Radboud Repository

Radboud University Nijmegen

PDF hosted at the Radboud Repository of the Radboud University Nijmegen

The following full text is a publisher's version.

For additional information about this publication click this link.
http://hdl.handle.net/2066/68768

Please be advised that this information was generated on 2019-04-19 and may be subject to change.

CentER

Discussion Paper

No. 2008–48

STRATEGIC VS. NON-STRATEGIC MOTIVATIONS OF SANCTIONING

By Jana Vyrastekova, Yukihiko Funaki, Ai Takeuchi

May 2008

ISSN 0924-7815

Tilburg University

Strategic vs. Non-Strategic Motivations of Sanctioning*

Jana Vyrastekova[1,2],Yukihiko Funaki[2,3], Ai Takeuchi[4]
[1]Radboud University, Department of Economics, Nijmegen, The Netherlands.
[2]Tilburg University, Department of Economics, Tilburg, The Netherlands.
[3]Waseda University, Tokyo, Japan.
[4]JSPS Research Fellow, Graduate School of Economics, Waseda University.

May 9, 2008

Abstract

We isolate strategic and non-strategic motivations of sanctioning in a repeated public goods game. In two experimental treatments, subjects play the public goods game with the possibility to sanction others. In the STANDARD sanctions treatment, each subject learns about the sanctions received in the same round as they were assigned, but in the SECRET sanctions treatment, sanctions are announced only after the experiment is finished, removing in this way all strategic reasons to punish. We find that sanctioning is similar in both treatments, giving support for nonstrategic explanations of sanctions (altruistic punishment). Interestingly, contributions to the public good in both treatments with sanctioning are higher than when the public goods game is played without any sanctioning, irrespective of announcing the sanctions to their receivers during the play of the game, or only after the game is finished. The mere knowledge that sanctions might be assigned increases cooperation: subjects correctly expect that nonstrategic sanctioning takes place against freeriders.

JEL Classification: C72, C92, D74.
Key words: altruistic punishment, nonstrategic sanctions, strategic sanctions, public goods, economic experiment.

1 Introduction

The efficacy of sanctioning in sustaining cooperation is well-documented in the experimental literature (Ostrom et al. 1992, Fehr and Gächter 2000, Egas and Riedl 2005, Masclet et al., 2003, Carpenter 2007, van Soest and Vyrastekova 2006). In various social dilemmas (public goods or common pool resource games) and parametrization thereof, experimental subjects are willing to incur costs in order to decrease payoff of others. Importantly, these payoff sanctions affect behavior in the social dilemmas and give rise to stable, or even over time increasing, cooperation.

Due to the impact of sanctions on behavior, we strive to understand the mechanisms that underlie sanctioning (see also Falk et al., 2005). Negative emotions held towards freeriders are hypothesized to be the proximate mechanism that sustains this outwardly costly behavior (Fehr and Gächter, 2002). Hence, the decision to assign a sanction is suggested to be nonstrategic. Not a result of a strategic and payoff-maximizing choice, it is commonly referred to in the literature as *altruistic punishment*. Indeed, Hopfensitz and Reuben (2005) provide evidence that self-reported emotions of anger are related to the punishment decisions. Also, there is evidence on the neurological processes underlying sanctioning. Quervain et al. (2004) measure brain activation patterns and relate sanctioning to the anticipated gratification. This evidence on pleasurable emotions related to sanctioning explains why (some) subjects are willing to incur its material costs. In view of this evidence, there is little doubt that altruistic punishment does exist.

Nevertheless, we should be aware that sanctioning could also be motivated by strategic considerations. Here we have in mind a rational, payoff-maximization-guided decision to assign a sanction for freeriding in a repeated game in order to manipulate the beliefs of others about the future consequences of free-riding.[1] Under the prevailing uncertainty about the preferences of other players, including the uncertainty about the presence of individuals willing to sanction for nonstrategic reasons, a rational, money-maximizing subject might find it profitable to impose sanctions early in the game in order to generate the expectation that altruistic punishers are present in the interaction, and that free-riding will

[1] Kreps et al. (1982) provide solution to rational cooperation in a finitely repeated prisoner's dilemma game in this spirit.

be sanctioned. The short-run costs incurred in this way might be compensated by long-run increase of cooperation by players trying to avoid sanctioning. Note that the observed sanctioning in repeated social dilemma games, which typically takes place in the initial periods of interaction, upon which the cooperation levels increase/sanctioning decreases, would be in line with non-strategic as well as strategic explanations of sanctioning. The nonstrategic explanations are supported by the fact that sanctions are found even in true one-shot interactions (Walker and Halloran, 2004) or in the last round of interactions (see the papers quoted above). At the same time, the sensitivity of the sanctioning decision to the cost/benefit parametrization of the sanctioning technology (Anderson and Putterman 2006, Carpenter 2007, Egas and Riedl 2005, Nikiforakis and Normann, forthcoming) is reminiscent of strategic motives in the choice to sanction.

Understanding the origins of sanctioning motivations is urgently relevant for the design of institutions which rely heavily on peer sanctioning, and where the working of centralized enforcement is precluded (e.g. microfinance, see Besley and Coate, 1995). If sanctions are prevailing strategic, then aspects that promote strategic reasoning should be stimulated (e.g. small groups, long-run interaction, information on the consequences of free-riding behavior). If, on contrary, sanctions are largely nonstrategic, we should learn more about the primitive mechanisms sustaining the peer sanctioning system (e.g. the role of emotions, relation to pro-social preferences).

In our paper, we therefore revisit a standard repeated public goods game with sanctioning in order to study whether the observed sanctioning can be related to the strategic management of the beliefs of other players, or whether it is nonstrategic and insensitive to possible long-run benefits associated with the initial investment into sanctioning. We disentangle the strategically and non-strategically motivated sanctions by setting-up an experiment with two treatments. Sanctioning is available in both of them, and in the STANDARD treatment, the sanctions assigned to a subject are revealed to her in the same round in which they were assigned. Contrary to that, in our main SECRET sanctions treatment, a subject is informed on the sanctions received in each round of interaction only at the end of the experiment. We argue that in this treatment, all strategic motivations for sanctioning are removed. Any remaining sanctioning is due to nonstrategic motivations, and not a result of a short-run cost vs. long run benefit payoff-maximization strategy. We compare the behavior in the two treatments in order to assess the relevance of strategic sanctioning in repeated public goods games.

A similar quest for disentangling strategic and nonstrategic (emotional) motivations of sanctioning can be found in the earlier work by Abbink et al. (2004)[2], and by Casari and Luini (2006). In both of these papers, actions of the subjects are restricted: Abbink et al. (2004) restrict the options to cooperate by using mini-ultimatum game, and additionally, the ultimatum game structure limits the sanctioning opportunities as well; Casari and Luini (2006) use public goods game with more complex sequential sanctioning stage in order to isolate the strategic motives. Moreover, the conclusions drawn in these two papers are contradictory. Abbink et al. find evidence in favor of strategic sanctioning, while Casari and Luini conclude that sanctions are mostly nonstrategic. In view of this scarce and contradictory evidence, the role the strategic sanctioning plays in a repeated public goods game is unclear.

The experiment reported here has the advantage of studying a standard public goods game, without restricting subjects' action choices to binary strategy sets (possibly avoiding randomization or opening a role for subjects' risk preferences), or by increasing the complexity of the sanctioning stage. We keep the sanctioning options constant across both treatments of the standard linear public goods game, and the only aspect that differs across the two treatments is whether a sanction (if any) can have an immediate impact on the behavior. Subjects can choose any level of cooperation, restricted by their endowments and integer contributions only, allowing in this way for small changes in the cooperation levels. In this way, we hope to shed more light on the relevance of strategic and nonstrategic motives of sanctioning in repeated interactions, as well as on the dynamics of cooperation under the threat of being sanctioned, whether this threat has an imminent or a delayed form.

Our findings support nonstrategic explanation of sanctioning in the repeated public goods game. We find that sanctioning takes place in both treatments, and similar lev-

[2] Abbink et al. (2004) also used design comparing treatments where feedback on a co-player's action in a two-player game is either observed in each round, or at the end of the experiment only.

els of freeriding in the public goods game are punished in a similar extent, whether the sanctions are or are not immediately announced to the sanctioned individuals. This lack of difference between sanctioning in the two treatments leads us to the conclusion that the sanctioning is prevailingly nonstrategic. Interestingly, we also observe that any form of sanctioning increases contributions to the public good, although unsurprisingly to a larger extent in the treatment where sanctions are immediately observed. We interpret the survival of cooperation in the treatment with possible - but not immediately observed sanctions - as an evidence for subjects' expectations of nonstrategic sanctioning, suggesting that sanctions do not have to hurt immediately in order to work. Observation that subjects expect to be sanctioned for freeriding, although they receive no immediate evidence, illustrates the crucial role of beliefs in altruistic punishment and speaks for sustaining of cooperation in societies where individuals do not necessarily interact in small groups, under constant scrutiny, but rather interact sporadically, with the information on their (uncooperative) behavior having long term consequences, overreaching those of the immediately experienced (social) sanctions.

