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# Social learning increases the acceptance and the efficiency of punishment institutions in social dilemmas

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## Abstract

Endogenously chosen punishment institutions perform well in increasing contributions and long-term payoffs in social dilemma situations. However, they suffer from (a) initial reluctance of subjects to join the punishment institution and (b) initial efficiency losses due to frequent punishment. We investigate experimentally the effects of social learning on the acceptance and the efficiency of a peer punishment mechanism in an institution choice experiment. Providing participants with a social history – presenting the main results of an identical previous experiment conducted with different subjects – decreases the initial reluctance towards the punishment institution significantly. With social history, cooperative groups reach the social optimum more rapidly and there is lower efficiency loss due to reduced punishment. Our findings shed light on the importance of social learning for the acceptance of seemingly unpopular but socially desirable mechanisms.

JEL classification: C92; H41

Keywords: Social dilemmas; Social history; Social learning; Punishment; Institution choice

# 1. Introduction

Experimental studies identify the possibility to punish free-riders as a valuable means to sustain cooperation in social dilemmas (Ostrom et al., 1992; Fehr and Gächter, 2000; see also the reviews by Gächter and Herrmann, 2009; and Chaudhuri, 2011). While *exogenously* (by the experimenter) installed punishment institutions succeed to increase contributions, they often do not produce significantly higher (overall) payoffs than the voluntary contribution mechanism (VCM) without the punishment option (cf. Egas and Riedl, 2008; Herrmann et al., 2008).<sup>1</sup>

A recent strand of studies show that *endogenous* choice of punishment institutions may also induce high contributions to a public good and increase the institution's efficiency (Sutter et al. 2010; Ertan et al., 2009; Gürer et al., 2010; Gürer et al., 2009; Tyran and Feld, 2006).<sup>2</sup>

Although punishment mechanisms in these studies are the more efficient institutions “in the long run”, their overall efficiency often suffer from two stable behavioral patterns. First, (initially) subjects show a great reluctance to interact with each other in the presence of punishment possibilities. Second, in punishment environments, in the beginning – similar to exogenously installed punishment institutions – there is an efficiency loss due to frequent punishment.

The research question of this paper is this: How can be the initial efficiency loss mitigated in order to improve the overall performance of endogenously chosen punishment institutions? This question is closely linked to the initial poor acceptance of the punishment institution. So, we may reformulate our research question: How the initial acceptance – and linked with that – the initial and hence the overall efficiency of endogenous punishment institutions could be increased?

Before proposing an answer to this question let us speculate on the reasons for the initial reluctance to choose punishment institution. First, subjects may have a “natural aversion” against punishment since they associate negative feelings with it. Social psychologists define negative sanctions as deliberate acts that lead to unpleasant inner states that the punished person wants to

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<sup>1</sup> In punishment institutions, there exist efficiency losses due to severe and/or frequent punishment acts, especially in the beginning phase of the play (see e.g. Decker et al., 2003); due to “anti-social” punishment (Cinyabuguma et al., 2006) or counter-punishment (Denant-Boemont et al., 2007; Nikiforakis, 2008) or if the cost of punishment is too high (Nikiforakis and Normann, 2008). Extending the experimental time horizon may improve the overall efficiency of the peer-punishment mechanism (Gächter et al., 2008, Rand et al., 2009; Ambrus and Greiner, 2010).

<sup>2</sup> We will discuss these studies in the related literature section.

avoid. Second, subjects may also fear to be exposed to unjustified punishment. In fact, in experiments, punishment of high contributors is a frequently observed phenomenon (Cinyabuguma et al., 2006; Herrmann et al., 2008). A third possible explanation is that subjects simply do not anticipate correctly that the punishment institution is the more efficient institution in the long-run. If subjects knew ex-ante that the punishment institution generates low efficiency in the beginning but yields high payoff in the future, they probably focus on the long-term benefit and join it right from the beginning. However, subjects could also focus on the downside caused by the short-term loss and hence shun away from the punishment institution.

In this study, we investigate the last proposed possible explanation, i.e., how ex-ante information about the punishment institution affects subjects' acceptance for this institution. For this, we conduct a social history treatment in which we provide subjects with the complete history of an endogenously chosen punishment institution as occurred in a previous experiment. This social history treatment (in the following abbreviated by SHT) is the exact replication of the PUN treatment from the study of Gürer et al. (2010) in which subjects individually choose in each period between institutions with and without punishment possibilities before interacting with others who choose the same institution in a public goods setting. The only difference between the PUN and the SHT treatments is that in SHT, a social history<sup>3</sup> reporting the main results of PUN is given to the subjects.

The social history provides subjects with information that may help them to identify cognitively that the punishment institution is the more efficient mechanism in the long run. On the other hand, social history may lead subjects to simply imitate the most common behavior in PUN without realizing intellectually that doing so they will be better off in the end. For example, subjects may imitate by simply choosing the historically most popular institution.

To identify unambiguously whether the behavior we would possibly observe in SHT is due to social learning and not mere imitation we conduct another treatment called SH-Half which provides subjects only with a subset of social history information given in SHT. Specifically, in SH-Half, we provide subjects solely with the history of institutional choice as occurred in PUN but with no other information given in the social history of SHT. If behavior observed in SH-Half

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<sup>3</sup> For details of the information presented in the social history see Section 3.

is closer to PUN and different from SHT, we may be more confident that what we observe in SHT is indeed social learning. If, however, behavior in SH-Half is more similar to SHT, then the data may be interpreted as an evidence for mere imitation.

