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Voluntary contributing in a neighborhood public good game: An experimental study

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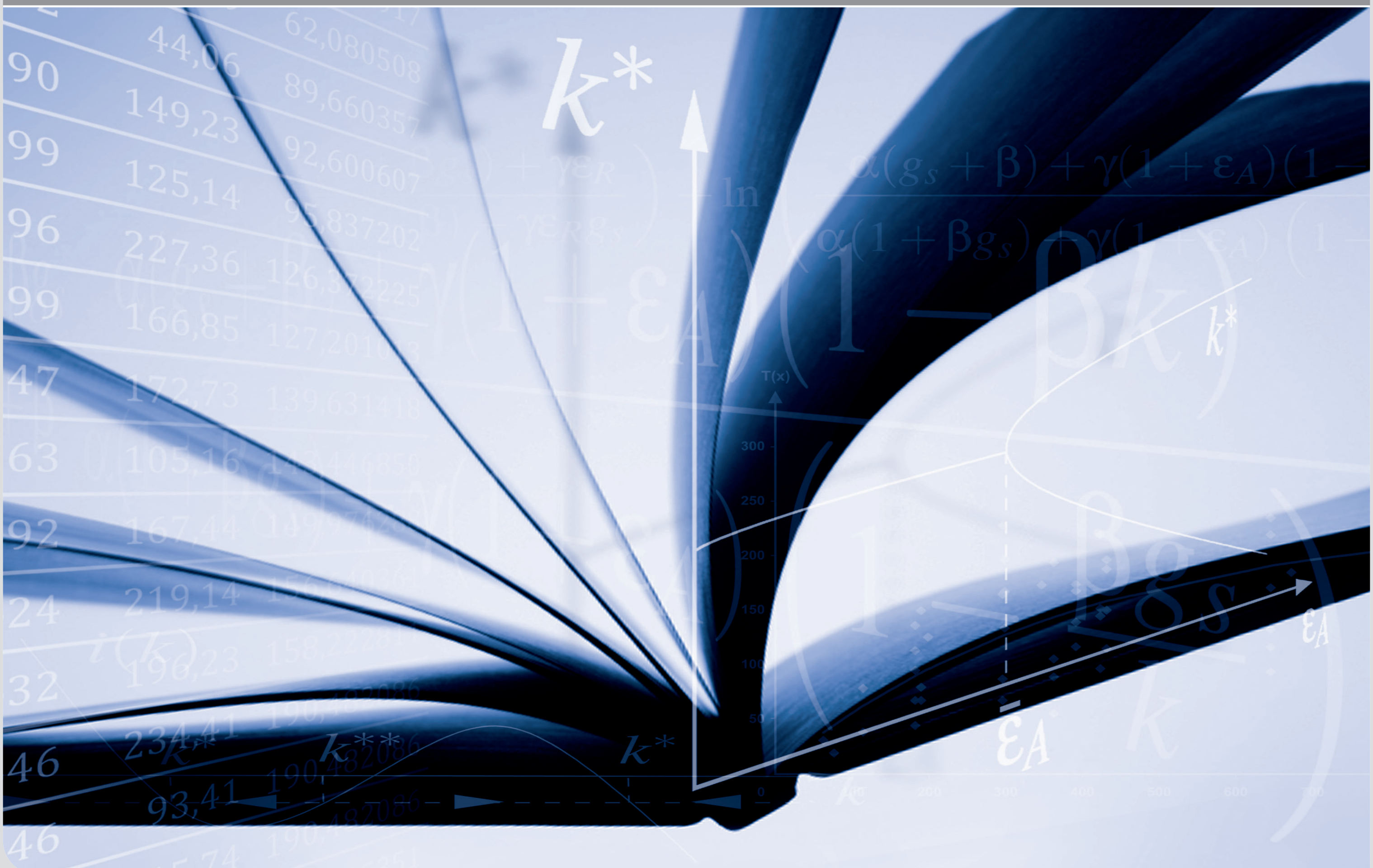

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Voluntary Contributing in a Neighborhood Public Good Game - An experimental Study -

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Abstract

In repeated Public Good Games contributions might be influenced by different motives. The variety of motives for deciding between (more or less) free-riding probably explains the seemingly endless tradition of theoretical and experimental studies of repeated Public Good Games. To more clearly distinguish the motives, we try to enrich the choice set by allowing players not only to contribute but also to locate their contribution to one of the player positions. The location choice affects what individual players gain, but not the overall efficiency of contributing, and allows for discrimination, e.g., rewarding and sanctioning co-players differently. Our experimental results show that adding location choice promotes voluntary cooperation, although discrimination itself has no significant effect on behavior.

