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# Partner Selection in Public Goods Experiments

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# Partner selection in public goods experiments*

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**Abstract**

This paper studies the effect of introducing costly partner selection for the voluntary contribution to a public good. Subjects participate in six sequences of five rounds of a two-person public good game in partner design. At the end of each sequence subjects can select a new partner out of six group members. Unidirectional and bidirectional partner selection mechanisms are introduced and compared to controls with random partner rematching. Results demonstrate significantly higher contributions in correspondence to unidirectional partner selection than to bidirectional selection and random rematching. Average monetary valuation of being able to choose a partner is substantially high and remains stable.

Keywords: public goods, partner selection, experiments

JEL-Classification: C91, D62, H41

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## 1 Introduction

Mounting evidence on reciprocal behavior in various social interactions (Andreoni 1988, Fehr and Gächter 2000, Isaac and Walker 1988) suggests that the usually observed decline of contributions in public goods experiments is mainly due to the influence of low contributors and reciprocal reaction of cooperators. In repeated public goods experiments subjects usually start contributing a large proportion of their endowment and then drastically reduce their contribution during the subsequent interactions. When starting over with a new sequence of repeated public good games, average contributions typically rise again substantially before they decrease, which is commonly referred to as the restart effect. These phenomena are robust against variations of the game, e.g., group size, marginal per-capita return, or partner and stranger design (e.g., Andreoni 1988, Croson 1996), and indicate that the decline in contributions is not due to learning the incentive structure of the game, but to reciprocity; meaning that "in response to friendly actions, people are frequently much nicer and much more cooperative than predicted by the self-interest model; conversely, in response to hostile actions they are frequently much more nasty and even brutal" (cf. Fehr and Gächter 2000, p. 159).

In order to address this conjecture, Gunnthorsdottir et al. (2001) sorted participants in a public good experiment according to their initial contribution into high, middle and low contributors. Highly cooperative individuals who interact repeatedly with similar types sustained high cooperation during the course of the experiment with only little decline, whereas subjects in the less cooperative group continued to free-ride. This evidence impressively confirms the hypothesis that heterogeneity of individuals and reciprocity are the major driving forces of poor efficiency in privately providing public goods and give raise to the idea that specific regrouping might improve the sustainment of cooperation.

The fact that in daily life people are often able to choose their interaction partners can be considered as an endogenous regrouping device, which is also an effective way to escape exploitation. Indeed, people frequently change or quit relationships with individuals who are not fulfilling the expected cooperative standards and look out for better opportunities, even if it involves substantial costs. Economic examples are various; producers, for instance, break-off established relationships and switch to different suppliers, managers lay off and recruit employees for work teams, families migrate to "better" districts or neighborhoods, and even sports teams spend huge amounts on purchasing their future team members.

Main object of the present study is to investigate if endogenous regrouping involving self-determined cost is effective in raising the voluntary contribution to a public good. We provide subjects with the opportunity to select their future interaction partner in a two-person public good game and employ two plausible selection mechanisms, unidirectional and bidirectional. Cooperative behavior in these two treatments of partner selection is compared to control treatments with random rematching. Evidence indicates efficiency increases in particular with unidirectional partner selection compared to the control treatments. Despite theoretical predictions, the monetary effort for choosing a partner is substantial highlighting the importance of deliberately establishing and quitting particular relationships.

The remainder of the paper is organized as follows. Section 2 reviews related literature, especially experimental studies on endogenous regrouping in social dilemma situations and summarize again our research agenda. Section 3 proceeds with illustrating the design and procedure of our experiment and section 4 reports the findings. Finally, section 5 concludes the paper with a brief discussion.

## 2 Related literature

In the economic literature, Tiebout (1956) was the first to propose local governments and the "freedom to move/choose" to overcome the conclusion of Musgrave (1939) and Samuelson (1954) that no market solution for public good provision at the central level can be found. Migration thus can solve the problem of efficient public[1] provision of collective goods. In particular, the larger the number of communities the higher the opportunity of heterogeneous agents to find the community that best fulfills their preferences, which pertain to both economic and non-economic variables, like the desire to associate with "nice people" (cf. Tiebout 1956, p. 418). In the context of a public good game, nice people are those who increase the group benefit by prosocial behavior (Fehr and Gächter 2000).

Ehrhart and Keser (1999) tried to reproduce an experimental environment that corresponds to the world depicted by Tiebout (1956). Subjects were free to move to or create a new community (group) at a small fixed cost, based on the information on average group contributions and the history of per capita returns from the public good in each group. Although the standard Nash-solution of the game is to contribute nothing and never incur the cost of switching or creating a group, results of

1 While Tiebout's model is concerned with the public provision of public goods, Jacquillat and Solnik (1998), for instance, propose an extension of the model to private provision of public goods.

this experiment demonstrate significantly higher average contributions compared to standard public good experiments and frequent migration across groups. Especially, cooperators tried to escape free riders who in turn attempted to "chase" the former. Although the findings seem convincing, economic incentives to contribute to the public good repeatedly change along with group size: While the individual return from the contribution to the public good decreases in group size, the social benefit increases. These opposing dynamics render it difficult to disentangle the effects of the change in group size and the freedom to move.

By using the standard voluntary contribution mechanism in an experiment with group sizes of four Page et al. (2002) investigated endogenous regrouping in a public good game. Based on the information about past average contributions of their fellows, subjects were asked to assign ranks from 1 ("most preferred") to 15 ("least preferred") to others expressing their desire to be matched together in a group, whereby each rank was charged with a small fixed amount. According to an algorithm calculating mutual rank assignments, subjects were assigned to new groups of four. Average contributions in the regrouping condition were significantly higher than in the baseline, and the vast majority of subjects chose to rank at least once in the experiment. In the baseline treatment, however, subjects repeatedly interacted in the same group throughout the experiment, thus lacking potential restart effects, which might already trigger the results in favor of higher efficiency with endogenous regrouping.

Hauk and Nagel (2001) experimentally studied a finitely repeated prisoners' dilemma game with two different partner selection mechanisms. Subjects could choose to take an outside option, which gives them a payoff higher than the one received when being exploited, or to enter the game, where they have to play with a partner who has been unilaterally or mutually selected. In the unilateral treatment the decision of one of the two potential partners to enter is enough to play the game, whereas in the mutual treatment both have to agree. Results of this experiment suggest that unilateral partner selection is more effective in lowering defection and increasing the proportion of unconditional cooperators in comparison to mutual selection.

The importance of investigating the freedom to choose interaction partners in social dilemma situations has been endorsed previously (e.g., Hayashi and Yamagishi 1998). However, little attention has yet been paid to the question whether cooperative behavior is sensitive to the institutional design of choosing the interaction partner. Furthermore, to the best of our knowledge, until now no attempt has been made to elicit the subjective valuation of being able to choose the interaction partner. Both issues are addressed in our study.

## 3 Experimental design and procedure

Aside from concentrating on the two main topics above, the experimental design attempts to cover two methodological concerns: First, in contrast to Page et al. (2002), our control treatments comprise random rematching of subjects with the same frequency as partner selection in the experimental treatments, thereby testing whether mere restart effects already account for the possible efficiency increase found in their study. Second, providing the opportunity to select an interaction partner requires publicizing the past behavior of participants. The prospect of having such information announced may by itself trigger more cooperative behavior. Thus, in order to disentangle this reputation effect from the efficacy of partner selection, we additionally consider a control treatment without revealing past behavior.

In general, our experiment comprises six sequences of a five-period public good game, in which subjects interact repeatedly with the same partner. At the end of each sequence new pairs are formed within a constant group of six subjects. Subjects are identifiable by a unique code (ID) from "A" to "F" that is once randomly assigned to group members for the whole experiment. Rematching of subjects into pairs is done either randomly (two control treatments) or endogenously (two experimental treatments). In the first experimental treatment endogenous rematching is based on a unidirectional selection mechanism (unidirectional), whereas in the second treatment it resembles a mechanism based on two-sided selection (bidirectional). In the two control treatments (random partner rematching and random partner rematching without history) partners are randomly determined at the beginning of each sequence. In each treatment subjects are aware of participating in a finitely repeated public good experiment with the same partner during one sequence but possibly another partner out of the group of six in other sequences. The particular partner rematching mechanism is explained in detail before the experiment starts.

### 3.1 The two-person public good game

In each round subjects receive an endowment of 25 experimental currency units (ECU).[2] Each subject can contribute part or all of her endowment to a public good

2 The exchange rates to € is 100:1, i.e. 100 ECU correspond to € 1.

receiving a constant marginal return of 0.8 from each ECU invested. The decision about the contribution to the public good is made simultaneously. At the end of each round subjects receive feedback about the total amount contributed to the public good by both partners, and their payoff in this round. The individual payoff $\pi_i$ is:

$$\pi_i^t = (y_i^t - g_i^t) + a \sum_i^n g_i^t \text{ with } n = 2, a = 0.8 \text{ where } a < 1 \text{ and } na > 1 \tag{1}$$

whereby ${y_i}^t$ is the endowment in each round, ${g_i}^t$ is the amount contributed to the public good by subject $i$ and $\sum_i^n g_i^t$ is the sum of contributions of the two partners. Following the backward induction rationale, zero contribution is a dominant strategy in this finite game, whereas the socially efficient outcome is achieved when both partners contribute their entire endowment. While the parameters of the public good games are constant for all treatments (see the instructions in the Appendix), partner rematching mechanisms and information provided at the end of each sequence vary between treatments.

### 3.2 Endogenous partner selection treatments

For both endogenous partner selection treatments subjects receive a fixed amount of 100 ECU that can be used for partner selection. Each ECU that is not invested in partner selection is added to the payoff. Applying again the backward induction rationale, a contribution $g_i$ of zero and hence no investment in the partner selection mechanism is the only strategy that survives repeated elimination of dominated strategies. However, by employing partner selection we want to explore individuals' evaluation of the opportunity to choose a partner instead of being randomly paired.

#### 3.2.1 Unidirectional partner selection

In the treatment with unidirectional partner selection subjects can use their endowment of 100 ECU for bidding in a two-stage second-price-auction for the right to choose their preferred partner (see Appendix A.4).

At the end of a sequence of public good games, i.e. after five rounds, subjects receive information about each group member's past contributions to the public good and the matching of the respective pairs. Then, subjects are first asked to submit a ranking of the other five group members according to their preference of being paired. Afterwards, they can bid any amount between 0 and 100 ECU on the right to choose their partner for the next sequence of public good games.

The winner, who bids the highest amount, pays a price corresponding to the second highest bid and is entitled to choose anyone of the other five group members. Once the first pair is determined, a second stage with the same auction mechanism as the first one follows, including only the four remaining group members. Their identification codes and matching is again displayed as well as the past contributions. The winner of the second auction paying the second highest bid of this auction chooses then one of the three available subjects as partner and the last pair is thus residually determined.

Bids that do not win are not deducted from the subjects' final earnings. In case of ties in the winning bid, the winner is randomly chosen among those involved, whereas in case of no positive bid the partner rematching is done randomly, which is eventually announced to the subjects. Before starting the next sequence, the ID of the new partner is displayed to subjects.

### 3.2.2 Bidirectional partner selection

Like in the unidirectional treatment, information on past contributions and the matching of group members is publicized after each sequence. Then, each subject is asked to allocate their endowment according to their willingness to find a new partner (see Appendix A.5). Subjects can either keep the whole amount of 100 ECU adding to their payoff or can allocate positive amounts to one or more of the group members. Assigned amounts are only deducted from the endowment but not added to any person's payoff.

Once everyone has decided on allocating amounts the computer rematches subjects into pairs according to the maximizing auctioneer's revenue principle using the following algorithm: For each possible combination of pairs within the group of six mutual assignments of points are calculated and summed up. Subsequently, the specific combination of pairs that maximizes the sum of mutual assignments is selected for implementation. The simplified example of Table 1 with four group members A, B C and D might clarify the procedure.