The set–up of this paper is as follows. In section 2 we present the game and the experiment design. The data are analyzed in section 3, and section 4 concludes.

2 The game and experimental design

2.1 The game

We implement a standard, finitely repeated linear public goods game with $N \geq 2$ players and with the possibility to sanction. In the stage game, all players first simultaneously choose their private contribution to the public goods game. The payoff of player $i = 1, .., N$ in one round of the public goods game prior to sanctioning is given by:

$$\pi_i = E - x_i + \alpha(x_i + X_{-i}) \tag{1}$$

where $x_i \in \{0, 1, ..., E\}$ is the contribution to the public good by player i with $i = 1, .., N$, and X_{-i} is the sum of contributions of all players other than i; we denote by $E > 0$ the initial symmetric endowment of each player, and α is the marginal return from the public good, with $\frac{1}{N} < \alpha < 1$.

After the decisions on the contributions to the public goods game, sanctioning can take place. Each player observes the contribution vector $\{x_1, ..., x_N\}$, receives an additional endowment $S > 0$, and has to choose what amount of (integer) points from the endowment S to assign to any of the other players. Let us denote by s_{ij} the amount of points player i assigns to player j, $j \neq i$ where $s_{ij} \in \{0, 1, ..., S\}$ and $\sum_{j \neq i} s_{ij} \leq S$. Player $i's$ payoff from sanctioning in one round is given by:

$$f_i = S - \sum_{j \neq i} s_{ij} - 3 \sum_{j \neq i} s_{ji} \tag{2}$$

Every point that player i assigns to player j implies a "sanction" of 3 points deducted from the payoff of the receiving player j at a cost of 1 point to the sanctioning player i.

Player i's payoff in the stage game with sanctioning is given by

$$\Pi_i = \pi_i + f_i. \tag{3}$$

In order to derive a subgame perfect Nash equilibrium prediction for the stage game with sanctioning played among rational, money-maximizing players with common knowledge of the game and the players' preferences for payoff maximization, we first note that sanctions are costly to the sender while yielding no direct material benefit to her. Hence, each player $i = 1, .., N$ will set $s_{ij} = 0$ to all $j \neq i$. No sanctions will be given and the predicted contributions in stage 1 are equal to the contributions in a public goods game without the sanctioning possibility. In order to derive those, we note that the private cost of one unit contribution to the public good, which is equal to 1, exceeds the private benefit of the contribution, which is equal to α, with $\frac{1}{N} < \alpha < 1$. Consequently, the only rational solution is to set $x_i = 0$ for $i = 1, ..., N$. This solution is inefficient, though, as the maximal (and also joint-payoff maximizing) payoff is obtained if each group member chooses contribution $x^* = E$.

Finally, if the stage game is repeated finitely many rounds, the backwards induction leads to the prediction that no sanctions will be given in any round, and contributions to the public good will be equal to 0 in all rounds.

The assumption of pure money-maximization may be too restrictive, though, and the public goods game with sanctioning might be also played by players with preferences differing from own-payoff maximization, in particular with preferences for altruistic punishment. These *altruistic punishers* do not choose $s_{ij} = 0$ for all $j \neq i$ independent of the contribution vector $\{x_1, ..., x_N\}$: conditional on the observed contribution vector $\{x_1, ..., x_N\}$, altruistic punishers are willing to bear the costs of sanctioning to the extent that these costs are compensated by the joy of the act or of the impact of their sanctioning, in whatever way it might be (e.g. by decreasing payoff inequalities, reciprocating to uncooperative behavior, seeking to express fairness norms etc.) We will refer to the sanctioning performed by the altruistic punishers as *nonstrategic sanctioning*.[3]

Additionally to this type of sanctioning, we argue, *strategic sanctioning* might take place in repeated interactions when players' preferences are private information. Strategic sanctioning comprises choices of rational money-maximizing players to assign the individually costly sanctions to freeriders in a repeated game because of the impact these sanctions are expected to have on the behavior and the beliefs of the players in the future interactions of the game. This mechanism of providing punishment (i.e. secondary public good) by rational money-maximizers is akin to rational cooperation in a repeated public goods game (Kreps et al. 1982). Sanctions will be provided by rational money-maximizers if the investment into generating the belief that altruistic punishers are present in the population would yield long-run benefit outweighing the short-run costs of sanctioning.

Note that both nonstrategic and strategic motivations of sanctioning will be present in a game where sanctions received in one round of the game can be related to the contribution made in that round, and when players actually receive information on the sanctions received by players in that round. Let us refer to this setup as STANDARD sanctions repeated public goods game. Contrary to this, when sanctioning is possible but players do not learn whether and who received sanctions during the play of the game, then players are not able to adjust their beliefs about the presence of altruistic

[3]Note that we do not wish to investigate the specific form of preferences leading to altruistic punishment, but rather to establish whether (a part of) the observed sanctioning does have an origin different from the altruistic punishment. Our design allows us to do so without assuming specific form of the altruistic punishers' preferences.

punishers in the population, and/or change their freeriding behavior towards cooperation in order to avoid future sanctioning. Consequently, there are no strategic motivations for sanctioning in this case, where subjects would assign sanctions in order to change the beliefs of others. Let us refer to this setup as SECRET sanctions repeated public goods game. The only difference in the STANDARD and SECRET sanctions public goods game is the information on sanctions sent/received, which is postponed till the end of the game in the SECRET sanctions case, but which is available after each round of interaction in the STANDARD sanctions public goods game.

Until now, the prevailing explanation of sanctioning in the literature is that of non-strategic motivations. We therefore state our null hypothesis as follows:

Null hypothesis (H0): Some subjects hold preferences for altruistic punishment. The sanctioning observed in repeated public goods games is due to the rational, more-than-payoff maximizing choices of these subjects. Consequently, the extent of sanctioning observed in the STANDARD and SECRET sanctions repeated public goods game will be the same.

As discussed above, strategic reasons for sanctioning cannot be excluded based on the evidence we have, hence, we state our alternative hypothesis:

Alternative hypothesis (HA): Rational, payoff-maximizing subjects are also willing to sanction freeriders in a repeated public goods game in order to manipulate the beliefs of others with respect to the presence of altruistic punishers in the interaction. Consequently, more sanctioning will be observed in the STANDARD sanctions repeated public goods game, where this is possible, than in the SECRET sanctions repeated public goods game, where no strategic motivations for sanctioning are present.

2.2 Experiment design

In the fall semester of 2006, we ran four experimental sessions at Tilburg University, the Netherlands. In total, 64 subjects participated in two treatments.[4] Each subject

[4] We run our experimental sessions on two days. Besides the regression analysis reported below, we also run regressions controlling for "day" effects by including day-dummy variable. All our results were

participated in only one treatment. The participants were students in economics, law, or business. The language of the experiment was English. Upon arrival, participants were randomly assigned to a computer terminal. They were informed that the experiment consists of two tasks, and instructions for each task (see Appendix) were read aloud just before the relevant task started. The experiment was fully computerized; the software was programmed using z–Tree (Fischbacher, 1999).

Each treatment consisted of two tasks. In Task 1, subjects were matched into groups of four (N=4) and participated in 10 rounds of the repeated public goods game without any sanctioning, with payoff function given by Equation (1), using $\alpha = 0.4$ and $E = 10$. They were informed that they would stay in the same group for all 10 rounds, but in each round, subjects would be assigned a new label (ranging from 1 to 4). In this way, subjects shared knowledge about the behavior of others in the group across rounds, but they could not identify individual group members across rounds. In each round, each subject received 10 tokens, and was asked to divide it between option I (public good) and option II (private good). All formulations were in a neutral language. After each round, each subject observed the contributions of all other subjects in his/her group.

At the beginning of Task 2, we regrouped all subjects into new groups, and we informed them that they will stay in the same group again for all 10 rounds of Task 2. Also, subject's labels changed again in each round, as it was in Task 1. In the second task, each round had two stages. In stage 1, subjects chose their contributions to the public good. Then they observed individual contributions, and received 10 tokens of stage 2 endowment (S=10). In stage 2, subjects were able to assign any of their stage 2 endowment to any of the other subjects in their group, and their payoff function was given by Equation (3).

The only thing that differed in the two treatments we implemented is the information feedback subjects received after assigning sanctions in Task 2. In the STANDARD sanctions treatment, subjects were informed on the number of sanctioning points they received in the same round in which these points were sent to them. In the SECRET sanctions treatment, subjects did not learn anything about the sanctioning points received up till the end of the experiment. Only after all 10 rounds of Task 2 were finished, each subject

robust to the inclusion of this dummy.

learned how many points he/she received in each round.

Let us comment on the type of partner design that we used, and in which the subjects remain in the same group, but their labels are re-assigned randomly after each round. In this way, the same group interacts repeatedly, but under the condition that a link among actions taken in different rounds is severed, i.e. by preserving anonymity across rounds. Hence, this design combines two advantageous features useful in our experiment: (i) the observations of sanctioning in various rounds are independent of contributions observed in the previous rounds as the identity of the sanctioned/sanctioning individual cannot be traced across rounds, (ii) subjects remain in the same group so that actions of some subject observed in one round will affect payoffs of other subjects in the group in another round as well. In this way, sanctioning can be "strategic" in relation to the contributions to the public good, so that a sanction assigned in one round might affect (if at all) both the behavior in the public goods game as well as the beliefs about future sanctioning in the following rounds.

