Preferences over Punishment and Reward Mechanisms in Social Dilemmas

by

Martin G. Kocher and Dominik Matzat*

Appendix

A.1 Experimental Instructions (originally in German)

*Baseline instructions describe the partner treatment. Differences in the stranger treatment are indicated by [**STRANGER**].*

* Martin G. Kocher (corresponding author): University of Munich, Germany, Queensland University of Technology, Brisbane, Australia, and University of Gothenburg, Sweden; Dominik Matzat: University of Munich, Germany. We are grateful for financial support through the *Ideenfonds* of the University of Munich, the Munich Experimental Laboratory for Economic and Social Sciences (MELESSA), and the German Science Foundation (GRK 801). Comments and suggestions by Dirk Engelmann, Julius Pahlke, Matthew Spitzer, seminar/session participants in Munich, the ESA European Conference, the Taxation, Social Norms and Compliance Conference at Nuremberg, the Workshop on Policy Experiments at VATT, Helsinki, and the *JITE* Conference 2015 improved the paper a lot.

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 other participants 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.

The whole experiment is computerized and will last up to two hours. All your decisions and answers remain anonymous. We evaluate data from the experiment only on the aggregate level 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 other participants will not find out how much you have earned.

The experiment consists of three parts. At the beginning of each part, you will receive the corresponding instructions for this part. The instructions will be read aloud and you will get time to ask questions. Please, do not hesitate to ask if anything is unclear to you. The decisions in different parts of the experiment are completely independent from each other.

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 nevertheless exceed the time. Only the information screens on which no decision is required to be taken will be turned off when time has run out.

In the interest of clarity, we will only use male terms in the instructions. These should be interpreted as being gender-neutral.

During the experiment your earnings will be calculated in “tokens.” At the end of the experiment, the “tokens” 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.

For means of help, you will find a pen on your table, which you, please, leave behind on the table after the experiment.

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 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 tokens to you and 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 tokens, and the other person loses 5 tokens. If the other person also chooses Option A, he, too, receives 10 tokens and you lose 5 tokens. In total, you therefore earn 5 tokens (10 tokens from your choice minus 5 tokens from the other person's choice).
- In case you choose Option B and the other person chooses Option A, you earn 2 tokens (7 tokens from your choice minus 5 tokens from the other person's choice). The other person earns 14 tokens (10 tokens + 4 tokens).

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 as follows: **20 tokens = 3 euro** (1 token = 15 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 but find out only about your total payoff from this part at the end of Part I.

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

Part II

At the end of the experiment, the tokens that you earn in Part II will be converted into euro at the exchange rate of **20 tokens = 0.6 euro** (1 token = 3 cent).

In 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. This part of the experiment consists of **10 identical periods**. Group composition remains constant over all periods [**STRANGER**: varies randomly from one period to the next]; this means you are connected to the same [**STRANGER**: different] persons in every period.

Endowment and Alternatives in Each Period

Each participant receives an initial endowment of **20 tokens** at the beginning of each period. These 20 tokens can be allocated to two alternatives, $\boldsymbol{X}$ and $\boldsymbol{Y}$:

1. You can put 0 to 20 tokens into **pot** $\boldsymbol{X}$. The sum of all contributions within your group to pot X will be multiplied by 1.6 and equally distributed among the group members afterwards. This means that for any token in pot X you receive 0.4 (= 1.6/4) tokens. For example, if the sum of tokens in pot X in your group is 60, each group member receives $60 \cdot 0.4 = 24$ tokens out of pot X. If all group members together contribute 10 tokens to pot X, you and all other group members receive $10 \cdot 0.4 = 4$ tokens from pot X.
2. You can put 0 to 20 tokens into **pot** $\boldsymbol{Y}$. The tokens in pot Y enter your profit one-to-one. For example, this means that if you contribute 6 tokens to pot Y, you receive exactly 6 tokens from pot Y.

Your profit per period is the sum of the earnings from pot X and from pot Y. Mathematically:

$$\textbf{Result (for group member } \boldsymbol{i}\textbf{)} = \mathbf{(20 - \boldsymbol{x}) + (\boldsymbol{S} \cdot 1.6)/4}$$
x = contribution of member i to pot X
S = sum of contributions of *all* group members to pot X

On the screen, you will be asked how many tokens you want to contribute to pot X. The rest of the tokens will automatically be allocated to pot Y. Saving tokens for a later period is therefore not possible. You can only choose integer numbers between and including 0 and 20 tokens.

After each period you receive information on the contributions to pot X and Y of all group members as well as what each group member has earned in this period. However, you are of course not able to link the information to specific persons in this room because all decisions (as mentioned above) will remain anonymous. Moreover, the participants'

IDs within your group will change every period so that it is impossible for you to track the behavior of other group members over periods. After receiving feedback, the next period starts. After 10 periods, this part of the experiment ends. The profits from all periods will be added and converted into euro.

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

Part III

At the end of the experiment, the tokens that you earn in Part III will be converted into euro at the exchange rate of **20 tokens = 0.6 euro** (1 token = 3 cent).

Again, this part of the experiment consists of **10 identical periods** in which you interact in groups of four. Nobody will find out with whom he forms a group – not during the experiment and not after the experiment either. The group composition is the same as in Part II and remains constant during the entire Part III, too [**STRANGER**: The group composition, as in Part II, varies randomly from one period to the next]. This means that you are connected to the same [**STRANGER**: different] persons in every period.

Endowment and Alternatives in Each Period

Each participant receives an initial endowment of **20 tokens** at the beginning of each period. However, each period now consists of three stages:

Stage 0:

For reasons of comprehensibility, the details of stage 0 will be described below.

Stage 1 (**same as Part II**):

In stage 1 you can again allocate your 20 tokens to two alternatives, $\boldsymbol{X}$ and $\boldsymbol{Y}$:

1. You can put 0 to 20 tokens into **pot** $\boldsymbol{X}$. The sum of all contributions within your group to pot X will be multiplied by 1.6 and equally distributed among the group members afterwards. This means that for any token in pot X you receive 0.4 (= 1.6/4) tokens. For example, if the sum of tokens in pot X in your group is 60, each group member receives $60 \cdot 0.4 = 24$ tokens out of pot X. If all group members together contribute 10 tokens to pot X, you and all other group members receive $10 \cdot 0.4 = 4$ tokens from pot X.
2. You can put 0 to 20 tokens into **pot** $\boldsymbol{Y}$. The tokens in pot Y enter your profit one-to-one. For example, this means that if you contribute 6 tokens to pot Y, you receive exactly 6 tokens from pot Y.

Your profit per period is the sum of the earnings from pot X and from pot Y. Mathematically:

$$\textbf{Result (for group member } \boldsymbol{i}\textbf{)} = \mathbf{(20 - \boldsymbol{x}) + (\boldsymbol{S} \cdot 1.6)/4}$$
x = contribution of member i to pot X
S = sum of contributions of *all* group members to pot X

On the screen, you will be asked how many tokens you want to contribute to pot X. The rest of the tokens will automatically be allocated to pot Y. Saving tokens for a later period is therefore not possible. You can only choose integer numbers between and including 0 and 20 tokens.

Stage 2:

You receive information on the contributions to pot X and Y of all group members and you may be able, depending on the decisions in stage 0, to change the result of your group members. There are three alternatives:

1. You, as a group, could have decided in stage 0 that it is possible to **subtract *L* tokens** from the result of another group member in stage 2 at **own costs of 1** ($L < 0$).
2. You, as a group, could have decided in stage 0 that it is possible to **add *L* tokens** to the result of another group member in stage 2 at **own costs of 1** ($L > 0$).
3. You, as a group, could have decided in stage 0 that the result of stage 1 remains **unchanged** ($L = 0$).

In case alternative 1 or 2 is chosen, each group member is able to change another group member's result in stage 2 by assigning a (subtraction or addition) point to this person. Assume, for example, your group agreed on $L = -2$. Then, in stage 2 each group member can decide for each other group member individually whether or not he wants to assign a subtraction point to this person. If he assigns a subtraction point to exactly one other group member, then his payoff will be reduced by one token and the payoff of the respective group member will be reduced by two tokens. If he assigns a subtraction point to two other group members, then his payoff will be reduced by $2 \cdot 1$ token and the payoff of both other group members will be reduced by 2 tokens each, etc.

