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. Here, we investigate the effects of social learning on the acceptence and the efficieny of a peer punishment institution in a community choice experiment. Subjects choose between communities with and without the possibility to punish peers before interacting in a repeated social dilemma situation. We find that 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. Moreover, 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; Community choice; Punishment; Institution choice

1. Introduction

For communities with an exogenously fixed composition of members, experimental studies identify decentralized (peer) punishment mechanism as a valuable means to sustain cooperation in social dilemmas (see e.g., Ostrom et al., 1992; Fehr and Gächter, 2000). While peer punishment succeeds to increase contributions in experiments, it also causes an efficiency loss due to high punishment acts, especially in the beginning phase of the play. As a consequence, peer punishment institutions do not produce significantly higher payoffs compared to standard voluntary contribution mechanism (VCM) without the punishment option (cf. Egas and Riedl, 2008). This observation seems to be valid not only for the "standard western" subject pools. Herrmann et al. (2008) show in a cross cultural study that in the majority of experiments punishment do not increase the payoffs significantly when it is compared to standard VCM.

The efficiency losses, however, are not independent of the institutional framework and parameters. Gächter et al. (2008) show that extending the experimental time horizon may improve the overall efficiency of the peer-punishment mechanism. If a public goods experiment with punishment stage is played over 50 periods it produces significantly higher payoffs than the VCM. Nevertheless, also in this study there still remains a considerable amount of initial efficiency loss. Thus, it takes time for the punishment

institution to unfold its full impact on payoffs.

Another strand of recent studies focus show that endogenous choice of punishment institutions may also help to improve contributions and its overall efficiency (e.g., Sutter et al., 2010; Gürerk et al., 2006, 2010). Sutter et al. (2010) investigate the effects of institution choice by *voting* between standard public goods, public goods with rewards, or public goods with punishment. Under unanimous voting, the punishment institution is rarely chosen. When it is selected, however, it is the most successful institution in eliciting high contributions. In Gürerk et al. (2010), in each of the 30 experimental periods, subjects freely and individually *choose* between communities with and without punishment possibilities before interacting with others who choose the same institution in a social dilemma situation. This 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%, and virtually no punishment is needed. As a consequence, in the second half of the experiment, the efficiency of the punishment institution is significantly higher than the efficiency of the non-punishment institution. Despite this final success of the punishment institution, there remain two problems. First, although more than 90% of subjects opt for the punishment institution in the end, *initially*, the great majority of subjects are reluctant to choose the punishment community. In the first period, only one third of the subjects opt for it.[1] Second, there is still a considerable amount of *initial* punishment activity that decreases efficiency in the beginning phase of the

[1]The reluctance against punishment institutions is also found by Sutter et al. (2010) and Gürerk et al. (2009).

experiment and have a negative effect on the overall efficiency.

How can the initial reluctance and the initial punishment be mitigated in order to improve the overall performance of endogenously chosen punishment institutions? 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 avoid. Recent experimental studies show that subjects indeed often prefer non-punishment communities when they have the choice between punishment and non-punishment or reward institutions (Botelho et al., 2007; Gürerk et al., 2009; Sutter et al., 2010). Second, subjects may also fear to be exposed to unjustified punishment. In fact, in experiments, punishment of high contributors is a frequently observed phenomenon (see e.g., Cinyabuguma et al., 2006 or Nikiforakis, 2008). Third, for subjects there may be a rational reason to "wait" before joining a punishment community. If the expected level of cooperation is the same in both communities then it may be rational for subjects to join non-punishment community first (to avoid the risk of punishment) and to wait and see how the situation in the punishment community develops before joining in. A fourth possible explanation is that subjects simply do not anticipate correctly that the punishment community is the more efficient community in the long-run. If subjects knew ex-ante that the punishment community is the superior community they would probably join it much quickly.

