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When to Leave the Carrots for the Sticks: On the Evolution of Sanctioning Institutions in Open Communities*

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Abstract

There is substantial evidence that punishment is more effective than rewards to maintain cooperation in social dilemmas. Yet, previous findings suggest that people generally dislike negative sanctioning institutions and avoid them when possible. We take a new perspective by directly comparing the migration between punishment and reward regimes in a social dilemma. In our laboratory experiments participants continuously "vote with their feet" by migrating between punishment and reward communities. In line with previous research, the vast majority of subjects in our experiment opts initially for the reward institution. Over time, however, more subjects start to join the less profitable punishment community. Analyzing the conditions which trigger migration, we show that full contributors are the first to migrate to the non-populated punishment communities. Followers cooperate almost fully without the requirement of actual punishment, thus reducing the welfare costs of the institution. Individual data suggest that income differences within communities and missing compensations for cooperators in the reward community are key factors for the decision to migrate.

Keywords: open communities, Voting with Feet, cooperation, sanctions, public goods
JEL-Classification: C72, C92, H41.

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1 Introduction

We face a large number of social dilemmas every day, ranging from local to international issues. Mitigation of income inequalities, the fight against terror, battling the spread of deadly diseases, and attempts to stop the progression of climate change are just a few examples of the latter type. The problem of how to promote pro-social behavior in this type of situations is consequently of pivotal importance for the existence of every society.

Among the multiplicity of means available to promote pro-social behavior in such situations, research has shown that (peer) punishment is particularly suited to foster cooperation (e.g., Fehr and Gächter, 2000, 2002; Gächter, Renner, et al., 2008). Indeed, a majority of social dilemma situations feature some sort of punishment institutions (see, e.g., Gardner et al., 1990). Yet, this observation is puzzling in itself. If asked for their preference, people mostly do not opt for a punishment regime, but for the complete opposite – a reward system which allows them to approve cooperative behavior (Gürerk et al., 2014; Sutter et al., 2010).[1] Such resentment towards sanctioning systems might stem from the possibility to misuse sanctions (e.g., Herrmann et al., 2008), the escalation of conflicts (e.g., Nikiforakis and Engelmann, 2011) or simply the efficiency loss due to destruction (e.g., Fischbacher and Gächter, 2010).

This raises the question under which conditions people start to realize the benefits of punishment – if they do at all. To study this question, we design an experiment that differs from previous approaches in the sense that we do not compare simply the outcome of a punishment and a reward system in terms of the degrees of cooperation and the efficiency obtained (e.g., Sefton et al., 2007). Rather, we are interested in experimental sequences of repeated choices between social dilemmas equipped with positive or negative sanctioning systems. To the best of our knowledge, we are the first to analyze subjects' behavior in experimental public goods games, in which they repeatedly "vote with her feet"[2] (at no cost) and migrate between a reward and a punishment system. Within this environment, we ask which factors lead to convergence to a choice of punishment system, and which degrees of cooperation are achieved.

Our study follows the literature that explores the effectiveness of either punishment in comparison to rewards or a combination of both mechanisms for solving social dilemmas (Andreoni et al., 2003; Sefton et al., 2007; Rockenbach and Milinski, 2006; Rand et al., 2009; Hauert, 2010; Hilbe and Sigmund, 2010; Milinski and Rockenbach, 2012). Similar to the setting in Gürerk et al., (2006, 2014), we implement migration in a repeated three-stage public goods game. In stage one, participants freely choose between two communities. In stage two, participants play a public goods game within their community. Finally, participants are informed about the others' contributions and, depending on the community, may or may not sanction or reward other community members in stage three. We implemented two treatment conditions: in PN, participants choose between a community with punishment and a community without pun-

[1] An exception can be found in the study by Dickinson et al., (2015) who let (among others) police commissioners choose between playing repeatedly a public good game with a rewarding or with a punishment system. In their study the majority of subjects favors rewards over sanctions, but police commissioner are more likely to vote for sanctions.

[2] In his seminal paper, Tiebout, (1956) first suggested that people "vote with their feet" for communities with an optimal provision of public goods.

ishment. In PR, participants choose between a community with punishment and a community with reward. While PN aimed to provide a baseline in terms of cooperation rate, PR addresses our research question.

We confirm the previous results in PN (e.g., Gürerk et al., 2014). The vast majority of participants move to the punishment community where almost full cooperation is obtained, while contributions in the non-punishment community remain low throughout the experiment. In PR we find much richer dynamics. Initially, almost all participants opt for the reward community, where contributions are stabilized at a constant rate. However, half way through the course of the experiment, participants in some groups start "exploring" the alternative community. In a sense, the existence of the reward community postpones the establishment of the punishment community. However, this saves punishment expenditures which is potentially of great importance for the overall efficiency of the public good (see, e.g., Gächter, Mengel, et al., 2017). The migrated players start contributing at high levels immediately almost without actual punishment required. High contributors are the first to migrate to the punishment community, retaining their high cooperation level. In the following periods, more participants join the non-populated punishment community and contribute at the maximum without previous punishment. A closer analysis shows that the lack of rewards targeted at cooperators predominantly triggers the migration. When the migration occurs, however, the total profits in the reward community remain higher than in punishment (due to a very favorable rewarding mechanism, details are discussed below), meaning that the players forgo higher profits for the sake of joining the community with a lower income inequality.

Our findings highlight the importance of the concept of income inequality for the rise and fall of the institutional arrangements: people seem to start discovering the benefits of another institution if their current institution substantially harms their fairness sentiments. Participants who do not receive significant rewards for high contributions migrate to the punishment community. Our results show that the migration from the reward to the punishment community spurs cooperation purely based on the mere threat of punishment. That is, the occurrence of the unfair rewarding system remedies the welfare loss of the punishment system.

