PARTNERS CONTRIBUTE MORE TO PUBLIC GOODS THAN STRANGERS: CONDITIONAL COOPERATION

by

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Abstract

In a series of experiments, we compare a situation where the same group of four subjects plays 25 repetitions of a public good game (partners condition) to a situation where subjects play this game in changing group formations over 25 periods (strangers condition). We observe that, on aggregate over all periods, subjects in the partners condition contribute significantly more to the public good than subjects in the strangers condition. This difference is significant already in the first period. In the strangers condition, contributions show a continual decay, while in the partners condition, contributions fluctuate on a relatively high level until they drastically decrease in the final periods. Our tentative explanation is that subjects' behavior in the public good situation represents conditional cooperation, characterized by both future-oriented and simple reactive behavior. With this interpretation, we are able to explain the observed differences between the two conditions.

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1. Introduction

In this paper we report on an experimental study of voluntary contributions to a public good, which focuses on the so-called *partners versus strangers comparison*. In our experiment, subjects played 25 repetitions of a simple public good game. In the partners condition the same group of subjects played this game repeatedly, while in the strangers condition subjects faced different group members in each repetition of the game. Game-theoretically, each player has a dominant strategy to make no voluntary contribution to the public good in each repetition of both conditions. It is a stylized fact, however, that in experiments subjects typically do make voluntary contributions in such a situation, albeit less than would be socially optimal.[1] The existing experimental evidence regarding the (dis-)similarity of the behavior of subjects in the partners and the strangers condition is mixed, though.

In a much cited article, Andreoni (1988) observed that strangers contributed more to the public good than partners. Palfrey and Prisbrey (1993) and Weimann (1994), on the other hand, found no difference in the contribution levels of the two conditions, but they did observe a higher variance of contributions in the strangers condition than in the partners condition. Recently, Croson (forthcoming) replicated Andreoni's design but obtained the opposite result. In her experiment, partners contributed more than strangers. Moreover, partners exhibited more variance in their contributions than strangers.

The reason for this mixed evidence may be that the results of these studies are based on few experimental sessions. Note that, strictly speaking, in the strangers condition, each session yields only one independent observation.[2] Therefore, in our experiment we organized 6 strangers sessions, yielding 6 independent observations. Together with 10 independent observations in the partners condition, we have sufficient data to allow analyses based on nonparametric test statistics.

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[1] For a survey, see Davis and Holt (1993) or Ledyard (1995).

[2] Indirect links may be established: Through the interaction, subject A has an influence on subject B, who influences subject C in a later repetition of the game, and so on.

Moreover, in contrast with the aforementioned experiments that used 10-fold repetitions of the public good game, our experiment consists of 25 repetitions. In our view, this provides a better opportunity for any difference in subjects' behavior to manifest itself.

After a detailed discussion of the experimental design and procedures in section 2 of this paper, we will present the main results in section 3. We first offer a rigorous statistical data analysis, based on strictly independent observations (section 3.1). Our results yield strong evidence for Croson's (forthcoming) observation that partners, on average, contribute more than strangers. This appears to be the case both in the first period and over all periods. We do not observe a significant difference in the variation of individual contributions within the independent groups in the partners condition and the strangers condition. We do, however, observe significantly more variation in the contribution levels of the independent partners groups than in the contribution levels of the independent strangers groups. In both conditions, a strong positive correlation between average group contributions in the first period and average group contributions over all following periods is observed.

The second part of our data analysis (section 3.2) more closely examines individual subject behavior. One of the results is that we identify a significantly larger number of free riders, who contribute nothing to the public good, in the strangers condition than in the partners condition. Another result is that, whereas contributions in the strangers condition show a continual decay, contributions in the partners condition stay at a relatively high level before they drastically decrease toward the end of the game. We show that this decrease is due to end-game behavior by the majority of subjects (Stoecker 1983, Selten and Stoecker 1986). In the strangers condition, as well, subjects exhibit a significant tendency to engage in end-game behavior; strangers' end games tend to be longer than those of partners.