Entries of Table 1 are amounts of ECU allocated by a subject to each other subject. In the example, subject A allocates 10 to B, 5 to C, and 10 to D; subject B allocates 20 to A, 8 to C and 7 to D; and so on. With four group members, three combinations of pairs exist: (i) A with B and C with D, (ii) A with C and B with D,

Table 1: Simplified example of point assignments in the bidirectional partner selection treatment with four subjects

| ID/allocates to | A | B | C | D |
|---|---|---|---|---|
| A | – | 10 | 5 | 10 |
| B | 20 | – | 8 | 7 |
| C | 0 | 6 | – | 1 |
| D | 0 | 3 | 7 | – |

or (iii) A with D and B with C. In the example above, the first combination yields a sum of mutual assignments amounting to 38, i.e. A allocates 10 to B, B allocates 20 to A, which sums up to 30; C allocates 1 to D, D allocates to 7 C, which sums up to 8, yielding 38 as the total sum of mutual assignments. The second combination yields a total sum of 15 and the third a sum of 24, rendering the first combination of pairs as the one implemented since it yields the maximum achievable revenue. This mechanism can easily be extended to six subjects as in our design. Mutual agreement is granted when two subjects allocate the entire available amount to each other; as in this case they will end up together for sure.[3] Assigning positive amounts to more than one group member enables subjects to express their preference in case of indifference between participants or to state their ranking of group members.

If nobody allocates a positive amount or if everyone allocates the same amount to everyone else random matching is announced and employed. Before entering the next sequence, subjects learn the ID of their new partner.

### 3.3 Random partner rematching treatment

In the first control treatment participants are randomly rematched into pairs (see Appendix A.2). However, the information about group members received at the end of each sequence is the same as in the two experimental treatments, i.e. past contributions of each group member as well as matching of group members. The timing of this information screen is self-paced, i.e., the subjects can decide when to exit the screen pressing a button. Once all group members have exited the information screen 180 seconds pass before the next sequence starts. This period of time, called cooling off period, has been introduced in order to induce a similar time interval between each sequence of the experiment as in the treatments with partner selection. Before entering the new sequence, the ID of the new partner is displayed.

3 For that reason, it is necessary to provide a fixed amount of extra endowment to everyone.

### 3.4 Random partner rematching treatment without history

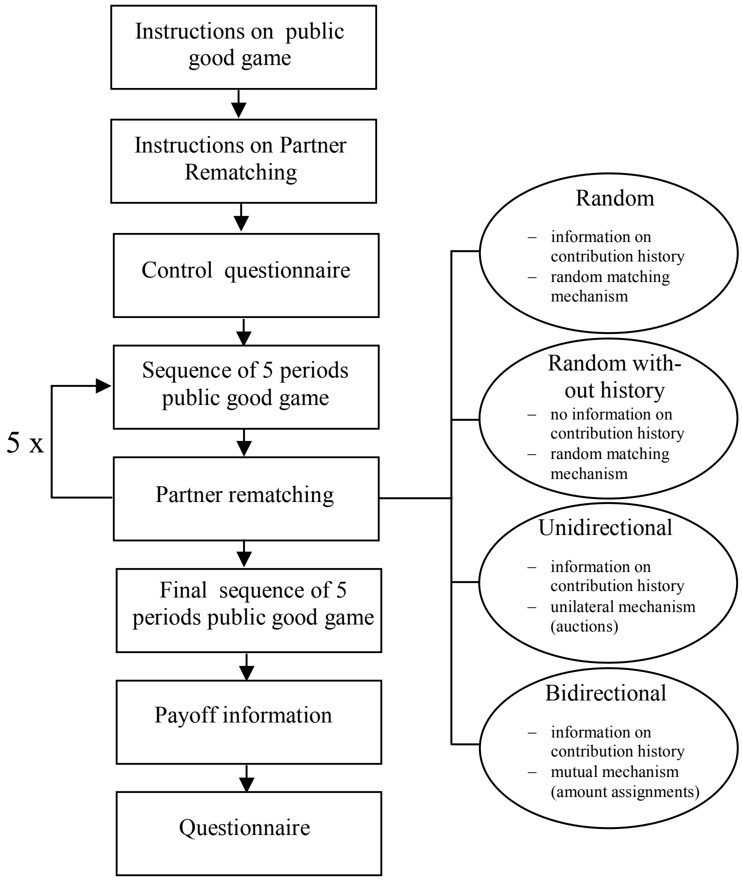
The second control treatment is identical to the first one with one major exception: At the end of each sequence, information on past contributions of group members is not provided (see Appendix A.3), still the matching of subjects is revealed. In this treatment, general reputation effects by disclosing contribution histories of group members can not affect behavior. By comparing the two control treatments, we are able to tell if these general reputation effects are already a major source of increasing cooperation and – in case of no difference in the results between the random partner rematching treatment and the experimental treatments – might even be more important than introducing partner selection. However, albeit foreclosing results, this speculation can not be confirmed.

### 3.5 Experimental procedure

In total, 144 students from various disciplines at the Friedrich Schiller University Jena volunteered to participate, the 59 males and 85 females aging from 18 to 50 ($M = 23.35, SD = 3.71$). Subjects were invited to take part in a decision experiment via a mailing list or personal recruitment at the campus. The experiment was computerized using z-tree (Fischbacher 1999) in the experimental laboratory of the Max Planck Institute for Research into Economic Systems and took 6 sessions with 24 subjects each. Each session lasted for about 70 minutes, and average earnings amounted to € 14.9 ($SD = 2.3$) including a show-up fee of € 2.50.

Figure 1 displays the sequence of events in the experiment. After reading the instructions and answering control questions, which were checked privately by the experimenters, subjects in all treatments started with the first sequence of five rounds public good games in randomly matched pairs. Afterwards, the respective rematching procedure (random or endogenous) was applied, subsequent to receiving information on the matching of pairs (in all treatments) and either learning the contribution history of group members (random rematching, unidirectional selection, bidirectional selection) or not (random rematching without history). At the beginning of the next sequence of public good games, subjects had to confirm to have read the identification code of their new partner on screen. The procedure of partner rematching was repeated five times, concluding with a final sequence of the public good games. After completing a short socioeconomic questionnaire, subjects were paid privately.

Figure 1: Sequence of events in the experiment




## 4 Results

This section starts with some descriptive results and subsequently tests for differences between endogenous and random partner rematching on the aggregate, with respect to efficiency increases due to endogenous rematching mechanisms as well as qualitative differences in contribution behavior. Finally, evidence on the monetary effort for partner selection as well as on patterns of individual behavior is presented.

### 4.1 Contribution behavior

*Comparison of partner selection and random partner rematching*
Figure 2 displays the average contribution over time to the public good for both experimental treatments (unidirectional and bidirectional) and the two control treatments (random rematching and random rematching without history). A Kruskal-

Figure 2: Average contribution to the public good over time


Wallis test rejects the hypothesis of equivalence between the mean contributions over time for the four treatments ($\chi^2_{df=3} = 35.58, p < 0.01$).

Comparing the two control treatments we cannot reject the hypothesis of equivalence of sample means ($M_R = 16.79, SD_R = 4.27, M_{RwH} = 17.55, SD_{RwH} = 3.23$, Mann-Whitney U- test:[4] $z = 0.16, p = .94$). Furthermore, Figure 3 reveals no substantial difference between the two patterns of contributions at any time during the experiment, indicating that the reputational effect of publicizing contribution histories only plays a minor role.

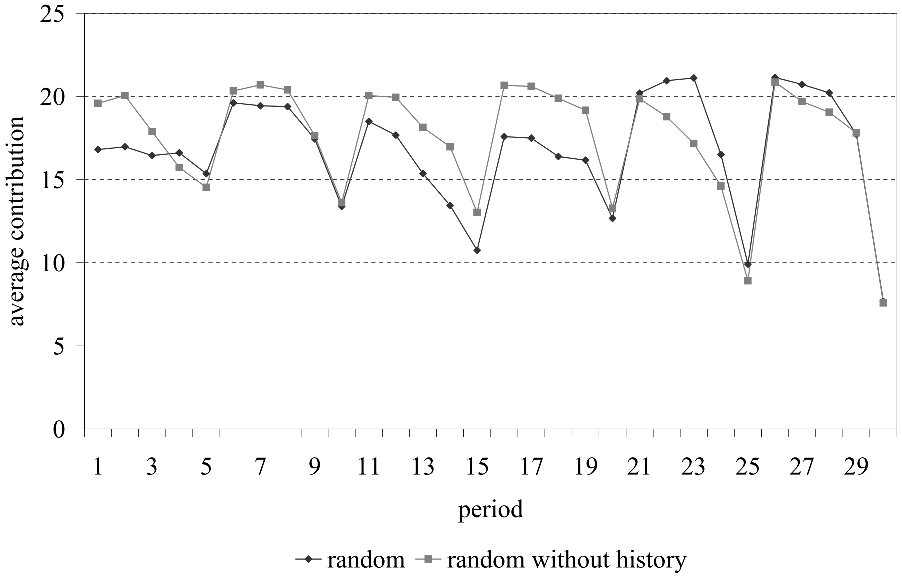
Result 1 *Voluntary contribution to the public good is not affected by revealing individual contribution histories.*

To answer the question whether the freedom to choose a partner significantly increases inclination to contribute to a public good, we start by testing the differences between the endogenous selection treatments and the random partner rematching treatment.[5]

4 For all subsequent tests, we consider six independent observations, one for each group of six participants, for each treatment.

5 We compare behavior to the first control treatment, since it equals the experimental treatments, except for random determination of partners. As we cannot reject the hypothesis of equivalence of the two control treatments, we do not expect differing results when comparing the endogenous

Figure 3: Average contribution over time in treatments random partner rematching and random partner rematching without history




On average, subjects facing bidirectional selection invest 67% of their endowment in the public good whereas participants in the unidirectional selection contribute 85%. Taking into account average contributions throughout all six sequences of public good games, we cannot reject the null hypothesis of equivalence between random partner rematching and unidirectional partner selection (Mann-Whitney U-test: $z = 1.44, p = .18$) and bidirectional partner selection, respectively ($z = 0.80, p = .49$). However, Figure 2 indicates higher cooperation in the unidirectional than in the random partner rematching treatment only in sequence two to five. It might well be that in the first sequence, where pairs are randomly formed and in the very last one, where the game has almost ended, the opportunity of partner selection does not play a role. Indeed, considering only these four sequences, the results are in favor of an efficiency increase with unidirectional partner selection ($M_R = 16.70, SD_R = 4.78, M_{UD} = 21.20, SD_{UD} = 2.68$, Mann-Whitney U-test: $z = 1.92, p = .06$) though not entirely affirmative on a five percent margin of error.

Still, if unidirectional partner selection is indeed a successful instrument to foster cooperation, one should expect higher average contributions of the two pairs that were voluntarily formed as opposed to the remaining pair that was residually

regrouping mechanisms with the random partner rematching without history. This intuition is confirmed by applying all tests as well to the second control treatment.

Table 2: Average contributions of pairs in the unidirectional treatment

| Sequence | Pair 1 | Pair 2 | Pair 3 |
|---|---|---|---|
| 1 | 14.9 | 14.9 | 16.0 |
| | *Endogenously formed* | | *Residual* |
| 2 | 23.7 | 20.6 | 18.5 |
| 3 | 20.3 | 23.3 | 19.2 |
| 4 | 22.6 | 21.9 | 20.0 |
| 5 | 24.5 | 23.1 | 16.6 |
| 6 | 22.2 | 21.9 | 10.9 |
| Total | 22.7 | 22.2 | 17.0 |

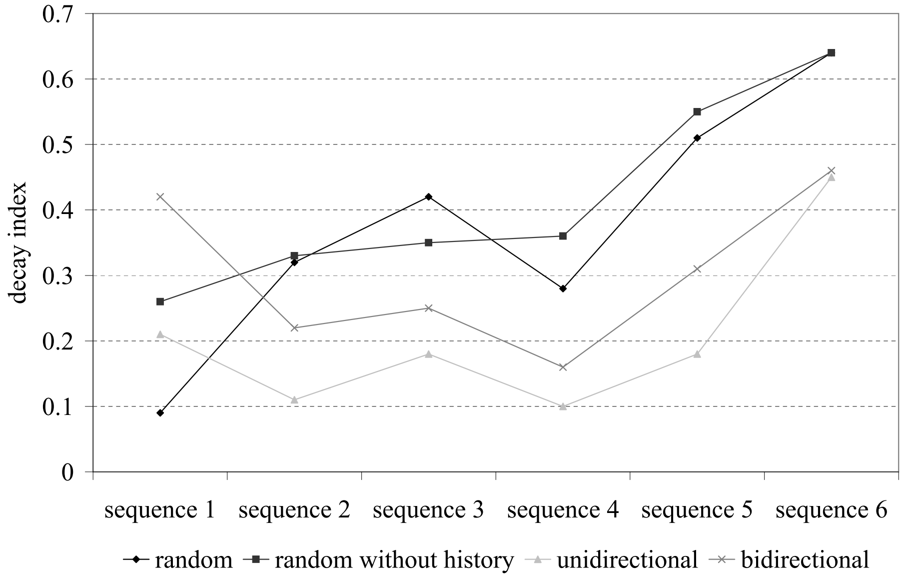
determined. Table 2 provides an overview of average contributions of each pair in total and for each sequence separately. In sequence one, where group members were randomly matched into pairs, contributions are roughly equal among pairs. Throughout sequences, the difference in contributions between the endogenously formed pairs and the remaining pair turns out significant (Friedman Test, $\chi^2_{df=2} = 11.92, p < .01$), supporting the effectiveness of unidirectional partner selection in increasing cooperation.