Keywords: Public Good Game, Neighborhood, Cooperation, Experimental Analysis

1 Introduction

Experimental research in economics has possibly been overshadowed too long by the "revealed motive" approach, where motives have been preferences, aspirations, or whatever one wanted to infer, namely to

- incentivize behavior, i.e., monetary earnings depend only on actions and
- derive the motive the researcher is interested in from observed behavior, although this may be triggered by monetary incentives as well as more or less uncontrolled other concerns.

This predominant methodology reverses the usual interpretation that motives and (action) beliefs determine behavior: instead of testing individual decision rationality, the researcher assumes it. An obvious alternative to this empirical method, which is still dominant in experimental economics, is to elicit not only behavior but also motives (preferences, aspirations, etc.) and beliefs (about the actions, motives, norms, etc., of others) and to incentivize these statements (see [1] and [7]).

Here we propose another way to weaken the "curse of the revealed motive approach," namely to increase the dimensionality of behavior. Instead of discussing this in abstract terms, we apply it to a repeated Public Good Game played by the same group of players (partners design). In a Public Good Game ([8], [10]) the contribution of a player can express

- how selfish, respectively inefficiency averse, the player is,
- how the player wants to reward or punish earlier choices of others,
- what the player wants to signal to his co-players,
- what the player expects the others to do,
- etc.

The multiplicity of reasons illustrates how difficult it can be to infer the actual reasons from behavior. By increasing the dimensionality of behavior, i.e., not only eliciting the contributions but allowing for other dimensions of behavior, these difficulties still exist but may be less serious.

There is, of course, a price to pay for such more informative data: One changes the game, typically by making it more complex. We do not claim that it is always worthwhile to pay this price but propose an awareness of the trade-off between richer data, allowing to more clearly infer the motives, on the one hand, and the complexity of the design on the other.

More specifically, we extend the (repeated) Public Good Game by allowing players to locate their contributions to one of the player locations, i.e., by imposing a network structure. This does not affect the overall efficiency of an individual contribution but only who gains more or less from it. If benefits depend on distance, the player where the contribution is located gains more from it than a more distant player. However, locating the own contribution to another position, makes a player suffer. As in ultimatum games (see [3] for a review) the costs of punishing and rewarding others are endogenous: the smaller the contribution the less costly it is to choose a non-self-serving location. The intention to sanction or to reward by location thus provides an additional reason for contributing less (for other studies of Public Good Games based in some network structure see, e.g., [5], [2]).

Will participants nevertheless choose non-self-serving locations to reward or punish their co-players? Corresponding results could allow us to interpret more reliably why participants choose higher or lower contributions in repeated Public Good Games implemented in a partners design.

Actually, only 16% of the participants never choose a non-self-serving location, i.e., they reward and punish others. In addition, without the option of choosing the location, there is less cooperation. Surprisingly, discrimination in the sense of choosing a non-self-serving location has little or no impact on the contribution level.

In Section 2 we introduce the voluntary contribution game with location choices and its simple neighborhood structure. Section 3 presents our hypotheses, while Section 4 provides an overview of our experimental design. The data, comprising the individual contributions and location choices, are analyzed in Section 5. Section 6 discusses our results. Section 7 concludes.

2 The Neighborhood Public Good Game

The Neighborhood Public Good Game is repeated T times. Four players ($I = \{1,2,3,4\}$) interact, and each Player $i \in I$ is assigned to a different corner of a square. The two players, occupying adjacent corners of the square, are the direct neighbors of a Player i, the other player is i's distant neighbor.

In each period $t \in \{1,...,T\}$, each Player i receives the same integer endowment $e > 0$. Player i then chooses the size of the contribution $c_t(i)$ with $1 \leq c_t(i) \leq e$ and his location $l_t(i) \in I$. Notice, that each player can contribute $c_t(i)$ to the position of his neighbors or his own position. Nevertheless, he always keeps the difference $e - c_t(i)$ for himself. The location of contribution $l_t(i)$ can be any corner of the square, i.e., the position of one of the four players. In the following, we will also refer to $l_t(i)$ as the player located in corner $l_t(i)$. Contributions have to be positive ($c_t(i) \geq 1$ for all i) to render their location always payoff relevant. Further, the whole contribution $c_t(i)$ can only be located to one location $l_t(i)$. That is, the player cannot divide the contribution among different locations.