2 Design, Hypotheses and Procedures

2.1 Design

To facilitate the comparison of our results, we implemented a design that is similar in the basic structure and the parametrization of Gürerk et al., (2006, 2014). The experiment consists of three stages: *community selection, public goods game* and *sanctioning,* that are repeated for 30 periods. The experiment is implemented in the groups of 12 players who interact anonymously.

Community selection: We analyze two treatment conditions. In PR players choose between two communities: one with a punishment system and another with a reward one. In PN players choose between a community with a punishment system and a community without any sanctioning system.[3] In each

[3]The terms "reward", "punishment" as well as "sanctioning" were not used in the instructions or in the course of the experiment. See the instructions in the Appendix.

treatment, players only interact within their chosen communities.

Public goods game: After choosing the community each player receives an endowment of x tokens. Players may simultaneously contribute an integer amount of $c_i (0 \leq c_i \leq x)$ to a common project. The player keeps the remaining endowment $(x - c_i)$. The sum of all contributions within one community, S, is multiplied by a factor a, and distributed evenly between all n members of the community (with $1/n < a/n < 1$) irrespective of the individual member's contribution.[4]

Sanctioning: After all the members of the community have made their contribution decision, they move to the sanctioning stage. Each player receives an additional endowment of y tokens as well as feedback on individual contributions of the other community members. In the punishment system players may assign punishment points to other community members reducing their own income by one and reducing the income of targeted community members by p tokens. The reward system functions similarly with assigned reward points reducing the own income by one and increasing the income of targeted community members by r tokens. The sanctioning decisions in both regimes are taken simultaneously by all players. Since identification of group members is possible only via ID numbers and these are randomly reshuffled in every period, our design does not allow for reputation building. Therefore immediate action is required if sanctions are to be imposed. In the community without any sanctioning system members receive an additional endowment of y tokens each, but cannot spend these tokens on sanctions.

After assigning sanctioning points, players receive feedback on their individual performance in the current period and the average performance for the past behavior in both communities. Each player receives feedback on all individual performances for both groups, which includes the contribution, the income after the public good game, received and distributed points – if applicable – and the total payoff of the current period. Additionally, players see the average contribution, average received points and average period payoff for both regimes for all previous periods.

The payoffs in tokens in the current period in the community without sanctioning (N) are

$$\pi_{iN} = (x - c_i + \frac{a}{n} S) + y, \tag{1}$$

where n equals the number of players choosing N in the current period ($1 < n \leq 12$). Therefore, there is no advantage of joining large groups.

In the sanctioning communities the payoffs are altered by the sanctioning points distributed to other members, s_i, and the sanctions received from other members of the community, s_{-i}

$$\pi_{iP} = (x - c_i + \frac{a}{n} S) + (y - s_i - p s_{-i}) \tag{2}$$

$$\pi_{iR} = (x - c_i + \frac{a}{n} S) + (y - s_i + r s_{-i}) \tag{3}$$

Participants play this game repeatedly for 30 periods. To reveal players' changing institutional preferences over time, we allow them to repeatedly select themselves at the start of the new period—prior to the contribution stage—into

[4]If a community consist of only one member, there is no possibility for a common project and the the entire endowment x is transferred to the private account.

communities with different sanctioning systems. Migration between communities is costless.

The results of the PN treatment are expected to replicate those of Gürerk et al., (2014), that is, all the participants strongly prefer the sanctioning regime. They join the punishment community and after actively punishing each other in the beginning contribute almost fully. In other words,

H_1: In the PN treatment, the majority of players prefer the punishment regime. They actively use punishment points to maintain the cooperation at the high level.

In line with the existing literature (e.g., Sutter et al., 2010), we anticipate that participants will join the reward community in the PR treatment at the start:

H_2: In the PR treatment the majority of participants initially joins the reward community.

The reward regime offers enormous efficiency gains depending on y and r in comparison to x and a. Following Gürerk et al., (2014), we choose the parameters such that $x = 20$, $y = 20$, $a = 1.6$, $r = 3$, and $p = 3$. As a consequence, our experimental setting tests deliberately the extreme case where the potential benefits from only two players mutually rewarding each other (i.e., 60 tokens per player) outweigh almost twice the benefits from full cooperation of those two players in the public good game (i.e., 32 tokens per player). That is to say, we test migration to the punishment regime under utmost unfavorable conditions.

Despite those income potentials in the reward regime, we ask whether there might be conditions which lead to migration. If at all, migration takes place in later periods of the experiment: people have typically a diminishing willingness to reward, and so in experiments without migration between the two regimes, the contributions in the reward community fall below those in the punishment community over time (Andreoni et al., 2003; Gürerk et al., 2014).

H_3: In the PR treatment participants gradually migrate from the rewards to the punishment community.

The crucial questions for our analysis is whether and why participants will start exploring the alternative institution and eventually migrate to the punishment community. As full contributors suffer most from free-riders in malfunctioning reward communities, we expect them to initiate the migration to the punishment regime. Yet, it is a priory unclear which specific circumstances trigger this process and we aim to provide an empirical answer.

2.2 Procedure

Experiments were conducted at the WISO Research Laboratory at the University of Hamburg in October, November and December 2015. Experiments were computerized using z-tree (Fischbacher, 2007). Subject were mostly students of various majors of the University of Hamburg. They were recruited online via hroot (Bock et al., 2014) and randomly assigned to treatments. No subject participated more than once.