Using these results and some additional observations, we offer, in section 4, a tentative explanation of individual behavior in the public good situation. Our explanation is based on the concept of conditional cooperation, with the two aspects of future-oriented and simple reactive behavior. The behavioral difference between partners and strangers shows largely in the first period. It seems that, in contrast to strangers, partners anticipate a prolonged

interaction with the same subjects and that this has a noticeable influence on their initial contribution decisions. Future-orientation also shows up in the end-game behavior in both conditions. In the final periods, subjects foresee or become aware of the ending of their interaction. After the first period and before the end game, subjects in both conditions show qualitatively the same simple reactive behavior, characterized by reciprocity.

The paper is concluded in section 5.

2. The Experiment

In the experiment, subjects played 25 repetitions of the following constituent game. Four subjects form a group. Each of the subjects is endowed with 10 tokens, which have to be allocated between two activities, called X and Y. This allocation decision has to be made independently of the other subjects. The payoff to each subject depends both on the subject's own decision and on the decision of the three other subjects in the group. Activity X has, for each subject, the nature of a private good. Each token allocated to activity X earns the subject an individual payoff of 10 Dutch cents. If a subject allocates no token to activity X, he gets no payoff from this activity. Activity Y has the nature of a public good. Each token allocated by any subject of the group to activity Y yields each subject a payoff of 5 Dutch cents. Thus, a subject may receive a payoff from this activity without having contributed to it. The aggregate payoff from both activities determines a subject's payoff for the constituent game. Total individual payoff for the experiment is determined by the sum of these payoffs over the 25 repetitions of the game.

The game-theoretic solution to the constituent game is straightforward. Whatever the decisions of the other subjects, a subject's individual return from activity X exceeds his individual return from activity Y. Thus, each subject has a dominant strategy to contribute the entire token endowment to activity X and nothing to activity Y. By the backward induction argument, in the 25-fold repetition of the game, the unique subgame-perfect equilibrium is, for each subject and in each repetition, to contribute nothing to activity Y. The maximum

payoff to the entire group however, is attained if in each repetition all subjects contribute all of their tokens to activity Y.

The computerized experiment was run at the CREED laboratory of experimental economics at the University of Amsterdam. Subjects were students majoring in economics (about 50 percent) and various other fields. As mentioned in the introduction, the experiments comprised a partners and a strangers condition. In total, we ran 6 strangers sessions and 2 partners sessions, with 20 subjects in each session. In the strangers sessions, in each of the 25 repetitions of the game, new groups were randomly formed. Although, over the repetitions, subjects met each other several times, they met in different groupings in each repetition, and they were never informed about the identity of the other subjects in the group. In the partners sessions, the 20 subjects were randomly divided into 5 groups of 4 subjects at the beginning of the session. The subjects, then, stayed in these groups during all 25 repetitions. In both the strangers sessions and the partners sessions, at the end of each repetition each subject was informed about the total contribution to activity Y in his or her own group in the repetition just finished. No information was given about the others' individual contributions. Note that the 6 strangers sessions yield 6 strictly independent observations. The 2 partners sessions, with 5 groups a piece, yield 10 independent observations.

Before the experiment started,[3] written instructions (available upon request) were read aloud. Then, the subjects were given the opportunity to ask questions before they individually had to go through additional, computerized instructions. These included exercises to make sure that the subjects understood the rules of the game. No examples of allocation decisions were given in these exercises in order not to bias the subjects in any way. The allocation of tokens on which the exercises were based had to be chosen by the subjects themselves. When all subjects had finished the exercises and no further questions were raised, the experiment started. Each subject was seated at a computer terminal in a separate cubicle. During the experiment each subject had the complete history of the games he or she was involved in

[3] Prior to the experiment, the subjects took part in a test on social value orientation. In this paper, we make no use of the results of the test. For a description of the test on social value orientation, see Keser and van Winden (1996) or Offerman et al. (1996).

available on the computer screen. Communication, other than through the decisions made, was not allowed. At the end of the experiment, each subject privately received, in cash, his or her payoff from the experiment. The average payoff, earned in about one and a half hour, was nearly 36 Dutch guilders in the partners condition and 30 Dutch guilders in the strangers condition.