The location or player position of contribution $l_t(i)$ determines its constant marginal productivity $\alpha(k, l_t(i))$. For any Player k the marginal productivity of an individual contribution $c_t(i)$ is

$$\alpha(k, l_t(i)) = \begin{cases} \overline{\alpha} & \text{for } l_t(i) = k \\ \alpha & \text{if } k \text{ and } l_t(i) \text{ are direct neighbors} \\ \underline{\alpha} & \text{if } k \text{ and } l_t(i) \text{ are distant neighbors} \end{cases}$$

where $1 > \overline{\alpha} > \alpha > \underline{\alpha} > 0$ and $\overline{\alpha} + 2\alpha + \underline{\alpha} > 1$. Thus, the payoffs are given by

$$u_t(k) = e - c_t(k) + \sum_i \alpha(k, l_t(i))c_t(i)$$

for all Players $k \in I$ and all periods $t = 1, \ldots, T$ with $1 \leq c_t(i) \leq e$ for all i and t. Although the location of contribution $l_t(i)$ affects the individual gains from $c_t(i)$, it does not influence the aggregated payoff of all players, $\sum_i u_t(k)$. The aggregated marginal benefit of a contribution is always $\overline{\alpha} + 2\alpha + \underline{\alpha}$.

Clearly, the solution (from payoff maximizing) strategy for all four Players i is $c_t^*(i) = 1$ and $l_t^*(i) = i$ in all periods t. However, for an efficient outcome all participants must choose $c_t^+(i) = e$ and can select any location choice $l_t(i)$ in all periods t.

3 Experiment

In the Neighborhood Public Good Game, which participants repeatedly interact with their neighbors, participants interact in a partners design. Previous studies (e.g., [9]) have shown that participants engage in initial cooperation but reveal a downward sloping development of contributions with a further decline of cooperation in the terminal period. We expect similar results for $c_T(i)$ in the Neighborhood Public Good Game, where our participants can additionally make self-serving location choices $l_t(i) = i$.

Hypothesis 1: Participants will cooperate significantly less in the terminal period T by

(a) low last contributions $c_T(i)$ and

(b) self-serving location choices $l_T(i) = i$.

By varying the values $\underline{\alpha}$, α, and $\overline{\alpha}$ without changing the sum $\underline{\alpha} + 2\alpha + \overline{\alpha}$, we can change the discrimination power. Larger differences can, for instance, allow to seriously harm the distant contact. Since we expected an increase in cooperation when participants have more discrimination power, we conducted two versions of the Neighborhood Public Good Game, Treatments $\overline{M}$ and $\underline{M}$, by using different values for $\underline{\alpha}$, α, $\overline{\alpha}$:

$$\overline{M} : \underline{\alpha} = 0.3, \alpha = 0.5, \overline{\alpha} = 0.7 \text{ and}$$
$$\underline{M} : \underline{\alpha} = 0.4, \alpha = 0.5, \overline{\alpha} = 0.6$$

Hypothesis 2: Participants will contribute more in the $\overline{M}$-Treatment than in the $\underline{M}$-Treatment.

In addition, we performed control Treatments $\overline{C}$ and $\underline{C}$ of the Neighborhood Public Good Treatments $\overline{M}$ and $\underline{M}$, where the location choices of participants are exogenously imposed. We did not inform participants of the control sessions how locations were determined - all the $\overline{C}$- and $\underline{C}$- instructions say is "Locations are predetermined and independent of your behavior."

Hypothesis 3: Participants will contribute more in the M- than in the C-Treatments.

4 Method

We conducted our experiments with 380 participants in the laboratory of the Max Planck Institute of Economics in Jena. All participants were recruited using ORSEE ([6]). They earned points as payoffs (100 points = €0.20) and received a show up fee of €2.50. The average payoff was €14.02.

The experiment was programmed and conducted with the software z-Tree ([4]). At the beginning of a session, participants were randomly seated in the laboratory. A session lasted 60 to 90 minutes, including 25 minutes for reading and understanding the instructions. We handed out the instructions in written form (see A for an English translation) which were also read aloud. After questions concerning the instructions were answered privately, understanding of the instructions was checked by a control questionnaire. Participants who were not able to answer these questions were replaced (altogether 15 participants). A participant who was replaced received €2.50 in addition to the show up fee.

At the end of each period, the experiment environment informed the participants of their payoff, the contributions $c_t(i)$, and the location choices $l_t(i)$ of all participants in the current period. No additional information concerning the behavior of other participants was given.

Participants played twice for twenty periods. The 32 participants of one session were split up in 8 groups of 4. In each period, participants received an endowment of 10 tokens. Each token was worth 10 points so that participants earned an integer number of points in each period. After the first twenty periods, participants were rematched with new partners (perfect strangers rematching).