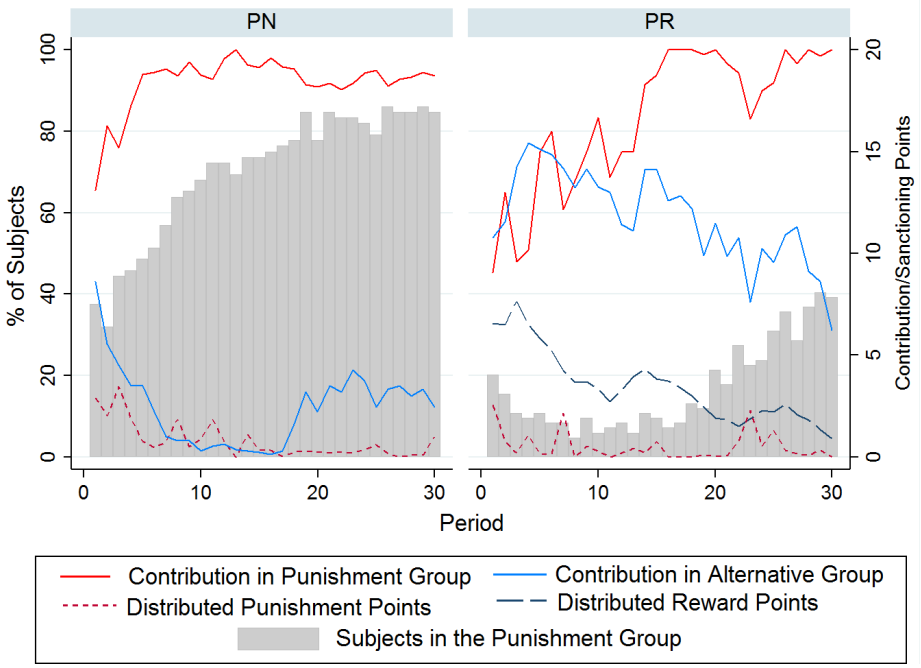

Figure 1: Community Choice, Contribution and the use of Points over Periods.

We conducted 7 sessions of approximately 2 hours each with 156 participants in total. In all but one session, 24 subjects participated. Subjects were randomly matched into two groups of 12, which remained unchanged throughout the experiment. The two groups played the game simultaneously, but independently, yielding 6 independent observations for the PN treatment and 7 independent observations for PR[5].

After being seated in cubicles, participants received a copy of the instructions, which were read aloud, followed by a comprehension test. As in the design of Gürerk et al., (2014) subjects were paid no show-up fee but granted a starting endowment of 1000 tokens, equivalent to 10 Euro. The conversion rate (1 token = 10 Eurocent) was common knowledge. At the end of period 30, individual token incomes were converted into Euro. After filling an a short questionnaire, subjects were paid privately and in cash. Payments ranged from 19.10 to 32.60 Euro with an average of 25 Euro.

3 Results

3.1 Dynamics of the community choice

Figure 1 displays the dynamics of the community choice over time. The left panel shows the migration between communities and the level of contributions in the PN treatment. The results for the PN treatment closely mirror the findings from Gürerk et al., (ibid.). Players quickly discover that the level of

[5]Data for one group in PR treatment was lost due to a hardware failure.

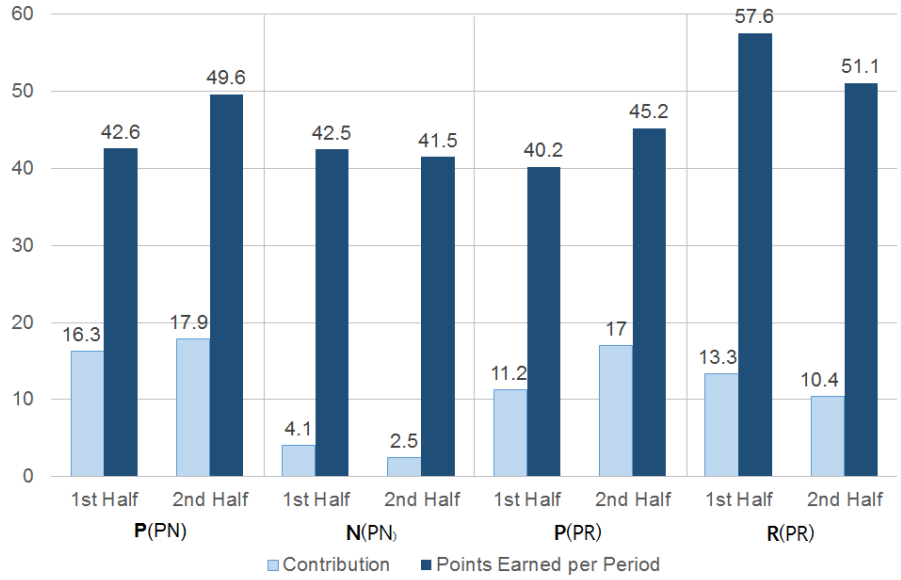

Figure 2: Average Contribution and Period Scores for periods 1-15 (1st Half) and 16-30 (2nd Half).

contributions and profits are higher in the punishing community, migrate there and contribute almost fully under the threat of punishment. Supporting our H_1 and the results from the previous literature, the majority of participants choose the punishment community if given the option between punishment and no sanction. The players achieve high levels of cooperation by using punishment in the initial periods.

The right panel of the graph, containing the PR treatment shows more variance over time: in the beginning, almost all the players choose the reward community, which gradually reaches the highest popularity around period 15 with about 90% of the population selecting it. The data support our hypothesis H_2: people initially prefer the reward community. However, the trend reverses in line with our hypothesis H_3 in the second half of the experiment; players start to migrate to the punishment community in increasing numbers. Thus our results demonstrate that there is no time-persistent preference for rewards. Subjects choose indeed the reward community initially, but as time passes they migrate to the punishment institutions.