Result 2 *Unidirectional partner selection considerably improves cooperation as compared to random partner rematching.*

In addition to quantitative data analysis it is important to consider qualitative effects, especially the time trend of behavior. The usual pattern of decreasing contributions is also evident in our experiment. Figure 4 plots decay indices, calculated for each treatment by the ratio of the difference between the contribution in the first and the last round to the contribution in the first round, which illustrates the percentage decrease of contributions throughout each sequence. After the second sequence, contributions in the endogenous partner matching treatments decrease less dramatically ($M_E = 0.25, SD_E = 0.13$) than in the two controls ($M_R = 0.40, SD_R = 0.16$) with random rematching (Mann-Whitney U-test: $z = 2.17, p = .03$). This evidence implies the presence of a structural difference induced by the endogenous selection procedures: cooperation in both partner selection treatments is more stable than in the control treatments. Figure 4 also illustrates the "end game effect", indicating the dramatic reduction of contributions to the public good in the last sequence of all treatments.

Result 3 *Cooperation in the treatments with partner selection is more stable over*

Figure 4: Decay index in each sequence by treatment

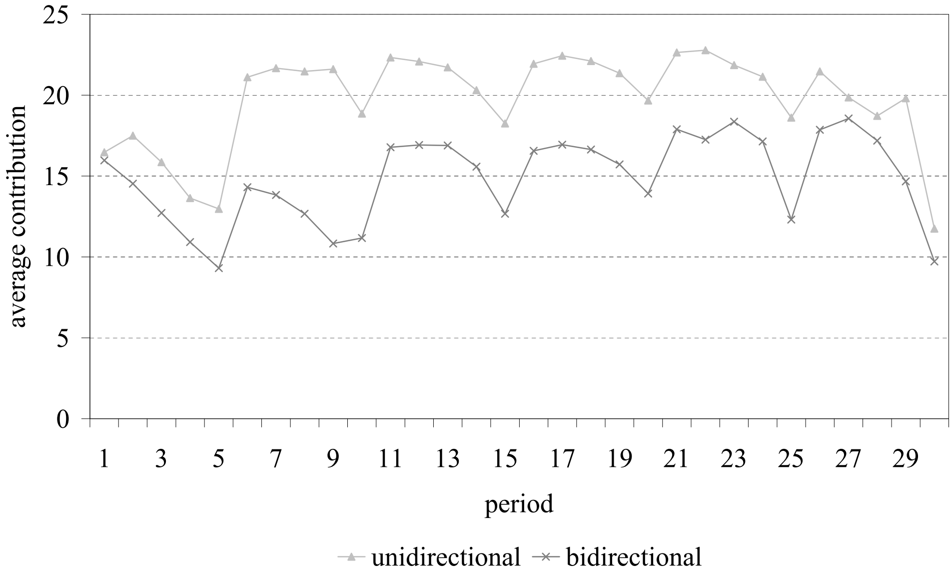



*time than in the treatments with random partner rematching.*

*Comparison of partner selection mechanisms*
In order to investigate whether cooperation is sensitive to the specific partner selection mechanism we compare behavior in the unidirectional and bidirectional treatment and find significantly higher average contributions (Mann-Whitney U-test: $z = 2.08, p = 0.04$) in the unidirectional selection treatment ($M_{UD} = 19.73, SD_{UD} = 2.23$) compared to the bidirectional selection treatment ($M_{BD} = 14.86, SD_{BD} = 4.01$). Overall, the average contribution to the public good in the unidirectional treatment corresponds to 79%, whereas in the bidirectional treatment it amounts to 59% of the endowment. As Figure 5 illustrates, contributions are significantly lower in the bidirectional treatment throughout time.

RESULT 4 *The efficacy of partner selection in improving cooperation is sensitive to the mechanism employed. Voluntary contributions are higher when partners are unidirectionally rather than bidirectionally selected.*

Figure 5: Average contribution over time in the unidirectional and the bidirectional partner selection treatment




### 4.2 Monetary effort for partner selection

*Descriptive evidence*

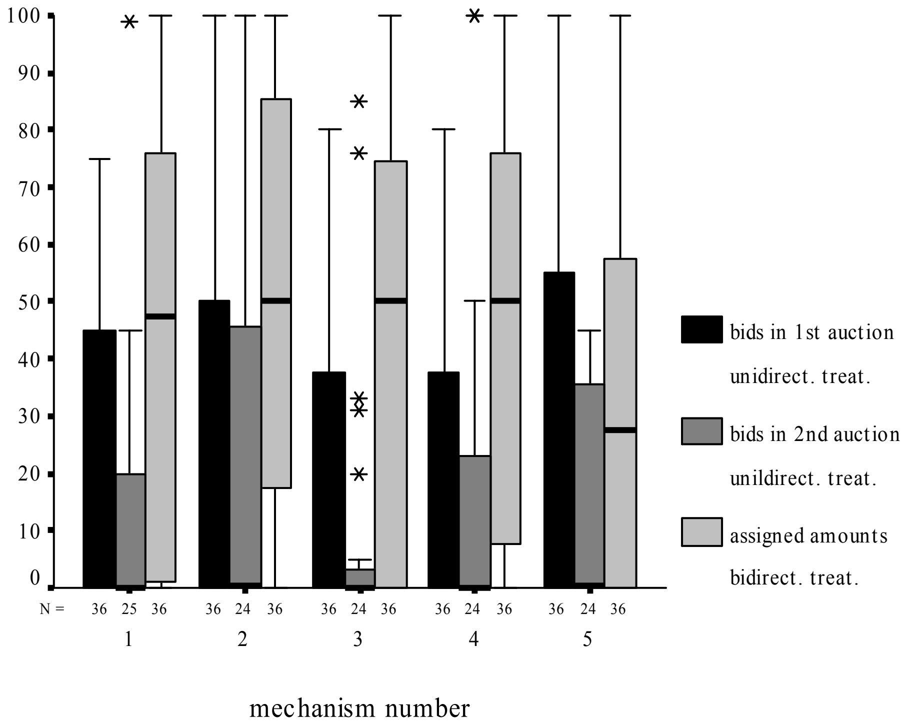
The boxplots of Figure 6 give a first impression of the distribution of bids in the first and second auction for each unidirectional mechanism and of amounts assigned for each bidirectional mechanism. Monetary effort for partner selection is dispersed over the entire possible range from 0 to 100 and skewed to the ends of the interval, implying that medians and quartile distances[6] are rather suitable measures of describing data.

Table 3 displays the 95%–confidence intervals around the median for the average bids in the first and second auctions of the unidirectional treatment and for the amount assignments in the bidirectional treatment. If 0 is not within the lower boundary of the interval we can infer that average bids are significantly greater than zero and thus reflect substantial monetary effort subjective evaluation of influencing pair constitution.

In the unidirectional treatment, the median first bid amounted to 17.5 ($QD = 37.6$) and the median second bid to 10 ($QD = 23.1$). Table 3 leads to the conclusion that bids in the unidirectional treatment are on average significantly higher than

6 Quartile distances are calculated as the difference of the third and second quartile.

Figure 6: Boxplots of first and second bids in the unidirectional and assigned points in the bidirectional treatment over time




zero, providing counterevidence to the theoretical Nash prediction of zero bidding. Regarding time patterns, a Friedman test reveals that neither first ($\chi^2_{df=4} = 2.89, p = .58$) nor second bids ($\chi^2_{df=4} = 0.81, p = .94$) decline significantly over time.[7] However, bids in the second auction are noticeably lower than in the first auction.

The fraction of zero bids in the first and second auction (13.9% and 21.2%, respectively, on average) is opposed to a considerable fraction of average bids equal or higher than 50 (19.6% and 14%, respectively). In total, five subjects out of 36 never bid a positive amount in any auction. Random matching within one's group due to equal bids occurred one time in the first auctions and three times in the second auctions.

Result 5 *Subjects' bids for choosing a partner in the unidirectional treatment are on average significantly greater than zero.*

Comparing actual partner selection by auction winners with the rankings of

7 Even with pairwise comparisons (Wilcoxon signed rank tests) of average bids throughout mechanisms no difference can be found.

Table 3: Confidence intervals for the average monetary effort for partner selection in the unidirectional and bidirectional treatment

| Treatment | | Median | $Q_{0.25}$ | $Q_{0.75}$ | 95% confidence interval |
|---|---|---|---|---|---|
| Unidirectional | $1^{st}$ Auction | 17.5 | 1.3 | 38.9 | [10;31] |
| | $2^{nd}$ Auction | 10 | 0.4 | 23.5 | [1;51] |
| Bidirectional | | 49 | 16.5 | 65.6 | [30;60] |

group members, the overwhelming majority of subjects (45 out of 55) acted consistent with respect to the preferences they submit earlier, i.e. they chose the highest ranked group member that was still available.

In the bidirectional partner selection treatment the median total amount assigned was 49 ($QD = 49.1$), which is significantly positive according to a 95% confidence interval. Subjects spend considerable amounts of money to avoid random rematching, which is - similar to the unidirectional treatment - contradictory to the standard Nash solution. Only three of the 36 subjects were never willing to assign amounts to preferred partners, whereas 17 subjects spent on average more than half of their endowment. Over time, average amount assignments remain fairly constant (Friedman-Test, $\chi^2_{df=4} = 5.15, p = .27$). On total average, 25% did not assign amounts to any group member, 41.1% of the subjects stated one group member as preferred partner, 7.2%, 6.1% and 5.6% of subjects seized the opportunity to assign amounts to two, three and four group members, respectively, and 11.1% assigned amounts to each group member, thereby providing a full ranking.

By relating the bids in the first auctions of the unidirectional treatment to the amounts assigned for endogenous rematching in the bidirectional treatment, it becomes evident that subjective eagerness to shape the future partnership is significantly higher in the latter one (Mann Whitney U-test: $z = 2.47, p = .01$).

Result 6 *Subjects' monetary effort for shaping the future partnership is higher in the bidirectional than in the unidirectional selection treatment.*

To understand potential benefits from selecting a partner rather than being randomly assigned, one has to consider the expected excess gains from two-sided cooperation over two-sided defection.[8] In the former case, subjects earn 200 ECU per sequence, in the latter case the expected income amounts to 125 ECU, i.e. the

8 The worst case, i.e. a cooperator being repeatedly exploited by a full free-rider, is not reasonable to consider, since this situation can easily be avoided.

endowment accumulated over the five periods.[9] The difference of 75 ECU is a sensible measure of potential gains by actively engaging in partner selection. Even when deviating from the strict rationale of dominant strategies, expenditures should not exceed 75 ECU. Remarkably, 10.6% of bids in the first auctions, 10.3% of bids in the second auction in the unidirectional treatment and 25% of point assignments in the bidirectional treatment exceed this value.

*Relating monetary effort for partner selection to contribution behavior*
Figures 7 and 8 relate the relative average contribution to the public good for each group to the behavior in the partner selection. Figure 7 shows that in the unidirectional treatment, the group with the highest contribution to the public good, i.e. group 3, nearly never engages in partner selection by bidding in the auctions. Conversely, contributions in the high bidding groups are on average lower. A Spearman correlation confirms the negative relation between contributions and bidding behavior in the unidirectional treatment as significant ($\rho = -0.94, p < .01$). In the bidirectional treatment, however, the relation between amounts assigned for partner selection and average group contributions to the public good is positive, yet not significant (Spearman's $\rho = .43, p = .39$), as illustrated by Figure 8.