Session	Average Contribution		Average Payoff	
	Round 1	Round 2	Round 1	Round 2
$\underline{M}$	5.24	5.17	152	151
$\overline{M}$	4.33	4.85	143	148
$\underline{C}$	3.77	4.06	137	140
$\overline{C}$	3.56	4.24	135	142

Table 1: Comparison of contribution and payoff per round in both repetitions

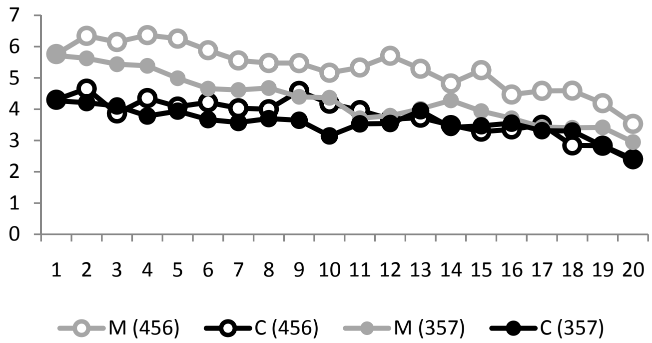

Figure 1: Development of contributions per treatment

After each session we paid participants privately. We conducted three sessions of each of the four Treatments ($\underline{M}$, $\overline{M}$, $\underline{C}$, $\overline{C}$), although with only 7 groups of 4 participants each in one session of Treatment $\underline{M}$.

5 Results

During each session, we repeated the game once. A comparison of the average contribution of each independent group shows an increase in contributions and payoffs in the repetition (binomial test, 10% significance level). For Treatment $\underline{M}$ alone there is no such experience effect.
Result 1: Rather than converging to the benchmark behavior, based on common and commonly known monetary opportunism, more experienced participants manage to cooperate more.

In the remainder, we will mainly focus on the analysis of the first round for two reasons: (1) In the first round, all groups are independent, and we can rely on more independent data points when testing. (2) Except for the higher contributions, and therefore higher payoffs, the second round reveals similar patterns for all treatments (consider Tables 1 and 2) so that it seems preferable to mention differences only where they occur.

5.1 Temporal aspects

To test Hypothesis 1, let us analyze the development of the average contributions.

	$\underline{M}$		$\overline{M}$		$\underline{C}$		$\overline{C}$	
Round	1	2	1	2	1	2	1	2
Overall average	5.24	5.17	4.33	4.85	3.77	4.06	3.56	4.24
Average per group	3.49	3.44	3.79	3.03	2.09	1.46	2.04	4.63
	6.90	6.26	3.18	4.45	1.53	1.60	1.48	7.51
	4.20	6.60	8.71	4.14	6.39	1.36	8.54	9.46
	2.39	3.10	1.86	6.23	5.21	3.79	2.54	3.96
	2.54	2.23	3.58	5.81	1.14	9.50	4.36	8.23
	2.11	2.68	7.75	5.34	2.96	2.19	4.83	5.33
	6.09	4.15	7.75	3.83	2.29	4.65	2.51	1.78
	4.68	1.44	2.18	8.11	1.14	1.21	5.38	2.89
	7.53	9.89	4.53	3.20	5.45	3.93	1.76	2.45
	6.48	3.53	4.51	3.78	1.89	2.88	2.90	2.05
	5.76	4.60	1.94	8.04	3.75	6.18	5.05	2.43
	7.95	5.34	5.55	2.75	4.50	8.95	3.36	1.68
	9.94	3.54	2.05	3.95	2.24	1.78	5.83	2.74
	6.40	4.48	4.11	3.00	7.31	2.46	6.65	8.25
	4.60	8.39	6.43	1.20	2.11	4.21	6.55	9.69
	6.99	8.89	1.93	8.70	2.39	2.93	1.48	1.69
	2.96	7.41	4.08	8.46	9.46	7.30	2.45	1.18
	4.03	7.80	6.56	3.71	2.84	2.14	1.40	4.49
	4.94	3.61	2.96	2.99	3.65	9.79	2.06	3.14
	5.45	3.99	6.11	4.65	2.94	3.53	1.75	2.06
	4.64	3.00	5.05	7.19	2.24	3.88	5.10	1.11
	4.44	5.15	1.73	1.26	7.33	4.20	1.65	3.85
	6.03	9.53	3.61	9.78	5.30	4.44	1.85	3.13
	-	-	3.88	2.91	4.30	3.33	4.04	9.21

Table 2: Average contributions per round

Figure 1 visualizes how contributions develop in all four treatments over all twenty periods. Although cooperation tends to be high during the first few periods, it decreases over time. Comparing the contributions in the first nineteen periods and the contributions in period 20 across all treatments and groups reveals a significantly smaller contribution in the last period (binomial test, 1% significance level). This result holds for all four treatments ($\underline{M}$-Treatment: binomial test, 5% significance level; other treatments: binomial test, 1% significance level).

To analyze whether the location choice of participants tends to be more self-serving in the last period of a treatment (Hypothesis 1 (b)), we rely on the relative frequency of self-selection and calculate this frequency both for the first nineteen periods as well as for the last period. A binomial test confirms on a significance level of 1% that over all M-Treatments the fraction of self-serving location choices increases in the last period. This also holds, when analyzing $\underline{M}$- (binomial test, 5% significance level) and $\overline{M}$-Treatments (binomial test, 1% significance level) separately.