At the end of stage 2 you will receive information, if applicable, on how many (subtraction or addition) points each group member assigned and received, as well as what each group member has earned in this period. Afterwards, the next¡ period starts. However, you will not find out on an individual level who assigned a point to whom and, as in Part II, you are of course not able to link information to specific persons in this room because all decisions remain anonymous. The participants' IDs within your group will change every period so that it is again impossible for you to track the behavior of other group members over periods.

During Part III you will take decisions in 10 identical periods that correspond to the description above. Each period consists of the three stages mentioned.

Now coming to the exact description of stage 0:

As already mentioned, you can choose between three alternatives that matter for stage 2:

1. **subtraction possibility:** possibility to **subtract *L* tokens** from the result of other group members in stage 2 ($L < 0$);
2. **addition possibility:** possibility to **add *L* tokens** to the result of other group members in stage 2 ($L > 0$);
3. **unchanged result** ($L = 0$).

For the subtraction and addition possibility you also have to determine the exact size of L within your group.

How does the selection process work within your group?

1. First, each group member states his preferred L-value out of the following interval: $L \in \{-5, -4, -3, -2, -1, 0, +1, +2\}$. Note that values $L < 0$ correspond to the subtraction possibility (**alternative 1**), $L = 0$ corresponds to **alternative 3** and values $L > 0$ correspond to the addition possibility (**alternative 2**).
2. The four L-values proposed by the group members will then be assigned to the three alternatives (i) $L < 0$, (ii) $L = 0$, and (iii) $L > 0$.
3. The alternative with the relative majority within the group will be implemented.
4. If $L = 0$ (no subtraction or addition possibility) gets the relative majority, stage 0 ends and is immediately followed by stage 1.
5. If $L < 0$ or $L > 0$ gets the relative majority, there will be a second voting round in which all four group members vote on the exact size of L. In doing so, group members are not tied to their previous proposals.

   If $L < 0$ gets the relative majority, the now available values are: $L \in \{-5, -4, -3, 2, -1\}$.

   If $L > 0$ gets the relative majority, the now available values are: $L \in \{+1, +2\}$.

   The mean of the second proposals of all four group members will finally be implemented for the whole group.
6. If there is a tie in the first voting round (this means that there is no relative majority for one alternative), one of the four first-round proposals of the group members will randomly be determined and directly implemented. Stage 1 will then start without having any further voting round.

Please note that the chosen L-value is valid only for the respective period. In the following period, the same election process starts again and the group can agree on a different value of L.

Description of Profits

In the following we summarize period profits depending on the alternative chosen in stage 0.

(a) Unchanged result ($\boldsymbol{L = 0}$):

Result (for group member i) = $(20 - x) + (S \cdot 1.6)/4$

x = contribution of member i to pot X

S = sum of contributions of *all* group members to pot X

(b) Subtraction possibility ($\boldsymbol{L < 0}$):

$$\begin{aligned}&\text{Result (for group member } i\text{)}\\ &\quad = (20 - x) + (S \cdot 1.6)/4 + \underbrace{L \cdot (\text{sum of received subtraction points})}_{\text{this expression is negative}}\\ &\qquad - \text{sum of assigned subtraction points}\end{aligned}$$

(c) Addition possibility ($\boldsymbol{L > 0}$):

$$\begin{aligned}&\text{Result (for group member } i\text{)}\\ &\quad = (20 - x) + (S \cdot 1.6)/4 + \underbrace{L \cdot (\text{sum of received addition points})}_{\text{this expression is positive}}\\ &\qquad - \text{sum of assigned addition points}\end{aligned}$$

The End

After the 10 periods, the whole experiment ends. Profits from all periods of Part III will be added and converted into euro. After filling out a short post-experimental questionnaire, you will receive your total earnings from the experiment privately and in cash.

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

A.2 The Preferences According to Fehr and Schmidt (1999) and Charness and Rabin (2002)

A.2.1 Theoretical Predictions with the Preferences According to Fehr and Schmidt (1999)

Standard VCM ($L = 0$). For $L = 0$, we can apply Proposition 4 of Fehr and Schmidt (1999, see p. 839). Following 4(a), each group member with $\gamma + \beta_i < 1$, i.e., $\beta_i < 0.6$, contributes $c_i = 0$ irrespective of the choices of her group members. Moreover, in line with 4(b) there is no equilibrium with positive contributions in the standard VCM if the number of group members with $\beta_i < 0.6$ is larger than $(n - 1) \cdot \gamma/2 = 0.6$. Hence, one person with $\beta_i < 0.6$ is already enough to completely destroy any cooperation within the group. Equilibria with positive contributions are only possible if *all* group members satisfy $\beta_i \geqslant 0.6$, i.e., we have four so-called "conditional cooperators" that are sufficiently averse to advantageous inequity. Note that this event is rather unlikely and occurs, following the parameter distribution given in Fehr and Schmidt (1999, p. 844), only in $0.4^4 = 2.56\%$ of cases. If it occurs, then there are according to 4(c) multiple equilibria and each group member contributes $c_i = c \in [0, E]$.

PROPOSITION A1 *In the standard VCM ($L = 0$), complete free-riding ($c_i = 0\,\forall i$) is the equilibrium outcome if at least one group member satisfies $\beta_i < 0.6$. Only if all group members fulfill $\beta_i \geqslant 0.6$, i.e., if they are sufficiently averse to advantageous inequity, there exist equilibria with positive contributions $c_i = c \in [0, E]$.*

VCM with Punishment ($L < 0$). For $L < 0$, we apply Proposition 5 of Fehr and Schmidt (1999, p. 841) to account for the punishment possibilities. Assume that there exists a group of $n' \leqslant n$ "conditional cooperators" who satisfy $\gamma + \beta_i \geqslant 1$, i.e., $\beta_i \geqslant 0.6$, whereas all other group members do not care at all about inequity, i.e., for them $\alpha_i = \beta_i = 0$. Further, denote k as the costs that arise when a subject punishes another group member. Note that we have $k = 1$ in the experiment. Consider then the following strategies derived from Proposition 5: All group members contribute $c_i = c \in [0, E]$. If each group member does so, no punishment occurs. If one of the selfish subjects deviates by contributing $c_i < c$, all conditional cooperators punish the deviator while the remaining subjects do not punish. If one of the conditional cooperators chooses $c_i < c$ or if some subject contributes $c_i > c$ or if more than one subject deviates from c, then one Nash equilibrium of the punishment game is played. These strategies form a subgame-perfect equilibrium with contribution level c and zero punishment if the following three conditions are satisfied: *(i)* no conditional cooperator benefits from contributing less than c, *(ii)* no selfish subject benefits from contributing less than c given the punishment of the n' conditional cooperators and *(iii)* each conditional cooperator has an incentive to punish selfish subjects who contribute $c_i < c$ thereby generating a credible punishment threat.[1]

[1] Note that deviating by contributing $c_i > c$ is never profitable as it both reduces the monetary payoff and increases inequity. Furthermore, there is no reason to punish if all group

Condition *(i)* is satisfied by construction as all subjects with $\beta_i \geqslant 0.6$ have an intrinsic motivation to contribute $c_i = c$ if all other group members contribute c (that is why we call them *conditionally* cooperative). Hence, conditional cooperators will never deviate from a symmetric equilibrium. Two things follow immediately: if $n' = 4$ there exists a multiplicity of equilibria in which each group member contributes $c_i = c \in [0, E]$ and if $n' = 0$, i.e., all subjects are selfish, there is no equilibrium with positive contributions. These findings are equivalent to the case of $L = 0$.

Regarding condition *(ii)*, notice the following: If a selfish subject deviates by contributing $c_i < c$, she obtains a monetary gain of $(c - c_i)(1 - \gamma)$ which she maximizes by choosing $c_i = 0$. However, if she gets punished by the n' conditional cooperators she additionally suffers a monetary loss of $n'|L|$. Hence, deviating from contributing c is never profitable as long as

$$c \leqslant \frac{n'|L|}{(1-\gamma)} \equiv \bar{c}.$$

The parameter $\bar{c}$ denotes the maximum contribution level that can be sustained in equilibrium given the marginal per capita return (MPCR) γ and n' conditional cooperators who punish through a leverage of $|L|$. The condition below shows that $|L|$ increases in $\bar{c}$. Hence, the requirements on the strength of the enforcement mechanism rise, holding the MPCR and n' constant, in the contribution level that one wants to sustain in equilibrium.

$$\frac{\partial |L|}{\partial \bar{c}} = \frac{(1-\gamma)}{n'} > 0.$$

It is noteworthy, that for our parameter constellation full cooperation (i.e., $c_i = 20\,\forall i$) is only possible for $n' = 3$ and $|L| \geqslant 4$ (and, of course, for $n' = 4$).