The experiment lasted about 1.5 hours, and participants earned on average 10,70 Euro (including 3 Euro participation fee).

3 Data analysis

In this section, we first analyze the sanctioning in the two treatments in order to address the role of strategic and nonstrategic sanctioning in the repeated public goods game. Then, we proceed to analyze the impact the sanctioning (if any) has on the behavior in the public goods game.

Let us first turn attention to our main question: is the sanctioning observed in a repeated public goods game largely nonstrategic, or do strategic motives play a significant role as well? Figure 1 summarizes the number of sanctioning points an individual sent on average to another subject, while controlling for the difference in the contributions of the sender and the receiver.[5] There is no striking difference between the two treatments,

[5] Note that we refer here only to Task 2 of the experiment, where sanctioning took place, i.e. rounds 11 till 20. No sanctioning took place in rounds 1 till 10, referred to as Task 1. If not mentioned explicitly, any analysis of the sanctioning behavior in this section is naturally restricted to the analysis of Task 2 of the relevant treatment.

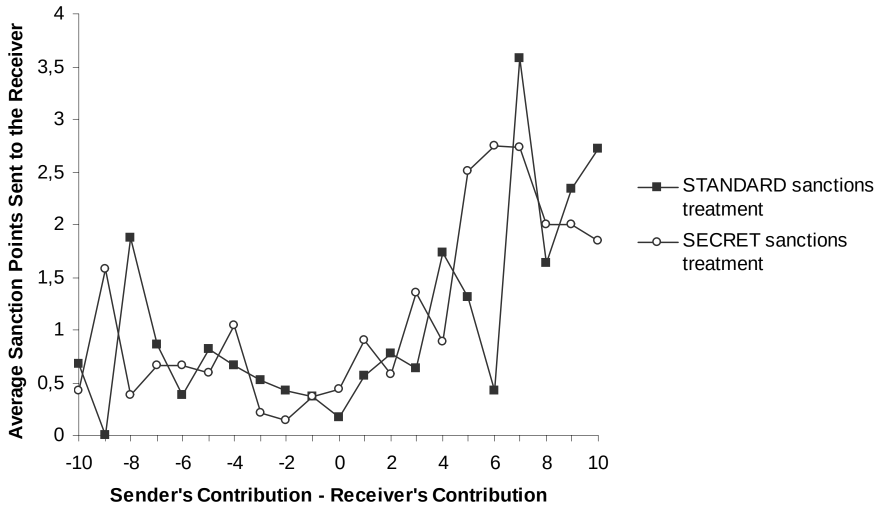


Figure 1: Average Sanction Points Sent: Controlling for the Difference Between the Sender's and the Receiver's Contributions.

and this is supported by a non-parametric test, according to which subjects in the two treatments send on average the same amount of sanctions for the same difference between the sender's and receiver's contribution (Wilcoxon paired test, p=0.768). The fact that we observe sanctions in the SECRET sanctions treatment is an evidence towards the presence of nonstrategic motives, as is the similarity in the pattern of sanctioning in the two treatments.[6]

Before proceeding to a regression analysis, making this point more precise, let us also note (see Figure 2) that the dynamics of sanctioning over time supports the nonstrategic nature of sanctions as well. In the SECRET sanctions treatment, where behavior in the public goods game does not change over time dramatically (see also panels (b) and (d) in Figure 4 below), the sanctions remain at the same level over all rounds of interaction. At the same time, sanctions in the STANDARD treatment lead to an increase in contributions to the public good with a concomitant decrease in sanctions over time - however, the sanctioning returns back in the last period of interaction. Inconsistent with strategic explantations for sanctioning, subjects do assign sanctions in the last period, when the

[6]The similarity is also preserved when we split the dataset into the first half of Task 2 (rounds 11 to 15) and the second half (rounds 16 to 20).

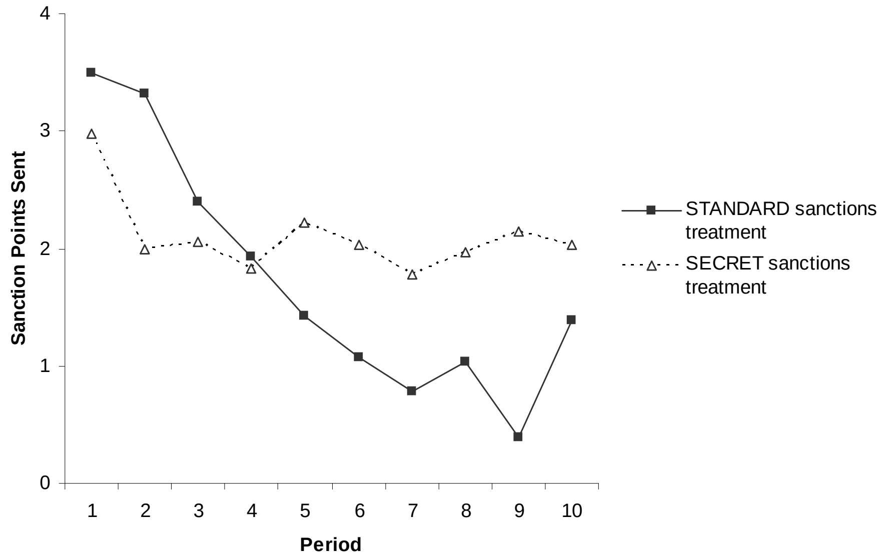


Figure 2: Average Sanction Points Sent per Period.

cooperation in the public goods game deteriorates, although they cannot expect any long run benefits from these end-game sanctions.

While the dynamics of the sanctioning suggests nonstrategic motives (see Figure 2), our conclusions cannot be made without relating the sanctioning to the behavior in the public goods game. In order to control for variables which might affect the choice to punish, we run logit regression explaining the decision of player i to sanction another player j. Our dependent variable is $sanction_{ij}$ where $sanction_{ij} = 1$ if $s_{ij} > 0$, and $sanction_{ij} = 0$ if $s_{ij} = 0$. We explain i's decision to sanction j by the difference between the public goods contributions by i and j, x_i and x_j. The two variables we include are $posxi\_xj$ which equals $x_i - x_j$ if $x_i > x_j$ and 0 else; and $negxi\_xj$ which equals $x_i - x_j$ if $x_i < x_j$ and 0 else. In this way, we allow for asymmetric effect of cases when player j is relative freerider compared to player i, and vice versa, when player j is relatively more cooperative than player i. We also use treatment dummy variable *secret* which equals 1 in the SECRET sanctions treatment and equals 0 in the STANDARD sanctions treatment. We interact the variables $posxi\_xj$ and $negxi\_xj$ with the dummy *secret* to determine whether the pattern of sanctioning differs across the treatments. Individual and period dummies are included. The period dummies are also interacted with *secret* to control

Variable	Coef.	Std. Err.	P>|z|
secret	0.335	0.519	0.519
$negxi\_xj$	-0.053	0.047	0.266
$negxi_xj*$secret	-0.045	0.067	0.491
$posxi\_xj$	0.418**	0.050	0.000
$posxi_xj*$secret	0.325**	0.089	0.000
_cons	0.823	0.584	0.159
Individual dummies	included		
Period dummies	included		
Period dummies interacted with dummy secret	included		
N=1590 (11 subjects dropped due to sanction_{ij}=0 for each j≠i in all 10 rounds)			
Log likelihood = -570.609			
Pseudo R2 = 0.4023			

Table 1: Logit Regression: Explaining i's Decision to Sanction or Not Sanction j.

for possible differences in the dynamics of sanctioning in the STANDARD and SECRET sanctions treatments.

The regression results can be found in Table 1. Based on them, we can conclude that the probability of assigning a sanction is significantly higher when the receiver contributes less than the sender: freeriders are being punished (coefficient on $posxi\_xj$ is positive and significant). Moreover, this effect is stronger in the SECRET sanctions treatment (coefficient on $posxi_xj*$secret is positive and significant). The session dummy *secret* is not significant.

In view of these results, we state:

Observation 1: Sanctions are prevailingly nonstrategic. Controlling for the differences in the sender's and receiver's contributions to the public good, we find that subjects sanction freeriders, and they are more likely to do so in the SECRET sanctions treatment than in the STANDARD treatment.

Hence, rather than finding more sanctioning in the STANDARD treatment (due to the strategic motivations), we find sanctioning is more likely to be triggered in the SECRET sanctions treatment. We suggest that this result might be related to the role emotions play in the sanctioning. In the SECRET sanctions treatment, no feedback is given about the sanctions received. Consequently, subjects are not exposed to the enforcement via receiving sanctions, that would motivate them to adjust their behavior in the public goods game. Consequently, the frustration of the cooperators vis-a-vis the freeriders is possibly stirred repeatedly in the SECRET sanctions treatment, resulting in emotions-driven motivations to sanction when the same freeriding behavior is observed over and over. This explanation, of course, is open to further research.