Result 2: There is a significant decrease in contributions as well as a significantly larger degree of self-serving location choices in the terminal period $T = 20$, confirming Hypothesis 1.

5.2 Influence of location choices

To analyze the impact of possible discrimination by location choices on behavior (Hypothesis 3), we first focus on the average contributions per group (see

	Cooperators		Defectors		Participants
	Strong	Weak	Weak	Strong	per Treatment
$\underline{M}$	4	21	16	4	92
$\overline{M}$	2	13	24	6	96
$\underline{C}$	2	10	33	7	96
$\overline{C}$	3	9	34	7	96

Table 3: Number of defectors and cooperators per treatment

Table 2). A two-sided Mann-Whitney-U test confirms on a significance level of 1% that the average contribution in M-Treatments is different from the average contribution in C-Treatments. More specifically, we can conclude that the average contribution of M-Treatments is higher. Moreover, when comparing only the $\underline{M}$- and the $\underline{C}$-Treatment, we can confirm these results (two-sided Mann-Whitney-U Test, significance level of 1%), whereas for $\overline{M}$- and $\overline{C}$-Treatments, we cannot reject the hypothesis of equal payoffs in both treatments on an acceptable significance level.
Result 3: Average contributions in M- are higher than in C-Treatments.

Why is there a clear difference when comparing $\underline{M}$- and $\underline{C}$-Treatments but no difference between $\overline{M}$- and $\overline{C}$-Treatments? To analyze the strategies of participants, we categorize the latter in four separate classes:

- *Strong Cooperators* contribute 10 tokens in all twenty periods.
- *Weak Cooperators* contribute 10 tokens not in all but at least in half the periods.
- *Weak Defectors* contribute 1 token not in all but at least in half the periods.
- *Strong Defectors* contribute 1 token in all twenty periods.

Table 3 lists the number of participants in the corresponding classes in all groups of each treatment. A comparison of the M- and C-Treatments with respect to the numbers of cooperators (both strong and weak) per group shows no difference between treatments. The results change, when analyzing $\underline{M}$- and $\underline{C}$-Treatments and $\overline{M}$- and $\overline{C}$-Treatments separately. While we find no difference between $\overline{M}$- and $\overline{C}$-Treatments, a significant difference between $\underline{M}$- and $\underline{C}$-Treatments exists (one-sided Mann-Whitney-U test, significance level 5%).

The results are similar, when analyzing the number of defectors (again, both strong and weak) per group. Here, a two-sided Mann-Whitney-U test shows a significant difference between M- and C-Treatments (significance level 5%). When analyzing the number of cooperators, this result does not hold for $\overline{M}$- and $\overline{C}$-Treatments, while it holds for $\underline{M}$- and $\underline{C}$-Treatments (two-sided Mann-Whitney-U test, significance level 5%).
Result 4: When categorizing the strategies of participants, we find no difference between the $\overline{M}$- and the $\overline{C}$-Treatment, whereas a significant difference in the number of defectors and cooperators exists when comparing the $\underline{M}$- and the $\underline{C}$-Treatment.

Next, we analyze the contribution level of non-self-serving locations (see Table 4). For contributions lower than 10 only nonsignificantly higher investments

	$c_t(i) = 1$	$1 < c_t(i) \leq 5$	$5 < c_t(i) < 10$	$c_t(i) = 10$	Sum
$\underline{M}$	420	195	95	179	889
$\overline{M}$	547	237	132	86	1002
$\underline{C}$	638	432	92	255	1417
$\overline{C}$	675	420	111	222	1428

Table 4: Number of contributions in non-self-serving locations

of non-self-serving locations occur for the $\overline{M}$- than for the $\underline{M}$-Treatment. The situation changes when we analyze the maximum contribution $c_t(i) = 10$. Here, the number of non-self-serving locations per group are significantly higher in the $\underline{M}$- than the $\overline{M}$-Treatment (one-sided Mann-Whitney-U test, significance level 5%).

Result 5: For very high contributions $c_t(i)$, i.e., $c_t(i) = 10$, the number of non-self-serving locations is significantly higher in Treatment $\underline{M}$ than in Treatment $\overline{M}$.

To sum up, we observe higher contributions in the $\underline{M}$-Treatment than in the $\underline{C}$-Treatment due to the different frequencies of cooperators and defectors. Therefore, we confirm Hypothesis 3 for these treatments. For the $\overline{M}$- and the $\overline{C}$-Treatment similar results do not hold. Here, neither the number of cooperators, nor the number of defectors, nor the contributions differ significantly. Apparently, the disciplining effect of "punishment by location" becomes weaker with additional discrimination power. In our view, this is due to the high costs of non-self-serving location choices in Treatment $\overline{M}$ and $\overline{C}$, where non-self-serving locations for high contributions are very rare.