Result 7 *In the unidirectional partner selection treatment, low cooperative groups submit on average higher bids than highly cooperative groups, whereas in the bidirectional partner selection treatment no systematic relation can be observed.*

### 4.3 Behavior on the individual level

*Reciprocal behavior*
To investigate whether subjects base their contributions on past behavior of their interaction partner a Panel Tobit regression with past own and partner's contribution to the lag one and their interaction as explanatory variables is run. Table 4 shows that reciprocal behavior is present in at least three of the four treatments as the coefficient for lagged partner contribution is significant for the random partner rematching treatment and the unidirectional and bidirectional partner selection treatments. Thus, participants adjust their own contribution positively to the experienced contribution of their partner in the previous round; they increase their

9 We assume that in order to avoid being exploited subjects would invest everything in the private account.

Figure 7: Relative average contribution (left part) per sequence and average bids per unidirectional mechanism (right part) in groups

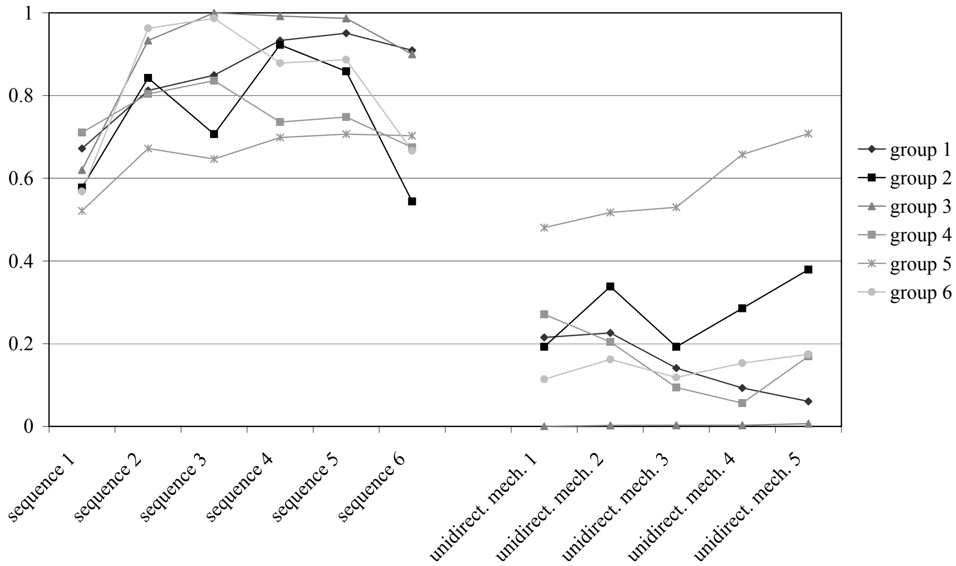



Figure 8: Relative average contribution (left part) per sequence and average amounts assigned per bidirectional mechanism (right part) in groups

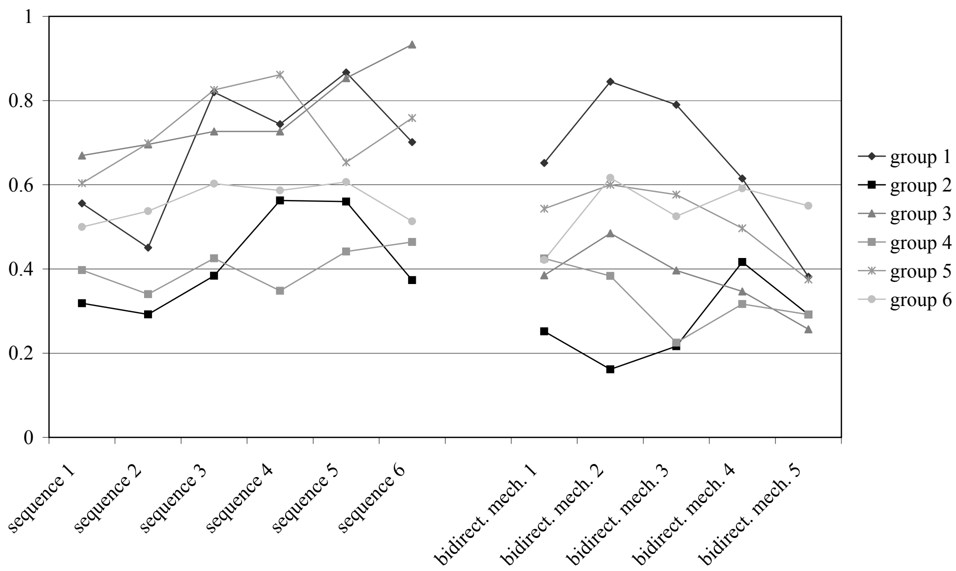


Table 4: Tobit regression on contributions

| Dependent variable: individual contribution<br>Method: Panel Tobit regression $g_i^t \in [0;25]$ with individual random effects | | | | |
|---|---|---|---|---|
| Variable | Random | Random without history | Unidirectional | Bidirectional |
| Constant | 1.91 (0.850)$^\star$ | 5.31 (1.14)$^{\star\star}$ | 2.84 (1.01)$^{\star\star}$ | 2.79 (0.72)$^{\star\star}$ |
| Lagged partner contribution $g_j^{t-1}$ | 0.26 (0.06)$^{\star\star}$ | 0.07 (0.07) | 0.28 (0.06)$^{\star\star}$ | 0.22 (0.05)$^{\star\star}$ |
| Lagged own contribution $g_i^{t-1}$ | 0.32 (0.06)$^{\star\star}$ | 0.07 (0.07)$^{\star\star}$ | 0.32 (0.06)$^{\star\star}$ | 0.30 (0.05)$^{\star\star}$ |
| Interaction $g_j^{t-1} * g_i^{t-1}$ | 0.01 (0.003)$^{\star\star}$ | 0.02 (0.003) | 0.01 (0.003)$^{\star\star}$ | 0.01 (0.002)$^{\star\star}$ |
| Log likelihood | -2848.52 | -2826.7 | -2690.97 | -2742.39 |
| Wald $chi^2(3)$ | 708.69 | 531.27 | 741.88 | 760.18 |
| p $> \chi^2$ | $< 0.0001$ | $< 0.0001$ | $< 0.0001$ | $< 0.0001$ |

Note: $^\star$ denotes significance at the 5% level, and $^{\star\star}$ denotes significance at the 1% level.
Standard errors in parantheses.

contribution if their partner contribution is high and decrease it when it was low. Additionally, we find that the own contribution in the past round as well as its interaction with the past partner contribution is crucial for current behavior.

Result 8 *Reciprocal behavior is prominent especially in the random partner rematching and the two endogenous partner selection mechanisms.*

*Patterns of individual behavior for all treatments*
Considering individual contributions to the public good 1080 data points for each treatment (contributions of 36 participants in 30 periods) are available. Based on this large number of observations, roughly three clusters of behavior can be identified: free-riding, characterized by a contribution in the range of 0 to 9,[10] cooperation, defined by investing the whole endowment of 25 to the public good and the remaining category in the middle range, that subsumes contributions from 10 to 24. Table 5 summarizes relative frequencies of these behavioral categories overall in the experiment, but separately for the four treatments. According to a $\chi^2$–test on absolute

10 Since observations of free-riders in the strict sense, i.e. contributions of only zero; are barely found in the two endogenous partner selection treatments, we extend the strict definition of free-riding behavior to an interval of an average contribution below 10 ECU.

Table 5: Categories of individual behavior in the four treatments

| Treatment | Free riding ($0 \leq g_i < 10$) | Cooperation ($g_i = 25$) | Middle range ($10 \leq g_i < 25$) |
|---|---|---|---|
| Random | 23.6% | 46.3% | 30.1% |
| Random without history | 16.6% | 46.1% | 37.2% |
| Unidirectional | 12.8% | 53.2% | 34.0% |
| Bidirectional | 25.8% | 33.0% | 41.2% |

frequencies one can reject the hypothesis of equal distribution of behavioral categories among the four treatments ($\chi^2_{df=6} = 129.13, p < .01$).

Especially in the unidirectional treatment a high fraction of cooperative behavior is observed which supports the evidence that unidirectional partner selection improves the voluntary contribution to public goods. Considering only the last rounds of each public good sequence even strengthens this finding: while free-riding noticeably outweighs cooperative behavior in the random rematching and the random rematching without history treatments(47.2% to 30.6% and 41.7% to 30.6%, respectively) as well as in the bidirectional partner selection treatment (43.5% to 25.4%), in unidirectional selection treatment cooperation is the modal behavior (43.5%) followed by free-riding (25.0%).

RESULT 9 *In the unidirectional treatment, full cooperation is the modal behavior overall and particularly in the final periods of the sequences and thus clearly dominates free-riding.*

*Classification of pairs in the partner selection treatments*

The identification of behavioral categories in the public good games introduced earlier allows investigating the activities of these different types in the partner selection mechanisms. Tables 6 and 7 provide an overview of bids and amount assignments of different types of individuals. In the unidirectional treatment, cooperators tend to submit lower first bids than free-riders especially in later sequences, indicating that their subjective valuation of selecting a partner is low. However, due to the little number of observations Kruskal-Wallis-tests on equivalence of bids among all three types does not confirm any significant differences.

Remarkably, the pattern is reversed in the bidirectional selection mechanism: later in the experiment, cooperators spend, on average, more money on partner selection than free-riders; however, due to the little number of observations the difference can only be confirmed as significant for the third and fourth partner selection

Table 6: Median first bids for classes of contribution behavior in each sequence in the unidirectional treatment

| | Free riders | | Cooperators | | Middle range contributors | | Kruskal Wallis test | |
|---|---|---|---|---|---|---|---|---|
| Sequence | n | Median bid | n | Median bid | n | Median bid | $\chi^2_{df=2}$ | p |
| 1 | 4 | 20 | 5 | 47.6 | 27 | 20 | 4.28 | .12 |
| 2 | 1 | 45 | 12 | 28 | 23 | 10 | 0.47 | .79 |
| 3 | 1 | 50 | 15 | 21 | 20 | 27.5 | 3.3 | .19 |
| 4 | 2 | 49.5 | 16 | 0.5 | 18 | 8 | 0.12 | .94 |
| 5 | 2 | 70.5 | 16 | 0.5 | 18 | 23 | 3.68 | .16 |
| 6 | 7 | – | 12 | – | 17 | – | – | – |

Table 7: Median amount assignments for classes of contribution behavior in each sequence in the bidirectional treatment

| | Free riders | | Cooperators | | Middle range contributors | | Kruskal Wallis test | |
|---|---|---|---|---|---|---|---|---|
| Sequence | n | Median bid | n | Median bid | n | Median bid | $\chi^2_{df=2}$ | p |
| 1 | 13 | 23 | 3 | 30 | 20 | 61 | 3.6 | .17 |
| 2 | 14 | 40 | 3 | 20 | 19 | 71 | 2.42 | .30 |
| 3 | 6 | 0 | 8 | 62.5 | 22 | 50 | 6.35 | .04⋆ |
| 4 | 10 | 0 | 9 | 60 | 17 | 50 | 7.98 | .02⋆ |
| 5 | 8 | 20 | 11 | 50 | 17 | 15 | 2.67 | .27 |
| 6 | 8 | – | 9 | – | 19 | – | – | – |

Note: ⋆ denotes significance at the 5 % level.

mechanism as seen in Table 7.

*Pair formation by types*

To gain a deeper understanding of the dynamics during the partner selection mechanisms, the following analysis is devoted to investigating pair formation. Relying on the previous classification of individual behavior, Tables 8 and 9 display the constitutions of pairs by different types for the unidirectional and the bidirectional treatment, respectively.[11]

Cooperators and free riders were hardly ever matched as partners in both treatments. However, as the general distribution of types is not equal among treatments,

11 The classification of pairs at the time of the partner selection mechanisms is done according to subjects' behavior in the previous sequences, as only past behavior can be the basis for partner selection at the beginning of each sequence. Additionally, classification of behavior in sequence one, where pairs were randomly formed and in sequence six after the last partner selection, is displayed in the ninth and tenth column, respectively.