Now, having answered our main question - and finding that sanctions are mainly nonstrategic - we now continue to investigate one equally interesting point, namely the impact of sanctioning on the contributions to the public good in our two treatments. They differ in the subjects' ability to respond to the sanctions received. In the SECRET sanctions treatment, subjects do not observe the sanctioning - if any - and hence cannot react to it. Sanctions cannot have any direct enforcing impact on the behavior. Does that mean that sanctions represent a pure social loss in the SECRET sanctions treatment?

The answer is no. Sanctions, although not observed in the SECRET sanctions treatment, do have an impact on the behavior in the public goods game! Let us now support this answer by two sets of results. First, we present nonparametric tests on the groups' average contributions to the public good, and then the results of a regression analysis on the adjustment of the subject's contribution to the public good over time.

The average contributions to the public good in the STANDARD and SECRET sanctions treatment are summarized in Figure 3, but more illustrative Figure 4 is presented as well. This figure maps the dynamics of contributions in both treatments in all groups over time, both in rounds 1-10 (in Task 1, without the possibility to sanction) and in rounds 11-20 (in Task 2, with the possibility to sanction).

At a first glance on Figure 3, it is clear that the possibility to assign sanctions, whether announced immediately after being assigned or not, does improve cooperation in the public goods game as compared to the rounds without sanctioning. This is marginally confirmed by the MWU test at a group level, when using all 16 groups and comparing their average contributions in rounds 1-10 (Task 1 without sanctions) to those in rounds 11-20 (Task 2 with possible sanctions) (MWU, N=32, p=0.094). This impact on contributions is significant in STANDARD sanctions treatment (MWU, N=14, p=0.026), but not in SECRET sanctions treatment (MWU, N=18, p=0.730). However, there is no significant difference in the *average contributions* in Task 2 in the two treatments (rounds 11-20 with

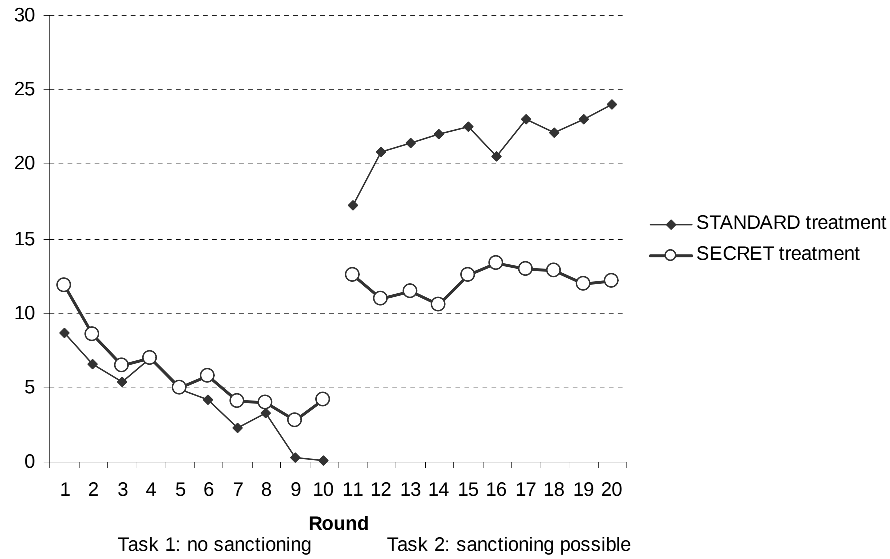


Figure 3: Average Group Contributions to the Public Good per Treatment and Period.

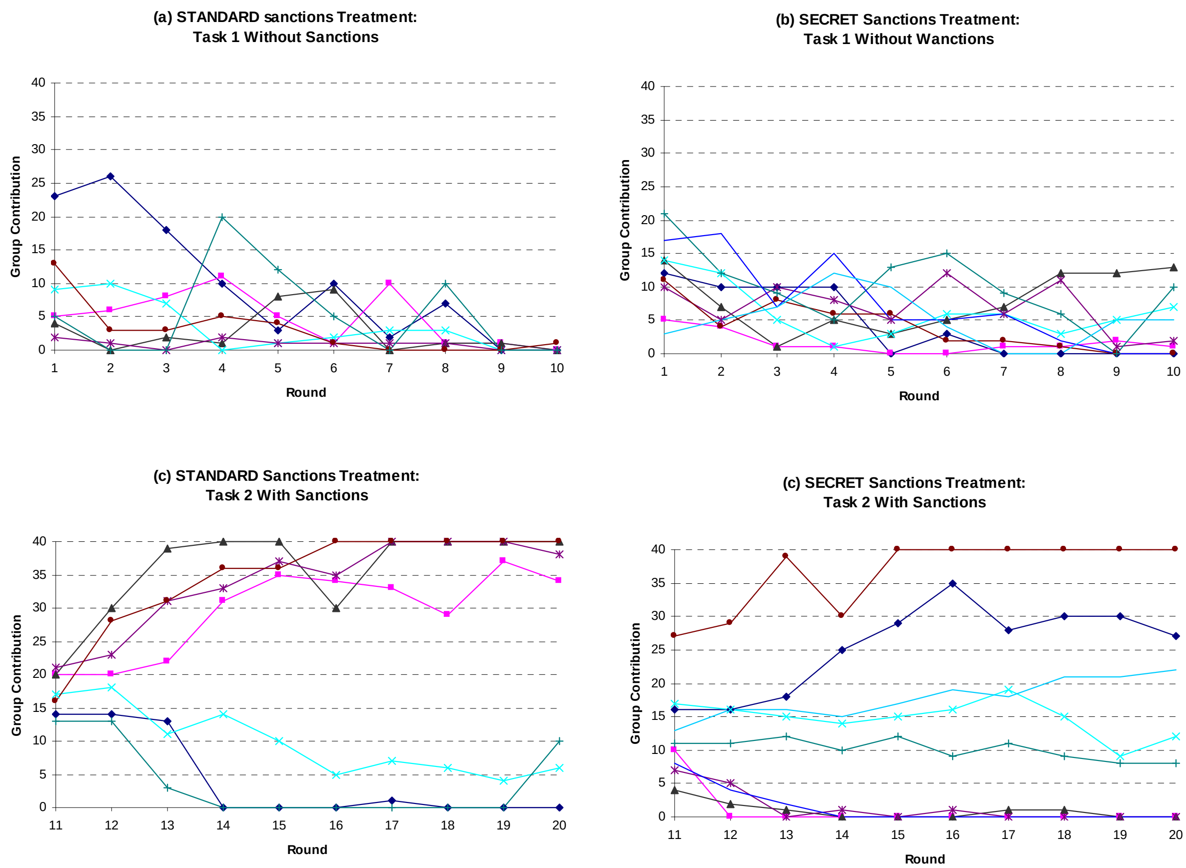


Figure 4: Contributions to the Public Good per Treatment, Group and Period.

possible sanctions) (MWU, N=16, p=0.210). This can be explained by the bifurcation of the group behavior in Task 2 in the STANDARD sanctions treatment where some groups increase and some decrease their contributions over time, while contributions do not change dramatically from the first till the last period in Task 2 in the SECRET sanctions treatment (compare panels (c) and (d) in Figure 4, respectively). In other words, the differences among groups are larger in Task 2 with STANDARD sanctions, but SECRET sanctions lead, on average, to the same efficiency gain as when the sanctions are announced and can immediately enforce cooperation.[7]

Observation 2: Both SECRET and STANDARD sanctions increase contributions to the public good.

In order to understand better this puzzling and rather spectacular finding, we use regression analysis and control for variables confounding the explanations of our observation. We run a multinomial logit regression explaining the change of own contribution to the public good between periods $t-1$ and t using data from Task 2 of our two treatments. There are two payoff-relevant pieces of information a subject could take into account when adjusting own contributions to the public good over time. First, and in the STANDARD treatment only, the sanctions received in the previous period could deter freeriding. We have shown before that sanctions are related to the contributions the sanction receiver made in the previous period as compared to the sender, and that freeriders are those who receive sanctions. If sanctions do have a deterrence impact, and the sanction receivers are motivated to avoid them in the future, then receiving sanctions makes it more likely

[7] The dynamics of contributions in Task 2 of the STANDARD and in the SECRET sanctions treatment seems to differ from that of the dynamics in Task 1 (the public goods game without the sanctioning), see Figure 4. Focusing on group level data, we find that in Task 1 (without sanctioning), 6 out of 16 groups show significant (at 5% level) negative Spearman rank correlation coefficient between the group's contribution and the period, while the correlation is insignificant in the remaining groups mainly due to the fact that subjects contribute close to 0 from the start (no decline is possible).

While the correlation is either negative or missing in Task 1, we find more variance in the behavior of groups in Task 2 of the SECRET and STANDARD sanctions treatments. We find both groups that show positive or negative significant correlations between group's contributions and the time period; as well as insignificant correlations at an initial level of contribution that is above 0.