Possible explanations for these migration patterns are the change in the rates of contribution and profits of different communities. Although a Mann-Whitney U-test shows that the average contribution is not significantly different in the treatments (PN 10.75 and PR 13.5 p=0.504)[6], a closer look at single communities reveals that the level of contribution differs significantly between them and that communities with P in the PN treatment condition[7] performs best,

[6]For all the further analysis only groups of 2 and more players were considered. The p-values can be found in Table A1 and Table A2 in the Appendix. All non-parametric statistical tests reported are two-tailed and take communities as units of observations.

[7]Hereafter denoted as P(PN), other groups are denoted accordingly.

with an average contribution of 17.4. It thus reconfirms that punishment seems to be better suited for sustaining a higher level of contribution. The reward community in our experiment secures a relatively stable level of contribution at ca. 60% of the full endowment level (11.9), however, with a decreasing trend.

In the sanctioning regimes it is not only the level of contributions but also the punishing and respectively rewarding behavior of players which affect the payoffs in any given period. Figure 2 displays average contributions and average period scores separated for the first and the second half of the experiment since the migration from the reward community begins approximately in period 15. The profits of the R(PR) community and P(PR) are significantly different averaged for the 30 periods and for the first half of the experiment (Wilcoxon signed-rank test p=0.018 and p=0.03 respectively). Despite the decrease in the second half, the profits remain higher than those of the P(PR) but the difference is not significant anymore (p=0.13).

The distributed points in Figure 1 show that the difference in profits between the groups stem from the active use of sanctioning. The use of reward and punishment points is not symmetric: punishment points in the P(PR) community are barely used, even when the group expands and attracts new members, while rewards are distributed frequently, although their use declines in the course of the game. Overall, profits in the reward community stay higher throughout the game, but this does not stop migration toward the punishment regime.

Turning to the sanctioning behavior in punishment communities, let us point out that the establishment of an effective punishment community in the PN treatment requires players to discipline each other in the first periods of the game only. A high level of contribution in the later periods relies on the threat of punishment, but for it to be credible the society has to undergo welfare losses in the earlier periods. In the punishment regime in the PR environment, however, the threat of punishment alone appears to be sufficient to promote cooperation from the very beginning. This observation is remarkable since there is gradual migration into P communities both in PN and PR. Migration between the two sanctioning institutions leads to less inefficiencies than migration into the punishment regime from a sanction free environment. The former type of migration promotes better adjustment of contribution norms. Migrants already experienced an alternative institutional setting (i.e., R) in which some community members used the (costly) sanctioning mechanism. Thus it seems less likely that new members of P(PR) question whether other group members will actually use punishment. As a consequence, they adjust their contributions accordingly making the actual use of punishment redundant. The existence of the reward community postpones the establishment of a flourishing punishment community, yet significantly increases the efficiency in the latter setting.

While in the PR treatment the mere threat of punishment is sufficient to ensure a high level of cooperation, in the reward regime actual rewarding of contributors is required in every period of the game to ensure pro-social behavior in future periods. Reward points are indeed frequently assigned in the beginning of the game but the level is decreasing over time.

For the evolution of a regime, the question who uses sanctioning mechanism is as important as whether it is used at all. Comparing Figures 3 and 4, we see that in the R(PR) in the first half of the game free-riders or those who do not contribute fully generously reward contributors. In the second half the total use of points decreases and now it is the contributors themselves, who have to bear

the costs of rewarding while not getting any compensation from the free-riders. This development may lead to an unequal distribution of income, which in turn may cause migration towards the punishment community. A first indication of this is the coincidence of (almost) fully contributing subjects who distrbute rewards and migrate subsequently (see Figure 4). In the next subsection we will analyze the possible reasons that drive migration between communities.

3.2 Migration between communities

One intuitive reason for subjects to switch regimes is pursuing higher profits. Players receive comprehensive feedback which includes individual profit of each player in both communities, contribution, received and distributed points (if applicable) for the current period as well as average score for all the periods already played. Therefore, players have well-informed expectations concerning the profits in the alternative community, even without joining it. However, higher profits cannot be the main driver of migration, since earnings remain higher in R(PR) throughout the experiment. Nonetheless, we still observe migration towards P(PR). Therefore, we will analyze other factors beyond mere monetary selfinterest, which potentially triggers migration from the profitable reward community.

There is a number of other potential factors which might explain the migration pattern (e.g., low minimum contribution in the own as well as high average contribution in the alternative community). We test those factors in a series of random effect panel probit regressions with a binary dependent variable taking the value of 1 for each subject, who migrated to the alternative community in the next period (t+1), and zero otherwise. We estimate separate regressions for each community which players potentially leave (e.g., P to N, or R to P). We add several control variables, which allow us to better capture underlying differences between positive and negative sanctions in the PR treatment: antisocial behavior (in addition to received points), difference in income within the community, difference in income between two communities, percentage of free-riders in the community, and the size of the community.

We include antisocial behavior as a dummy variable which takes a value of 1 for a full cooperator, who receives any number of punishment points in P or receives no reward points at all in R. Although withholding rewards may not necessarily be seen as an act of punishment, intuitively these situations are very similar: full cooperators in P invest maximum effort to increase the community's payoff, clearly at the cost of reducing their own payoff. Decreasing their payoffs even further by punishment is likely to decrease their willingness to contribute in the future, and, as such violates the interest of the community. Along the same line of argument, not rewarding full contributors in R violates group interest as well: while increasing the overall payoff of the community, the full contributors' payoffs remain the lowest in the community if they are not compensated via rewards.[8] Therefore, the variable antisocial behavior provides a proxy for similar effects in the punishment and the reward community.

Difference of income between two communities captures the profit maximizing motive of migration and measures the difference between the average payoff

[8]On a related issue Gangadharan et al., (2016) show that rewards are unable to establish high levels of cooperation if they do not achieve equal income distributions.