5.3 Influence of discrimination power

To confirm that participants are more cooperative in $\overline{M}$- Treatments than in $\underline{M}$-Treatments (Hypothesis 2), we compare the average contributions in both treatments. Quite surprisingly, but possibly explained by our previous Result 5, the overall average contribution per group in $\underline{M}$-Treatments is higher than in $\overline{M}$-Treatments. However, using a two-sided Mann-Whitney-U test, we cannot reject the null hypothesis of equal contributions in both treatments on any acceptable significance level, which rejects Hypothesis 2.

The average contributions of $\overline{C}$- and $\underline{C}$-Treatments are quite similar. Using a Mann-Whitney-U test, we cannot reject the hypothesis of equal contributions on any acceptable significance level.

Result 6: There exists no significant difference in contributions between $\overline{M}$-and $\underline{M}$-Treatments and $\overline{C}$- and $\underline{C}$-Treatments, respectively.

Comparing the first period contribution per group in Treatments $\overline{M}$ and $\underline{M}$ reveals no significant difference (Mann-Whitney-U test). Likewise, comparing the location choice of the contribution in the first period by a Mann-Whitney-U test does not allow to reject the hypothesis of equal frequencies of self-serving location choices in the $\overline{M}$- and $\underline{M}$-Treatments. Hence, we can conclude that participants behave similarly in the first period of the $\overline{M}$- and $\underline{M}$-Treatments.

Similar results hold for the following period. Neither the number of cooperators nor the number of defectors differed significantly between the $\overline{M}$- and

	Cooperators		Defectors		Participants
	Strong	Weak	Weak	Strong	per Treatment
$\underline{M}$	6	39	27	17	92
$\overline{M}$	6	43	31	13	96

Table 5: Number of location defectors and location cooperators per treatment

$\underline{M}$-Treatment (two-sided Mann-Whitney-U test). The same result holds for the $\overline{C}$- and $\underline{C}$-Treatment (two-sided Mann-Whitney-U test).

Finally, we classified strong location cooperators, i.e., participants who always invest in other positions, and weak location cooperators, i.e., participants who invest in other positions for at least half the periods. Accordingly, we defined strong and weak location defectors (see Table 5 for the absolute frequencies per treatment). We compared the fraction of location defectors (both strong and weak) and location cooperators (both strong and weak) between Treatments $\overline{M}$ and $\underline{M}$ but found no significant differences using a two-sided Mann-Whitney-U test.

Result 7: Location choices and initial play do not vary between the $\overline{M}$-and $\underline{M}$-Treatment and the $\overline{C}$- and $\underline{C}$-Treatment, respectively.

6 Discussion

In M-Treatments participants contribute more and thereby reveal greater trust in the behavior of others, whereas participants in C-Treatments seem to realize their lack of discrimination power. The variance of α-values has no impact on the contribution level in the first period: between both M-Treatments and both C-Treatments there exists no significant difference in first period contributions (Result 7).

The effect of discrimination power is confirmed in the following periods: contributions in M-Treatments are higher than in C-Treatments (Result 3). Punishment and rewarding helps to increase the number of cooperators and to decrease the number of defectors, at least when we compare $\underline{M}$- Treatments and $\underline{C}$-Treatments (Result 4).

The variance between α-values has an impact on discrimination power. The more similar all α-values are, the less discrimination power a participant has. Therefore, we expected higher contributions in $\overline{M}$-Treatments, which could not be confirmed, however (Result 3).

In our view, this effect results from the costs of punishment and rewarding, where we define punishment as contributing the smallest possible amount and choosing the most distant location to the person who should be punished. Rewarding, in turn, is defined by investing the highest possible amount and locating it to the person who should be rewarded. Independent of the realized α-values, the costs of punishment do not change much as punishing participants contribute little. This changes, when we analyze rewarding. A cooperative participant, who rewards a distant contact, faces a much higher cost in the $\overline{M}$-than in the $\underline{M}$-Treatment. In the $\overline{M}$-Treatment, she loses 0.4 of her investment, when switching from her position to the position of the distant contact, while she loses only 0.2 of the investment in the $\underline{M}$-Treatment. Therefore, the lower cost of rewarding can enhance cooperation in the $\underline{M}$-Treatment more than in the $\overline{M}$-Treatment. The experimental data confirm this: the number of maximum investments in non-self-serving locations per group is higher in the $\underline{M}$- than in the $\overline{M}$- Treatment (Result 5).