Finally, condition *(iii)* requires that the punishment threat is credible. Hence, we compare a conditional cooperator i's utility change in the punishment stage if she punishes the deviator with her utility change if she does not punish maintaining the assumption that the $n' - 1$ other conditional cooperators punish the deviator. The former utility change is not worse than the latter if the following inequality holds:[2]

$$\begin{aligned} & -k - \frac{\alpha_i}{n-1}(n - n' - 1)k - \frac{\alpha_i}{n-1}(k - n'|L|) \\ \geqslant & -\frac{\alpha_i}{n-1}(-(n'-1)|L|) - \frac{\beta_i}{n-1}(n'-1)k. \end{aligned}$$

The left-hand side of the condition describes the case that person i punishes the deviator and consists of three terms. The first term captures the monetary costs of punishing. The second term contains the disadvantageous inequity towards the $n - n' - 1$ selfish subjects who contribute but do not punish and the third term comprises the disadvantageous inequity towards the deviator who receives punishment by all n' conditional cooperators.

members contribute c due to the lack of inequity.

[2] Note that we assume in the condition that the free-rider's payoff after punishment is not below those of the conditional cooperators. This is satisfied for $c \geqslant n'L - k$ which is in our experiment for sure the case if $c \geqslant 14$.

On the right-hand side we have the case that person i does not punish. Then, there is disadvantageous inequity towards the deviator based on the punishment of the $n'-1$ other conditional cooperators and advantageous inequity towards the $n'-1$ punishing conditional cooperators. If we rearrange and simplify the above condition we arrive at

$$\frac{|L|}{k} \geqslant (n-n') + \frac{1}{\alpha_i}[(n-1) - \beta_i(n'-1)].$$

Note that this inequality condition can be fulfilled even if there is only one conditional cooperator. Hence, punishment can be a credible threat. Inserting $k = 1$ and $n = 4$ the critical value of L is given by

$$|L| = (4-n') + \frac{1}{\alpha_i}[3 - \beta_i(n'-1)].$$

Thus, we can compute how the critical value of $|L|$ changes with regard to the inequity aversion parameters α_i and β_i:

$$\frac{\partial|L|}{\partial\alpha_i} = -\frac{1}{\alpha_i^2}[3 - \beta_i(n'-1)] < 0 \quad \text{for } n' \geqslant 1,$$

$$\frac{\partial|L|}{\partial\beta_i} = -\frac{n'-1}{\alpha_i}\begin{cases} = 0 & \text{for } n' = 1, \\ < 0 & \text{for } n' > 1. \end{cases}$$

Both derivatives are negative (except for $n' = 1$ in, when β_i does not play any role for the determination of $|L|$). This means that the requirement on $|L|$ which is necessary to make the punishment threat credible (holding n' constant) decreases in both inequity aversion parameters. Or, put it differently, the less inequity averse the conditional cooperators are, the stronger the punishment mechanism must be to induce punishment of deviators. Hence, a higher value of $|L|$ is more likely to make punishment of free-riders credible. To give some numerical examples, first consider $n' = 3$. If we assume the lowest bounds on α_i and β_i each conditional cooperator has to satisfy per definition, i.e., $\alpha_i = \beta_i = 0.6$, the critical value is $|L| = 4$. On the contrary, if we for example assume that each conditional cooperator satisfies $\beta_i = 1$ and $\alpha_i = 4$, all $|L| \geqslant 1.25$ make punishment credible. Similarly, for $n' = 2$ ($n' = 1$), the corresponding values for $|L|$ are 6 (8) and 2.5 (3.75).[3]

To sum up, the preferences according to Fehr and Schmidt provide two reasons to vote for a strong punishment instrument in voting round two. First, the higher $|L|$, the less restrictive are the requirements on the conditional cooperators' inequity aversion parameters α_i and β_i and, hence, the more likely is punishment a credible threat and cooperation possible in a subgame-perfect equilibrium. Second, the higher $|L|$ the higher contribution levels can be sustained in equilibrium for a given number of punishing conditional cooperators. Note that efficiency strictly increases in equilibria with higher contribution levels which makes the implementation of a strong punishment instrument profitable. As the mean value of proposed L parameters is implemented within the group, each group member affects the result and has therefore a preference for $L = -5$.

[3] Note that in our experiment the punishment leverage is restricted by $|L| \leqslant 5$.

Proposition A2 *In the VCM with punishment ($L < 0$), a group of $n' \leqslant n$ conditional cooperators with $\beta_i \geqslant 0.6$ can enforce positive contributions $c \leqslant n'|L|/(1-\gamma) \equiv \bar{c}\ \forall i$ if each conditional cooperator cares sufficiently about disadvantageous inequity. Equilibria with positive contributions (and zero punishment) can more easily be sustained when $|L|$ increases and can support higher contribution levels. Hence, subjects in voting round two have an incentive to vote for the maximum punishment level $L = -5$. If all group members satisfy $\beta_i \geqslant 0.6$, equilibria with $c_i = c \in [0, E]$ can be sustained irrespective of L.*

VCM with Reward ($L > 0$). Analogous to the case of punishment, we assume that there exists a group of $n' \leqslant n$ "conditional cooperators" who satisfy $\beta_i \geqslant 0.6$, whereas all other group members have $\alpha_i = \beta_i = 0$. Moreover, the costs of rewarding another subject are defined by $k = 1$ in the experiment. Consider the following strategies: All group members contribute $c_i = c \in [0, E]$. If each group member does so, each of the n' conditional cooperators rewards all her group members while the other subjects do not reward. If one group member deviates by contributing $c_i < c$, no group member rewards the deviator. If some subject contributes $c_i \geqslant c$ or if more than one subject deviates from c, then one Nash equilibrium of the reward game is played.

Let us check whether the reward incentive is credible given that all group members contribute c. Note that selfish subjects never reward as they do not care at all about inequity. For a conditional cooperator i we have to determine whether the utility change of rewarding is beneficial or not. We assume in the following condition that she either rewards all her group members (left-hand side) or none of them (right-hand side):[4]

$$-(n-1)k - \frac{\alpha_i}{n-1}(n-n')[L+(n-1)k] \ \geqslant\ -\frac{\beta_i}{n-1}(n'-1)[L+(n-1)k].$$

The first term on the left-hand side captures the monetary costs of rewarding each of the other $n-1$ group members while the second term describes the disadvantageous inequity towards the selfish subjects who do not reward. The term on the right-hand side denotes the advantageous inequity towards the $n'-1$ conditional cooperators who reward. If we rearrange, this leads to the following expression:

$$(n-1)k + \frac{1}{n-1}[L+(n-1)k][\alpha_i(n-n') - \beta_i(n'-1)] \leqslant 0.$$

Inserting $k = 1$ and $n = 4$ and further rearranging yields

$$\alpha_i(4-n') - \beta_i(n'-1) \leqslant -\frac{9}{L+3}.$$

Note that in our reward institution $1 \leqslant L \leqslant 2$ holds and, hence, the right-hand side cannot be larger than $-9/5$. To fulfill the latter condition, i.e., to make reward credible, the left-hand side has to be smaller than this value. However, this is never satisfied

[4] This is done because there is no possibility for subject i to distinguish between selfish and nonselfish subjects.

for $n' < n$. To see this, consider the most critical case $n' = 3$, in which the condition demands at least $\alpha_i - 2\beta_i \leqslant -9/5$. Inserting the lowest possible value of α_i, $\alpha_i = \beta_i$, would imply $\beta_i \geqslant 9/5$, which is impossible. Thus, irrespective of L there is no equilibrium in which reward is used only by a subgroup of individuals. For $n' = n$, however, mutual reward can be part of the equilibrium. In this case the condition shortens to $\beta_i \geqslant 3/(L+3)$ or $L \geqslant 3/\beta_i - 3$. Hence, the critical value of L decreases in β_i (see the following condition) and the minimum requirements on β_i lie between $\beta_i \geqslant 0.75$ for $L = 1$ and $\beta_i \geqslant 0.6$ for $L = 2$:

$$\frac{\partial L}{\partial \beta_i} = -\frac{3}{\beta_i^2} < 0.$$

To sum up, if all group members satisfy $\beta_i \geqslant 0.6$, each contribution level $c_i = c \in [0, E]$ can be sustained in a subgame-perfect equilibrium like in the absence of reward ($L = 0$). Moreover, mutual reward can be part of such an equilibrium if $L = 2$. For lower levels of L, mutual reward is only possible if we have correspondingly stronger assumptions on β_i. Thus, subjects have an incentive to vote for $L = 2$ in the second voting round to increase prospects for mutual reward and to make reward more beneficial. As the mean value of proposed L parameters is implemented, this incentive holds for each group member.