In this study, we focus on the investigation of the two last proposed

possible explanations. We contrast them by asking whether the lack of information about the high cooperation levels in the punishment institution is a critical force that drives the reluctance to join the punishment institution. We conjecture that endogenous choice coupled with the possibility of "social learning" may be a good way to improve the acceptance and the overall efficiency of punishment institutions. As an experience-based information device, a social history[2] may lower people's reluctance towards the punishment community by correcting the false expectation on its performance. To test this we conduct a social history treatment (SHT) which is the exact replication of the PUN treatment from the study of Gürerk et al. (2010). The only difference is that in SHT, a social history, which contains the main results of PUN, is given to the subjects. If - contrary to our conjecture - people are rational waiters, social history should even increase the reluctance against the punishment institution.

Our conjecture is backed by experimental work on (naive) "advice giving" which unfolds its impact through social learning. Schotter (2003) reviews the first studies on advice giving and finding that advice changes behavior of the "advice takers", i.e., subjects who have taken advice play the same game differently than the advice givers. Chaudhuri et al. (2006) report that advice - given as free-form text messages by individuals - increase contributions in a public good experiment (and mitigates free-riding) if the advice is made public and becomes common knowledge. In their influential trust game study, Berg et al. (1995) find that a social history treatment - compared to the

[2]For details of the information presented in the social history see Section 2.

baseline treatment - has significant effects on subjects' choices. With social history, both amounts invested by the sender and the amount sent back by the responder increase. On the other hand, there is also some literature reporting no change in subjects' behavior when they are provided with a social history (Fehr and Rockenbach, 2003).

The following section describes the experimental design and procedure. Results are presented in Section 3. Section 4 concludes.

2. Experimental Design

The experiment is based on a social dilemma game of 30 repetitions including three stages in each period: In Stage 0, 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 i is endowed with 20 experimental tokens and can anonymously invest $g_i \in 0 \leq g_i \leq 20$ in the joint project.[3] The defining characteristic of a social dilemma is fulfilled independent of the number of members n^{Θ} with $\Theta \in 1, 2$ in each community because the marginal per capita return a is $1/n^{\Theta} < a < 1$ for all n^{Θ} with $2 \leq n^{\Theta} \leq N$. In PuC, Stage 1 is followed by a punishment stage. 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 token lowers the payoff of the punished

[3]If only a single player joins a community, no joint project can be created and the endowment of the player is automatically transferred to own private account. This player has no decision in stages 1 and 2.

subject by three tokens. After each period, participants receive feedback about individual contributions, received punishment tokens and payoffs in both communities.

In SHT, the social history is handed out to subjects before the experiment starts. For both communities it separately tabulates the averages of the number of community members, contributions, payoffs, and the received punishment tokens in PuC of the baseline treatment PUN for each period. Additionally, the over-time evolutions of the averages are visualized in figures. 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. None of the 72 subjects had participated in a similar experiment before. An experimental session lasted on average two hours. Average earnings were 24 Euros.

3. Results

3.1. Initial community choices, contributions, punishment, and efficiency

Does social history lead to an immediate (first period) effect on subject's chocies and contributions?

Result 1. *Social History lowers the initial reluctance to join punishment community and increases the initial cooperation in PuC.*

Social history has significant effects on subjects' initial community choices and contributions. First, it decreases the initial reluctance to join PuC significantly. In SHT, in period 1, 54.2% of subjects prefer PuC. This percentage

is significantly higher ($p = 0.037$) than the fraction of subjects who opt for PuC in the baseline treatment PUN (31.2%).[4] Social history has also an immediate effect on contributions. The fraction of high contributions ($g \geq 15$) in the punishment community of SHT (74.0%) in the first period is significantly larger ($p = 0.051$) than the percentage of high contributors in PuC of PUN (53.7%). The more cooperative decisions of subjects in PuC of SHT results in a higher initial cooperation level. In PuC of SHT, subjects contribute 78.7% of their endowment to the joint project, while in PuC of PUN 66.0% of the endowment is invested ($p = 0.086$).