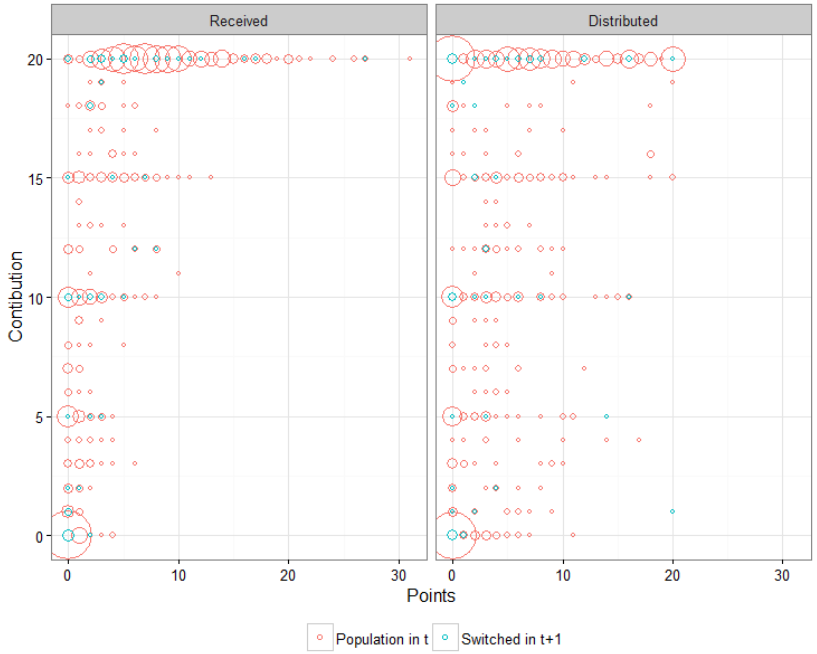

Figure 3: R(PR), received and distributed points depending on contribution in the 1st half of the game.

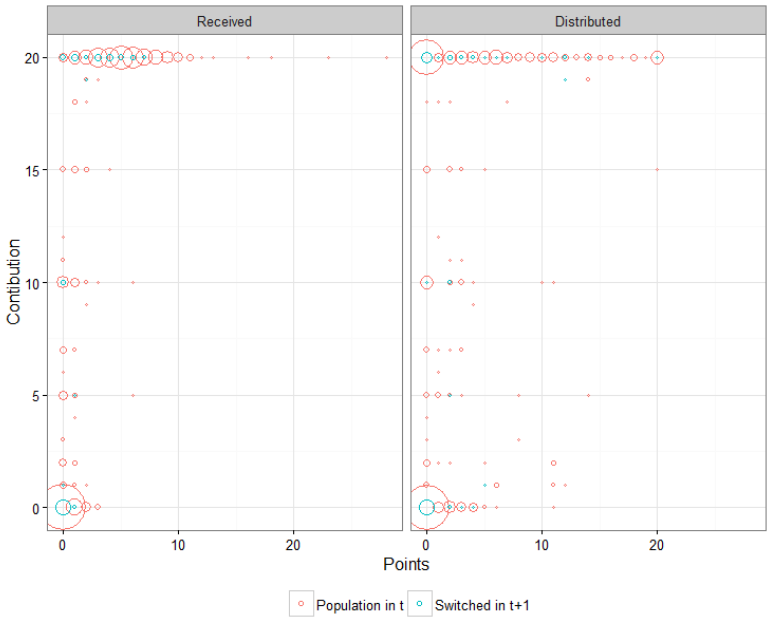

Figure 4: R(PR), received and distributed points depending on contribution for the 2nd half of the game.

per period between communities.[9]

Since rewards decline in later periods of the experiment, income inequalities may arise within the group between contributors and free-riders. As this inequality could be an important motivation for migration, we included the difference in income within the community in the regressions. We use the total period payoff, that is, the sum of payoffs obtained in the public goods and in the sanctioning stage. For this, for each player the payoff inequality is calculated in the spirit of Bolton and Ockenfels, (2000) as *Difference of income within community= ln(Actual payoff/ Equal payoff)*. As in the Bolton-Ockenfels model, we measure inequality as the difference between the actual individual share and one-n$^{\text{th}}$ share of the sum of payoffs assuming that players prefer small differences (precisely, we use the logarithm of the shares as discussed in Jasso, (2007)).[10] From this approach is follows that if one earns more than the equal share, the logarithm has positive value. If subject earns less than the equal share, the value turns negative, and zero reflects perfect equality.

We control for the share of free-riders relative to contributors in the community (measured as percentage of free-riders in the community), since it is possible that the contributors will self-select into the communities with the smaller share of free-riders. Size of the community is controlled for to see if the size of the community plays a role for the migration decision.

Table 1 shows the post-estimation of the probit regressions. Our random effect panel probit regressions have standard errors clustered on the experimental subgroup level.[11] The average marginal effects allow to estimate not only the direction of the correlation, but also provide some interpretation for the coefficients. Specifications 1 and 2 describe migration within the PN treatment, while 3 and 4 display the coefficients for the PR treatment. The regression confirms that there are different motivations for migrating between rewards and punishment within the PR treatment. Moreover, results show that different mechanisms drive migration from the punishment community in the two treatment conditions. That is, the punishment community in itself functions differently depending on the alternative institution.

Column 1 shows that apart from minimum contributions in own community and average contribution in the alternative community, it is the income differences within a community and between competing communities which drive the participants away from the non-sanctioning community. As for migrating from P(PN) to N(PN), being punished increases the probability of migration in the next period but there is no significant effect of antisocial punishment. The level of contributions in own as well as in the alternative community influences the migration decision. It is also the only direction of migration where the size of the group has significant effect on the decision to change the group: players are less likely to leave bigger punishment community.

