The 10000 feet view at the results shows a highly significant effect of the religious prime. However, it does not really explain the mechanism behind this effect and most of the variation between contributions is not captured – the the R^2 is around just 0.05 for all models.

To add explanatory power to the statistical analysis, I asked the subjects about their motives and expectations. These questions immediately followed the contribution decision to ensure salience of the prime condition. Subjects were asked to indicate whether there exists a “morally correct” contribution decision, if “yes”, what amount is the “morally correct” contribution, how important the payoff of other group members is to them, how important their own payoff is to them, their expectation of the average contribution of the other group members.

Out of the 264 participants, 137 said that a "morally correct" contribution decision exists. More than half of these participants (71) agree that a full contribution is morally correct, the average amount chosen is 15.23. The importance of the other's and the own payoff are measured on a seven-point Likert-scale (1 = lowest importance, 7 = highest importance). The mean result for the other's payoff is 3.48, the mean for the own payoff is 6.13. The average expectation for the other's contribution is 9.50, about one point higher than the actual average contribution.

Table 22 shows linear regressions that include the motives and expectations as independent variable.[71] Two of the four new variables are large and highly significant – the importance of the other's payoff and the expectation of the other's contribution. An increase of the importance of the other's payoff by 1 increases the own contribution by about one point, so going from the low end to the high end increases the contribution by about 30% of the initial endowment. An increase in the expectation of the other group members' contribution by one point increases the own contribution by about 0.8 points. Both the importance of the own payoff and the view that a "morally correct" decision exists do not influence the contribution.

Both the dummies for the religious and the social prime lose about 60% of their value compared to the regressions in Table 21 and become insignificant. This result suggests that the effect religious and social priming works through the concern for the others' well-being and – via the willingness to conditionally cooperate – the expectation that others will cooperate.

We can see the impact of the religious and the social prime on the motives and expectations in Table 23. I show a probit regression for the existence of a "morally correct" decision and tobit regressions for the importance of the own payoff and the others' payoff as well as the expectation of the average contribution of the other group members.[72] Both the religious prime and the social prime significantly increase the importance of the others' payoff, both by about ¾ of a point on the Likert scale. The social prime additionally significantly increases the expectation by nearly two full points. The religious prime also increases the expectation by nearly one point, however, this increase is not significant.

[71] I also tested for an effect of age and gender on the contribution decisions, both variables turn out to be insignificant.

[72] Linear regressions show similar results, see Appendix B, Table 26.

Table 22: Contributions dependent on treatment, motives and expectations (OLS regressions)

	Dependent variable: contribution			
	Model 1	Model 2	Model 3	Model 4
REL dummy	0.762 (0.657)	0.778 (0.654)	0.850 (0.675)	0.714 (0.663)
SOC dummy	1.166 (0.765)	1.121 (0.756)	1.113 (0.755)	1.210 (0.763)
PUB dummy	0.383 (0.560)	0.414 (0.563)	0.345 (0.564)	0.387 (0.560)
Moral dummy	-0.225 (0.165)	-0.198 (0.173)	-0.229 (0.167)	-
Importance Other's Payoff	0.992*** (0.202)	0.967*** (0.201)	0.989*** (0.201)	1.007*** (0.199)
Importance Own Payoff	-0.085 (0.227)	-0.109 (0.227)	-0.119 (0.227)	-
Expectation Other's Contribution	0.786*** (0.058)	0.792*** (0.058)	0.791*** (0.057)	0.781*** (0.060)
Abrahamic dummy	-	-0.883 (0.613)	-	-
Self-Religion: High	-	-	-0.066 (0.771)	-
Self-Religion: Medium	-	-	0.766 (0.704)	-
Constant	-2.283 (1.841)	-1.611 (1.827)	-2.373 (1.779)	-3.166*** (0.691)
# Observations	264	264	264	264
R^2	0.61	0.62	0.61	0.61

Notes: *** Significant at 1% level; ** significant at 5% level; * significant at 10% level. Robust standard errors in parentheses.

Both the existence of a "morally correct" decision and the importance of the own payoff are not significantly affected by the treatment conditions.