In the first period, subjects in PuC of SHT invest less tokens (2.3) in punishment than subjects in PuC of PUN (3.4, $p = 0.138$). Higher contributions and lower punishment in the first period of PuC of SHT result in higher first period payoffs in PuC of SHT (29.2 tokens) than in PuC of PUN (26.4 tokens). This difference, however, is statistically not significant ($p = 0.431$).

3.2. Evolution of community choices and contributions

Does the lower initial reluctance against 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 NPC than observed in PuC of PUN?

Result 2. *"Full participation in PuC" is reached more rapidly and is more stable in SHT than in PUN.*

[4] All reported non-parametric statistical tests are two-tailed Mann-Whitney U-tests and use the session averages as independent observations.

Panel (a) of Figure 1 shows the evolution of community choices. In PUN as well as in SHT, for all but one society it is true that there is at least one period in which all subjects of the respective society join PuC. 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, $p = 0.033$). Moreover, once established, the state of full participation is more stable in PuC of SHT than in PuC of PUN. The average number of consecutive periods with full participation in PuC amounts to 15.4 periods in PuC of SHT but only to 5.6 in PuC of PUN ($p = 0.027$). Thus, in PuC of SHT, full cooperation is established not only more quickly but it also lasts longer. In the very last period, only one subject (1.4%) in SHT does not opt for PuC whereas in PUN 8 subjects (8.4%) choose NPC.

3.3. Overall punishment behavior

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

Result 3. *Overall, punishment causes fewer expenses and it is less severe in PuC of SHT than in PuC of PUN.*