Nevertheless, such equilibria are rather unlikely as $\beta_i \geqslant 0.6\ \forall i$ appears only in about 2.56% of cases. If one group member satisfies $\beta_i < 0.6$, this group member has no incentive to reward and, hence, there is no reward at all within the group. It follows that we observe complete free-riding in equilibrium, irrespective of L, when there is at least one group member with $\beta_i < 0.6$. Hence, subjects are indifferent between both positive leverage levels in this case.[5]

Proposition A3 *In the VCM with reward ($L > 0$), complete free-riding ($c_i = 0\ \forall i$) and zero reward arise in equilibrium if at least one group member satisfies $\beta_i < 0.6$. In this case, subjects are completely indifferent between leverage levels. Only if all group members fulfill $\beta_i \geqslant 0.6$, i.e., if they are sufficiently averse to advantageous inequity, there exist equilibria with positive contributions $c_i = c \in [0, E]$. Moreover, in equilibrium subjects are willing to reward each other if all of them satisfy $\beta_i \geqslant 3/(L+3)$. As mutual reward can more easily be sustained and is more beneficial when L increases, subjects have an incentive to vote for $L = 2$ in the second voting round.*

Institutional Voting (first voting round). We have seen that for the case of $\beta_i \geqslant 0.6\ \forall i$ equilibria with positive contributions $c_i = c \in [0, E]$ can be sustained irrespective of the chosen leverage level. Moreover, if $L = 2$ mutual reward can for sure be part of the equilibrium strategy. Hence, subjects have an incentive to vote for $L = 2$ if $\beta_i \geqslant 0.6\ \forall i$ holds in order to implement the most profitable equilibrium. Note that voting for $L = 2$ weakly dominates the alternative reward option $L = 1$ in the first voting round if we assume that ties occur with some positive probability (e.g., because

[5] If we apply trembling-hand perfection, inequity-averse subjects might have an incentive to vote for $L = 1$ as this leverage level minimizes the monetary consequences of an accidental use of the reward instrument.

subjects make mistakes). Otherwise, subjects would be indifferent between $L = 1$ and $L = 2$ as the exact level of reward is only determined in the second voting round.

In contrast, if there is at least one group member satisfying $\beta_i < 0.6$, positive contributions cannot be sustained in equilibrium in both the standard VCM and the reward institution. Taking into account the distribution of β presented in Fehr and Schmidt (1999), this is the large majority of cases (97.44%). The situation differs in the punishment institution. Here, a single conditional cooperator can already be enough to enforce positive contributions if she is sufficiently averse to disadvantageous inequity. The likelihood of this event and the enforceable contribution level increase in the implemented leverage level and, thus, subjects should choose $L = -5$ in the second voting round if punishment was selected. Choosing $L = -5$ also weakly dominates the other punishment levels in voting round one when subjects believe that ties happen with some positive probability. For the case of $L = -5$, one conditional cooperator with $\beta_i \geqslant 0.6$ and $\alpha_i \geqslant 1.5$ is sufficient to sustain equilibria with positive contributions. Following Fehr and Schmidt (1999), 40% of subjects satisfy $\beta_i \geqslant 0.6$ and $\alpha_i \geqslant 1$. If we assume that 30% also fulfill $\alpha_i \geqslant 1.5$,[6] the probability of having at least one such inequity-averse conditional cooperator in a four-person group is $1 - 0.7^4 = 75.99\%$. Hence, cooperation chances are greatly improved under the punishment institution compared to the standard VCM or the reward institution and it is therefore optimal (in most of the cases) to vote for $L = -5$.

Proposition A4 *Given that subjects can vote for the standard VCM, the VCM with punishment or the VCM with reward by choosing a leverage level out of* $[-5, 2]$*, they prefer the punishment institution and choose* $L = -5$ *as this maximizes cooperation possibilities and payoffs.*

A.2.2 Theoretical Predictions with the Preferences According to Charness and Rabin (2002)

Standard VCM ($L = 0$). For $L = 0$, a selfish subject with $\lambda_i = 0$ has obviously no incentive to contribute to the public account. A subject that cares about social welfare (i.e., $\lambda_i > 0$) has to consider that contributing one unit to the public account reduces her monetary payoff by $1 - \gamma$, increases the sum of group members' payoffs by $n\gamma - 1$, and decreases the minimum payoff in the group by $1 - \gamma$.[7] Weighting these aspects according

[6] This percentage cannot be directly inferred from Fehr and Schmidt (1999) as they only state that 40% of subjects fulfill $\alpha_i \geqslant 1$ and 10% even satisfy $\alpha_i \geqslant 4$. By employing 30% we therefore carefully assume a decreasing probability mass in the interval $[1, 4]$.

[7] Note that the decrease in the minimum payoff is strictly true only for the case in which no other subject contributes. If there are already positive contributions, a subject could, on the contrary, increase the minimum payoff by contributing positive amounts. In this case the condition changes into $\delta_i \leqslant 6 - 3/\lambda_i$, which also yields $\lambda_i \geqslant 0.5$ but contains a less restrictive requirement for δ_i. For the ease of analysis we neglect this aspect in the following. Note that the condition generates contribution incentives *irrespective* of group members' decisions.

to the utility function yields the following inequality:

$$-(1-\lambda_i)(1-\gamma)+\lambda_i(1-\delta_i)(n\gamma-1)-\lambda_i\delta_i(1-\gamma)\geqslant 0.$$

If we rearrange and insert $\gamma = 0.4$ and $n = 4$, we arrive at

$$\delta_i \leqslant 1-\frac{1}{2\lambda_i}.$$

The condition shows that subject i contributes to the public account if $\lambda_i \geqslant 0.5$ (necessary to get nonnegative values for δ_i) and if δ_i is sufficiently low, depending on the exact value of λ_i (for sure $\leqslant 0.5$).[8] In this case, i.e., if she cares enough about group efficiency, she contributes her entire endowment E. On the contrary, subjects with $\lambda_i < 0.5$ do not contribute. Note that the condition contains only the individual's own social-welfare parameters. Hence, if it is satisfied, she contributes independent of the number of free-riders within the group. Such subjects are called "cooperators."[9]

PROPOSITION A5 *In the standard VCM ($L = 0$), each group member with $\lambda_i < 0.5$ contributes $c_i = 0$. On the contrary, group members who fulfill $\lambda_i \geqslant 0.5$ and $\delta_i \leqslant 1 - 1/2\lambda_i$, i.e., who are sufficiently total-surplus oriented, contribute their entire endowment: $c_i = E$.*

VCM with Punishment ($L < 0$). Assume that there exists a group of $n'' \leqslant n$ "cooperators" who satisfy $\lambda_i \geqslant 0.5$ and $\delta_i \leqslant 1 - 1/2\lambda_i$, whereas all other group members do not care at all about social welfare (i.e., $\lambda_i = 0$). Note that cooperators can only motivate selfish subjects to contribute $c_i > 0$ if the latter's monetary gain from contributing is higher than from free-riding. This is fulfilled if $c \leqslant n''|L|/(1-\gamma) \equiv \bar{c}$. However, the punishment threat is not credible with the preferences according to Charness and Rabin (2002). The act of punishing would reduce (i) a cooperator's own payoff, (ii) the sum of group members' payoffs, and perhaps even (iii) the minimum payoff in the group. Hence, punishment of free-riders does never occur and no subject can be motivated to contribute through the threat of punishment. Subjects are therefore indifferent between leverage levels and equilibrium outcomes equal those of $L = 0$.[10]

PROPOSITION A6 *In the VCM with punishment ($L < 0$), punishment is not credible and subjects are indifferent between leverage levels. Like for $L = 0$, each group member with $\lambda_i < 0.5$ contributes $c_i = 0$, while group members who fulfill $\lambda_i \geqslant 0.5$ and $\delta_i \leqslant 1 - 1/2\lambda_i$ contribute their entire endowment: $c_i = E$.*

[8] Strictly speaking, subject i is indifferent if the condition holds with equality. In the following, we mostly ignore such indifferences for simplicity.