Result 2. *The subjective importance of the other group members' payoff and the expectation of the other group members' contribution significantly increase contributions. The social prime significantly increases both these characteristics, the religious prime significantly increases the subjective importance of the other group members' payoff.*

Table 23: Impact of treatments on motives and expectations (probit and tobit regressions)

	Dependent variable:			
	Moral Dummy	Importance Other's Payoff	Importance Own Payoff	Expectation Other's Contribution
	Probit	Tobit	Tobit	Tobit
REL dummy	0.116	0.747*	0.581	0.916
	(0.191)	(0.423)	(0.507)	(1.077)
SOC dummy	-0.100	0.771*	0.677	1.926*
	(0.189)	(0.420)	(0.503)	(1.064)
PUB dummy	0.043	0.448	-0.050	-0.228
	(0.155)	(0.343)	(0.413)	(0.874)
Constant	0.023	2.559***	7.149***	8.730***
	(0.154)	(0.346)	(0.427)	(0.867)
# Observations	264	264	264	264
Pseudo R^2	0.00	0.01	0.00	0.00

Notes: *** Significant at 1% level; ** significant at 5% level; * significant at 10% level. Standard errors in parentheses.

The effect of the public decision on the contribution is small and insignificant in all regression models. This fact indicates that the social "observe and judge" effect of my implementation of the public decision is quite weak. Not surprisingly, the test for a crowding out of social approval and divine approval does not yield significant results (the full regression results are in Appendix B, Table 27). However, the interaction effect has the expected negative sign and is not far away from statistical significance.

3.4.2 Test for independence of the religiousness variables

The questions for the data collection of the religiousness variables are asked after the contribution decision in the public goods game. This sequence is necessary to avoid a religious prime for all participants. This approach carries the risk that the primes not only effect the contribution decision but also the answers to the religiousness questions, rendering a statistical analysis futile. Therefore the participants had to solve a further neutral scrambled sentence task between the public goods game and the questionnaire to "erase" the priming effect. This approach was effective, there is no relationship between the measures for religiousness and the treatments, as you can see in Table 24.

Table 24: Impact of treatments on self-reported religiousness (probit and tobit regressions)

	Dependent variable:	
	Abrahamic dummy	Self-Religion
	Probit	Tobit
REL dummy	0.000	-0.047
	(0.194)	(0.360)
SOC dummy	-0.199	-0.516
	(0.191)	(0.359)
PUB dummy	0.075	0.002
	(0.157)	(0.293)
Constant	0.302*	2.486***
	(0.156)	(0.291)
# Observations	264	264
Pseudo R^2	0.00	0.00

Notes: *** Significant at 1% level; ** significant at 5% level; * significant at 10% level. Standard errors in parentheses.

3.5. Discussion and conclusion

This chapter presents a standard public goods game with religious, pro-social and neutral primes and analyzes the results of the implementation in a laboratory setting. Participants solve a scrambled sentence task – they have to form a four-word sentence out of five given words – filled with religious, pro-social or neutral keywords, before making decisions in a standard public goods game.

I provide three main empirical results: First, both the religious and the pro-social prime increase the average contribution in the public goods game. Second, the subjective importance of the other group members’ payoff and the expectation of the other group members’ contribution positively influence the own contribution. Third, both the religious and the pro-social prime increase the subjective importance of the other group members’ payoff, the pro-social prime also increases the expectation of the other group members’ contribution.

I do not find statistical significant support for the hypothesis that social approval based on observation by other participants crowds out a divine approval effect of the religious prime. However, both a weak form of a public decision and relatively few observations for the PUB/REL treatment might play a role in the lack of statistical significance. Further research in this direction might be fruitful.

Appendix

A. Experimental instructions (originally in German)[73]

Instructions

Welcome to the experiment!
Thank you very much for your participation!

During the experiment you and all other participants will be asked to solve tasks, to make decisions and to answer questions. Your decisions as well as the decisions of the participants you are matched with determine your earnings from the experiment according to the following rules.
Please stop talking to other participants from now on. If you have any questions after going through the instructions or while the experiment is taking place, please raise your hand, and the experimenter will come to you and answer your questions privately. In case the question is relevant for all participants, its answer is repeated aloud.
The whole experiment is computerized and will last approximately **45 minutes**. All your decisions and answers remain anonymous. You will not find out with whom you are matched in each of the experiment's parts and how much each of the other participants earns.
The experiment consists of **six** parts. At the beginning of each part, you will receive the corresponding instructions for this part. The instructions will be read out loud and you will get time to ask questions. Please, do not hesitate to ask if anything is unclear to you. Your decisions in one part of the experiment **do not** have any effects on other parts, exceptions will be clearly stated in the instructions. In the interest of clarity, we will only use male terms in the instructions. They should be interpreted as being gender-neutral. For means of help, you will find a pen on your table.
While taking your decisions at the PC, there will be a clock counting down in the right upper corner of the screen. The clock serves as a guide for how much time you should need. You may exceed the time. The input screens will **not** be turned off when time has run out. However, the information screens on which no decision is required to be taken will be turned off when time has run out. Once you have taken a decision or have read through a screen, please confirm by clicking on the "OK" button.
Your earnings in the experiment will be calculated in **"points"**. You can earn points in several parts of the experiment. How you can earn points is explained in the instructions for the respective parts. At the end of the experiment, the "points" get converted into euro at the exchange rate **4 points = 1 €** (1 point= 25 cents). In addition, you receive 4 euro for your arrival on time.
If you have any questions, please raise your hand now. I will come to you and answer your questions privately.