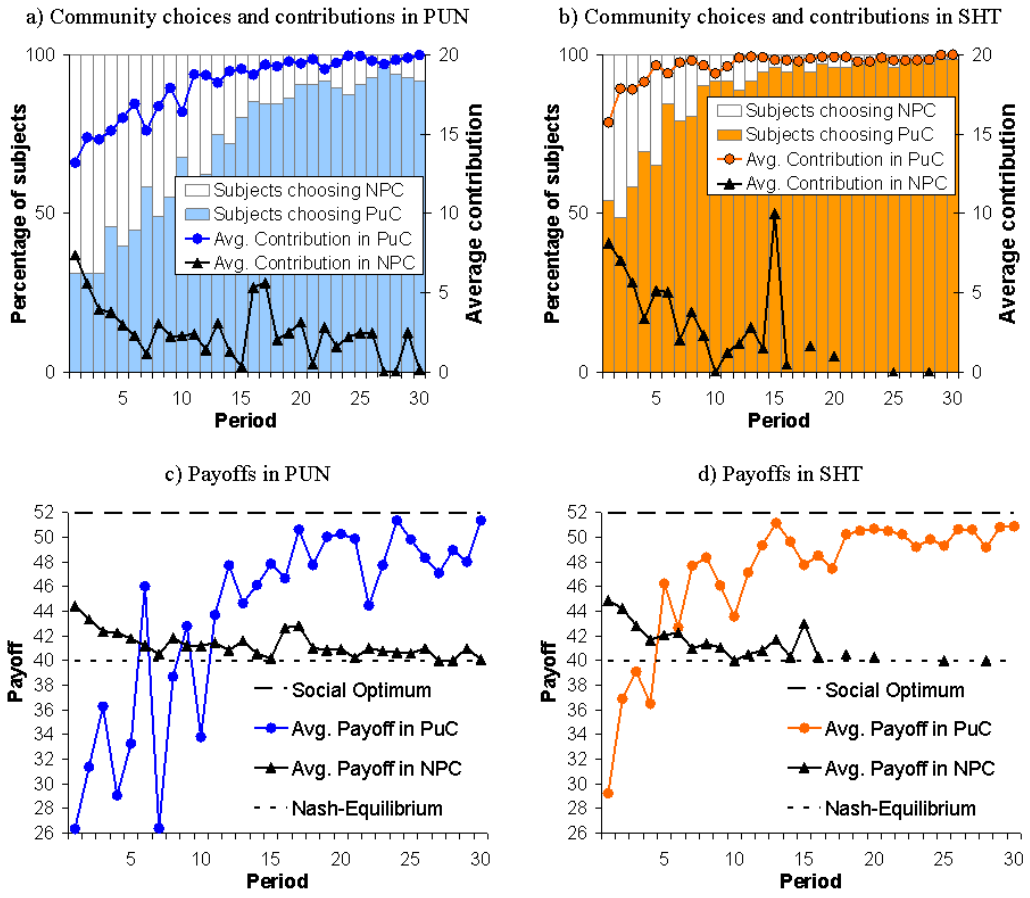

Figure 1: Average numbers

The less contributing subjects[5] in PuC of SHT receive more often punishment than their counterparts in PuC of PUN. In PuC of SHT, less-contributors receive punishment tokens in 38.5% of all possible cases while in PuC of PUN this is only true in 25.5% of the cases ($p = 0.101$). Hence, subjects in PuC of SHT show less mercy against less-contributors than subjects in PuC of SHT do. Overall, tokens sent per punishment instance, however, is significantly lower in PuC of SHT (2.4 tokens) than in PuC of PUN (3.1) ($p = 0.043$). Interestingly, in PuC of SHT, subjects with relatively high contributions are also punished. On average, a punished subject in PuC of SHT contributed more to the joint project than a punished subject in PuC of PUN (17.4 versus 15.1 tokens, $p = 0.022$). Hence, it seems that subjects in PuC of SHT try to establish a higher contribution norm. The frequency of unjustified ("perverse") punishment, i.e., the percentage of instances when the punished person contributed equally or more than the punisher is roughly the same in PuC of SHT (1.7%) and in PuC of PUN (1.8%). The average severity of unjustified punishment, however, is significantly lower in PuC of SHT (1.5 tokens per instance) than in PuC of PUN (1.9 tokens, $p = 0.075$).

3.4. Overall efficiency

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

Result 4. *The payoffs of the PuC catch up with the payoffs of NPC more quickly in SHT than in PUN. Overall efficiency (over both communities) is*

[5]With respect to subject i, less-contributors are subjects who contribute strictly less than subject i in PuC.

higher in SHT than in PUN.

In SHT as in PUN, in the first period, subjects in NPC obtain higher payoffs than subjects in PuC. The initial payoffs in PuC of SHT (29.2) are higher than the first period payoffs in PuC of PUN (26.4). As a consequence, the initial payoff differential between NPC and PuC is lower in SHT (15.7 tokens) than in PUN (18.2 tokens). Moreover, in SHT, average earnings in PuC catch up with the payoffs in NPC more rapidly than in PUN. In SHT, already in fifth period, members of PuC earn more than members of NPC (cf. Figure 1 panel d). From period five onwards, 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 c). The average period where the earnings in PuC exceed the earnings in NPC is 7.2 in SHT, while it is 15.1 in PUN ($p = 0.037$). Hence, PuC becomes the more profitable community much earlier in SHT than in PUN.

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 both treatments in three phases of the experiment. In all phases, the payoffs in SHT are higher than in PUN. In SHT, the average payoff of a society (over all three phases) amounts to 47.1 tokens while it is 44.5 in PUN. 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 and 37.5% in PUN. Thus, the gains from cooperation are higher in SHT than in PUN ($p = 0.101$).