[9] Note that these subjects are *un*conditionally cooperative in contrast to the model of Fehr and Schmidt (1999).

[10] The concept of trembling-hand perfection suggests that subjects vote for $L = -1$ as this minimizes the impact of an accidental use of the punishment instrument.

VCM with Reward ($L > 0$). Again, define a group of $n'' \leqslant n$ cooperators who satisfy $\lambda_i \geqslant 0.5$ and $\delta_i \leqslant 1 - 1/2\lambda_i$, whereas all other group members do not care at all about social welfare (i.e., $\lambda_i = 0$). Consider the following strategies: Each cooperator contributes $c_i = E$, while all other group members contribute $c_i = c \in [0, E]$. If each group member does so, each of the n'' cooperators rewards all her group members while selfish subjects do not reward. If one selfish subject deviates by contributing $c_i < c$, no group member rewards the deviator. If one of the selfish subjects chooses $c_i > c$ or if one of the cooperators contributes $c_i < E$ or if more than one subject deviates, then one Nash equilibrium of the reward game is played.

We have to check our three conditions: First, we need cooperators that have an intrinsic motivation to contribute E, i.e., satisfy $\lambda_i \geqslant 0.5$ and $\delta_i \leqslant 1 - 1/2\lambda_i$. This is fulfilled by construction. It follows immediately that if $n'' = 0$, there is no equilibrium with positive contributions (and reward) and if $n'' = 4$, there exists an equilibrium in which each group member contributes $c_i = E$.

Second, a selfish subject does not benefit from contributing $c_i < c$. Deviating leads to a monetary gain of $(c - c_i)(1 - \gamma)$ but generates a monetary loss of $n''L$, because it destroys reward of the n'' cooperators. This results in the analogous condition as for the preferences according to Fehr and Schmidt:

$$c \leqslant \frac{n''L}{(1-\gamma)} \equiv \bar{c}.$$

If this condition is satisfied, a selfish subject cooperates. Note that the leverage level L increases in the maximum contribution level $\bar{c}$ as shown above. Hence, higher contribution levels of selfish subjects can only be enforced, holding the MPCR and n'' constant, if the reward mechanism becomes stronger. It is, however, noteworthy that for our reward institution with $L \leqslant 2$, full cooperation (i.e., $c_i = 20\ \forall i$) is never possible if there is at least one selfish group member. From this member only contributions up to a level of $c = 10$ can be enforced (the latter for the case of three cooperators and $L = 2$).

Third, it must be beneficial for a cooperator i to reward selfish subjects. Hence, we compare the utility change in the reward stage when cooperator i rewards all her group members with the utility change if she only rewards the $n'' - 1$ other cooperators given that they stick to their reward strategy.[11] This yields the following inequality:

$$\begin{aligned}
&(1-\lambda_i)\big[(n''-1)L-(n-1)k\big] \\
&\quad+\lambda_i\Big[\delta_i\big[(n''-1)L-(n-1)k\big] \\
&\qquad\qquad+(1-\delta_i)\Big(n''\big[(n''-1)L-(n-1)k\big]+(n-n'')(n''L)\Big)\Big] \\
&\geqslant (1-\lambda_i)\big[(n''-1)L-(n''-1)k\big]
\end{aligned}$$

[11] Note that "reward only cooperators" instead of "reward nobody" is the relevant alternative strategy as it can reduce monetary costs without decreasing the minimum payoff in the group. Further, due to the linearity of preferences it can never be profitable to discriminate within the group of cooperators and/or the group of selfish subjects. For $n'' = 4$, there is no selfish subject and the following calculations do not hold. We will cover this special case below.

$$
\begin{aligned}
&+ \lambda_i \Big[\delta_i \big[(n''-1)L - (n''-1)(6-1.5n'')k \big] \\
&\quad + (1-\delta_i) \Big((n''-1)\big[(n''-1)L-(n-1)k\big] + (n-n'')(n''-1)L \\
&\qquad + 1\big[(n''-1)L-(n'-1)k\big] \Big) \Big].
\end{aligned}
$$

Rearranging and simplifying leads to

$$
\frac{L}{k} \geqslant \frac{(1-\lambda_i)(n-n'') + \lambda_i\delta_i\big((n-1)-(6-1.5n'')(n''-1)\big) + \lambda_i(1-\delta_i)(n-n'')}{\lambda_i(1-\delta_i)(n-n'')}.
$$

Note that the right-hand side is larger or equal to 1 as the last term of the numerator equals the denominator and both prior terms are nonnegative. From this it follows that for $L = k$ the reward strategy can only be credible through indifference if $\lambda_i = 1$ (first term vanishes) and in the case of $n'' = 1$ additionally $\delta_i = 0$ (second term vanishes). Hence, if there is no efficiency gain in rewarding, reward can only be part of the equilibrium if cooperators do not care at all about their costs ($\lambda_i = 1$) and if reward either does not influence the minimum payoff ($n'' > 1$) or subjects do not care about the "Rawlsian" criterion ($\delta_i = 0$). Further, note that by inserting $n = 4$ the condition reduces to

$$
\frac{L}{k} \geqslant \frac{1}{\lambda_i(1-\delta_i)} \quad \text{for } n''=1 \qquad \text{and} \qquad \frac{L}{k} \geqslant \frac{1-\lambda_i\delta_i}{\lambda_i(1-\delta_i)} \quad \text{for } n''>1.
$$

Inserting $k = 1$ and $n = 4$ yields the following critical value of L:

$$
L = \frac{(1-\lambda_i)(4-n'') + \lambda_i\delta_i\big(3-(6-1.5n'')(n''-1)\big) + \lambda_i(1-\delta_i)(4-n'')}{\lambda_i(1-\delta_i)(4-n'')}.
$$

The critical value of L changes with regard to the social-welfare parameters λ_i and δ_i as follows:

$$
\frac{\partial L}{\partial \lambda_i} = -\frac{1}{\lambda_i^2(1-\delta_i)} < 0;
$$

$$
\frac{\partial L}{\partial \delta_i} = \frac{1}{(1-\delta_i)^2}\left(\frac{1}{\lambda_i} + \frac{5-6.5n''+1.5n''^2}{4-n''}\right) \begin{cases} > 0 & \text{for } n''=1, \\ \geqslant 0 & \text{for } n''>1. \end{cases}
$$

Hence, the requirement on L that is necessary to make reward credible decreases in the social-welfare parameter λ_i and increases in the maximin parameter δ_i. Regarding λ_i, this means that the more social-welfare-oriented subjects are, the less efficient can the reward mechanism be to sustain reward in equilibrium. Or, reversing the interpretation, a higher value of L puts less restriction on subjects' social-welfare parameters and is therefore more likely to make reward credible. Regarding δ_i, note that a higher weight on the maximin aspect of social welfare vice versa decreases the importance of the efficiency concern. Hence, we need a higher value of L to compensate for the reduced weight on efficiency, as efficiency is the only reason for cooperators to reward selfish subjects. The weight δ_i is irrelevant (see the zero derivative in the condition) for the special case of $n'' > 1$ and $\lambda_i = 1$, because in this situation there is no trade-off between the different aspects of the utility function, as subjects do not care about their own monetary costs and the minimum payoff cannot be affected by the reward choice. To give some numerical examples, first consider $L = 1$. As already mentioned above, in this case reward can only be part of an equilibrium strategy in the extreme case of $\lambda_i = 1$. Moreover, for $n'' = 1$ we additionally need $\delta_i = 0$. For $L = 2$ (and $k = 1$), we require $\delta_i \leqslant (2\lambda_i - 1)/2\lambda_i$ for $n'' = 1$ and $\delta_i \leqslant (2\lambda_i - 1)/\lambda_i$ for $n'' > 1$. Note that the first condition exactly equals the cooperator's constraint from above, while the second condition is less demanding than the first one. Hence, each cooperator can credibly reward selfish subjects for $L = 2$. In comparison to the case of $L = 1$ reward possibilities are greatly improved. Therefore, subjects have an incentive to vote for $L = 2$ in the second voting round to improve conditions for the reward of selfish subjects (and to raise the enforceable contribution level). Note that this incentive holds for all group members as the mean value of the proposed parameters is implemented.[12]