This variety of the group-based correlation coefficients further corroborate our findings from the regression analysis reported below, namely that the public goods game played in the absence of sanctioning (Task 1) is different both from that played in the presence of SECRET or of STANDARD sanctions (Task 2).

to increase own contribution, and less likely to decrease own contribution in the following period. Second, and in both treatments, subjects motivated by sanction avoidance would respond to their relative position in the group. Contributing less than others, on average, in the group implies that the subject is freeriding on at least one other group member. If subjects expect to be sanctioned for freeriding and want to avoid sanctions, then contributing less than others on average gives an incentive to increase own contribution. Note that if nonstrategic sanctioning is expected, the relative position in the group is relevant for the formation of expectations of sanctioning in both treatments. Hence, by observing the impact of own contribution relative to the group average in the SECRET sanctions treatment and the STANDARD sanctions treatment, we can measure whether subjects believe that others engage in nonstrategic sanctioning.

In the regressions, our dependent variable, Δx_{it}, is defined by $\Delta x_{it} = -1$ if the subject decreases own contribution ($x_{i,t} - x_{i,t-1} < 0$), $\Delta x_{it} = 1$ if the subject increases own contribution ($x_{i,t} - x_{i,t-1} > 0$), and $\Delta x_{it} = 0$ otherwise. As independent variables, we include: (1) variable $finerec$ which equals to the number of punishment points sent by the others to player i in period $t-1$ in the STANDARD treatment ($\sum_{j \neq i} s_{ji}$), and equals 0 in the SECRET sanctions treatment, and (2) variables $posxi\_xavg$ and $negxi\_xavg$ measuring whether player i in the previous period $t-1$ contributed more or less than the other players on average, respectively; $posxi\_xavg = 1$ if $x_{i,t-1} - \frac{1}{N} \sum_j x_{j,t-1} > 0$ and $posxi\_xavg = 0$ otherwise; and $negxi\_xavg = 1$ if $x_{i,t-1} - \frac{1}{N} \sum_j x_{j,t-1} < 0$ and $negxi\_xavg = 0$ otherwise. We interact both of these variables with the treatment dummy $secret$, where $secret = 1$ in the SECRET sanctions treatment, and equals 0 otherwise. Our results can be found in Table 2.

With respect to the overt enforcement, we find that receiving a sanction makes it less likely to decrease own contribution ($finerec$ negative and significant in explaining $\Delta x_i = -1$); i.e. sanctions prevent erosion of cooperation. We do not find the effect that sanctions directly stimulate cooperation in our data.

More interesting, though, is that we do find evidence for the role of expected sanctioning: a subject who contributed less than the group average was more likely to increase own contribution as a response (the coefficient $negxi\_xavg$ is positive and significant

	$\Delta x_i = -1$			$\Delta x_i = 1$		
Variable	Coef.	Std. Err.	P>|z|	Coef.	Std. Err.	P>|z|
secret	-1.618	1.460	0.268	-1.278	1.637	0.435
posxi_xavg	0.327	0.961	0.734	-3.328**	1.181	0.005
posxi_xavg∗secret	6.842**	2.025	0.001	0.781	1.670	0.640
negxi_xavg	-0.593	1.472	0.687	4.187**	1.570	0.008
negxi_xavg∗secret	1.800	1.981	0.364	-3.391*	1.821	0.062
finerec	-0.275**	0.100	0.006	0.097	0.089	0.272
_cons	-5.052*	2.604	0.052	-0.371	1.930	0.848
Individual dummies				included		
Period dummies				included		
Period dummies interacted with secret				included		
N=576						
Log likelihood = -164.908						
Pseudo R2 = 0.7393						

Table 2: Multinomial Logit Regression: Explaining i's Change in Contribution to the Public Good in Games With Sanctioning.

in explaining $\Delta x_i = 1$). Although this effect is less pronounced in the SECRET sanctions treatment (the coefficient $negxi\_xavg{*}\text{secret}$ is negative and significant in explaining $\Delta x_i = 1$) it is still present even when sanctions are not announced to their receivers (the relevant sum of the coefficients $negxi\_xavg + negxi\_xavg{*}\text{secret}$ is positive and significant in explaining $\Delta x_i = 1$). Consequently, subjects who observe that they contributed less than others do increase their contribution, and this even in the SECRET sanctions treatment. Without observing sanctions (if any) for being a freerider, subjects adjust their behavior towards higher contributions, because - we argue - they expect that they are being sanctioned by altruistic punishers.[8] Let us also remark that our main findings are stable with respect to variations of the model, in which we selectively include/exclude the individual and period dummies. In particular, in all these variations, the coefficient $negxi\_xavg + negxi\_xavg{*}\text{secret}$ is positive and significant in explaining $\Delta x_i = 1$. Subjects contributing less than others on average in the group do increase their contributions in the SECRET sanctions treatment.

[8] Let us also note that subjects also avoid being the sucker in their group. When contributing more than the group average, subjects are more likely to decrease own contribution in the SECRET sanctions treatment (coefficient $posxi\_xavg{*}\text{secret}$ is negative and significant in explaining $\Delta x_i = -1$); and less likely to increase own contribution in both treatments (coefficient $posxi\_xavg$ is negative and significant in explaining $\Delta x_i = +1$)

	$\Delta x_i = -1$			$\Delta x_i = 1$		
Variable	Coef.	Std. Err.	P>|z|	Coef.	Std. Err.	P>|z|
secret	2.144	2.961	0.469	-1.164	2.043	0.569
$posxi\_xavg$	6.350**	1.493	0.000	0.475	0.889	0.593
$posxi\_xavg$*secret	0.330	2.247	0.883	-2.965**	1.486	0.046
$negxi\_xavg$	0.765	1.302	0.557	0.752	1.193	0.529
$negxi\_xavg$*secret	-1.079	1.879	0.566	0.929	1.076	0.388
_cons	-4.492**	1.978	0.023	1.382	1.429	0.333
Individual dummies				included		
Period dummies				included		
Period dummies interacted with secret				included		
N=648						
Log likelihood = -230.28096						
Pseudo R2 = 0.6618						

Table 3: Multinomial Logit Regression: Explaining i's Change in Contribution to the Public Good in games Without Sanctions Observed.

Before concluding that this behavior is due to the expected nonstrategic sanctioning (i.e. sanctioning which might be taking place but is kept unannounced for the moment), we have to control for the possibility that a subject who contributed less than the group average in the previous round might increase own contribution in the current round due to positive reciprocity. In order to isolate such positive reciprocity motives from the motives of avoiding expected nonstrategic sanctioning, we run one more regression in which we explain the adjustment of contributions in Task 1 and in Task 2 of the SECRET sanctions treatment. In both tasks, subjects choose public good contributions and observe no sanctions, but in Task 2, sanctioning *might be* taking place. Hence, the comparison of the contribution adjustments in the two tasks allows us to identify the role of to the secret sanctions; i.e. the role of the expectations of nonstrategic sanctioning.

We run multinomial regression similar to that in Table 2 using the same explanatory variables as before, while dropping the irrelevant variable $finerec$ (subjects observe no sanctioning in the two games we compare). The results of the analysis can be found in Table 3.

Recall that we run this regression in order to avoid confusing an increase in own contributions motivated by the avoidance of expected altruistic punishment (possible only in Task 2) with motivations of positive reciprocity (possible both in Task 2 as well as in

Task 1). We find that positive reciprocity plays no role in neither of the two tasks: (coefficients on $negxi\_xavg$ and $negxi\_xavg{*}\text{secret}$ are both insignificant in explaining $\Delta x_i = 1$). Having controlled for the alternative explanation of positive reciprocity, we now can state:

Observation 3: Subjects expect that nonstrategic sanctioning takes place. Consequently, when sanctioning is possible, players are more likely to increase own contributions when their contributions are below the group average, even if they currently cannot observe whether sanctions are actually being used or not.

4 Conclusions

Cooperation in public goods games can be sustained by peer sanctioning if some individuals hold preferences for altruistic punishment. For these individuals, the material costs incurred in sanctioning are compensated by the act or the impact of the sanctioning itself. We suggest that nonstrategic motivations cannot be fully separated from strategic motivations for sanctioning that arise in repeated games. Under incomplete information on the individual preferences, (some) players might find it profitable to mimic the behavior of altruistic punishers and assign sanctions strategically to freeriders in order to stimulate the beliefs that altruistic punishers are present in the population. In repeated interactions, the costs of sanctioning incurred in the short run might be more than compensated by the gains from cooperation in the long run.

Assessing the role of strategic sanctioning is important as the two forms of sanctioning in repeated interactions - nonstrategic and strategic - could result in different advice on the design of institutions which rely on the peer sanctioning system. For example, strategic motives of sanctioning would result in advice to design institutions that promote strategic motives, e.g. constrain the interactions to small groups, with a rich feedback on behavior of the group members. As such designs might be costly, or restrictive, the relevance of the strategic enforcement of cooperation by imitating altruistic punishment is of more than of academic interest.

In this paper, we therefore designed a simple experiment of a repeated public goods game with sanctioning with two treatments. The incentives for nonstrategic sanctioning were present in both of the treatments, but the strategic incentives were present only in one of them. In the control treatment, we replicated a STANDARD sanctions public goods game, where after each round, subjects can assign sanctions, and immediately learn whether they received sanctions. In our main treatment, the SECRET sanctions public goods game, the possibility to assign sanctions was unchanged, but the information on received sanctions is obtained only at the end of the experiment. Consequently, all strategic motivations to assign sanctions are removed in this treatment. By comparing the extent and patterns of sanctioning in the two treatments, we can assess the relevance of strategic sanctioning in the repeated public goods games.