Columns 3 and 4 contains the estimations for the migration within the PR treatment. Antisocial behavior (i.e., not assigning any points to full contrib-

[9]Difference of income between two communities is defined as follows $DifferenceR(PR) = (AveragePeriodIncomeR(PR) - AveragePeriodIncomeP(PR)$ and respectively $DifferenceP(PR) = (AveragePeriodIncomeP(PR) - AveragePeriodIncomeR(PR)$; therefore, we expect to have same sign of the coefficient for migration in both directions.

[10]Jasso, (2007) originally includes "fair outcome" in the equation instead of the "equal payoff." Since the current paper does not deal with different fairness concepts, for our purposes the principle of fair share appears to be feasible.

[11]The group of 12 participants, which remained unchanged throughout the experiment.

Table 1: Marginal Effects of the Determinants for Migration

Switched in t+1	(1) N to P	(2) P to N	(3) R to P	(4) P to R
Received Points		0.00781***	-0.000441	-0.00267
		(0.00205)	(0.00169)	(0.0165)
Antisocial Behavior		0.00400	0.0828***	0.272***
		(0.0190)	(0.0243)	(0.0235)
Minimum of Others' Contribution in Own Community	-0.0108*	-0.00214**	-0.00239***	-0.00490
	(0.00581)	(0.000960)	(0.000908)	(0.00548)
Maximum of Others' Contribution in Own Community	-0.00574	-0.00282***	-0.00579***	-0.0154
	(0.00551)	(0.000507)	(0.00147)	(0.0137)
Average Contribution in Other Community	0.0122***	0.00536***	0.000867	0.0277***
	(0.00446)	(0.000911)	(0.00128)	(0.00666)
Difference of Income within Community	-0.630***	0.000316	-0.0404**	-0.0489
	(0.181)	(0.0172)	(0.0195)	(0.173)
Difference of Income between Communities	-0.00569***	0.000393	-0.000943**	-0.00237
	(0.00168)	(0.000379)	(0.000417)	(0.00304)
% of Free-Riders in Community	-0.000980	-0.000497	0.000983**	0.00364*
	(0.000777)	(0.000507)	(0.000468)	(0.00203)
Size of the Community	0.00851	-0.00489***	-0.00256	-0.00944
	(0.00974)	(0.00181)	(0.00628)	(0.0103)
Observations	2,049	2,049	2,385	2,385
R^2	0.44	0.56	0.35	0.62

Note: Radom-effects Probit estimation; standard errors in parentheses,
*** p<0.01, ** p<0.05, * p<0.1;
R^2 is calculated for the respective panel probit specification and is mentioned here for completeness. R^2 is calculated after McKelvey & Zavoina.

utors) clearly has the strongest impact on the decision to migrate from the reward to the punishment community (column 3). Further of significant impact are minimum and maximum contribution in the own community, the difference of income within the community and between the communities as well as the share of free-riders. The migration from the punishment to the reward community (column 4) again is mainly determined by the antisocial behavior (i.e., punishing full contributors). For this decision the average contribution of the alternative community and the share of free-riders are significant driving factors as well. Neither the level of contributions in one's own community (minimum and maximum contribution) nor the size of the communities influence the migration decision from P to R.

Notably, the number of sanctioning points itself does not affect the likelihood to migrate in neither R to P nor P to R case. The coefficient for the antisocial punishment, however, is significant, positive and by far of the highest magnitude for both directions of migration. Thus, not the size of sanctioning drive players away, but the instance of antisocial punishment dramatically increases the likelihood of switching. In other words, if sanctions are used to hinder and not to promote cooperation, the alternative community is seen as more attractive.

Earlier, we speculated that migration – particularly of contributors, who suffer the most from the free-riding – might be triggered by the share of free-riders in the group. Yet, increasing numbers of non-contributors have a significant, but rather small effect. The significant and comparatively large effect of unequal distribution of income within the community allows the following interpretation: the share of free-riders in itself seems to have little influence on the decision to leave the community. Only if free-riding is the primary source of inequality within the community and non-contributors do not generously assign reward points to contributors and do not reduce inequality, migration is triggered (recall Figures 3 and 4). Therefore, the influence of the share of non-contributors is of minor importance only.

Along the same line of arguments, the difference of income within the community seems to be a major driver for the migration from R to P, and even more so from N to P (see specifications 1 & 3). In turn, the more equal are outcomes within the community, the less likely players are to migrate. Thus, for the rewarding regime to function, it is important to ensure that outcomes are evenly distributed. In fact, it is of pivotal importance not only how many rewarding points do contributors receive in total,[12] it is also crucial who assigns them. If free-riders fail to coordinate the equalization of outcomes within the community, contributors migrate to the alternative institution. Subjects seem to prefer a punishment community with more evenly distributed payoffs over more profitable reward institution.

Overall, our regression results show that internal, within-community factors (such as minimum and maximum contribution and the distribution of incomes) which are not dependent on the performance of the alternative community are of major importance for the decision to migrate from R to P. Migration from P to R on the contrary, depends to a greater extent the performance of the alternative institution. Hence, the P(PR) community grows with players unsatisfied with the distribution of incomes in the R(PR) community. As the antisocial behavior and inequality play the major role for migrating in the upcoming period, it is

[12] Recall that there are enormous efficiency gains in R even for mutual rewards of two players.

likely that full contributors who are not rewarded at all (thus suffering from both factors) are the first switch to the alternative regime. Active rewarding of contributors, therefore, appears to be necessary not only to ensure a high level of contribution in the next periods, but also to keep contributors in the community and prevent migration to the punishment community in the first place. As the use of reward points decreases steadily over time, more and more contributors remain unrewarded and migrate.