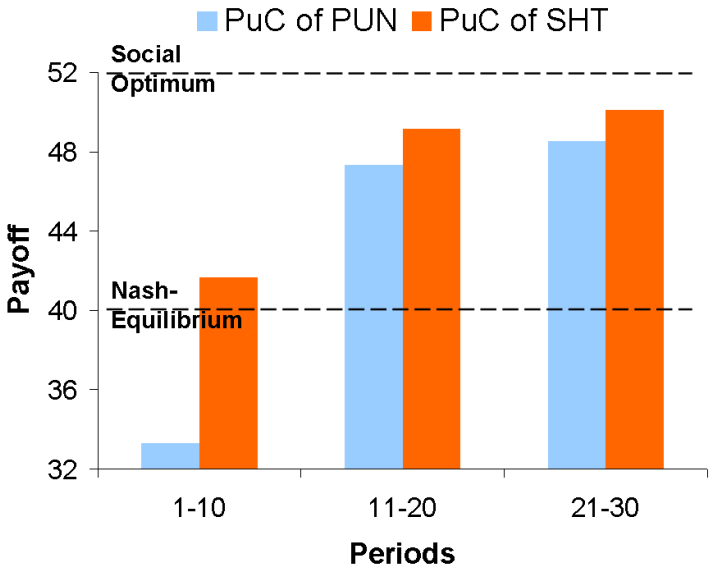

Figure 2: Overall payoffs

4. Conclusion

In this study, we explore whether informed subjects are less reluctant than uninformed subjects to join a community with a peer punishment mechanism in a social dilemma situation and whether the society consisting of informed subjects obtain a greater efficiency. We find a clear effect of social history on the very first community choice. In SHT, initially, significantly more subjects join the punishment community than in PUN. Moreover, the subjects joining the PuC of SHT immediately start to cooperate on a much higher level than the subjects in PuC of PUN. With social history, less-contributors are punished more frequently but not as severe as in the baseline treatment. As a consequence, the payoff differential that is negative for the punishment community in the beginning, gets positive more quickly in SHT than in PUN. As a consequence, the punishment community in 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.

Our findings shed light on the importance of experience-based information for the acceptance of seemingly unpopular but socially desirable mechanisms. In reality, often, there is resistance among citizens against reforms that are considered efficiency-enhancing by the experts. One reason for the resistance may be that there is a "status quo bias" when the implications of the reform for individuals are not clear. People resist to reform if they do not know who the gainers and who the losers will be (cf. Fernandez and Rodrik, 1991). If the consequences of the installation of an (new) institution to solve a social dilemma appear disadvantageous (at least to some individuals), clear communication and explanation of the merits of the planned action in a coherent way may help to mitigate possible frictions that possibly occur during the transition process.

Appendix A. Instructions

Instructions for the experiment

General Information

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 yourself.

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 x sum of the contributions of all group members / number of group members

Thus, your payoff in Stage 1 amounts to: 20 - your contribution to the project + 1.6x sum of the contributions of all group members / 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 - 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 - sum of the tokens that you assigned to other group members - 3x (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 - your contribution to the project + 1.6 x sum of the contributions of all group members / number of group members

+ Your payoff from Stage 2 20 - 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 it happens that 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 eLab at the University Erfurt in January 2004. 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 notice: 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

	Average number of group members		Average contribution		Average received negative tokens		Average payoff	
Pd.	**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
	Average over all periods							
	3.4	**8.6**	**2.9**	**18.8**	**-**	**1.4**	**41.8**	**45.7**

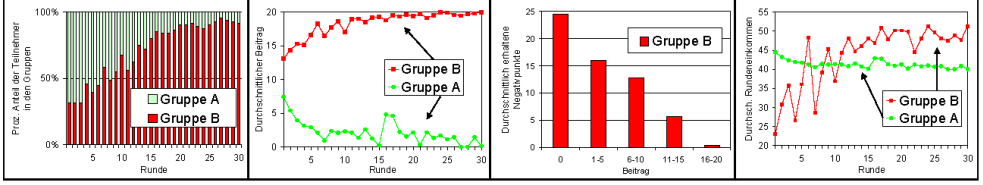

Figure A.3: Social History

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