We find that the extent and patterns of sanctioning are the same in both treatments, giving support for prevailingly nonstrategic origins of sanctioning. Additionally, our equally interesting finding is the observation that not only sanctions that subjects could immediately observe, but also sanctions which remained unannounced up till the end of the experiment, did have an impact on contributions to the public goods game in the direction of increasing efficiency. The impact that even unobserved sanctions have on contributions to the public good might be surprising at first, but can be explained by the role of expectations. We find that subjects in the STANDARD sanctions treatment increase their contributions to the public good after they observed to have contributed less than others. This effect is also present - although to a smaller extent - in the SECRET sanctions treatment. We interpret this as an evidence for the role of expectations of nonstrategic sanctioning. Subjects try to avoid nonstrategic sanctions - which they expect although do not observe - and this disciplines their cooperative behavior in the public goods game.

To summarize, we do not find significant effect of strategic motivations for sanctioning in the repeated public goods game in our experiment. Sanctions are prevailingly nonstrategic, and subjects also expect that nonstrategic sanctioning takes place. Hence, even sanctions which are not immediately observed do have a deterrence impact on freeriding and can enforce cooperation to some extent. Based on this evidence, we believe that the line of research focusing on the mechanism of nonstrategic sanctioning (role of emotions and origins of emotions, neuroeconomic studies) is central to our understanding of the peer sanctioning mechanism, and its institutionalized application in mechanisms relying on it. The evidence on the expectation of nonstrategic sanctioning, and the related impact of unobserved sanctions on the cooperation, opens a range of fascinating questions on sustaining cooperation by altruistic punishment.

5 APPENDIX - EXPERIMENT INSTRUCTIONS

Introduction

You will now participate in an experiment on economic decision–making (the project EDM1). The experiment will last approximately 1.5 hours. You will be paid 5 Euro participation fee immediately after the experiment. Any additional earnings you will make in the experiment will be paid to you next week (and after the participation in the project EDM2). How much you earn today crucially depends on your and others' decisions in today's experiment. Note that whatever you do in this experiment will not have any effect on the project EDM2. The two projects are independent, and have no connection between each other.[9]

During the whole experiment, you are not allowed to talk to other participants. Disobeying this rule will result in your exclusion from the experiment. In this experiment, you will participate in two tasks. You will earn points in each of them and these points translate into real money that will be paid to you next week.

The exchange rate is: 1 points = 3 Cents; 100 points = 3 Euros.

The experiments consists of two independent Tasks. We first read instructions for Task 1, then you participate in Task 1, and then the same takes place for Task 2. Your earning for Task 1 is independent from earning for Task 2.

Task 1

This task has 10 rounds. In each round, you will be in a group with three other participants; a group therefore consists of four participants in total. Note that you will be matched in the same group in each round of Task 1, but each individual will receive a different identity name, ID 1, 2, 3 or 4 in each round.

[9] The project EDM2 used eye-tracking machines to measure decision processes in matrix games. As announced to the students, the current project was fully payoff-independent from this other project EDM2, and we used separate recruitment into sessions to give a credible signal of this independence.

Tokens I put into the joint project(x)	The sum of tokens of the other three subjects in the group(Y)										
	0	3	6	9	12	15	18	21	24	27	30
0	10	11.2	12.4	13.6	14.8	16	17.2	18.4	19.6	20.8	22
1	9.4	10.6	11.8	13	14.2	15.4	16.6	17.8	19	20.2	21.4
2	8.8	10	11.2	12.4	13.6	14.8	16	17.2	18.4	19.6	20.8
3	8.2	9.4	10.6	11.8	13	14.2	15.4	16.6	17.8	19	20.2
4	7.6	8.8	10	11.2	12.4	13.6	14.8	16	17.2	18.4	19.6
5	7	8.2	9.4	10.6	11.8	13	14.2	15.4	16.6	17.8	19
6	6.4	7.6	8.8	10	11.2	12.4	13.6	14.8	16	17.2	18.4
7	5.8	7	8.2	9.4	10.6	11.8	13	14.2	15.4	16.6	17.8
8	5.2	6.4	7.6	8.8	10	11.2	12.4	13.6	14.8	16	17.2
9	4.6	5.8	7	8.2	9.4	10.6	11.8	13	14.2	15.4	16.6
10	4	5.2	6.4	7.6	8.8	10	11.2	12.4	13.6	14.8	16

Figure 5: Payoff Table.

For example, participant labelled ID 1 in one round is not the same individual as participant labelled ID 1 in another round.

Earnings

In every round, you will receive 10 tokens. You decide on how many of these tokens to use for a joint project. If you choose to put x tokens in the joint project and the sum of tokens chosen by the other three subjects in your group equals Y, your payoff for this round will be: Payoff = $10 - x + 0.4*(x + Y)$

This means that choosing x tokens for the joint project decreases your payoff by x, and increases your payoff by 0.4 times x. At the same time, it increases the payoff of everyone else by 0.4 times x. When making your decisions, you can use the above formula, but you can also make use of the Payoff Table below. This Table contains the number of points you can earn for different combinations of the number of tokens 'x' you can choose for the joint project and the sum of number of tokens 'Y' the other three subjects choose for the joint project. Please, have a look at the Payoff Table now.

In the first column (in grey), you find all possible actions you may choose, that is the number of tokens you put into the joint project 0,1, . . . 10. In the first row (in grey), you find (some) of the possible sums of tokens chosen by the other three subjects. Your payoff in points can be found for each combination of 'x' and 'Y' in the Payoff Table.

Example: Suppose you choose 4 tokens. In the grey column, find the row that begins with 4. And, suppose the other three subjects choose 12 tokens in total. In the grey row, find the column that begins with 12. Look in the Table for the intersection of the row starting with 4 and the column starting with 12. You find that your earnings in points for that case would be 12.4 points.

Observe: the number of points you earn depends crucially on the choices of the other three subjects

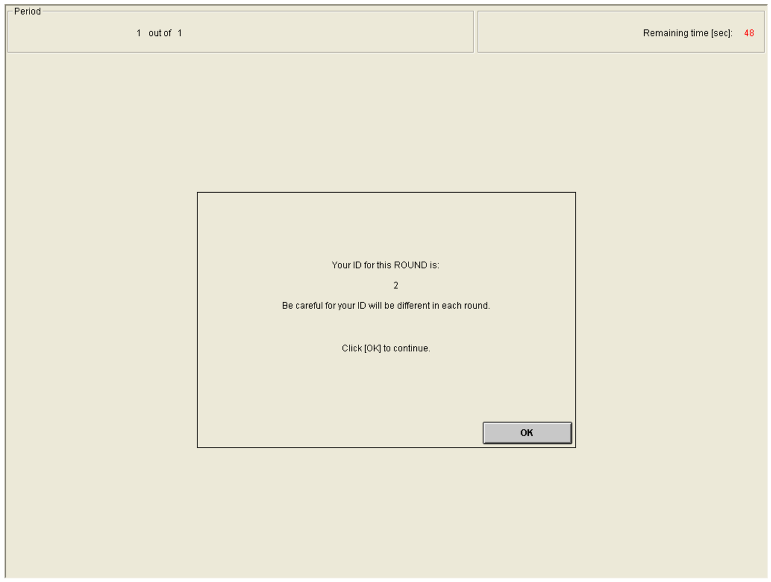


Figure 6: Screen 1.

in your group. If, for example, you choose 2 tokens for the joint project and if the sum of choices of other group subjects is 0, you earn 8.8 points, however, if the sum of choices of the other group subjects is 15 then you earn 14.8 points. Also, the number of points earned by the others depends on your choices. For example, if the other three subjects were all choosing 3 (which makes Y = 9) and you chose 0, their payoff would be 10.6, where as if you chose 6, their payoff will be 13. Other group subjects affect how many points you earn, and you affect how many points they earn.

We will now explain how the computer screens look like.

SCREEN 1 (see Figure 6)

This is the screen which tells you your ID for this round. The ID will range from 1 to 4. After checking your ID, click on OK to proceed.

SCREEN 2 (see Figure 7)

Here you decide on how many tokens you will use for the joint project in this round. Use the keyboard to type in one of the numbers 0, 1 . . . 10 and confirm your choice by pressing OK.