Taking a closer look at who migrates first into non-populated[13] punishment community in the PR treatment (Fig.5) confirms the former claim: we see that the number of migrating subjects with a previous contribution of 20 is twice as high as the number of free-riders and those who contributed moderately. While most participants return to the reward community after one period, a large fraction of the migrated full contributors remains in the punishment community. A proportionality test supports that mostly full contributors migrate first and stay in the unpopulated punishment community: the proportion of full contributors migrating into an unpopulated punishment regime and remaining there for more than one period is significantly higher than the share of full contributors within the reward community in general (p=0.06). Within those who migrated into an unpopulated punishment regime and remained there for more than one period the proportion of full contributors (14 out of 21) is significantly higher than proportion of free-riders (3 out of 21, p= 0.000) and of contributors (4 out of 21, p=0.000), as well as of the two latter categories combined (p=0.0005).

4 Conclusion

It seems that the conditions triggering the migration to the punishment community are unequal income distribution within the reward community and assigning no reward points to full contributors. While punishment institutions were found to be initially unattractive and avoided if possible by a majority of experimental studies (e.g., Sutter et al., 2010), our results suggest that players gradually join the punishment institutions, leaving unequal reward institutions. In turn, a reward-based society runs the risk of losing the highest performing members when it fails to acknowledge their achievements. Even highly efficient institutional arrangements lose their attractiveness due to the nonrecognition of individual fairness concerns.

In addition, our experimental results indicate an important avenue for the emergence of sanctioning institutions, which allows to promote cooperation with the help of punishment, but without initial losses of efficiency: if there is a competition between punishment and reward communities, the gradual migration allows the punishment mechanism to sustain high levels of cooperation persistently by threat (rather than actual punishment). To be more precise, migrants already experienced an institutional setting in which some community members defend contribution norms by (costly) sanctioning. There is no need to question whether other group members execute the punishment mechanism, so new members adjust their contributions accordingly. This makes the actual use of punishment redundant, while leading to more homogeneously cooperating communities as envisioned by Tiebout (1956). This result gains additional importance in the light of the recent findings of Gächter, Mengel, et al., (2017):

[13] A community is considered to be unpopulated if its population consists of up to 1 person.

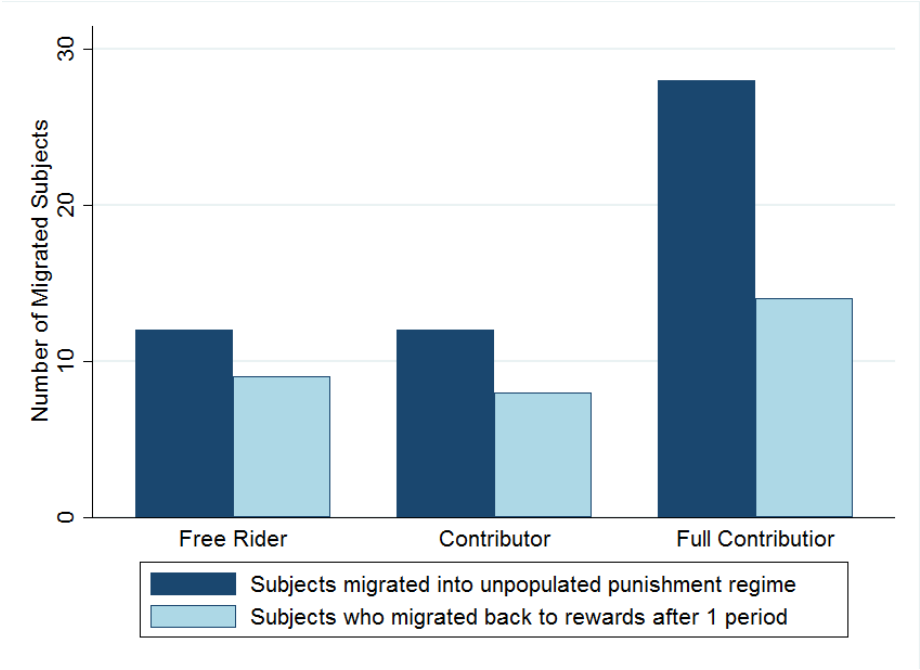

Figure 5: Subjects, who migrate into non-populated punishment community classified by their last contribution before migrating (full contributors contributed 20, free-riders – 0, contributors – any amount between 19 and 1). Aggregate over all periods.

if profits from previous periods are endowments for the next, than the welfare loss from punishment in the early periods grows exponentially and is particularly harmful. Here, the gradual migration into punishment communities from existing competing institutions may promote high levels of cooperation without the initial loss of welfare due to actual punishment.

Our findings highlight the importance of a factor which is easily overlooked in socio-economic research: the institutional frame of open societies reflects institutional competition. Institutional designs do not develop in isolation, they rise and fall in competition with alternative mechanisms. That is to say, real world settings are rich on social dilemmas and potential institutional arrangements for them. The gradual comparison and movement between alternative settings assure the emergence of persistent solutions for dilemmas serving best our needs, both in terms of efficiency and – equally important – in terms of equality.

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A Appendix

Here are the results of the the Mann-Whitney U test performed for different subgroups with the population of more than 1 player (see tables A1&A2). Table A3 is an alternative representation of the data displayed on Fig.1 in the main body of the paper. Below you also find the English instructions for the experiment (PR treatment).