While in $\overline{M}$-Treatments participants can impose higher punishments and reward their co-players, their costs are relatively high. In consequence, participants do not reward in the $\overline{M}$-Treatment as much as they do in the $\underline{M}$-Treatment, which outweighs the effect of higher discrimination power. This is confirmed by Result 7: with more discrimination power participants do not contribute more nor do they choose non-self-serving locations more often.

7 Conclusion

Unlike in traditional four-person Public Good Games, participants are organized in a square and could locate their contribution in one of the four positions. How much a participant benefits depends on the distance of the contribution to the own position.

There is no trend toward the benchmark of free-riding and self-serving locations but rather an increase of cooperation when the game is repeated (Result 1). In each repeated game, participants reveal end game behavior by choosing low contributions and investing in their own position. Removing the possibility of choosing the investment location reduces contributions. More discrimination power, however, does not increase contributions.

At first sight, this result seems quite surprising: more discrimination power does not enhance cooperation any further. In our view, this is due to the fact that more discrimination power, as captured here, does indeed allow to punish or reward a distant neighbor more effectively but only at the cost of an even greater loss, where the own contribution is rather high. Apparently, the opposite effects outweigh each other.

8 Acknowledgments

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A Instructions

Welcome to this experiment and thank you very much for your participation. You will receive €2.50 for showing up in time. During the experiment, you will have the opportunity to earn additional money. Please stay calm and switch of your mobile phone. Please read these instructions carefully which are identical for all participants. Communication among the participants is not allowed. If you do not follow these rules, we have to exclude you from the experiment and, consequently, from any payment. To ensure that you understand the instructions, we ask you to answer several control questions before beginning the experiment. If you have any questions, please raise your hand. One of the experimenters will then come to you and answer your question in private. The endowment of €2.50 for showing up in time as well as any other amount of money, you earn during the experiment, will be paid to you in cash at the end of the experiment. We will pay you privately to ensure that no other participant becomes aware of the amount of your payment.

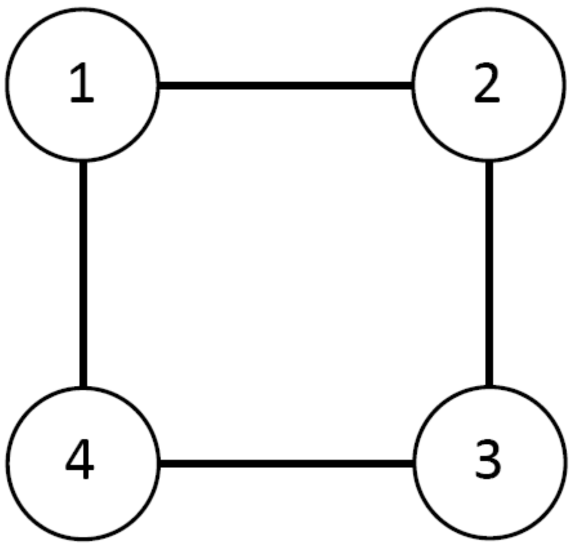

Figure 2: Placement of participants within one group

Your payment depends on your own decisions as well as the decisions of other participants. The payoff in the experiment is measured in points. The points you earn during the experiment will be converted into euro at the end of the experiment and paid to you. You find the conversion rate at the end of this document. You and all other participants enter their decisions independently of other participants in individual computer terminals.

Course of the Experiment
At the beginning of the experiment, you are randomly assigned to three other participants, forming groups of four. Each member of your group will be randomly positioned in one corner of a square (see Figure 2). The two other partic-

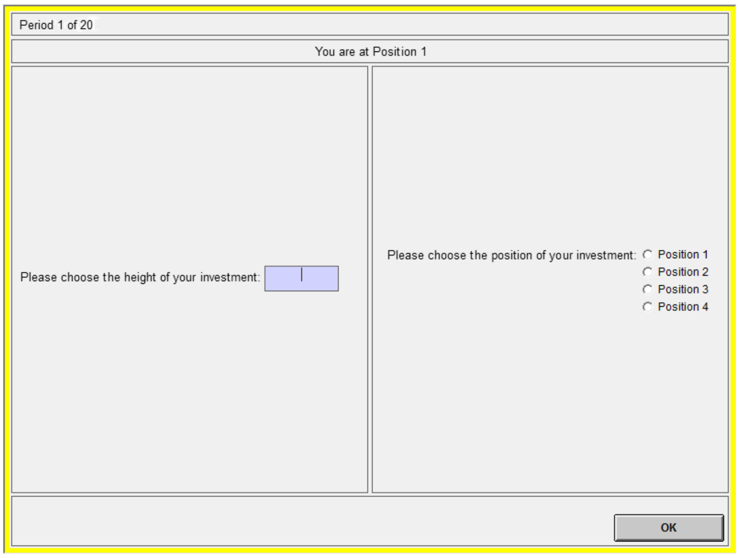

Figure 3: Decision screen

ipants, who share one line of the square with you, are your direct neighbors, the fourth is your distant neighbor. The participants in one group will not necessarily sit side by side. The composition of the group and the positioning remain unchanged. In the following, "partners" stands for the participants in your group. The participants of other groups are not considered in the remainder of these instructions.