Previous experimental studies show that social history may affect subjects' behavior. In their influential "trust game" study, Berg et al. (1995) find significant effects of social history on subjects' choices. With social history, both amounts invested by the sender and the amount sent back by the responder increase. A replication study by Ortmann et al. (2000) with some additional treatments confirms the results of Berg et al. (1995). On the other hand, there is also some literature reporting no change in subjects' behavior when they are provided with information on earlier play of another cohort (Fehr and Rockenbach, 2003). This study is a variant of the trust game in which the sender states how much she wants the responder to transfer back and may activate a punishment option (or not) for the case the responder does not meet the desired amount. The results show if senders choose to activate the punishment option, then the actual back transfers are lower and senders earn less than when senders deliberately refrain from using the fine. In a social history treatment, senders were informed about this result. Knowing that, roughly the same percentage of senders still activated the punishment option, i.e., social history did not change senders' behavior.

Like social history, advice giving<sup>4</sup> also unfolds its impact through social learning. Schotter (2003) reviews a series of studies on advice giving, most of them "intergenerational games". In these studies, successors who take advice from their predecessors play the same game differently than their advice givers did. The advice takers tend to follow the advices of the advice givers. Chaudhuri et al. (2006) report that advice – given as free-form text messages by individuals – increases contributions to a public good if it becomes common knowledge.

With one exception, the above studies show that people apparently react to information provided in social history and advices. In some settings, this information helps increase trust and positive reciprocity (Berg et al. 1995, Ortmann et al. 2000), in others it serves as a coordination device, e.g., in a public goods setting moving the contributions to rather high levels even in the absence

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<sup>4</sup> Advice giving differs from the social history in our study since it involves an active transfer of personal experience between individuals and groups. We are interested in situations, in which the experience made with a mechanism is transferred passively to others rather than directly and personally.

of any sanctions (Chaudhuri et al. 2006). Thus, altogether, we believe that the findings from the existing studies on social history and advice giving presented above support the hypothesis that social history in our experiment could have an enhancing effect on cooperation and an accelerating effect on the speed of convergence to the socially efficient state of full cooperation.

Our main results support the conjectures posed above. With social history, the initial acceptance of the punishment institution increases significantly. Contributions towards the public good are significantly higher than without social history right from the beginning and they converge earlier to socially efficient level. If we consider the society as a whole including both punishment and non-punishment institutions, the payoffs are the highest with social history. Our results underline the relevance of transferring experience based information to increase efficiency. We contribute to the existing literature by confirming the cooperation enhancing effect of social history in a more complicated experimental setting than previous studies. Furthermore, we show that the driving force behind the success of social history is social learning rather than mere imitation.

The following section discusses the related literature on endogenous institution choice. Section 3 describes the experimental design and procedure. Results are presented in Section 4. Section 5 concludes.

## **2. Related literature**

Previous experimental studies provide evidence that subjects are reluctant to choose a punishment option/institution when they have the choice only one-time. If subjects play a series of prisoners' dilemma games without punishment option first and decide afterwards whether to have a punishment option in the second phase or not, then 46% of subjects opt against using the punishment option in the second phase (Dal Bó et al., 2010). In Botelho et al. (2007), after having experienced both punishment and non-punishment institutions subjects decide whether they want to have the punishment option in the final period or not. Over all sessions, 77.8% of subjects opt against the punishment option. Sutter et al. (2010) investigate the effects of institutional choice by letting subjects vote for a VCM, an institution with reward possibility, and an institution with punishment possibility. Under unanimous voting, the punishment institution is rarely chosen. When it is selected, however, it is the most successful institution in eliciting high contributions; and it is significantly more efficient than the VCM.

If the one-time choice is between different punishment institutions, most subjects choose the softer punishment institution: In Decker et al. (2003), subjects play a public good game under two different punishment institutions before having the vote which of these two institutions should govern their interaction in the last phase of the experiment. The vote is always between a peer punishment institution and a “softer” punishment institution that set some limits to peer punishment. In three different votes, at least half of the subjects vote for the softer punishment institution (68.8%, 65.6%, 50.0%).

Different than the papers discussed above, in the following studies, subjects may choose between a non-punishment institution and a punishment institution more than one time. In Ertan et al. (2009), in a public goods setting, subjects have the choice between different punishment institutions and a VCM without any punishment. Voting is repeated after a couple of periods (in one treatment there are 3 votes, in the other 5). In the very first vote, 57% of groups opt for the VCM. In the last vote, only 12.5% of the groups opt for the VCM while all remaining groups prefer applying the punishment institution. In this study, the most successful institution is one of the punishment institutions – in terms of contributions and efficiency.

In the first period of the Gülerk et al. (2010) study, given the choice between a punishment and a non-punishment institution, 68.8% are reluctant to join the punishment institution while in the last period only less than 10% of the subjects do not prefer it. The simple voting with feet mechanism has great impact on contributions. Towards the end of the experiment, contributions in the punishment institution converge to almost 100% while the contributions in the non-punishment institution are virtually zero. In the second half of the experiment, the efficiency of the punishment institution is significantly higher than the efficiency of the non-punishment institution.

In another study Gülerk et al. (2009) model a teamwork situation. The manager decides whether her team should interact in an environment with punishment or reward possibilities. In the first phase of the experiment, 95% of the managers opt for the rewarding scheme. In the third and last phase of the experiment, however, 45% of the managers choose the punishment institution. In the endogenous treatment of the study by Tyran and Feld (2006), subjects vote whether to play a 3-person public good game under a punishment institution or not. In the first vote, 50% of subjects vote against the punishment institution. In the second vote, however, only 30% are against the

punishment institution. The efficiency in treatment “mild punishment” is higher if this institution is endogenously chosen than exogenously installed.

To sum up: From the studies discussed in this section the following pattern emerges. Initially, there is a great reluctance to choose efficient punishment institutions. With repetition, however, the acceptance of the punishment institutions increases.