Table 8: Frequencies of pair classifications at each stage of partner selection in the unidirectional treatment

| Player | | Sum of the five mechanisms | Mechanism number $1^{st}$ | $2^{nd}$ | $3^{rd}$ | $4^{th}$ | $5^{th}$ | Sequence 1 | Sequence 6 |
|---|---|---|---|---|---|---|---|---|---|
| c | c | 17 (18.9%) | 1 | 2 | 6 | 5 | 3 | 2 | 3 |
| c | m | 25 (27.8%) | 2 | 7 | 3 | 4 | 9 | 1 | 6 |
| c | f | 5 (5.6%) | 1 | 1 | 0 | 2 | 1 | 0 | 0 |
| m | m | 39 (43.3%) | 12 | 8 | 8 | 7 | 4 | 12 | 5 |
| m | f | 3 (3.3%) | 1 | 0 | 1 | 0 | 1 | 2 | 1 |
| f | f | 1 (1.1%) | 1 | 0 | 0 | 0 | 0 | 1 | 3 |
| Total sum | | 90 (100%) | 18 | 18 | 18 | 18 | 18 | 18 | 18 |

Note: c denotes cooperator, m represents middle range contributor and f denotes free-rider.

Table 9: Frequencies of pair classifications at each stage of partner selection in the bidirectional treatment

| Player | | Sum of the five mechanisms | Mechanism number $1^{st}$ | $2^{nd}$ | $3^{rd}$ | $4^{th}$ | $5^{th}$ | Sequence 1 | Sequence 6 |
|---|---|---|---|---|---|---|---|---|---|
| c | c | 11 (12.2%) | 0 | 1 | 3 | 3 | 4 | 0 | 4 |
| c | m | 11 (12.2%) | 3 | 0 | 2 | 3 | 3 | 3 | 1 |
| c | f | 1 (1.1%) | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| m | m | 31 (34.4%) | 7 | 6 | 8 | 5 | 5 | 6 | 8 |
| m | f | 22 (24.4%) | 3 | 7 | 4 | 4 | 4 | 5 | 2 |
| f | f | 14 (15.6%) | 5 | 3 | 1 | 3 | 2 | 4 | 3 |
| Total sum | | 90 (100%) | 18 | 18 | 18 | 18 | 18 | 18 | 18 |

Note: c denotes cooperator, m represents middle range contributor and f denotes free-rider.

it is difficult to draw conclusions merely based on pair constitutions. Thus, it is interesting to investigate how types of individuals decided in the mechanism based on the information they received, i.e. their own and potential partners' contribution history.

Data for the unidirectional treatment are mainly restricted to the actual formation of pairs. In 16 of the 17 cases where two cooperators formed a pair in any of the mechanisms, one of them won the auction and deliberately chose the other cooperator, whereas only one time two cooperators were matched together as the residual pair. In 15 out of the 25 cases, in which a middle range contributor and a cooperator end up together, the middle range contributor was the winner of the auction, whereas only one time it was reversed. The remaining nine pairs of this category were matched together as remaining players in the group. Three out of the five pairs consisting of a cooperator and a free-rider emerged because the latter won the auction and chose the cooperator. Remarkably, in one of the remaining cases a cooperator selected a free-rider as partner, who became a cooperator thereafter,

Table 10: Frequencies of intentions to be paired with a particular type in each bidirectional mechanism

| Type | | Mechanism number | | | | | |
|---|---|---|---|---|---|---|---|
| Own | Preferred Subject | $1^{st}$ | $2^{nd}$ | $3^{rd}$ | $4^{th}$ | $5^{th}$ | Total |
| c | c | 1 | 2 | 5 | 8 | 9 | 25 |
| c | m | 1 | 1 | 2 | 1 | 0 | 5 |
| c | f | 0 | 0 | 0 | 0 | 0 | 0 |
| m | c | 4 | 4 | 6 | 7 | 5 | 26 |
| m | m | 12 | 10 | 9 | 7 | 5 | 43 |
| m | f | 1 | 1 | 0 | 0 | 0 | 2 |
| d | c | 2 | 1 | 2 | 1 | 2 | 8 |
| d | m | 5 | 7 | 1 | 2 | 3 | 18 |
| d | f | 1 | 3 | 0 | 0 | 0 | 4 |
| c | - | 1 | 0 | 0 | 0 | 2 | 3 |
| m | - | 2 | 3 | 5 | 2 | 7 | 19 |
| f | - | 5 | 3 | 5 | 7 | 3 | 23 |
| c | indifferent | 0 | 0 | 0 | 0 | 0 | 0 |
| m | indifferent | 1 | 1 | 1 | 1 | 0 | 4 |
| f | indifferent | 0 | 0 | 0 | 0 | 0 | 0 |
| | sum | 36 | 36 | 36 | 36 | 36 | 180 |

Note: c denotes cooperator, m represents middle range contributor and f denotes free-rider.

whereas the last pair of this category was matched residually. The 39 pairs that consisted of two middle range contributors were nearly unexceptionally formed because only these types were available in the group or because of residual matching. The same holds true for the three pairs of middle range contributors and free-riders and the one pair consisting of two free-riders. In summary, evidence again strengthens the impression that in the unidirectional treatment lower contributors were more inclined to choose a cooperator as partner than cooperators were concerned to ensure interaction with an equal type.

In the bidirectional treatment, however, individual preferences with respect to all group members – as evident by ECU assignments – are available additional to actual pair formation. Therefore, by taking the highest ECU assignment as indicator for the most preferred group member, conclusions about the intentions of being paired with specific types can be drawn. Table 10 lists the own type in the first column and the type of the most preferred subject in the second columns for each sequence and displays absolute frequencies of these constellations for each mechanism. All possibilities are displayed including the decision to abstain from active partner selection and assigning equal amounts to all group members (indifferent).

Table 11: Proportion of cooperators and free-riders being indifferent to random matching in the unidirectional and bidirectional partner selection mechanisms

| | Unidirectional | | | | | | Bidirectional | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mechan. | Cooperators | | | Free riders | | | Cooperators | | | Free riders | | |
| nr. | N | n(0) | %(0) | N | n(0) | %(0) | N | n(0) | %(0) | N | n(0) | %(0) |
| 1 | 5 | 1 | 20% | 4 | 1 | 25% | 3 | 1 | 33.3% | 13 | 5 | 38.5% |
| 2 | 12 | 4 | 33.3% | 1 | 0 | 0% | 3 | 0 | 0% | 14 | 3 | 21.4% |
| 3 | 15 | 8 | 53.3% | 1 | 0 | 0% | 8 | 0 | 0% | 6 | 5 | 83.3% |
| 4 | 16 | 8 | 50% | 2 | 1 | 50% | 9 | 0 | 0% | 10 | 7 | 70% |
| 5 | 16 | 8 | 50% | 2 | 0 | 0% | 11 | 2 | 18.1% | 8 | 3 | 37.5% |

In summary, behavior of cooperators and free riders differs considerably among mechanisms. In the unidirectional treatment, high contributors rather bid low on average in contrast to low contributors, whereas in the bidirectional mechanisms, cooperators were willing to spend more money on shaping the future partnership than free-riders. Recalling the finding of Ehrhart and Keser (1999) that cooperators try to escape free-riders, while in turn, free-riders chase them, we find similar results in our experiment, even though differences among partner selection mechanisms are prominent: in the unidirectional treatment, cooperators are rather passive while free-riders try to chase them, whereas in the bidirectional treatment, cooperators are more active in avoiding free riders than the latter are in chasing them. To confirm this impression, we contrast the fraction of cooperators and free riders who do not engage in active partner selection in both experimental treatments. Table 11 displays the percentage of cooperators and free-riders who do submit a positive first bid[12] (in the unidirectional treatment) or do not assign a positive amount to any other group member (in the bidirectional treatment).

If the percentage of free-riders who abstains from bidding or assigning amounts is lower than the percentage of passive cooperators, free-riders are more occupied with "chasing" cooperators, than the latter are with fleeing away from them and looking for equal types. Although the low number of observations for both types renders this evidence fairly anecdotic, this particular pattern is especially reflected in the unidirectional treatment, confirming the previous findings that low contributing subjects are willing to spend more money on partner selection than cooperators. In

12 In the unidirectional treatment, only the first bids are considered in order to have a direct comparison to the bidirectional treatment, where the willingness to choose a partner is only elicited once during a mechanism.

the bidirectional treatment, free-riders are more passive in assigning amounts than cooperators, suggesting that cooperators are more engaged in affecting the partner rematching, and thus potentially “fleeing away” from free-riders.

## 5 Discussion

In his seminal paper Tiebout (1956) suggests “voting with one’s feed” to overcome the impracticality of a market solution to the provision of public goods. More precisely, individuals should be free to move to the communities that best satisfy their preferences for collective goods. Similarly, recent literature on reciprocal behavior suggests that grouping individuals by their cooperative disposition substantially increases overall efficiency in public good provision, since initial high contributors continue their cooperative behavior undisturbed by free-riders who, in turn, also maintain their attitude facing similar co-players. In real life, the common retreat from being exploited is to quit one’s membership in an abusive societal environment. The reason why social dilemmas are frequently well resolved in various fields of social interaction might be the possibility to choose whom to collaborate with. Examples are various: As a scientist, one chooses the co-authors in a project, people decide on the neighborhood to live in for many reasons, such as safety or social exchange with similar people, coaches of soccer teams buy future players, and even criminals choose their partners in crime.

To investigate how the opportunity to choose the interaction partner in a social dilemma situation affects cooperative behavior we employed a repeated two-person public good game where players could spend amounts on being paired with their desired partner of their group of six. As illustrated by the examples of everyday life stated previously, the choice to join a group can but need not necessarily rely on mutual agreement. Thus, the infinite number of possible mechanisms how to endogenously form partnerships can at least be divided in two broad categories of unidirectional selection, meaning one partner chooses the other without her explicit agreement, or bidirectional selection, where individuals need to have some degree of mutual appreciation to collaborate. In our study, we compared unidirectional and bidirectional partner selection in a public good game to a control treatment with random partner rematching and elicited subjects’ monetary valuation of choosing their partners.

We find that unidirectional partner selection considerably fosters cooperation and overall efficiency and attenuates the usual decline of cooperation over time.

For bidirectional partner selection we cannot confirm higher average cooperation compared to randomly matched pairs, yet the usual decline of contributions over time is as well alleviated. Controlling for the presumably aggrandizing effect of publishing contribution histories of individuals on cooperation rates, we can conclude that this reputation effect among group members does not play a major role.

Individuals are on average willing to spend significant amounts to avoid random partner matching, whereby the average monetary effort is higher in the bidirectional treatment. Surprisingly, the evaluation of choosing a partner is not decreasing over time, even though cooperation is substantially high in the unidirectional selection treatment and at least stable on a lower level in the bidirectional selection treatment. Both mechanisms differ in how heterogeneous types of contributors behave during partner selection. In the unidirectional treatment cooperators engage only little in bidding in later sequences, while free-riders pursue active partner selection by submitting higher bids. Conversely, in the bidirectional partner selection treatment cooperators are assigning higher amounts to affect partner rematching than free-riders. Therefore, it is important to note that both the efficacy of partner selection and the specific reaction of individuals with distinct cooperative dispositions are thus sensitive to the matching method.

In general, the opportunity to choose interaction partners seems to be one solution to the problem of the efficient private provision of collective goods, as it is a natural way to punish free-riders by turning one's back on them. Even when costs of choosing partners are endogenous, constituting a realistic aspect in our view, individuals are willing to give up substantial parts of their income to determine their future partnership.

Still, it has to be clarified, why the two mechanisms of partner selection trigger diverse results in terms of efficiency increases as well as in terms of the monetary effort for partner selection by different behavioral types. The most obvious reason why bidirectional partner selection performs worse than unidirectional is that it gives raise to an additional coordination problem within the social dilemma situation while in the unidirectional treatment, partner selection is straightforward and easy to implement. Additionally, being selected by someone – even though not necessarily on the grounds of mutual appreciation – enhances group identity (see Tajfel and Turner 1979, for the theoretical concept) and thus might reinforce commitment to the partnership.