Finally, let us briefly consider $n'' = 4$. In this case there is no selfish subject and positive contributions need not be enforced as each subject has an intrinsic motivation to contribute $c_i = E$. However, mutual reward is not necessarily part of the equilibrium because a cooperator in the reward stage can have an incentive to reward none of her group members. Therefore, we have to check the following inequality:[13]

$$\begin{aligned}
&(1-\lambda_i)\big[(n''-1)L-(n-1)k\big] \\
&\quad + \lambda_i\Big[\delta_i\big[(n''-1)L-(n-1)k\big] \\
&\qquad\quad + (1-\delta_i)\Big(n''\big[(n''-1)L-(n-1)k\big] + (n-n'')(n''L)\Big)\Big] \\
\geqslant\ &(1-\lambda_i)(n''-1)L \\
&\quad + \lambda_i\Big[\delta_i\big[(n''-1)L-L-(n-1)k\big] \\
&\qquad\quad + (1-\delta_i)\Big((n''-1)\big[(n''-1)L-L-(n-1)k\big] + (n-n''+1)(n''-1)L\Big)\Big].
\end{aligned}$$

Rearranging and simplifying leads to the following condition that holds irrespective of n'':

$$\frac{L}{k} \geqslant \frac{(n-1)(1-\lambda_i\delta_i)}{\lambda_i(2\delta_i - 1 + (1-\delta_i)n)}.$$

Inserting $k = 1$ and $n = 4$ yields the following critical value of L:

$$L = \frac{3 - 3\lambda_i\delta_i}{\lambda_i(3 - 2\delta_i)}.$$

[12] Selfish subjects are indifferent if the maximum contribution level $\bar{c}$ is enforced. However, if they believe that there is a possibility to participate in the cooperators' gains from choosing $L = 2$ or if we use a reasonable equilibrium refinement argument like Pareto optimality this leads to the conclusion that those subjects always vote for $L = 2$.

[13] Note that this inequality holds for all $1 < n'' \leqslant 4$ but does not capture the most relevant deviation for $n'' < 4$.

The critical value of L changes with regard to the social-welfare parameters λ_i and δ_i as follows:

$$\frac{\partial L}{\partial \lambda_i} = \frac{-3}{\lambda_i^2(3-2\delta_i)} < 0;$$

$$\frac{\partial L}{\partial \delta_i} = \frac{6-9\lambda_i}{\lambda_i(3-2\delta_i)^2} \begin{cases} > 0 & \text{for } \lambda_i < 2/3, \\ = 0 & \text{for } \lambda_i = 2/3, \\ < 0 & \text{for } \lambda_i > 2/3. \end{cases}$$

Hence, the requirement on L that is necessary to make reward credible in the case of $n'' = 4$ decreases in the social-welfare parameter λ_i, while the relative influence of the maximin aspect of social welfare δ_i can be positive or negative (depending on λ_i). To give some numerical examples, first consider $L = 1$. In this case the condition requires $3\lambda_i \geqslant 3 - \lambda_i\delta_i$. If we combine this requirement with the cooperator's constraints $\lambda_i \geqslant 0.5$ and $\delta_i \leqslant 1 - 1/2\lambda_i$, we find that for credible reward λ_i has to lie in the interval $[0.875, 1]$ with δ_i appropriately. Note that, compared to $n'' < 4$, it is more likely that a cooperator rewards all her group members because reward increases the minimum payoff in the group. For $L = 2$, again, each cooperator with $\lambda_i \geqslant 0.5$ and $\delta_i \leqslant 1 - 1/2\lambda_i$ (the cooperator's constraints) can credibly reward as the condition shortens to $\delta_i \leqslant 6 - 3/\lambda_i$, whose right-hand side is greater than $1 - 1/2\lambda_i$ for all $\lambda_i \geqslant 0.5$. To sum up, in the case of $n'' = 4$ subjects have an incentive to vote for $L = 2$ in the second voting round to improve conditions for mutual reward (and its impact). Again, this incentive holds for all group members as the mean value of the proposed parameters is implemented.

Proposition A7 *In the VCM with reward ($L > 0$), a group of $n'' \leqslant n$ cooperators with $\lambda_i \geqslant 0.5$ and $\delta_i \leqslant 1 - 1/2\lambda_i$ can enforce positive contributions $c \leqslant n''L/(1-\gamma) \equiv \bar{c}$ from the selfish subjects if each cooperator cares sufficiently about efficiency to reward those group members. The enforcement becomes easier and can entail higher contribution levels, the higher L is. Hence, subjects have an incentive to vote for $L = 2$ in the second voting round. The latter holds also if there is no selfish subject as a higher leverage level improves the conditions for mutual reward and its impact.*

Institutional Voting (first voting round). As we have seen, each group member with $\lambda_i \geqslant 0.5$ and $\delta_i \leqslant 1 - 1/2\lambda_i$ has an intrinsic motivation to contribute $c_i = E$, irrespective of the chosen institution. On the contrary, selfish subjects never contribute positive amounts both in the standard VCM ($L = 0$) and in the punishment institution ($L < 0$). Only in the reward institution they can be motivated to contribute positive amounts if there are cooperators who care sufficiently about efficiency. Hence, subjects have an incentive to vote for the reward institution in the first voting round to implement an equilibrium with higher contribution levels and reward.[14] As the first voting round only

[14] Note that selfish subjects are indifferent if the reward institution is implemented with the maximum contribution level $\bar{c}$. However, as stated in footnote 83, there are reasonable arguments why selfish subjects vote for the VCM with reward even in this case.

determines the institution, subjects are indifferent between $L = 1$ and $L = 2$. However, assuming a small positive probability of observing ties leads to the result that choosing $L = 2$ weakly dominates $L = 1$.

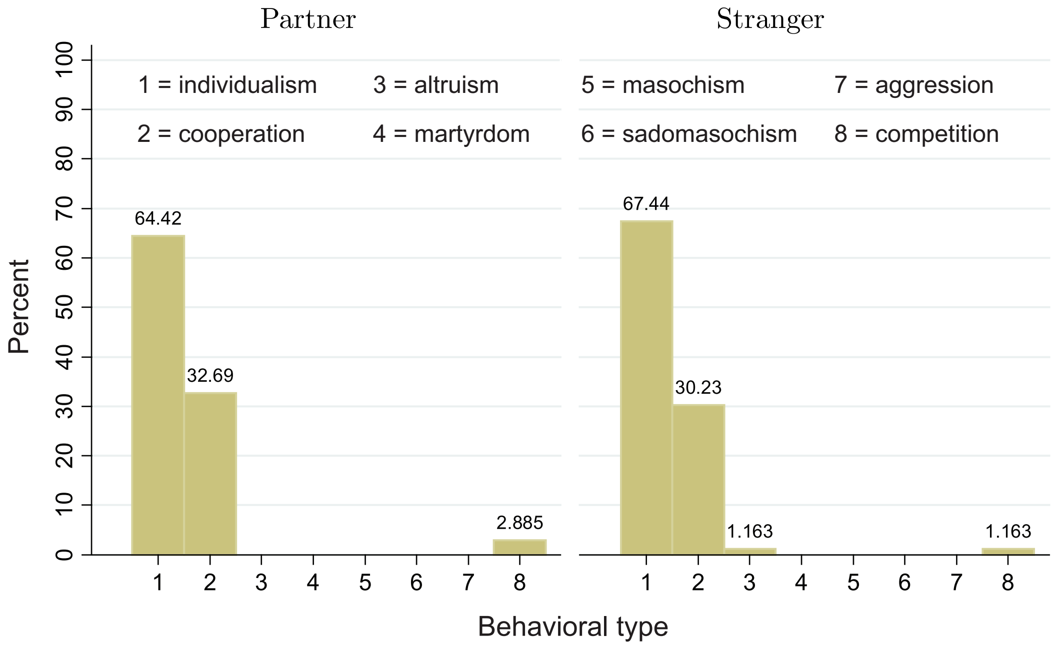
Proposition A8 *Given that subjects can vote for the standard VCM, the VCM with punishment or the VCM with reward by choosing a leverage level out of* $[-5, 2]$*, they prefer the reward institution and choose* $L = 2$ *as this maximizes cooperation possibilities and payoffs.*

A.3 Further Results

Results from the Social-Value Orientation Questionnaire (ring test).