### 3. Experimental Design

The experiment is based on a social dilemma game of 30 repetitions including three stages in each period: In Stage 0,  $N$  participants in each “society” (representing an independent observation) choose (without a cost) between a non-punishment community (NPC) and a community with punishment possibilities (PuC). In Stage 1, each player is endowed with 20 experimental tokens and can anonymously invest  $g$  ( $0 \leq g \leq 20$ ) in the joint project.<sup>5</sup> The defining characteristic of a social dilemma is fulfilled independent of the number of members  $n^\theta$  with  $\theta \in \{1,2\}$  in each community because the marginal per capita return  $a$  is  $1/n_i^\theta < a < 1$  for all  $n_i^\theta$  with  $2 \leq n_i^\theta \leq N$ .<sup>6</sup> In PuC, Stage 1 is followed by a punishment stage (Stage 2). Here, all subjects are endowed with 20 additional tokens and may anonymously assign punishment tokens to each other (subjects in NPC also receive additional 20 tokens and simply keep these). Each received punishment token lowers the payoff of the punished subject by three tokens. After each period, all participants receive feedback about contributions, received punishment tokens and payoffs in both communities.

In SHT, the social history is handed out to subjects before the experiment starts. Participants were told that they would receive a report sheet about the decisions done by the participants of a previous experiment which was conducted in the [...] before and that they should read the report.

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<sup>5</sup> If only a single player joins a community, no joint project can be created and the total endowment of the player is automatically transferred to own private account. Therefore this player has no decision in Stage 1 and Stage 2.

<sup>6</sup> While marginal gains from a unilateral defection (if other players contribute fully) is increasing with the group size, however, the marginal expected punishment is increasing too. Suppose, in case of a unilateral defection, each full contributor punishes the defector very smoothly only with 1 punishment token. This implies that – in case of unilaterally defection – the expected payoff reduction from received punishment in large groups outweighs the increase in income by far. The experimental data from the original treatment PUN (Güerke et al. 2010) and also from many other studies involving peer punishment provide evidence for such harsh punishment of defectors.



For both communities, the social history separately tabulates the averages of the number of community members, contributions, received punishment tokens in PuC, and the payoffs of PUN for each period. Additionally, the over-time evolutions of the averages are visualized in figures. In SH-Half, subjects were given only the history of institutional choice as occurred in PUN.<sup>7</sup> The experiment was programmed and conducted with z-Tree (Fischbacher, 2007). Subjects were recruited for voluntary participation via the online recruitment system ORSEE (Greiner, 2004) and were randomly allocated to treatments. In total, 264 subjects participated in 22 independent observations.<sup>8</sup> An experimental session lasted on average two hours. Average earnings were 24 Euros.

## 4. Results

### 4.1. Initial periods

Does social history have an immediate effect on subject's behavior?

**Result 1.** *Social history increases the initial acceptance of the punishment institution and increases the initial cooperation in PuC.*

In SHT, in the first period, 54.2% of subjects prefer PuC. This percentage is significantly higher ( $p = 0.037$ ) than the fraction of subjects who opt for PuC in PUN (31.2%) and in SH-Half (33.3%,  $p = 0.024$ ).<sup>9</sup> The acceptance remains robust if we consider the first five periods. On average, 59.2% of subjects opt for PuC in SHT whereas only 35.8% and 28.8% choose PuC in PUN and SH-Half respectively (SHT vs. PUN:  $p = 0.026$ ; SHT vs. SH-Half:  $p = 0.001$ ).

Social history has an immediate effect on contributions in the initial periods. In period 1, the fraction of high contributions ( $g \geq 15$ ) is significantly larger in PuC of SHT (74.0%) than in PuC of PUN (53.7%,  $p = 0.051$ ) and in PuC of SH-Half (17.2%,  $p = 0.001$ ). The overall initial

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<sup>7</sup> See Appendix for the two versions of the social history that were handed out to subjects in SHT and in SH-Half.

<sup>8</sup> 96 subjects (in 8 independent observations) participated in the original study PUN (conducted in December 2003), 72 (6 observations) in the social history treatment SHT (conducted in November 2004), another 96 (8 observations) in SH-Half (conducted in November 2011). Most participants were students recruited from economics, law, and social sciences departments.

<sup>9</sup> All reported non-parametric statistical tests are two-tailed Mann-Whitney U-tests and base on independent observations.

cooperation level in the first five periods is also highest with social history. In PuC of SHT, on average, subjects contribute 88.5% of their endowment while in PuC of PUN 70.1% of the endowment is invested ( $p = 0.013$ ) and in PuC of SH-Half 40.1% ( $p = 0.001$ ).

Social history also immediately affects punishment behavior. In the first five periods, subjects in PuC of SHT invest considerably less tokens (3.6) in punishment than subjects in PuC of PUN (4.8 tokens) and in PuC of SH-Half (4.4 tokens) though the differences between treatments are statistically not significant. These differences could be driven by the initial high contributions in SHT making the use of punishment less necessary than in PUN and SH-Half. Higher contributions and lower punishment expenses in the initial periods result in higher average payoffs in PuC of SHT. In the first five periods, subjects in PuC of SHT earn on average clearly more (36.9 tokens) than subjects in PuC of PUN (29.9,  $p = 0.181$ ) and in PuC of SH-Half (27.8,  $p = 0.059$ ).