The results resemble the superiority of Hauk and Nagel (2001)'s mutual partner choice for cooperation in prisoner's dilemma games. However, their mechanisms imply the choice between exiting and earning a sure payoff or entering the game (on unilateral or mutual agreement) and hoping for a cooperative partner, whereas in our setting subjects cannot exit the game but only strive for being matched with a cooperative partner. However, the conclusion of both studies could be that the natural intuition about mutual agreement in forming teams being superior to unidirectional selection is failing. Mutual agreement may give raise to coordination problems that are not existent when one partner is eligible for initiation of the relationship. Even though individuals may be reluctant if selected by a non-desired partner, resentments can be overcome by the entitlement of being chosen.

Our findings may serve the understanding why and how cooperation in the realistic environment of being free to choose partners might function and how the success is sensitive to the structure of endogenous partnership formation. The ambitious goal of future research is to extend this rather narrow framework of partner selection to group formation, and gain a deeper insight in endogenous regrouping mechanisms.

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## Appendix: Instructions and Control Questionnaire

A.1. General instructions for the public good game in all treatments

### Welcome to the experiment

You are now taking part in an economic experiment on individual decision making. If you read these instructions carefully, you can, depending on your decisions, earn a considerable amount of money. Therefore, it is very important that you read these instructions carefully. **The instructions handed to you serve your private information only. It is prohibited to communicate with other participants during the experiment.** In case you have questions, please raise your arm and one of the experimenters will come to your cabin and answer your question. If you violate these rules we will have to exclude you from the experiment and all payments.

All amounts are displayed in ECU (Experimental Currency Unit). The exchange rate is **100 ECU = 1 EURO.** At the end of the experiment you will privately receive your total payoff in Euros.

At the beginning of the experiment participants are randomly divided into groups of 6. Throughout the whole experiment this group composition remains the same. The experiment is divided into 6 phases, whereby one phase lasts for 5 rounds. In total there are 30 rounds.

At the beginning of the first phase pairs of subjects are randomly formed within the groups of 6. Thus, each participant is randomly assigned one of the other group members, to whom we will subsequently refer as co-player. These pairings remain constant throughout the first phase, i.e. 5 rounds. Your decisions and the decisions of your co-player will determine your payoff in each round.

After each phase you will get a new participant of your group as co-player. It is still possible that you interact with the same participant more than once. The detailed instructions for the formation of new pairs after phase one are provided below.

Each group member receives an identification code (A to F), which remains the same throughout the whole experiment. Your actual identity will never be revealed during the experiment; that means no participant ever learns the actual identity of his/her group members. At the beginning of each phase your identification code as well as the identification code of your co-player is displayed on screen. This means you will know with whom you are paired in each phase.

Each round of the experiment consists of two stages. In the first stage you have to decide how to distribute your endowment between a private account and a common project with your respective co-player. In the second stage you receive feedback on your payoff.

## *Detailed description of the single rounds*

### *First Stage*

At the beginning of every round each participant receives 25 ECU as endowment. Your task is to decide how to use your endowment. You have to decide how much you want to transfer to a private account (alternative A) and how much you want to contribute to a common project with your co-player. Your payoff in each round is the sum of the payoff from your private account and the payoff from the project.

<u>Your payoff from your private account (alternative A):</u>

For each ECU that you transfer to your private account you obtain one ECU payoff. That means, if you transfer x ECU to your private account, you receive exactly x ECU payoff from your private account. Noone else benefits from your private account. You specify the amount transferred to your private account by stating your contribution to the project:

**private account = 25 – contribution to the project**

<u>Your payoff from the project (alternative B):</u>

The payoff you receive of the projects is calculated as follows: You obtain the sum of your and your co-player's contribution that is multiplied by 0.8. This means:

**Your payoff from the project = 0.8 x (your contribution + your co-player's contribution).**

For your co-player the income from the project is calculated just in the same way, i.e. your co-player receives exactly the same payoff from the project as you.

<u>Total payoff in one round:</u>

**(25 – contribution to the project) + 0,8 x (sum of contributions to the project)**
**(payoff from alternative A) + (payoff from alternative B)**

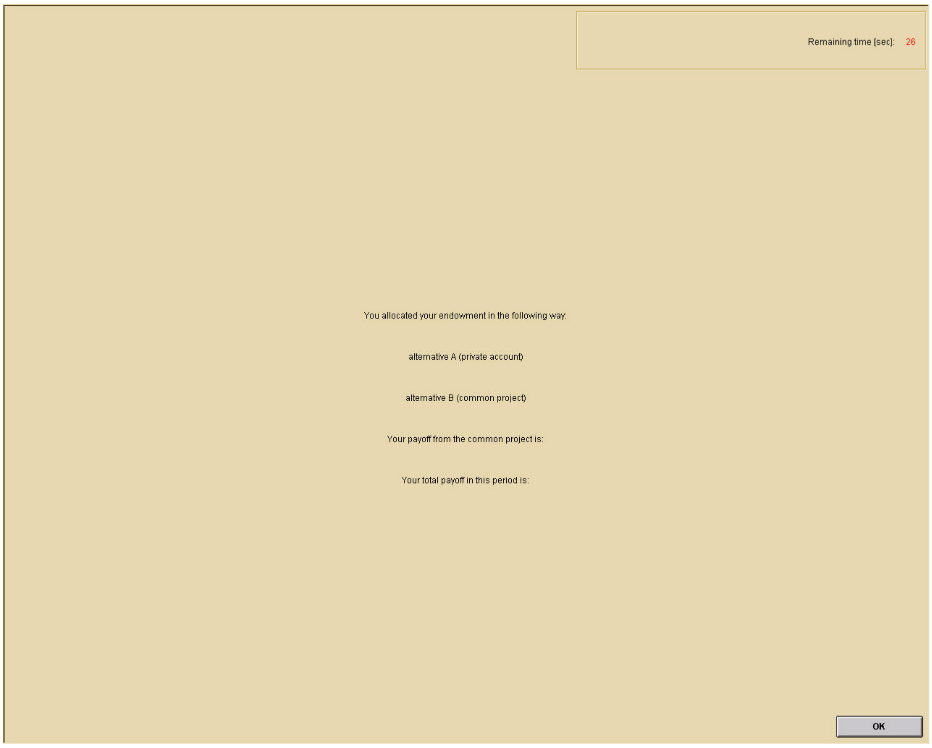
For each ECU, that you transfer to your private account you receive a payoff of one ECU. Supposing you contributed this ECU to the project instead, then the sum of contributions to the project would rise by one ECU. Your payoff from the project would rise by 0.8 x 1 = 0.8 ECU  However, your co-player's payoff from the project would also rise by 0.8 ECU, so that the total payoff from the project for you and your co-player would rise by 1.6 ECU. Your contribution to the project therefore also raises the payoff of your co-player, as well as your co-player's contribution raises your payoff. For each ECU that your co-player contributes to the project you earn 0.8 x 1 = 0.8 ECU.

Below you see the screen on which you have to make your decision in each round.


In the middle of the screen you see the current phase and round and your endowment.
Your endowment is 25 ECU in each round. You decide how to distribute these 25 ECU between alternative A (private account) and alternative B (project) by stating the amount you want to contribute to the common project. (alternative B). For that, you have to type in a number between 0 and 25 in the box in the middle of the screen. By doing so you simultaneously decide how many ECU you transfer to the private account (alternative A; i.e. 25 – contribution to the project). After you typed in the amount, you have to click OK to confirm. You cannot revise your decision once you have confirmed it.

***Second Stage***

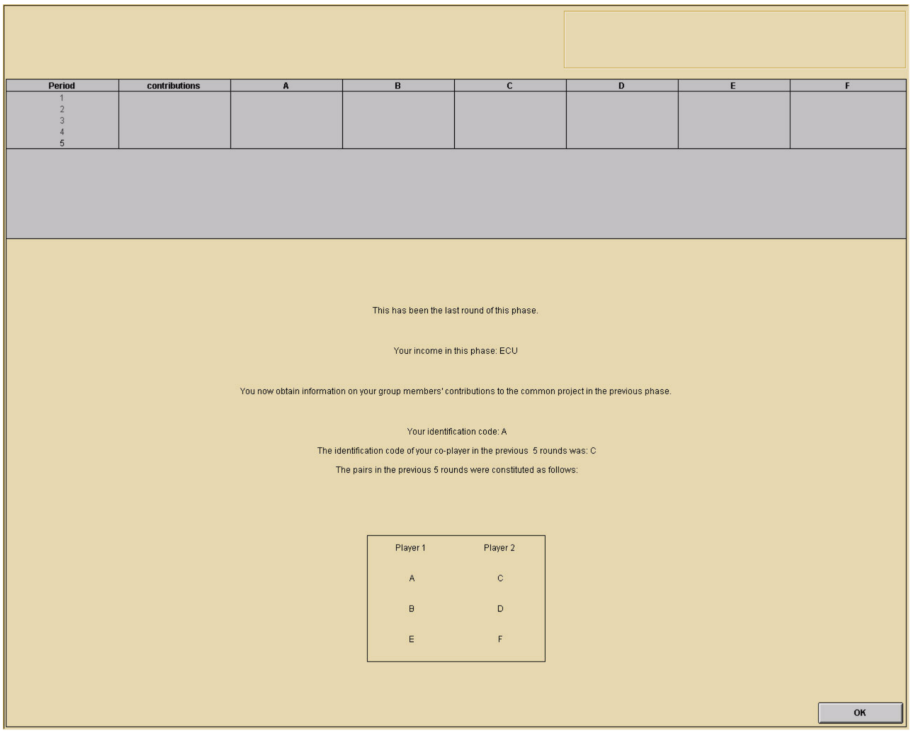
In the second stage feedback on your payoff and its single components in the respective round is provided. You see on screen how you have distributed your endowment on alternative A and B, your payoff from the project and your total payoff in this round. You do not have to make a decision in this stage.



A.2. Instructions for the rematching of pairs in the treatment random partner rematching:

## *Detailed description of the pairing process after each phase*

After each phase you see the following information screen:




You see a table where the contributions of all group members in the previous rounds are listed. Additionally, you obtain information on the pairings of group members in the previous phase. In the example above, group member A was paired with C, B with D and E with F. Furthermore, you obtain information on your total payoff in the previous phase and once again your and your co-player's identification code.

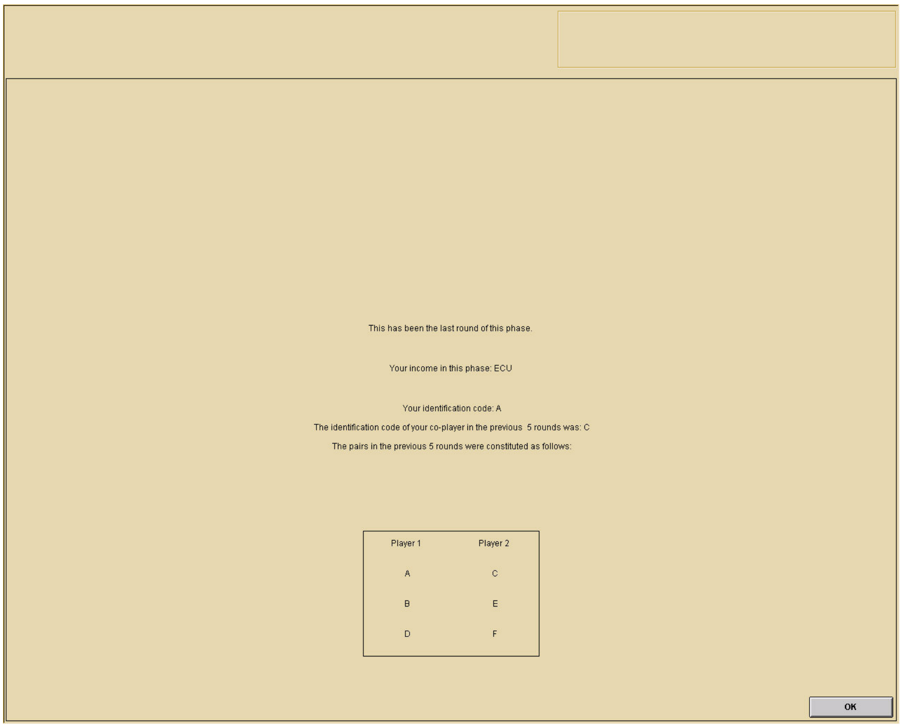
After you have confirmed this screen (in any case after 90 seconds) the next phase starts. At the beginning of the current phase pairs of group members are again randomly formed. You will learn again your identification code (which remains the same) and the identification code of your co-player on screen.