Warning: Before pressing OK, make sure your choice is correct. You cannot change your decision after you have pressed OK. After having pressed OK, you will be asked to wait until all experiment participants have done the same. The experiment continues only after all experiment participants pressed OK. We therefore kindly ask you not to delay your decision too much. After pressing OK, a waiting screen will

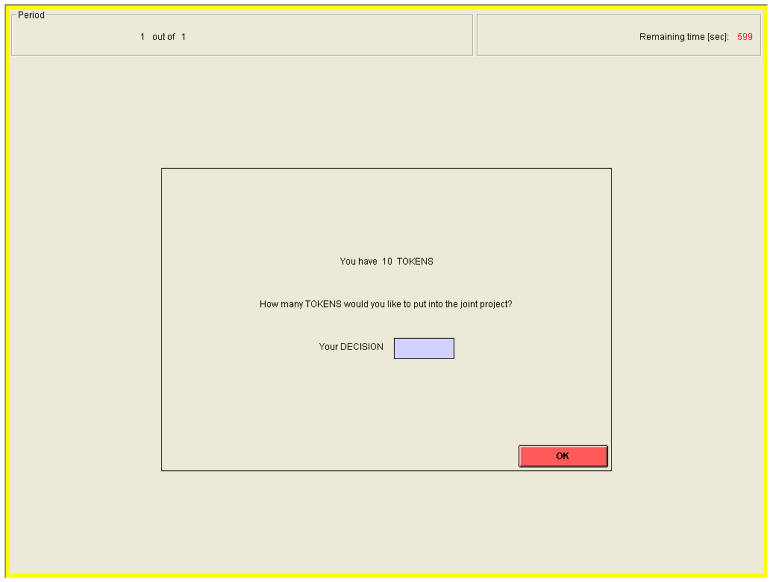


Figure 7: Screen 2.

appear. After all experiment participants have pressed OK, Screen 3 will appear.

SCREEN 3 (see Figure 8)

In the upper part of this screen you find a table with information on the number of tokens chosen for the joint project by each subject as well as the payoff that you earned. In the lower part, you find the same information for all group subjects. Click on OK if you are done with checking the information.

Please, raise your hand if you have any questions at this moment. The experiment now starts with a short test to make sure that everybody understands how you earn your points. Use the formula or the Payoff Table to answer the following questions. After all experiment participants answered all the questions correctly, the experiment will begin.

Understanding Test (after Task 1)

1) If you use 3 tokens for the joint project and the other three subjects use 10 tokens each, what is the number of points you earn? ....

2) If you use 9 tokens for the joint project and the other three subjects use a total of 6 tokens, what is the number of points you earn? ....

3) Circle the correct answer:

1. You are given 10 tokens at the beginning of each round.
2. You are given 10 tokens only at the first round, and in the rest of the rounds, you will

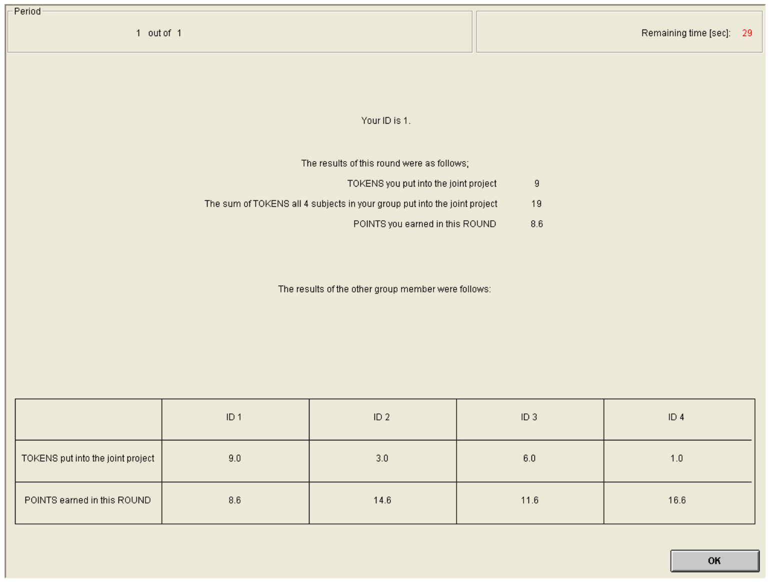


Figure 8: Screen 3.

chose from the remainders of the tokens from the previous rounds.

3. You are given some number of tokens from 0 to 10 at random.

4) Circle the correct answer:

1. You will be in the same group with the same 3 subjects for every round in Task 1, and their ID will be the same for every round. The ID 1 in the first round will continue to be ID 1 for the rest of the rounds.

2. You will be in the same group with the same 3 subjects for every round in Task 1, but the ID will be different in every round. The person with ID 1 in the first round will not always be ID1.

3. You will be matched to different 3 subjects in the beginning of every round. The ID will also be different between the rounds.

Please raise your hand when you are finished with the understanding test. We will now start the experiment with two UNPAID TRIAL rounds. Use these two rounds to learn how the computer program works. After that, we will match you into groups and the experiment will start.

Task 2

Task 2 also has 10 rounds. You will be again randomly matched into a group of four. This group will be a different group than in TASK 1. Again, you will stay in the same group for 10 rounds but your ID will change in each round.

In Task 2, every round consists of two stages. Stage 1 of every round is the same as Task 1. Also the Payoff Table is the same as before. Let us explain Stage 2.

In the beginning of Stage 2 of a round (which immediately follows Stage 1 in each round), you will receive 10 tokens, which are worth 10 points to you. You can spend any number of these 10 tokens to reduce the points from the earnings of the other three subjects. Every token you spent will decrease the earnings of the subject receiving it by 3 points. The sum of tokens you spend in Stage 2 must not exceed 10. Your earning in a round can be written in the following equation:

Payoff in Stage 1+(10 - number of TOKENS that you spent in Stage 2)− (3∗the sum of TOKENS that the other three subjects spent on you in Stage 2).

Let us give one example. Say that in Stage 1 you earned 11.1 points. In Stage 2, say you spent 2 tokens on the other subject, and the sum of tokens the other 3 subjects spent on you were 1 tokens. Your earning for this round will be: 11.1 + 10 - 2 - 3 * 1 = 16.1

[In STANDARD sanctions treatment: After everyone made their decision in Stage 2, you will learn results of Stage 2 as well the total number of points you earned in this round.]

[In SECRET sanctions treatment: After everyone made their decision in Stage 2, you will receive the summary of Stage 1 earnings. The only information you will receive on Stage 2 is your remainders of the 10 tokens, which is 10 minus the number of tokens you spent. This is the amount of points you will earn in Stage 2 if no other subjects spend any token on you. The other results of Stage 2 – such as the number of tokens spent on you by other three, as well the number of tokens that were spent and received by others - and the total number of points you earned in each round will be given to you only after you finish all 10 rounds. (We explain the summary screen below.)].

We will now explain how the computer screens look like. SCREENS 1 to 3 are very similar to the screens discussed in Task 1.

SCREEN 4 (see Figure 9)

In the upper part of this screen you find a table with information on the number of tokens chosen for the joint project by each subject in Stage 1 of this round and the points each subjects earned in Stage 1. In the lower part of this screen, you are asked to make a decision on how many tokens from your 10 tokens you want to spend to decrease the earnings of each of the other three subjects. For each subject in your group, you have to put in a number between 0 and 10; the sum of the number of tokens you spend must not exceed 10 tokens. For yourself, you must put in 0. Press OK, when you are ready to

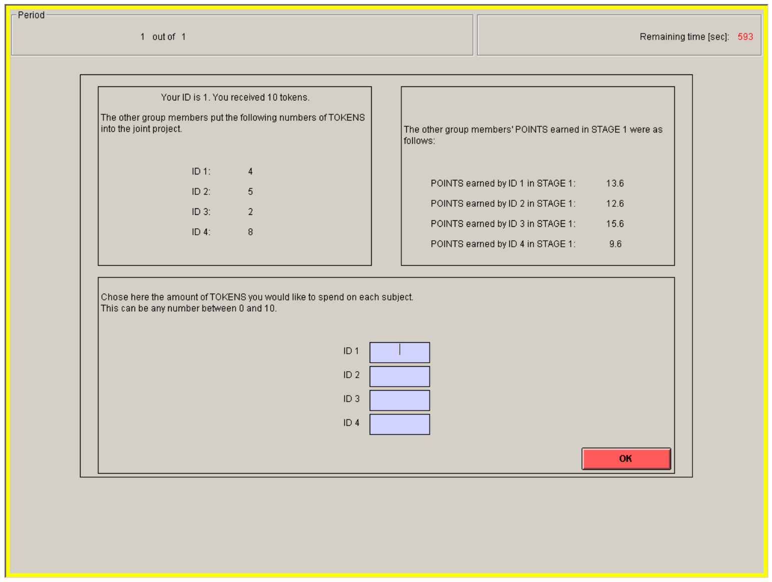


Figure 9: Screen 4.

continue. A waiting screen will appear. The experiment continues only after all experiment participants have pressed OK, and therefore we kindly ask you not to delay your decision too much.