Figure 2 shows the arrangement of participants in one group. For example, the direct neighbors of the participant at position 1 are located at positions 2 and 4. The distant neighbor is located at position 3.

This experiment consists of twenty periods. At the beginning of each period, you will receive 10 tokens. Subsequently, you have to make two decisions:

- on the amount of your investment, i.e., the number of tokens ranging from 1, 2, ..., 9, 10, and
- on where to place your investment, more precisely: in which partner, i.e., at your position, the position of a direct neighbor or a distant neighbor.

While making your decision, you will see the following display on your computer screen (see Figure 3). Your position is visualized in the upper area of the screen. On the left side you decide on the amount of your investment, and on the right side you choose the partner in whom you want to place your investment.

Your Payoff
At the end of each period, your payoff is calculated, based on the decisions of all participants. The result of this calculation is shown on the computer screen.

The calculation of your payoff is as follows. For each token you have kept, you receive 10 points. You receive 7 points for every invested token assigned to you; for each token assigned to a direct neighbor you receive 5 points; and for every token assigned to the distant neighbor you receive 3 points. For the final payoff the points are added up over all periods. For 100 points you receive €0.20. Payoff is rounded to the next higher amount divisible by 5 euro cent.

This is repeated twenty times. Hence, all groups and the groups' assignment to positions in the square remains identical for all twenty periods. Please remain seated during all periods and only get up when asked.

After these twenty periods the experiment is continued, and you will receive separate instructions.

Instructions - Restart
Participants are reassigned to groups. During the reassignement, we ensure that none of your previous partners is part of your new group.

Apart from this, the rules are identical.

At the end of the experiment, the number of your cabin will be called out and your points will be exchanged into euro.

A.1 Differences in instructions

For all experiments the instructions for the restart were identical.

A.1.1 Differences between C and M Treatments

During *C*-Treatments, the three paragraphs between "This experiment consists of twenty periods. [..], in whom you want to place your investment." are replaced with the following text:

"This experiment consists of twenty periods. In the beginning of each period, you will receive 10 tokens. Subsequently, you have to make one decision: on the amount of your investment, i.e., the number of tokens ranging from 1, 2, ..., 9, 10.

In addition to the amount of the investment you specified yourself, the placement of your investment, i.e., in which partner, i.e., at your position, the position of a direct neighbor or the distant neighbor, is given by the computer terminal. The assignment is independent of your behavior.

While making your decision, you will see the following display on your computer screen (see Figure 4). Your position is visualized in the upper area of the screen. On the left side you decide on the amount of your investment. Additionally, you see the result of the placement of your investment to a partner made by the computer terminal."

No other changes were made in the instructions.

A.1.2 Differences between $\underline{M}$,$\underline{C}$ and $\overline{M}$,$\overline{C}$ Treatments

For the $\underline{M}$,$\underline{C}$-Treatments in the paragraph "The calculation of your payoff is as follows: [...] Payoff is rounded to the next higher amount divisible by 5 euro

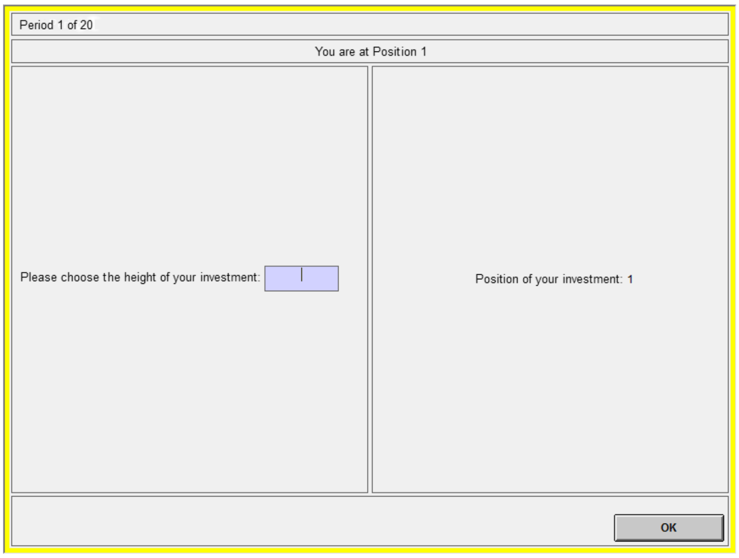

Figure 4: Decision screen

cent." the multplier of tokens was changed to 4, 5, and 6, respectively.

No other changes were made in the instructions.

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