This process of forming new pairs will be conducted at the beginning of each new phase.

A.3. Instructions for the rematching of pairs in the treatment random partner rematching without history:

## *Detailed description of the pairing process after each phase*

After each phase you see the following information screen:




You see a table which contains information on the pairings of group members in the previous phase. In the example above, group member A was paired with C, B with E and D with F. Furthermore, you obtain information on your total payoff in the previous phase and once again your and your co-player's identification code.

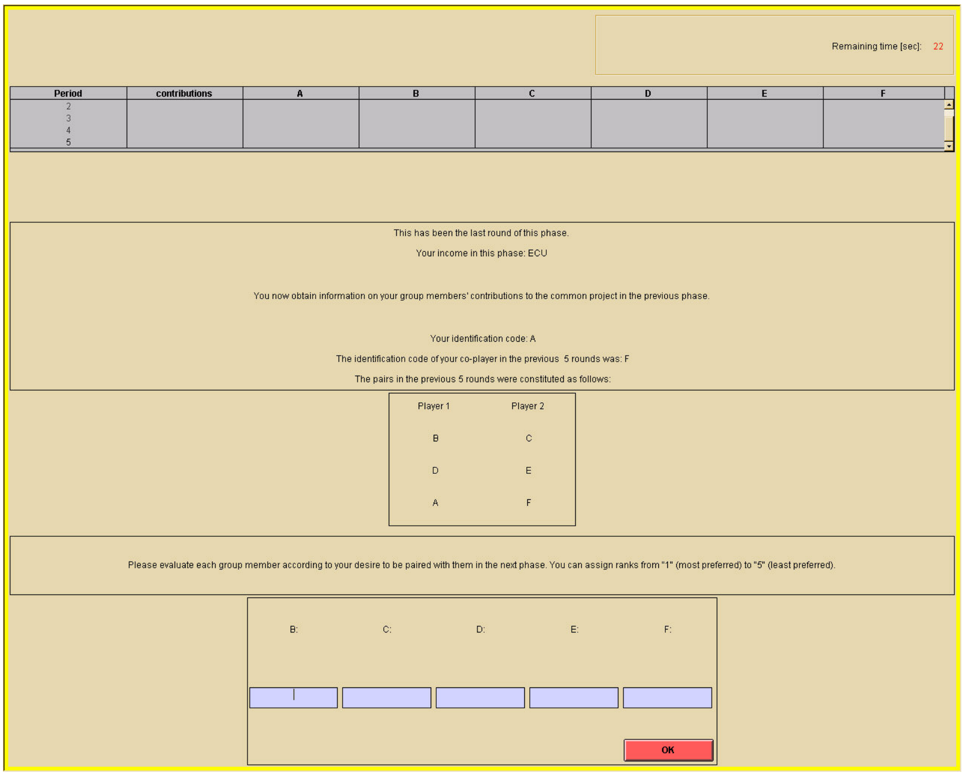
After you have confirmed this screen (in any case after 90 seconds) the next phase starts. At the beginning of the current phase pairs of group members are again randomly formed. You will learn again your identification code (which remains the same) and the identification code of your co-player on screen.

This process of forming new pairs will be conducted at the beginning of each new phase.

A.4. Instructions for the rematching of pairs in the unidirectional partner selection treatment

## *Detailed description of the pairing process after each phase*

After each phase you see the following information screen:




You see a table where the contributions of all group members in the previous rounds are listed. Additionally, you obtain information on the pairings of group members in the previous phase. In the example above, group member A was paired with F, B with C and D with E. Furthermore, you obtain information on your total payoff in the previous phase and once again your and your co-player's identification code.

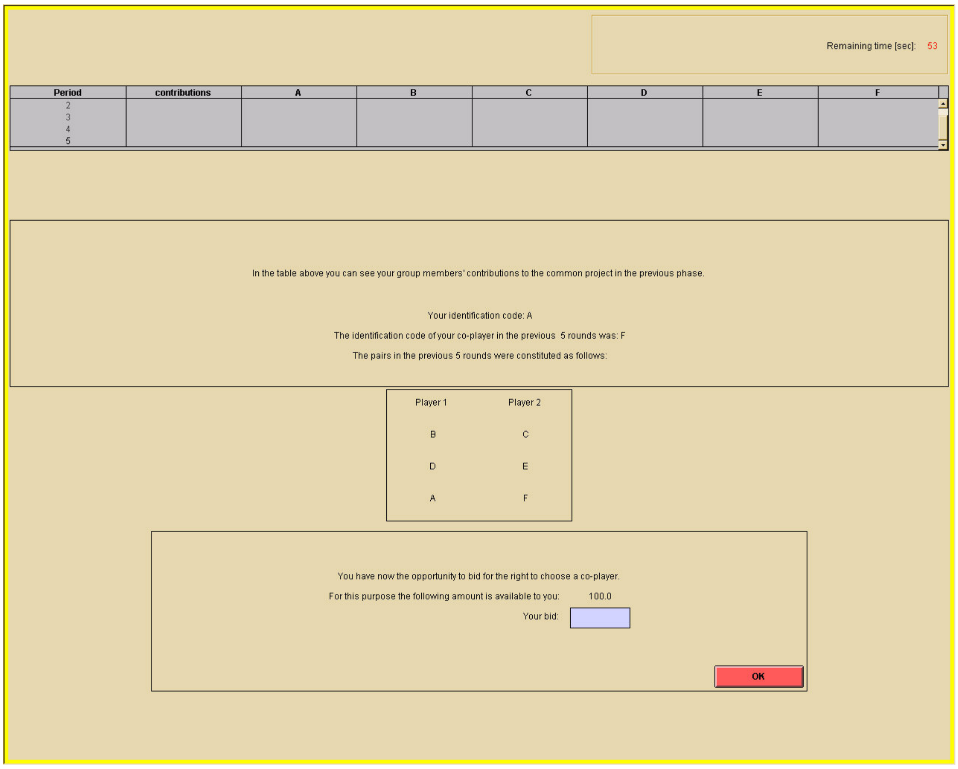
At the bottom of the screen you see 5 boxes in order to evaluate the 5 other group members. The evaluation should be done in a ranking from one to 5. You have to rate your other group members in the light of your desire to get them as a co-player for the next phase. The group member, with whom you would like to be paired most preferably, should be assigned rank 1, and the group member, with whom you would like to be paired least preferably should be assigned rank 5. For assigning rank one please type in 1 in the box below the identification code of the respective group member, for assigning rank two type in 2, for assigning rank three type in 3, for assigning rank four type in 4, and for assigning rank five type in 5.
Afterwards you have the opportunity to bid for the right to choose a co-player, which entitles you to choose the group member that will be your co-player for the next phase.

### *Auctioning the right to choose a co-player*

Each group member receives and auction endowment of 100 ECU, which he/she can either keep or use for the auction. In this auction all six group members have the opportunity to purchase the right to choose a co-player, which enables the winner of this right to choose the co-player for the next phase among the remaining group members. In total, two group members can win this right that means there will be two auctions. The winner of an auction receives the right to choose the co-player, has to pay the second-highest price submitted and is entitled to choose the preferred co-player. All group members submit their bid at the same time and therefore do not learn about the bids of the others.

*First auction*

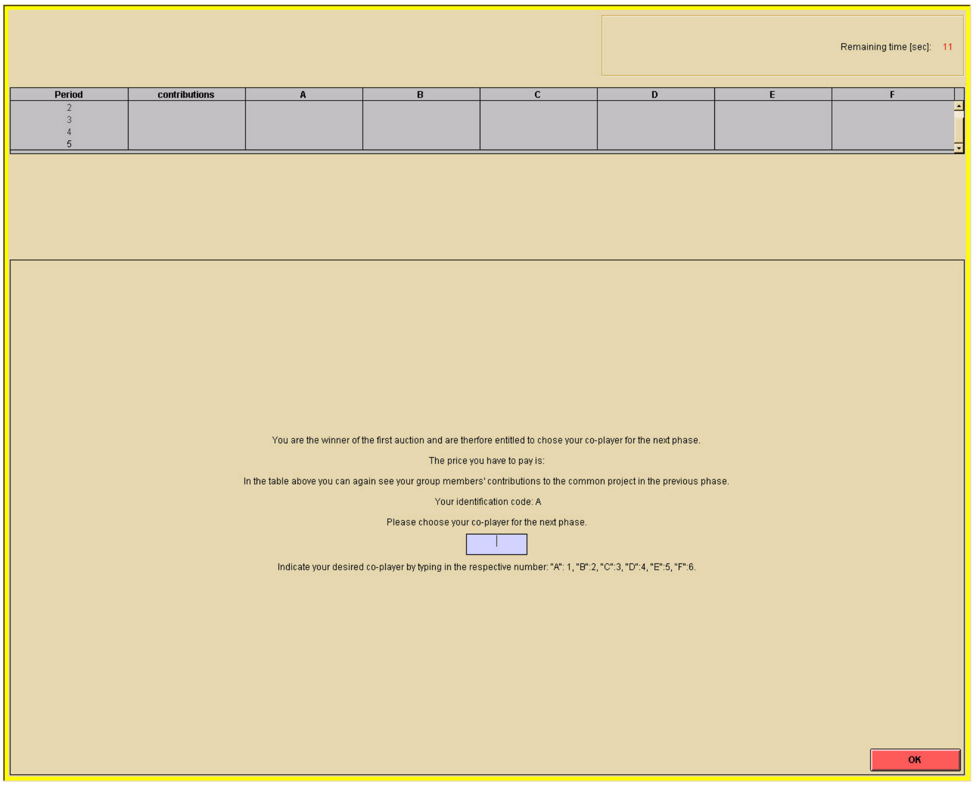
For the auction the following screen appears:




In the upper half of the screen the same information as on the previous screen is displayed. Additionally, there is a box on the lower right hand to type in your bid. In this box you have to type in a bid from 0 to 100. If you do not want to participate in the auction, please type in 0. After everyone has submitted a bid, the winner is found.

You are the winner of the first auction if you submitted the highest bid in your group. This entitles you to choose one among the remaining 5 group members as your co-player for the next phase and you have to pay the second highest bid submitted. This amount will be deducted from your auction endowment, the rest will be added to your payoffs at the end of the experiment.

In order to choose a co-player the following screen appears only for the winner of the first auction:




The contributions of all group members in the previous rounds are again listed. Below the winner sees how much (s)he has to pay for the right to choose a co-player and (s)he can type in the respective number of the co-player (s)he chooses.

<u>Example:</u>

Suppose the following bids are ranked left to right from highest to lowest, i.e. player B submitted the highest bid, C the second highest and so on. In this case B is the winner of the first auction. Player B can therefore choose his/her preferred co-player and pays a price amounting to the bid player C submitted (second highest bid).

B: ECU    C: ECU    D: ECU    E: ECU    F: ECU

Please note:

a) If more than one group member submitted the highest bid, the winner of the first auction is determined randomly out of these subjects.
b) If all 6 group members submit the same bid, all three pairs will be formed randomly.

In both cases you will be informed on the screen.

*Second Auction*

You only participate in the second auction if you

a) are not the winner of the first auction
b) have not been chosen as a co-player by the winner of the first auction

Again, a screen will appear containing a box to submit your bid in the second auction as well as the identification codes of the group members who still participate in this second auction and who can still be chosen. At the bottom of the screen you can again submit a bid from 0 to 100 to the box. If you do not want to participate in the second auction, please type in 0.

Your are the winner of the second auction if you have submitted the highest bid of the four remaining group members. This entitles you to choose one among the three other group members as your co-player for the next phase and you have to pay the second highest bid submitted. This amount will be deducted from your auction endowment, the rest will be added to your payoffs at the end of the experiment.
In order to choose a co-player a screen will appear on which the winner of the second auction sees the group members who are still available and can type in the number of the respective group member (s)he chooses.

Please note again:

a) If more than one group member submitted the highest bid, the winner of the second auction is determined randomly out of these subjects.
b) If all 4 group members submit the same bid, the remaining two pairs will be formed randomly.