SCREEN 5 (see Figure 10)

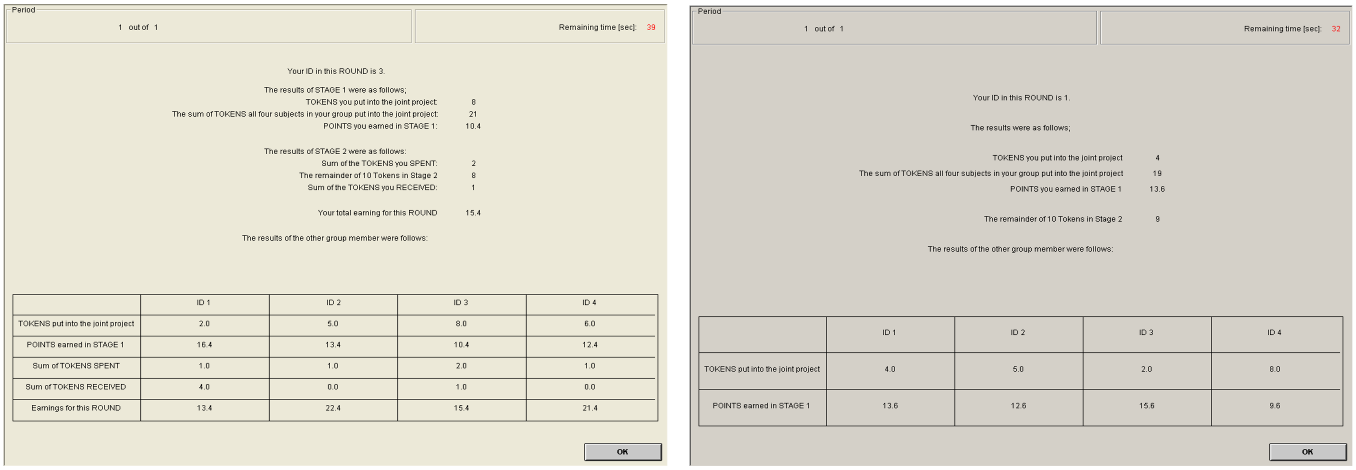
In this screen you will be provided with all the information about this round. You will learn about the points you earned in each stage of the round and about the points each of the other subjects in your group earned in Stage 1.

[In STANDARD sanctions treatment: You also learn the number of tokens each subject in your group, including you, spent and received in this period in Stage 2.]

[In SECRET sanctions treatment: The other results of Stage 2 such as: the number of tokens the other three subjects spent on you, or the number of tokens that the other subjects spent or received, or the total number of points you earned in a round, will not be shown in each round. Only at the end of the experiment, after all 10 rounds are finished, you will be able to find these information about the decisions made in Stage 2.]

SCREEN 6 (see Figure 11)

At the end of all 10 rounds you will obtain a summary information screen with both the information on Stage 1 and Stage 2. In this screen, you will be able to observe all choices in Stage 1 and Stage 2 in each round. You will be able to see the number of tokens you spent to decrease the points of other



(a) STANDARD treatment

(b) SECRET treatment

Figure 10: Screen 5.

subjects as well as the number of tokens the other three subjects spent to decrease your earnings, and the final points for each round. You can also see this information for all of the subjects in your group, for each round.

Please, raise your hand if you have questions at this moment. The experiment now starts with a short test to make sure that everybody understands how the points are earned. Use your Table to answer the following questions. After all experiment participants answered all questions correctly, the experiment will begin.

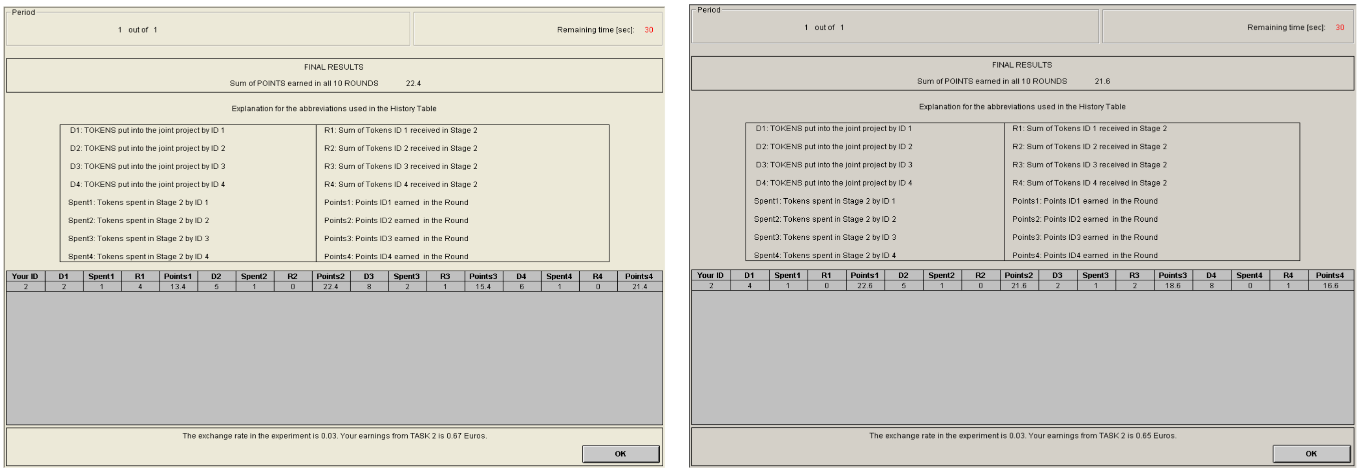
Understanding Test (after Task 2)

1) If you spend 2 tokens on one of the subjects in Stage 2, what is the total number of points by which you have decreased the payoff of that subject? ....

2) If each of the other three subjects in the group spends 1 token on you in Stage 2, what is the total number of points by which they decreased your earnings? ....

3) Say your earning from Stage 1 was 12.6. If you spend 2 tokens on one subject and none for the others, and each of the other three subjects in the group spend 1 token on you (you received 3 tokens), what is the number of points you will earn in this round? ....

Please raise your hand and have your answers checked by the experimenter. After everyone has finished, we will start the experiment with two UNPAID TRIAL rounds. Use these two rounds to learn how the computer program works. After that, we will match you into new groups and the experiment



(a) STANDARD treatment (b) SECRET treatment

Figure 11: Screen 6.

will start.

References

[1] Abbink, K., Sadrieh, A. and Zamir A. (2004) "Fairness, Public Good, And Emotional Aspects of Punishment Behavior", Theory and Decision 57, 25-57.

[2] Anderson, Ch. M. and Putterman, L. (2006) "Do Non-Strategic Sanctions Obey the Law of Demand? The Demand for Punishment in the Voluntary Contribution Mechanism", Games and Economic Behavior, 54(1), 1-24.

[3] Besley, T. and Coate, S. (1995) "Group Lending, Repayment Incentives and Social Collateral", Journal of Development Economics, 46(1), 1-18.

[4] Carpenter, J.P. (2007) "The Demand for Punishment", Journal of Economic Behavior and Organization 62 (4), 522-542.

[5] Casari, M. & Luini, L. (2006) "Peer Punishment in Teams: Emotional or Strategic Choice?", Purdue University Economics Working Papers 1188, Purdue University, Department of Economics.

[6] Egas, M. and Riedl, A. (2005) "The Economics of Altruistic Punishment and the Demise of Cooperation", Tinbergen Institute Discussion Papers 05–065/1. Amsterdam: University of Amsterdam.

[7] Falk, A., Fehr, E. and Fischbacher, U. (2005) "Driving Forces Behind Informal Sanctions", Econometrica 73 (6), 2017-2030.

[8] Fehr, E. and Gächter, S. (2000) "Cooperation and Punishment in Public Goods Experiments", American Economic Review 90, 980–994.

[9] Fehr, E. and Gächter, S. (2002) "Altruistic Punishment in Humans", Nature 415, 137-140.

[10] Fischbacher, U. (1999) "z–Tree. Toolbox for Readymade Economic Experiments". IEW Working paper 21, University of Zurich.

[11] Hopfensitz, A. and Reuben, E. (2005) "The Importance of Emotions for the Effectiveness of Social Punishment", Tinbergen Institute Discussion Paper 2005-075/1.

[12] Kreps, D. M., Milgrom, P., Roberts, J., and Wilson, R. (1982) "Rational Cooperation in the Finitely Repeated Prisoners' Dilemma", Journal of Economic Theory, 27, 245–252.

[13] Masclet, D., Noussair, Ch., Tucker, S. and Villeval, M.C. (2003) "Monetary and Nonmonetary Punishment in the Voluntary Contributions Mechanism", American Economic Review 93(1), 366–380.

[14] Nikiforakis, N. and Normann, H. T. "A Comparative Statics Analysis of Punishment in Public-Good Experiments", forthcoming in Experimental Economics, available at SSRN: http://ssrn.com/abstract=1021197.

[15] Ostrom, E., Gardner, R. and Walker, J. (1992) "Covenants With and Without Sword: Self–Governance is Possible", American Political Science Review 86, 404–417.

[16] Quervain, D.J.F., Fischbacher, U., Treyer, V. Schellhammer, M., Schnyder, U., Buck, A. and Fehr, E. (2004) "The Neural Basis of Altruistic Punishment", Science 305, 1254-1258.

[17] van Soest, D.P. and Vyrastekova, J. (2006) "Peer Enforcement in Common Pool Resource Experiments: The Relative Effectiveness of Sanctions and Rewards, and The Role of Behavioral Types". in: J. List (ed), Using Experimental Methods in Environmental and Resource Economics, Edward Elgar.

[18] Walker, J.M. and Halloran, W.A. (2004) "Rewards and Sanctions and the Provision of Public Goods in One–Shot Settings", Experimental Economics 7, 235–247.