#### 4.2. *Evolution of community choices and contributions*

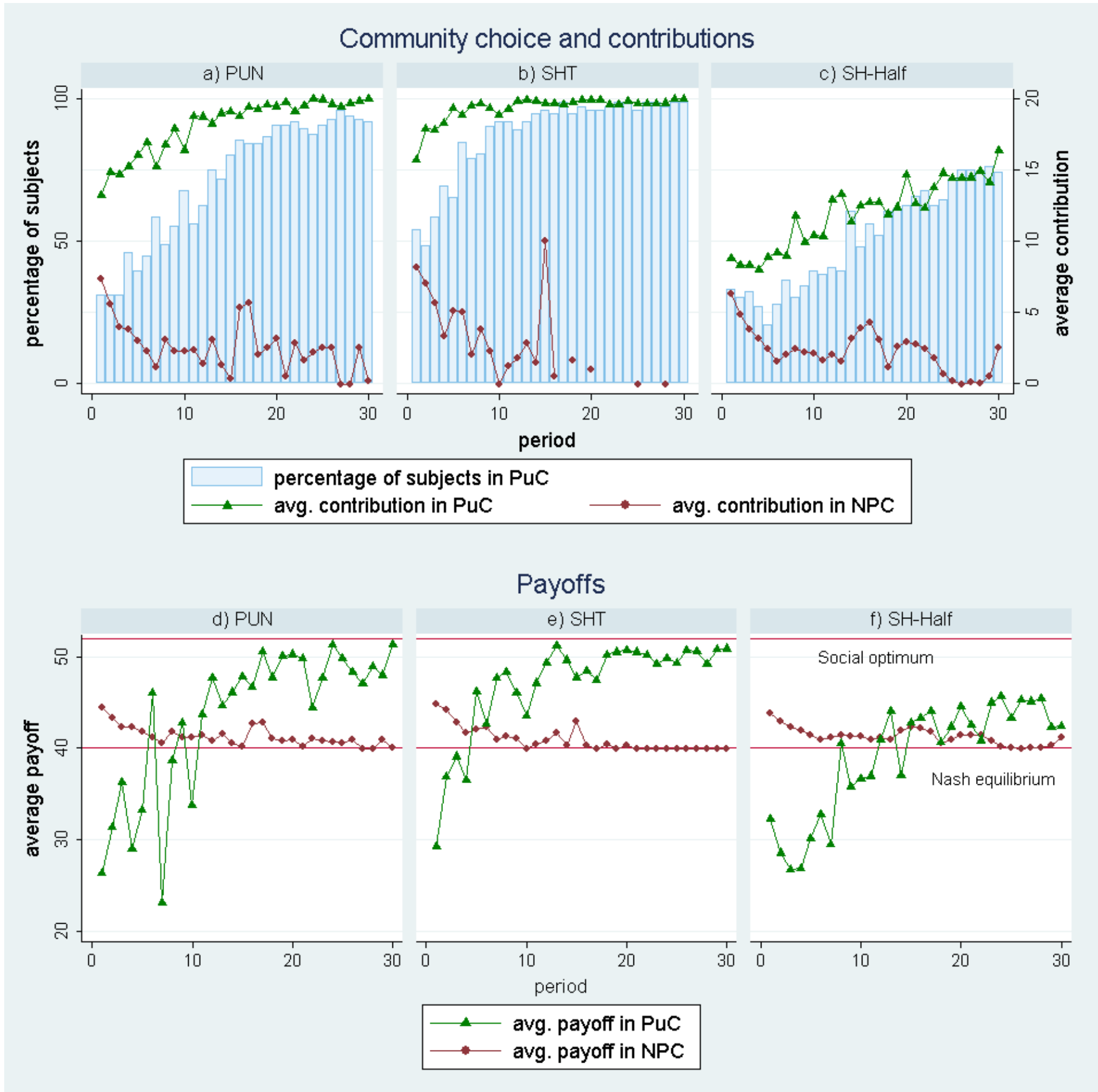
Does the higher initial acceptance of the punishment community and the higher initial cooperation in PuC of SHT lead to a more accelerated acceptance of PuC by the subjects who initially opted for the non-punishment community than in the other treatments?

**Result 2.** *“Full participation in PuC” is reached more rapidly and is more stable in SHT than in PUN and in SH-Half.*

Panel a)-c) of Figure 1 shows the evolution of institution choices. In PUN as well as in SHT, for all but one society (observation) it is true that there is at least one period in which all subjects of the respective society join the punishment institution (in SH-Half 5 out of 8 societies). Such a period of “full participation in PuC” is observed much earlier in PuC of SHT (on average in period 9.6) than in PuC of PUN (period 17.6,  $p = 0.033$ ) and also earlier than in PuC of SH-Half (period 19.6,  $p = 0.016$ ). Moreover, the state of full participation is highly stable in PuC of SHT. The longest period of continuous full participation in PuC amounts on average to 15.4 rounds in SHT but only to 5.6 in PUN ( $p = 0.027$ ) and 2.6 periods in SH-Half ( $p = 0.024$ ). Thus, in PuC of SHT, full cooperation is established not only more quickly but it also lasts longer.<sup>10</sup>

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<sup>10</sup> Data from each single observation in PUN and SHT basically reflect the pattern of the averages as shown in Figure 1 panels a) and b). This means, in each single observation, percentages of subjects choosing PuC increase over time



**Figure 1:** The bars in panel a)-c) show the percentage of subjects choosing the punishment institution in each treatment. Average contributions from both institutions are also depicted in panels a)-c). Panels d)-f) display average payoffs in both institutions.

and also contributions in PuC show a steadily increasing trend. In SH-Half, however, two out of eight observations do not follow these patterns. In these two observations, there is no increasing trend in percentages of subjects choosing PuC and also no steadily increasing trend of contributions.

### 4.3. Overall punishment behavior

Does social history affect the amount invested in punishment and the severity of punishment acts? Whether social history would lead to less or more punishment than observed in the baseline treatment is not clear. Social history could lead to less punishment because of the initial high cooperation level and the higher number of cooperative subjects. It could also lead to even more punishment if social history encourages subjects who would not punish otherwise to imitate their predecessors' behavior from the baseline treatment and punish.