Figure A1

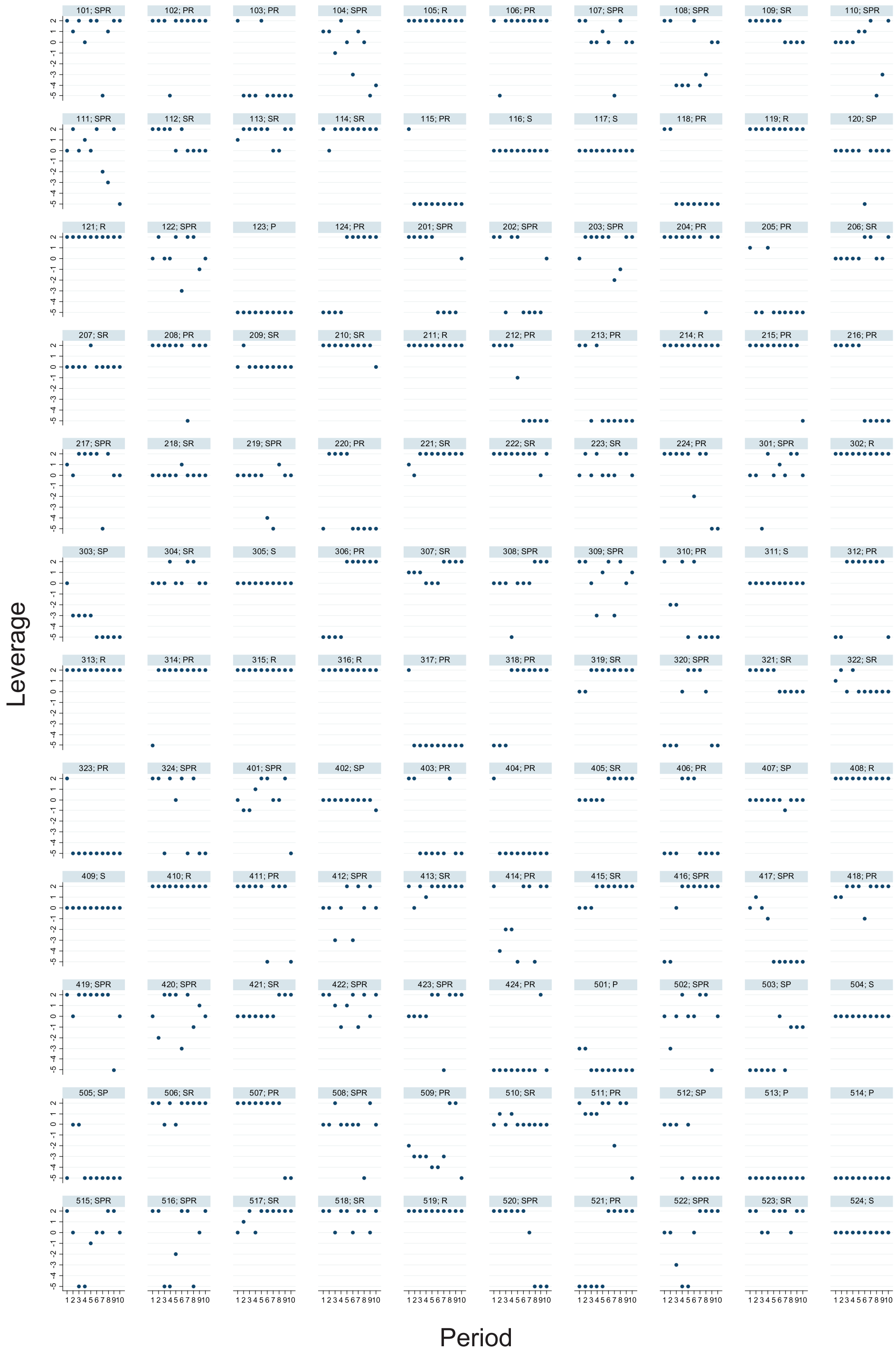
Distribution of Behavioral Types by Treatment (consistency index $\geqslant 20$ required)



Individual's Voting Behavior in the First Voting Rounds. Figures A2 and A3 report the detailed voting behavior of each of our participants in the partner and stranger treatment, respectively. Subjects with a number between 101 and 124 took part in the first session, subjects with 201–224 in session two, etc. Moreover, subjects are sorted that way that persons 101–104 (105–108, etc.) formed a group in the partner treatment, while each block of 12 subjects formed a matching group in the stranger treatment (e.g., 601–612, 613–624). Letters show which institutions subjects preferred over the course of the experiment. S stands for the standard VCM, P for VCM with punishment and R for VCM with reward. For example, a subject classified by SR never votes for VCM with punishment but prefers in at least one period each of the other two institutions.

Figure A2

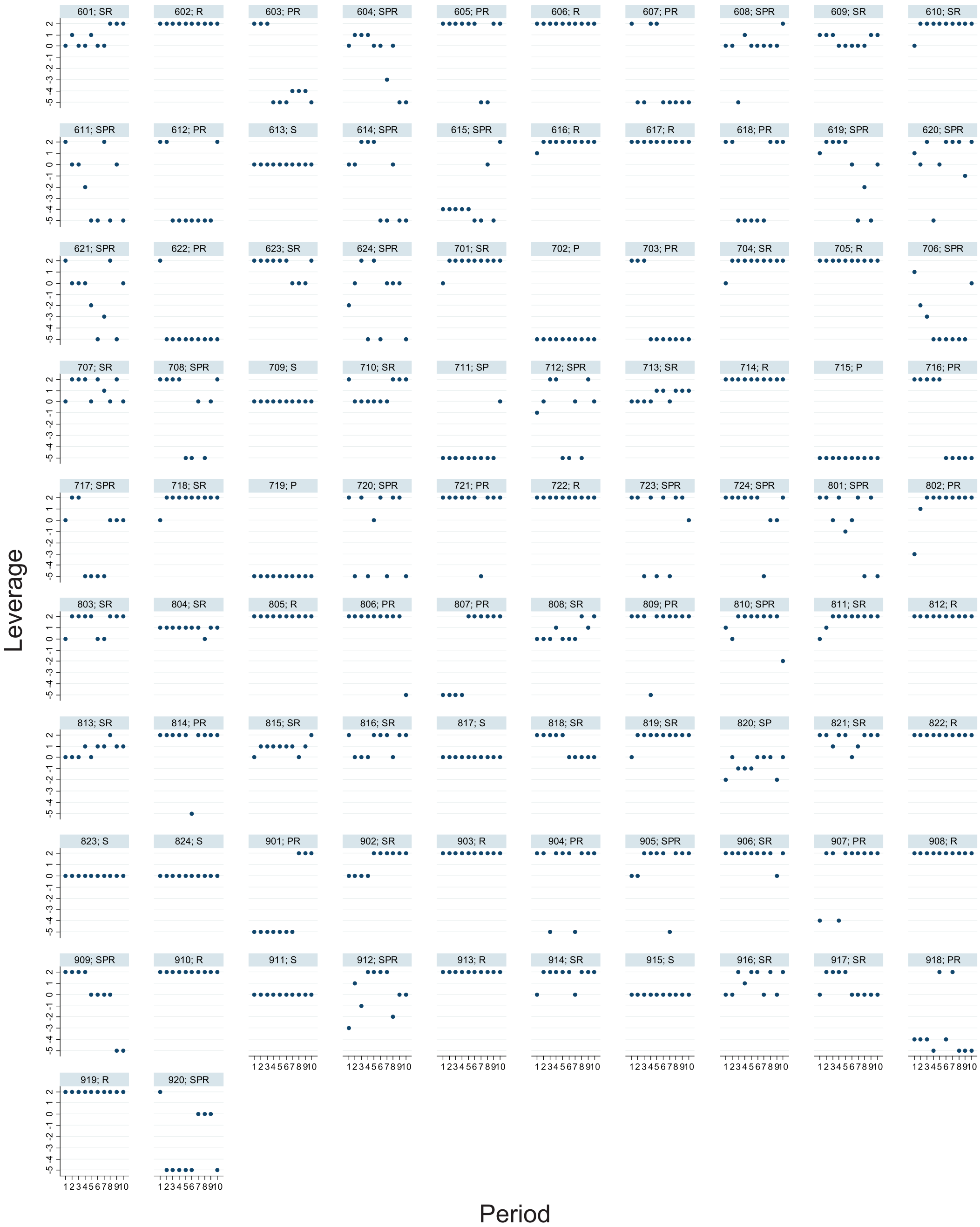
Preferences for L Over Time in Partner Treatment (for each person separately)



Overall, we observe 291 (26.94%) institutional switches between periods in the partner and 203 (24.52%) switches in the stranger treatment. Whereas switches away from the reward institution go approximately one half into the standard VCM and one half