[73] Baseline instructions describe treatment PRI. Differences in PUB are indicated by [PUB].

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Part I

In the first part of the experiment you solve linguistical tasks. These tasks take all the same form: **Five** words are displayed on the screen. From these **five** words you have to form a complete and grammatically correct **four**-word sentence. Please enter this sentence on the screen.

At first you get **one** practice task, subsequently you solve **ten** of these tasks.

If you have any questions, please raise your hand now. I will come to you and answer your questions privately.

Part II

At the start of part II, everybody in the room will be randomly assigned to a group of three. You and the other participants will learn neither during nor after the experiment with whom you were matched in this part.

Part II consists of two stages, the **contribution stage** and the **distribution stage**.

Contribution stage:

At the start of the contribution stage all participants receive a private endowment of **20 points**. These points are distributed by each participant between two alternatives, the group account and the private account. All group members can discretionary decide how to distribute the points between the group account and the private account.

The group account:

The contributions of all group members are added up. The sum is multiplied by 1.5 und distributed to all group members in the distribution stage (see below). Examples: If the sum of the contributed points is 50, then there are 50*1.5=75 points to be distributed in the distribution stage. If the sum of the contributed points is 10, then there are 10*1.5=15 points to be distributed in the distribution stage.

The private account:

The contribution of a group member to his private account is the difference between his private endowment and the contribution to the group account. The contribution to the private account goes point for point into the earnings of the respective person. Examples: If a group member contributes 6 points to the group account, he receives 14(=20-6) points for his private account. If a group member contributes 17 points to the group account he receives 3(=20-17) points for his private account. The other group members receive nothing from the private account of the respective person.

Distribution stage:

In the distribution stage the group account is equally divided between the three group members. Each group member receives 1/3 of the group account.

Earnings:

Your earnings are the sum of your distributed share from the group account and your private account.

At the end of the experiment, you will be informed about the contributions of the other group members to the group account, the distribution from the group account, your private account and your earnings in part II. Directly following part II you will not receive any feedback.

[PUB: At the end of the experiment you will also be informed about the contribution to the group account of three randomly selected participants. At the same time three randomly selected participants will be informed about your contribution to the group account. All participants will be informed only about other participants who are not in their own group.

The information is displayed in the following way:

The contribution of participants on seat [seat number of the selected participant] is [contribution to the group account of the selected participant].]

If you have any questions, please raise your hand now. I will come to you and answer your questions privately.

Part III

In part III you are asked to answer a questionnaire at your computer. The questions refer to part II.

The first question is: „Estimate the sum of the contributions of the other group members to the group account (minimum 0, maximum 40).“ If your estimation is correct, you earn 4 points.

At the end of the experiment, you will be informed whether your estimation was correct.

Additional questions follow. Most questions offer answer options, some questions require text answers. In the latter case enter your answer into the blue box on screen and confirm by pressing the enter key.

If you have any questions, please raise your hand now. I will come to you and answer your questions privately.

Part IV

Part IV is analogous to part I.

You solve ten new tasks.

If you have any questions, please raise your hand now. I will come to you and answer your questions privately.

Part V

In part V you are asked to answer a questionnaire at your computer.

Most questions offer answer options, some questions require text answers. In the latter case enter your answer into the blue box on screen and confirm by pressing the enter key.

If you have any questions, please raise your hand now. I will come to you and answer your questions privately.

Part VI

In part VI you are informed about the results from part III and part IV. After that, payment of your total earnings in the experiment takes place.

If you have any questions, please raise your hand now. I will come to you and answer your questions privately.