**Result 3.** *On average, punishment expenses are lower in SHT than in PUN and SH-Half.*

Overall, punishment expenses per subject (per period) are lower in PuC of SHT (1.0 tokens) than in PuC of PUN (1.5 tokens,  $p = 0.192$ ) and in PuC of SH-Half (1.8 tokens,  $p = 0.142$ ). This difference could be due to the higher contribution level in PuC of SHT. The higher the contribution level the less punishment is needed. Indeed, on average, a punished subject in PuC of SHT contributed more to the joint project than a punished subject in PuC of PUN did (17.4 vs. 15.1 tokens,  $p = 0.022$ ) and also more than in PuC of SH-Half (10.7 tokens,  $p = 0.001$ ).

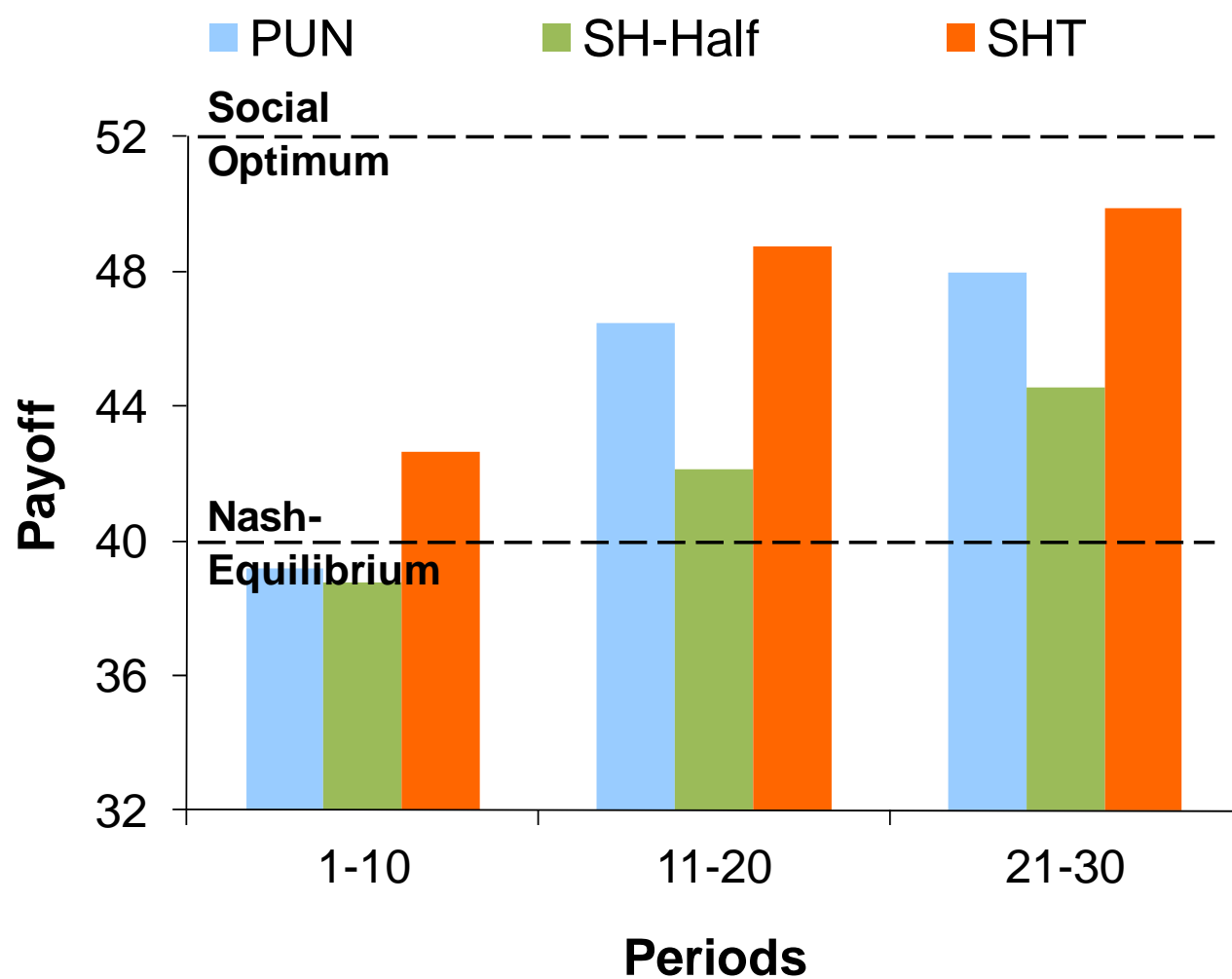
In PuC of SHT, subjects engage more often in punishment of others who contributed less than themselves. In PuC of SHT, less-contributors receive punishment tokens in 53.9% of all possible cases (in PuC of PUN: 52.8%, in PuC of SHT: 33.8%). On the other hand, the frequency of anti-social punishment, i.e., punishment against others who contributed equally or more is roughly the same in PuC of SHT (1.8%) and in PuC of PUN (2.2%). The average severity of anti-social punishment, however, is lower in PuC of SHT (1.5 tokens per instance) than in PuC of PUN (1.9 tokens,  $p = 0.075$ ) and in PuC of SH-Half (1.8 tokens,  $p = 0.345$ ).

### 4.4. Efficiency

Does social history decrease the efficiency losses? How does the efficiency develop over the course of the experiment?