In both cases you will be informed on the screen.

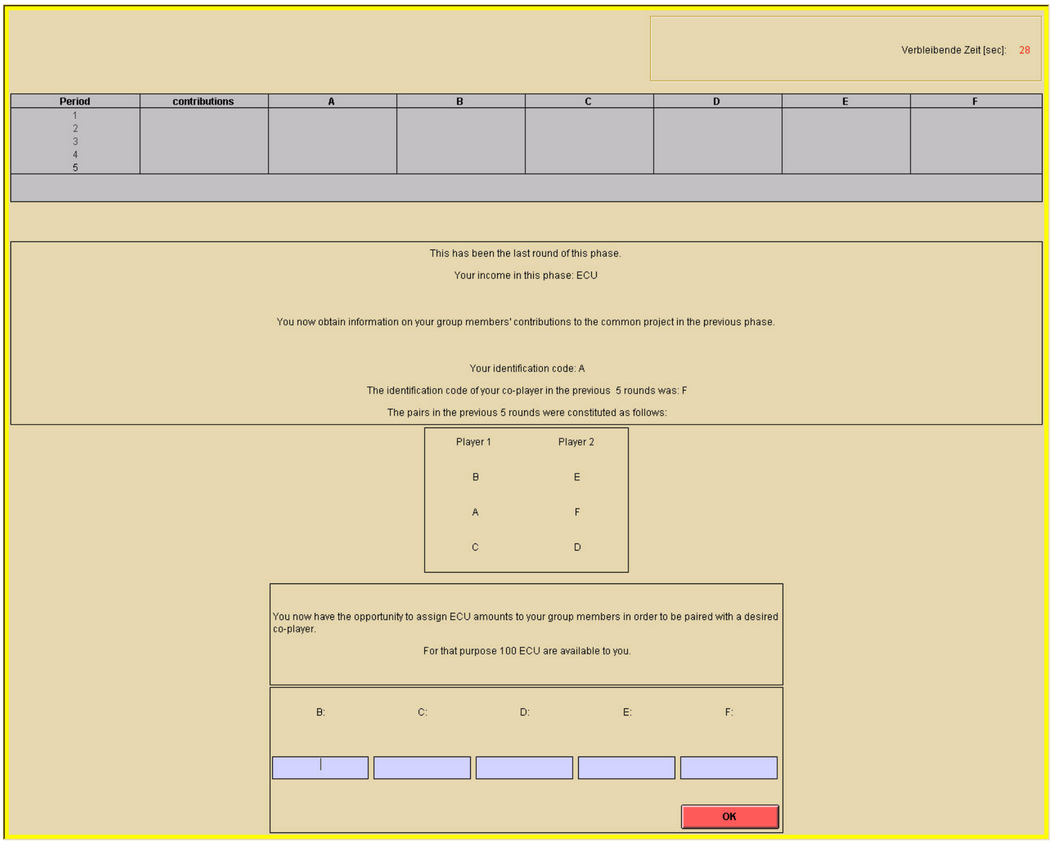
If you are neither winner of the first nor winner of the second auction and you have not been chosen as co-player by any of the two winners you will automatically form a pair for the next phase with the other remaining group member.
If you are not a winner in any of the two auctions your total auction endowment will be added to your payoffs at the end of the experiment.

Thank you for your participation and good luck!

A.5. Instructions for the rematching of pairs in the bidirectional partner selection treatment

## ***Detailed description of the pairing process after each phase***

After each phase you see the following information screen:




You see a table where the contributions of all group members in the previous rounds are listed. Additionally, you obtain information on the pairings of group members in the previous phase. In the example above, group member A was paired with F, B with E and C with D. Furthermore, you obtain information on your total payoff in the previous phase and once again your and your co-player's identification code.

***Detailed description of the co-player selection:***

Each group member obtains an endowment of 100 ECU, which (s)he can either keep or use for the co-player selection in order to be paired with a desired group member in the next phase. You can assign all or parts this endowment to one or several group members. On screen you see five input boxes associated with the identification codes of your group members. Please note, that you have to fill in all five boxes, that means if you do not want to assign a positive amount to the respective group member, please type in 0. The amounts that you fill in will not be transferred to this person, but just deducted from your payoff. This means that the endowment not assigned (100-amounts assigned) will be added to your payoffs at the end of the experiment.

After all players have assigned amounts (0 or positive) to all other group members, the computer will calculate the sum of mutual assignments for each possible pair. For example: the sum of mutuals assignments of A and B consists of the amount that player A assigned to B and the amount that player B assigned to A. In analogy, the calculations for all possible pairs A-C, A-D, …, B-C, B-D and so on are done. Subsequently, the sums of mutual ECU assignments for every possible combination of pairs is calculated.

In total, there are 15 different combinations of pairs, which can occur within the group as you see in the table below. A-B, C-D, E-F, for instance, means that A is paired with B, C is paired with D and E is paired with F.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1: | A-B, C-D, E-F | 4: | A-C, B-D, E-F | 7: | A-D, B-C, E-F | 10: | A-E, B-C, D-F | 13: | A-F, B-C, D-E |
| 2: | A-B, C-E, D-F | 5: | A-C, B-E, D-F | 8: | A-D, B-E, C-F | 11: | A-E, B-D, C-F | 14: | A-F, B-D, C-E |
| 3: | A-B, C-F, D-E | 6: | A-C, B-F, D-E | 9: | A-D, B-F, C-E | 12: | A-E, B-F, C-D | 15: | A-F, B-E, C-D |

The computer chooses the combination of pairs, that yields the highest sum of **mutual** ECU assignments. These pairings are implemented in the next phase. The following example will clarify this process.

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***Example:***

In order to illustrate how the computer chooses the pairings that will be implemented, please consider the simplified case of only 4 group members. The calculations are completely analogous for 6 group members.

With 4 group members W, X, Y and Z only the following 3 combinations of pairs within the group are possible:

1: W-X, Y-Z

2: W-Y, X-Z

3: W-Z, X-Y

Supposing the 4 players assign amounts to each other in the following way. The boxes correspond to the screen inputs for each player.

| | | | |
|---|---|---|---|
| | X | Y | Z |
| W: | 72 | 0 | 12 |
| | W | Y | Z |
| X: | 65 | 27 | 5 |
| | W | X | Z |
| Y: | 12 | 0 | 81 |
| | W | X | Y |
| Z: | 8 | 31 | 16 |

The computer calculates the sum of mutual ECU assignments for each pair, and subsequently adds up these sums for each of the three possible combinations of pairs. The combination of pairs that yields the highest total sum of mutual ECU assignments is selected. Those pairs are implemented in the next phase. In the example above the calculations are done in the following way:

1. For the combination W with X and Y with Z:
W assigns to X 72, X assigns to W 65, yielding a sum of 137.
Y assigns to Z 81, Z assigns to Y 16, yielding a sum of 97.
Adding up those two sums, we obtain the sum of mutual ECU assignments for the first possible combination of pairs within the group. This total sum amounts to 137 + 97 = 234.

2. For the combination W with Y and Y with Z:
W assigns to Y 0, Y assigns to W 12, yielding a sum of 12.
X assigns to Z 5, Z assigns to X 31, yielding a sum of 36.
Adding up those two sums, we obtain the sum of mutual ECU assignments for the second possible combination of pairs within the group. This total sum amounts to 12 + 36 = 48.

3. For the combination W with Z and X with Y:
W assigns to Z 12, Z assigns to W 8, yielding a sum of 20.
X assigns to Y 27, Y assigns to X 0, yielding a sum of 27.
Adding up those two sums, we obtain the sum of mutual ECU assignments for the third possible combination of pairs within the group. This total sum amounts to 20 + 27 = 47.

The computer selects the combination that yields the highest total sum. In the example above it chooses combination 1: W with X and Y with Z, because with this combination the total sum of mutual ECU assignemts is 234 and thus higher than the total sum of any other combination of pairs. This combination is implemented in the next phase, meaning that the pairs are formed according to this combination.

---

Considering the example above one can derive some general statements:

It is possible to assign a positive amount to more than one group member. As you can see in the example, player W has assigned player X and player Z a positive amount. This provides the possibility to state a preference for several group members, whereby a higher amount for one player means that (s)he is preferred to the other.

The higher the amount you assign to a specific group member, the higher the chances of being paired with that group member in the next phase. That means, if two group members want to be paired in the next phase , **both** should assign a positive amount to each other. You see in the example, that W and X have assigned high amounts to each other leading to their pairing for the next phase.

Coming back to the general case of 6 group members, please note the following additional rules:

a) If two or more of the 15 possible combinations yield equal total sums, one of thise combinations is determined randomly and the respective pairs are implemented in the next phase.
b) If no one assigns a positive amount to any other group member, the pairs are determined randomly.
c) If each group member assigns the same amount to every single other group member, the pairs are determined randomly. This case implies that the total sums of all possible combinations are equal.

After the pairs are selected by the computer, every group member learns the identification code of his new co-player for the next phase.

Thank you for your participation and good luck!

A.6. Control questionnaire for the public good game in all treatments

## *Control Questions*

The control questions serve for your better understanding only. The experimenters will come to your place and check for the right answers. In case you provide wrong answers, you are asked to revise them. The experiment continues as soon as everyone has filled in the right answers. However, your answers in this questionnaire will not influence for final payoff in any way.

1. You and your co-player have got an endowment of 25 ECU. No one contributes to the common project, that means you and your co-player both tranfer the whole endowment of 25 ECU to the private account.

   What is your payoff in this round? ________________

   What is the payoff of your co-player in this round? ________________

2. You and your co-player have got an endowment of 25 ECU. You and your co-player both contribute the whole endowment of 25 ECU to the project.

   What is your payoff in this round? ________________

   What is the payoff of your co-player in this round? ________________

3. You and your co-player have got an endowment of 25 ECU. Your co-player contributes 10 ECU to the project.

   What is your payoff in this round, if you contribute 10 ECU to the project?

   ________________

   What is your payoff in this round, if you contribute 0 ECU to the project?

   ________________

A.7. Additional control questionnaire for the unidirectional partner selection treatment

4. Your identification code is A, and in the first auction you submit a bid of 45 ECU. The remaining bids are as follows:

   B: 37 C: 30 D:61 E: 37 F: 31

   Who wins the first auction, how much does the winner have to pay (auction price) and what added to the winner's payoff at the end of the experiment (rest)? Assume that the group member chosen be the first winner is F, who participates in the second auction?

   winner's identification code: ___________ auction price: ________________

   rest: ______________

   identification codes of participants in the second auction : ______________________

## A.7. Additional control questionnaire for the bidirectional partner selection treatment

4. Please consider the simplified case of only 4 group members.

Assume that the 4 players W, X, Y and Z assign amounts to each other in the following way:

| | X | Y | Z |
|---|---|---|---|
| W: | 12 | 65 | 0 |

| | W | Y | Z |
|---|---|---|---|
| X: | 72 | 12 | 0 |

| | W | X | Z |
|---|---|---|---|
| Y: | 27 | 16 | 31 |

| | W | X | Y |
|---|---|---|---|
| Z: | 5 | 81 | 8 |

With 4 group members W, X, Y and Z only the following 3 combinations of pairs within the group are possible:

1: W with X, Y with Z

2: W with Y, X with Z

3: W with Z, X with Y

Which pairs are going to be implemented in the next phase? Please calculate step-by step the sums of mutual ECU assignments for each of the 3 combinations in the following way. Please copy the amounts of the boxes above and calculate the sum of mutual ECU assignments in each row (*). Then, add up both sums to the total sum of mutual ECU assignments of this combination (#).

combination 1:

W assigns to X _____, X assigns to W______, sum:_______ (*)

Y assigns to Z ______, Z assigns to Y ______, sum:_______ (*)

total sum:________ (#)

combination 2:

W assigns to Y _____, Y assigns to W______, sum:_______ (*)

X assigns to Z ______, Z assigns to X ______, sum:_______ (*)

total sum:________ (#)

combination 3:

W assigns to Z _____, Z assigns to W______, sum:_______ (*)

X assigns to Y ______, Y assigns to X ______, sum:_______ (*)

total sum:________ (#)

Combination _____ is chosen by the computer. Thus, the following pairs are implemented:

___ with___, ___ with ____