Figure A3

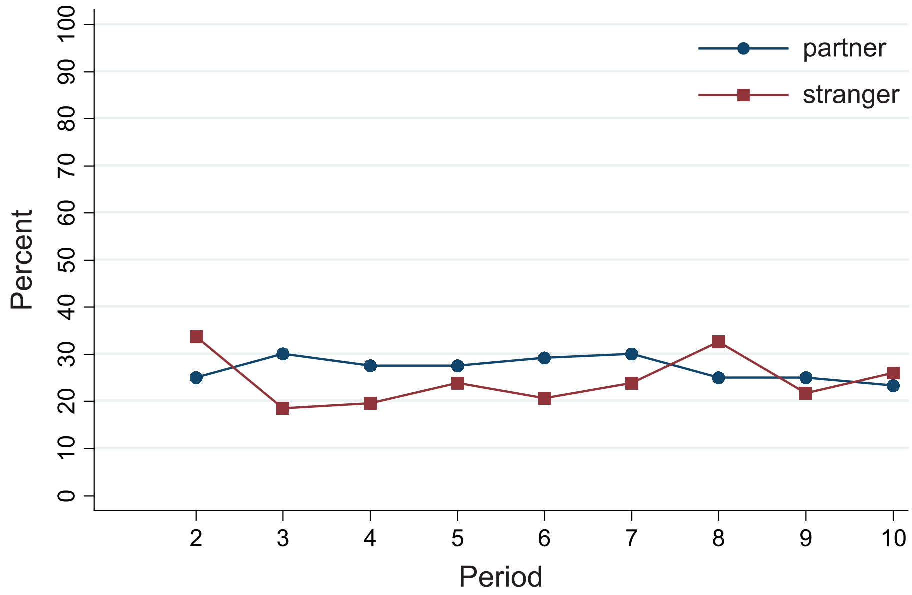
Preferences for L Over Time in Stranger Treatment (for each person separately)



into the punishment institution (48.85% into standard VCM in Partner vs. 43.04% in Stranger), switches away from the standard VCM and the punishment institution go in large majority into the reward institution (71.59% and 73.61% in Partner vs. 76.47% and 57.14% in Stranger).

Institutional Switches Over Time.

Figure A4
Percentage of Institutional Switches Compared to Previous Period by Treatment



Evolution of Contributions.

Figure A5
Average Contributions Over Time in Partner Treatment

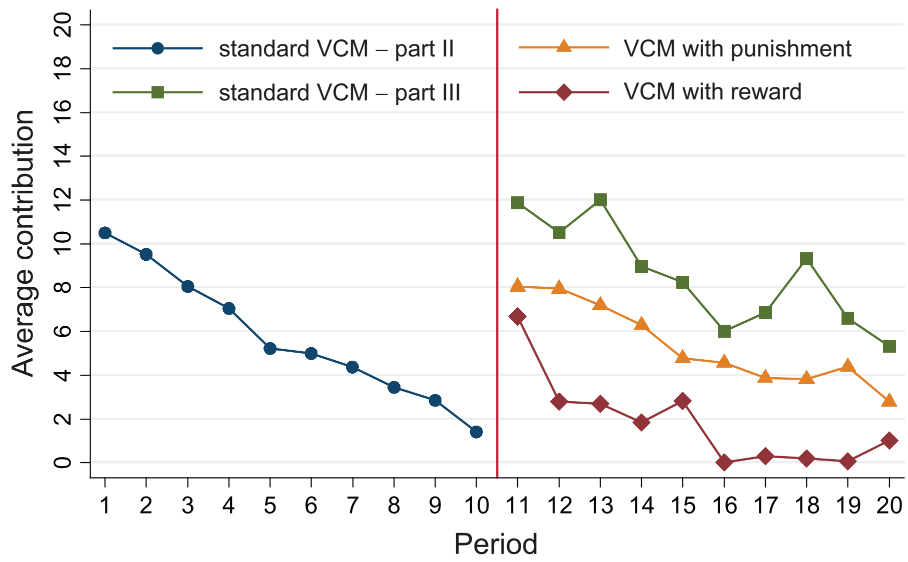
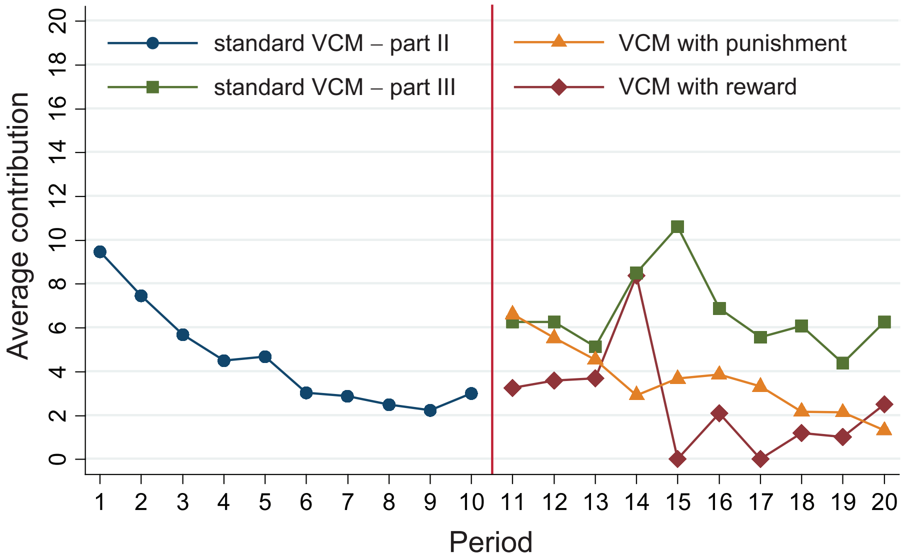


Figure A6
Average Contributions Over Time in Stranger Treatment



A.3.1 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 1). 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 1). 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°

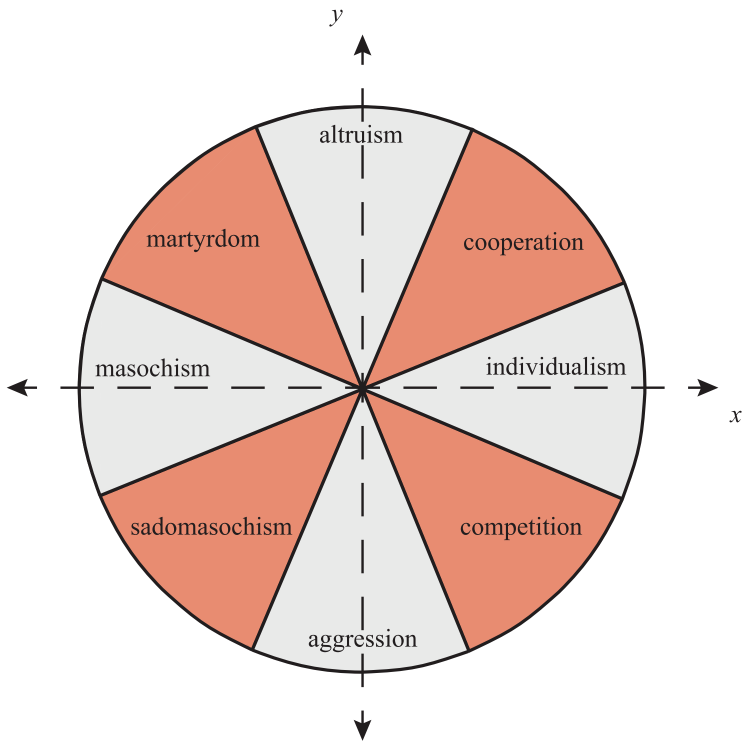
Table A1
The 24 Allocation Tasks

Question number	Option A your payoff (x)	Option A other's payoff (y)	Option B your payoff (x)	Option B 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

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*.

Figure A7
Classification of Behavioral Types



References

Charness, G., and M. Rabin (2002), "Understanding Social Preferences with Simple Tests," *The Quarterly Journal of Economics*, 117(3), 817–869.

Fehr, E., and K. M. Schmidt (1999), "A Theory of Fairness, Competition, and Cooperation," *The Quarterly Journal of Economics*, 114(3), 817–868.

Martin G. Kocher
University of Munich
Geschwister-Scholl-Platz 1
80539 Munich
Germany
martin.kocher@lrz.uni-muenchen.de

Dominik Matzat
University of Munich
Geschwister-Scholl-Platz 1
80539 Munich
Germany
dominik.matzat@lrz.uni-muenchen.de