**Result 4.** *The payoffs in PuC catch up with the payoffs in NPC more quickly in SHT than in PUN and in SH-Half. Overall efficiency (over both institutions) is higher in SHT than in PUN and in SH-Half.*

As can be seen in Figure panels d)-f), in the first period, subjects in NPC obtain higher payoffs than subjects in PuC in all three treatments. In SHT, however, average payoffs in PuC catch up with the payoffs in NPC more rapidly than in PUN and in SH-Half. In SHT, already in fifth period, members of the punishment institution obtain higher payoffs than members of NPC (cf. Figure 1 panel e). From period five on, the payoffs in PuC are constantly higher than the payoffs in NPC. In contrast, in PUN, the payoffs in PuC oscillate strongly and catch up with the payoffs in NPC only in period 11 (cf. Figure 1 panel d). The average period in which the earnings in PuC exceed the earnings in NPC is 7.2 in SHT, while it is 15.1 in PUN and 16.8 in SH-Half. Hence, PuC becomes the more profitable community significantly earlier in SHT than in PUN ( $p = 0.037$ ) and in SH-Half ( $p = 0.006$ ).



**Figure 2: Overall payoffs**

From the social planner's perspective, one of the most interesting issues concerns the efficiency in the society including all its communities. Figure 2 shows the overall society earnings in each treatment in three phases of the experiment. In all phases, the payoffs in SHT are higher than in

PUN and SH-Half. In SHT, the average payoff of a society (over all three phases) amounts to 47.1 tokens while it is 44.5 in PUN (41.9 in SH-Half). The surplus ratio, i.e., the actual surplus generated by cooperative behavior in the experiment divided by the maximum possible surplus amounts to 59.2% in SHT. This efficiency level is higher than the level PUN (37.5%,  $p = 0.101$ ) and SH-Half (15.3%,  $p = 0.005$ ).<sup>11</sup>

## 5. Conclusion

In this study, we explore whether informed subjects are less reluctant than uninformed subjects to join an institution with a peer punishment mechanism in a social dilemma situation and whether the society consisting of informed subjects obtain a greater efficiency. We observe a clear effect of social history on the institution choice. With social history, initially, significantly more subjects join the punishment community than in the baseline treatment. Moreover, with social history, subjects joining the punishment community start to cooperate on a much higher level than the subjects who join the punishment community in the baseline treatment. With social history, the punishment expenses are also lower. In the beginning, in both treatments, the payoff differential between the punishment and the non-punishment community is negative for the punishment institution. However, with social history, the payoffs in PuC catch up with the payoffs in NPC more quickly than they do in PUN. As a consequence, the punishment institution of SHT attracts subjects more quickly than the PuC of the baseline treatment. The socially efficient “ideal” state of “full participation” with (almost) full contributions is reached significantly earlier in PuC of SHT than in PuC of PUN. With social history, overall efficiency gains for the society as a whole are higher than without it.

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<sup>11</sup> As a referee pointed out, in SH-Half, full cooperation is observed less frequently, and compared to PUN, the payoffs in SH-Half are relatively low than one possibly may expect. Indeed, the difference between the efficiency levels in PUN and SH-Half are quite high (37.5% vs. 15.3%,  $p = 0.130$ ). These differences are mainly due to the greater variance in contribution behavior we observed in PuC of SH-Half (as also mentioned in footnote 10). Why, there is such a variation? First, unlike in PUN, subjects in SH-Half *have* to deal with some ex-ante information on the institution choice. Possibly, the low acceptance rates of PuC in PUN in the beginning that are shown to subjects in SH-Half influenced their beliefs and cooperation behavior such that these subjects contributed less than they would if they had no information on institution choice at all (as in PUN). A second possibility (as pointed out by the same referee) is that the effect observed here could possibly be due to the different timing of PUN and SH-Half treatments (the sessions for SH-Half were conducted 8 years after PUN). For all treatments, we recruited subjects in the same campus from the same fields of study and no subject (in any treatment) did participate in a similar experiment before. Hence, it seems unlikely that the relatively low payoffs we observe in SH-Half are predominantly caused by a subject pool (cohort) effect.

Hence, with respect to our research question, the data clearly show that ex-ante knowledge about the punishment institution does not shun away the subjects from joining it. This information, provided to the subjects with the social history, does rather increase the initial acceptance of the punishment institution significantly. Moreover, social history works as a catalyst in reaching full contributions more quickly and in obtaining a higher overall efficiency.

To identify whether the driving force behind the success of social history is social learning or imitation we conducted the SH-Half treatment in which subjects were provided with less information from the baseline treatment than in SHT. For all important variables, the data we observe in SH-Half is closer to PUN than to SHT. This regularity in behavior supports the conjecture that what is going on in SHT is indeed social learning and not mere imitation. This finding is a novel contribution of our paper to the literature compared to previous experimental studies on social learning.

Although our findings unambiguously show that social history has clearly increased the initial acceptance and the overall efficiency of the punishment institution still there is potential for “improvement”. Roughly half of the subjects (45.8%) do not join the punishment community initially. Why is this? A possible reason could be the fear of anti-social punishment. Future research could clear this question by conducting an experiment that could restrict unjustified punishment in the punishment institution. Probably, more subjects choose then the punishment institution initially. Moreover, since unjustified punishment would be ruled out, the efficiency of the punishment institution may also increase.

## **Acknowledgements**

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# Appendix

## Instructions for the experiment

At the beginning of the experiment you will be randomly assigned to one of 2 subpopulations each consisting of 12 participants. During the whole experiment you will interact only with the members of your subpopulation. At the beginning of the experiment, 1000 experimental tokens will be assigned to the experimental account of each participant. Course of Action: The experiment consists of 30 rounds. Each round consists of 2 stages. In Stage 1, the group choice and the decision regarding the contribution to the project take place. In Stage 2, participants may influence the earnings of the other group members.