B. Further Analysis

Table 25: Contributions dependent on treatment dummies and religiousness (OLS regressions)

	Dependent variable: contribution				
	Model 1	Model 2	Model 3	Model 4	Model 5
PRI/REL dummy	3.089** (1.446)	3.089** (1.443)	3.671** (1.849)	3.080** (1.455)	4.790*** (1.854)
PUB/REL dummy	2.733* (1.463)	2.752* (1.466)	3.346* (1.898)	2.734* (1.468)	4.984** (1.988)
PRI/SOC dummy	4.067*** (1.357)	3.988*** (1.361)	4.015*** (1.366)	4.069*** (1.365)	4.009*** (1.359)
PUB/SOC dummy	4.089*** (1.536)	4.050*** (1.543)	4.063*** (1.544)	4.085*** (1.541)	4.154*** (1.535)
PUB/NEU dummy	1.876 (1.618)	1.894 (1.621)	1.888 (1.625)	1.878 (1.628)	1.846 (1.639)
Abrahamic dummy	-	-0.881 (0.926)	-0.579 (1.163)	-	-
Abrahamic * rel. prime dummy	-	-	-0.935 (1.914)	-	-
Self-Religion: High	-	-	-	-0.045 (1.140)	0.731 (1.475)
Self-Religion: High * rel. prime dummy	-	-	-	-	-2.078 (2.318)
Self-Religion: Medium	-	-	-	-0.061 (1.095)	1.101 (1.354)
Self-Religion: Medium * rel. prime dummy	-	-	-	-	-3.896* (2.276)
Constant	5.933*** (0.988)	6.482*** (1.173)	6.294*** (1.265)	5.972*** (1.204)	5.266*** (1.307)
# Observations	264	264	264	264	264
R^2	0.04	0.04	0.04	0.04	0.05

Notes: *** Significant at 1% level; ** significant at 5% level; * significant at 10% level. Robust standard errors in parentheses.

Table 26: Impact of treatments on motives and expectations (OLS regressions)

	Dependent variable:			
	Moral Dummy	Importance Other's Payoff	Importance Own Payoff	Expectation Other's Contribution
REL dummy	0.092	0.621**	0.276	0.862
	(0.314)	(0.298)	(0.231)	(0.897)
SOC dummy	-0.334	0.593**	0.382*	1.738**
	(0.297)	(0.292)	(0.223)	(0.815)
PUB dummy	-0.012	0.260	-0.074	-0.180
	(0.244)	(0.243)	(0.176)	(0.706)
Constant	1.695	2.944	5.944	8.707
	(0.259)	(0.217)	(0.192)	(0.661)
# Observations	264	264	264	264
R^2	0.01	0.03	0.01	0.02

Notes: *** Significant at 1% level; ** significant at 5% level; * significant at 10% level. Robust standard errors in parentheses.

Table 27: Test for crowding out of social approval and divine approval (OLS regressions)

Dependent variable: contribution				
	Model 1	Model 2	Model 3	Model 4
REL dummy	1.325 (0.826)	1.351 (0.824)	1.585* (0.861)	1.231 (0.842)
SOC dummy	1.161 (0.766)	1.117 (0.757)	1.110 (0.756)	1.207 (0.764)
PUB dummy	0.766 (0.742)	0.805 (0.743)	0.830 (0.736)	0.740 (0.746)
Moral dummy	-0.232 (0.166)	-0.205 (0.173)	-0.238 (0.168)	-
Importance Other's Payoff	0.976*** (0.201)	0.950*** (0.201)	0.968*** (0.201)	0.992*** (0.198)
Importance Own Payoff	-0.087 (0.227)	-0.112 (0.227)	-0.126 (0.224)	-
Expectation Other's Contribution	0.790*** (0.058)	0.795*** (0.058)	0.797*** (0.057)	0.784*** (0.061)
Abrahamic dummy	-	-0.889 (0.615)	-	-
Self-Religion: High	-	-	-0.076 (0.773)	-
Self-Religion: Medium	-	-	0.885 (0.706)	-
PUB * REL dummy	-1.150 (1.074)	-1.170 (1.082)	-1.472 (1.090)	-1.057 (1.083)
Constant	-2.427 (1.865)	-1.753 (1.846)	-2.571 (1.790)	-3.318 (0.739)
# Observations	264	264	264	264
R^2	0.61	0.62	0.62	0.61

Notes: *** Significant at 1% level; ** significant at 5% level; * significant at 10% level. Robust standard errors in parentheses.

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