Contibutions	P(PN) 17.4	N(PN) 4.1	PN 10.8
P(PR) 15.0	p=0.0455	p=0.0043	
R(PR) 11.9	p=0.0455	p=0.0027	
PR 13.5			p=0.504

Table A1: Contribution, Mann-Whitney U test

Points per period	P(PN) 47.7	N(PN) 42.5	PN 45.1
P(PR) 44.7	p=0.32	p=0.15	
R(PR) 54.4	p=0.01	p=0.003	
PR 49.6			p=0.03

Table A2: Points per period, Mann-Whitney U test

Periods	Contribution				Distributed points			% of Subjects in the Punishment Group	
	P(PN)	N(PN)	P(PR)	R(PR)	P(PN)	P(PR)	R(PR)	PN	PR
1-3	14.9	6.2	10.6	12.2	2.8	1.2	6.9	38.0	15.5
4-6	18.3	3.1	13.7	15.1	1.1	0.5	5.9	48.6	9.5
7-9	19.1	0.9	13.6	14.2	1.0	1.3	4.0	62.0	8.9
10-12	19.0	0.5	15.1	12.6	1.2	0.2	3.1	70.8	7.1
13-15	19.5	0.3	17.3	13.1	0.5	0.5	4.0	72.2	8.7
16-18	19.3	0.7	20.0	12.5	0.2	0	3.4	76.4	9.5
19-21	18.3	3.0	19.7	10.4	0.2	0.1	2.1	82.4	17.1
22-24	18.4	3.7	17.8	9.5	0.3	1.2	1.9	82.9	24.6
25-27	18.6	3.1	19.2	10.6	0.3	0.6	2.3	83.3	31.7
28-30	18.8	2.9	19.9	8.0	0.4	0.1	1.4	85.2	38.9

Table A3: Table representation of Figure 1

A.1 Instructions: PR treatment[14]

Instructions for the experiment

General instructions

At the beginning of the experiment you will be randomly divided into **2 groups of 12 participants** each. During the experiment, you will be interacting only with the members of the same subgroup.

At the beginning of the experiment each participant receives a **starting endowment of 1000 points**. Before the beginning of the experiment there are 5 questions of understanding.

Procedure

Experiment consists of **30 rounds.** Each round consists of 2 stages. The first stage includes the choice of the group and decision about the contribution into the common project. In the second stage participants can affect the outcome of other members of his/her group.

First Stage

(i) Choice of the group

In the first stage, each participant can decide, which group to join.

There are two different groups:

	Affecting the income of the other members of the group
Group	A: Through assignment of negative points
	B: Through assignment of positive points

(ii) Contribution to the common project

Each round in the beginning of the first stage each member of the group receives an **endowment** of **20 Points**.

You decide how many of the 20 Points you want to **contribute** to the common project. The remaining part of the endowment, you **keep to yourself.**

Calculation of your income from the first stage

Your income from the first stage consist of two parts:

- **Points which you kept to yourself** = Endowment – your contribution to the common project
- Your **profit from the common project** = 1.6 x sum of all the contribution to the project of all the community members/ number of members in the community

Therefore, **your income from first stage** is:

20 – your contribution to the common project +
1.6 x Sum of all the contributions to the common project of all the members of the community / Number of members in the group

The profit from the common project will be calculated according this formula individually for each member of the community. **Please note:** Each member of the community receives the same profit

[14]This is a translation of the original German instructions which can be obtained from the authors upon request.

from the common project. It means that each member of the group profits from **all** the contributions to the project.

Second Stage

Assignment of Points

In the second stage, you see how much each member of the group contributed to the common project. **(Please note: The sequence of players is reshuffled every round.** Therefore, it is not possible to identify a group member over different rounds by their position in the displayed list.)

By assigning points, you can **increase, decrease** or leave the income of the other group members **unchanged**.

In the second stage of every round each participant receives **20 additional points**. You decide how many of these 20 points you want to **assign** to the other group members. You **keep** the remaining points to yourself. To check how many points you have assigned, press the *Calculate Points* button on your screen.

- **Each positive point,** which you assign to a group member, **increases the income of this group member by 3 Points**.
- **Each negative point,** which you assign to a group member, **reduces the income of this group member by 3 points.**
- If you assign **0 points** to a group member, **the income of this group member remains unchanged.**

Calculation of your income from the second stage

Your income from the second stage consist of three parts:

- **Points kept to yourself** = 20 – sum of the points you assigned to the other group members.
- **plus 3 times the number of positive points** you received from the other group members

or

- **minus 3 times the number of negative points** that you received from other group members.

Therefore, **your income from second stage** is:

20 – sum of the points you assigned to the other group members

+3 x (Positive points, which you received from the other group members)

or

– 3 x (Negative points, which you received from the other group members)

Calculation of your round income

Your round income is calculated as follows:

	Your income from the first stage	= 20 – your contribution to the common project + 1.6 x Sum of all the contributions to the common project of all the members of the community / Number of members in the group
+	Your income form the second stage	= 20 – sum of the points you assigned to the other group members +3 x (Positive points, which you received from the other group members) or – 3 x (Negative points, which you received from the other group members)
=	Your round income	

Special case: single group member

Should you be **the only member in your group**, you receive 20 points in the first stage and 20 points in the second stage, that is our round income is **40**. You cannot act neither during the first nor during the second stage.

Information at the end of the round

At the end of the round, you will receive a detailed overview of the results from all groups. For each member of the group, you will see: their contribution to the project, their income from the first stage, points they assigned (if possible), points they received (if possible), their income from the second stage and their round income.

History

Starting in round two, before the start of a new round you will see an overview of the average results (as above) of all previous rounds.

Total income

The total income from the experiment consists of the starting capital of 1000 points plus the sum of the round incomes of the 30 rounds.

At the end of the experiment, your total income will be paid at an exchange rate of 1 € per 100 points.

Please note:

No communication is allowed during the entire experiment. If you have a question, please raise your hand. All decisions are anonymous, meaning that none of the other participants or the experimenters will know the identity of the person who has made a particular decision. The payout is also anonymous: no participant will know how much other participants have earned.

Good Luck!

DFG Research Group 2104
– Latest Contributions

2017:

Neuhofer, Sabine, Paetzel, Fabian, Schwaninger, Manuel and Traub, Stefan: Recognition of needs in a dictator game: Experimental evidence on information-sensitive giving behavior. Working Paper Nr. 2017-10.
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