### Stage 1

#### (i) The Group Choice

In Stage 1, each participant decides which group she wants to join. There are two different groups that can be joined:

	Influence on the earnings of other group members
Group A:	No
Group B:	Yes, by assigning negative points

#### (ii) Contributing to the Project

In stage 1 of each round, each group member is endowed with 20 tokens. You have to decide how many of the 20 tokens you are going to contribute to the project. The remaining tokens will be kept by you.

**Calculation of your payoff in stage 1:** Your payoff in stage 1 consists of two components:

- tokens you have kept = endowment - your contribution to the project
- earnings from the project =  $1.6 \times \text{sum of the contributions of all group members} / \text{number of group members}$



Thus, your payoff in Stage 1 amounts to:  $20 - \text{your contribution to the project} + 1.6 \times \text{sum of the contributions of all group members} / \text{number of group members}$

The earnings from the project are calculated according to this formula for each group member. Please note: Each group member receives the same earnings from the project, i.e. each group member benefits from all contributions to the project.

### **Stage 2: Assignment of Tokens**

In stage 2 it will be displayed how much each group member contributed to the project. (Please note: Before each round a display order will randomly be determined. Thus, it is not possible to identify any group member by her position on the displayed list throughout different rounds.) By the assignment of tokens you can reduce the payoff of a group member or keep it unchanged.

In each round each participant receives additional 20 tokens in stage 2. You have to decide how many from the 20 tokens you are going to assign to other group members. The remaining tokens are kept by yourself. You can check the costs of your token assignment by pressing the button Calculation of Tokens.

Each negative token that you assign to a group member reduces her payoff by 3 tokens.

If you assign 0 tokens to a group member her payoff won't change.

**Calculation of your payoff in stage 2:** Your payoff in stage 2 consists of two components:

- tokens you kept =  $20 - \text{sum of the tokens that you have assigned to the other group members}$
- less the threefold number of negative tokens you have received from other group members

Thus, your payoff in Stage 2 amounts to:  $20 - \text{sum of the tokens you assigned to other group members} - 3 \times (\text{the number of tokens you received from other group members})$

**Calculation of your round payoff :** Your round payoff is composed of Your payoff from Stage 1  $20 - \text{your contribution to the project} + 1.6 \times \text{sum of the contributions of all group members} / \text{number of group members}$

+ Your payoff from Stage 2  $20 - \text{sum of the tokens that you have assigned to other group members}$   
-3 x (the number of tokens you have received from other group members)  
= Your round payoff

**Special case:** If you are the only member in your group you receive 20 tokens in Stage 1 and 20 tokens in Stage 2, i.e., your round payoff amounts to 40. You neither have to take any action on Stage 1 nor on Stage 2.

**Information at the end of the round:** At the end of the round you receive a detailed overview of the results obtained in all groups. For every group member you are informed about her: Contribution to the project, payoff from the Stage 1, assigned tokens (if possible), received tokens (if possible), payoff from Stage 2, round payoff.

**History:** Starting from the 2nd round, in the beginning of a new round you receive an overview of the average results (as above) of all previous rounds.

**Report sheet about the decisions of participants of a previously conducted experiment:** Each participant receives a report sheet about the decisions of participants of a previous experiment which was conducted in the [...]. In this report you will find average numbers of the decisions of the participants. Please read this report before you decide.

**Total Payoff:** The total payoff from the experiment is composed of the starting capital of 1000 tokens plus the sum of round payoffs from all 30 rounds. At the end of the experiment your total payoff will be converted into Euro with an exchange rate of 1 per 100 tokens.

**Please note:** Communication is not allowed during the whole experiment. If you have a question please raise your hand out of the cabin. All decisions are made anonymously, i.e., no other participant is informed about the identity of someone who made a certain decision. The payment is anonymous too, i.e., no participant learns what the payoff of another participant is.

We wish you success!

# Report sheet for the experiment (Treatment SHT)

Pd.	Average number of group members		Average contribution		Average received negative tokens		Average payoff	
	A	B	A	B	A	B	A	B
1	8.3	3.8	7.4	13.1	-	6.2	44.4	23.0
2	8.3	3.8	5.4	14.4	-	4.5	43.2	30.8
3	8.3	3.8	3.9	15.3	-	3.3	42.4	35.8
4	6.5	5.5	3.2	15.1	-	5.6	41.9	26.7
5	7.3	4.8	2.9	16.6	-	3.5	41.7	36.1
6	6.6	5.4	2.1	18.3	-	0.7	41.3	48.3
7	5.0	7.0	0.9	16.5	-	5.3	40.6	28.6
8	6.1	5.9	2.4	17.7	-	2.9	41.4	39.2
9	5.4	6.6	2.1	18.6	-	1.5	41.2	45.4
10	3.9	8.1	2.3	17.0	-	3.3	41.4	36.8
11	5.3	6.8	2.1	19.0	-	1.8	41.3	44.3
12	4.5	7.5	1.4	19.0	-	0.8	40.8	48.1
13	3.0	9.0	2.6	18.5	-	1.6	41.5	44.8
14	3.4	8.6	1.2	19.2	-	1.3	40.7	46.1
15	2.4	9.6	0.2	19.3	-	0.9	40.1	48.1
16	1.8	10.3	4.8	18.8	-	1.1	42.9	46.9
17	1.9	10.1	4.6	19.5	-	0.2	42.8	50.9
18	1.9	10.1	2.2	19.3	-	0.9	41.3	47.9
19	1.6	10.4	1.5	19.6	-	0.4	40.9	50.2
20	1.1	10.9	2.1	19.4	-	0.4	41.3	50.2
21	1.1	10.9	0.3	19.7	-	0.5	40.2	49.9
22	1.0	11.0	2.1	19.1	-	1.7	41.3	44.6
23	1.3	10.8	1.3	19.5	-	0.9	40.8	48.0
24	1.5	10.5	1.7	19.9	-	0.2	41.0	51.3
25	1.1	10.9	1.1	19.9	-	0.6	40.7	49.6
26	0.9	11.1	1.4	19.6	-	0.9	40.9	48.1
27	0.5	11.5	0.0	19.5	-	1.1	40.0	47.5
28	0.8	11.3	0.0	19.7	-	0.7	40.0	48.8
29	0.9	11.1	1.4	19.8	-	1.0	40.9	47.7
30	1.0	11.0	0.1	20.0	-	0.2	40.1	51.3

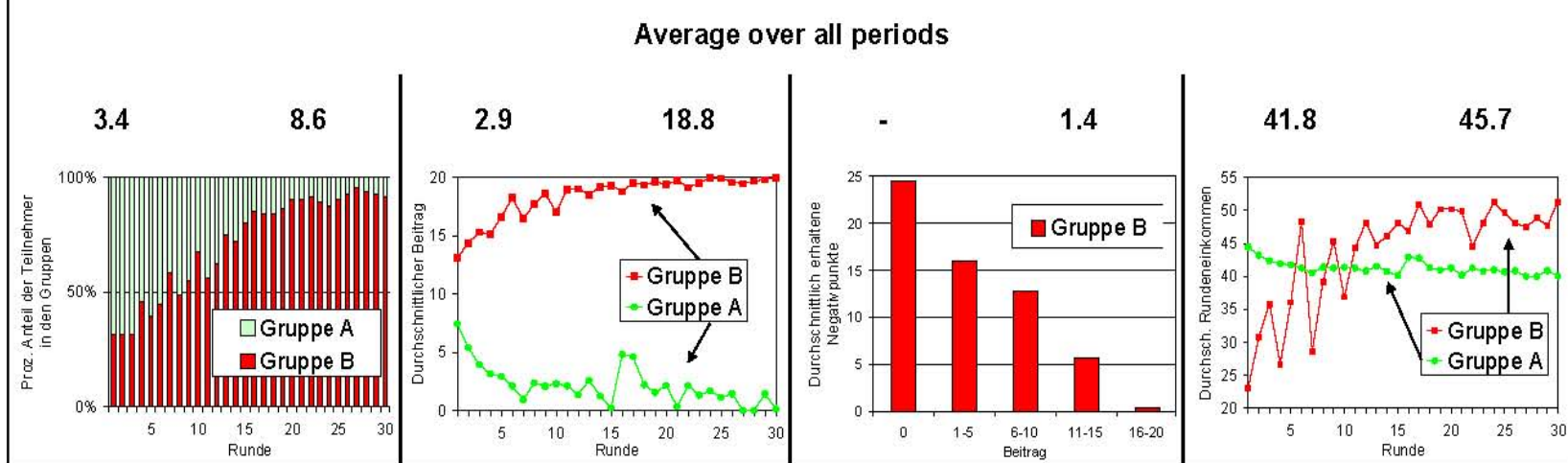


Figure 3: The social history provided in SHT treatment

## Report sheet for the experiment (Treatment SH-Half)

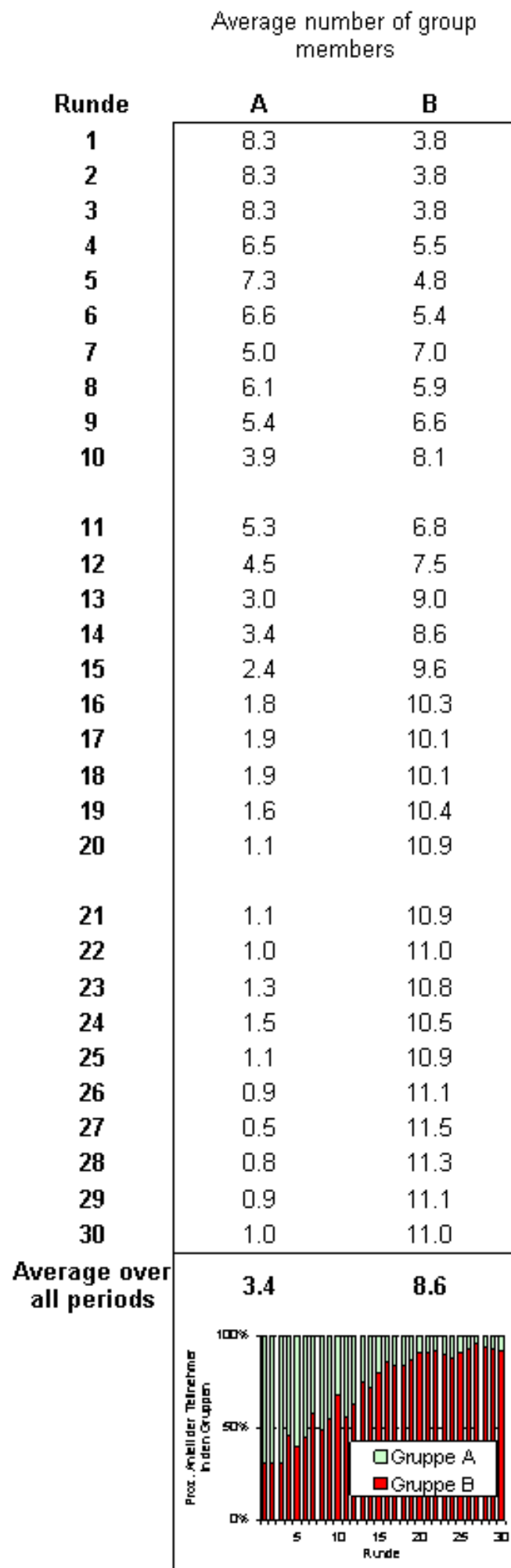


Figure 4: The social history provided in the SH-Half treatment

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