3. Results

In the first part of this section, we present a rigorous statistical data analysis focusing on the partners-strangers comparison. This part of the analysis will, with one exception, be based on data for the independent subject groups. In the second part of this section, we try to identify some features of individual behavior, in both the partners and the strangers condition. Following Siegel (1987), nonparametric statistical test methods will be used. For each test we require a significance level of either 1 or 5 percent.

3.1 Major results

Figure 1 shows the time paths of the average contributions to the public good (activity Y) in the strangers condition and in the partners condition. The averages are taken over the 40 subjects in the partners experiment and the 120 subjects participating in the strangers experiment. We see that, on average, partners contribute more than strangers in each period. The average contribution, over all repetitions and all subjects, is 4.53 tokens (standard deviation 3.95) in the partners condition and 1.90 tokens (standard deviation 3.05) in the strangers condition.

To show that this difference in the contribution levels of partners and strangers is statistically significant, consider table 1. The second column of this table presents, for each independent subject group, the average contribution to the public good over all 25 repetitions. S1 to S6 represent the 6 independent subject groups in the strangers condition, where each group

comprises 20 subjects. P1 to P10 are the 10 independent subject groups in the partners condition, where each group comprises 4 subjects. Applying a two-tailed Mann-Whitney U test, we can reject the null hypothesis that average contribution levels are the same at the 5 percent significance level. We conclude that the contribution levels of strangers and partners are significantly different.

Figure 1 further suggests that partners start out, already in the first period, with a higher contribution level than strangers. Applying a Mann-Whitney U test for the null hypothesis of no difference between the individual decisions in the partners and in the strangers condition, we can reject the null hypothesis at the 5 percent level (two-sided test). We conclude that partners significantly tend to contribute more in the first period than strangers.

From table 1 it can also be observed that average contributions to the public good vary more among the independent partners groups than among the independent strangers groups. To demonstrate, we consider for each independent partners group the absolute deviation of its average contribution from the grand average of 4.53 in the partners condition and, similarly, for each independent strangers group the absolute deviation of its average contribution from the grand average of 1.90 in the strangers condition. These values are reported in column 3 of table 1. Applying a Mann-Whitney U test, we can reject the null hypothesis of no difference at the 5 percent level (two-sided test). As the average absolute deviation is 2.12 in the partners condition and 0.52 in the strangers condition, we conclude that the deviation tends to significantly be higher in the partners condition than in the strangers condition.[4]

Having observed significantly more variation among the contributions of independent partners groups than among the contributions of independent strangers groups, we now ask whether the variation within the partners groups is different from the variation within the strangers groups. Column 4 of table 1 shows for each independent subject group the standard

[4] For further evidence, we apply a Moses test for the hypothesis that the average contributions of partners groups are more extreme than those of the strangers groups. The null hypothesis that there is no difference in the variation of the average contributions between the groups in the partners and the strangers condition can be rejected at the 1 percent significance level.

deviation of contributions to the public good. Another interesting measure of variation within a subject group is presented in column 5 of table 1. It is a measure of stability of the individual decisions. A subject's individual stability measure is defined as the average absolute change in his contributions from one period to the next. The group stability measure is calculated as the mean of the group members' individual stability measures. Applying Mann-Whitney U tests and requiring significance at the 5 percent level, we can reject neither the null hypothesis that the standard deviations of the contributions within the independent subject groups tend to be the same in both conditions nor the null hypothesis that the group stability measures tend to be the same in both conditions. Thus, we have no statistical evidence for a significant difference in the variation of contributions within the independent subject groups in the partners and the strangers condition.[5]

These results show that a statistically significant behavioral difference is induced by the two conditions, partners and strangers. This difference does not only manifest itself in the aggregate contribution levels, showing that partners contribute more than strangers. It also shows up in the variation of the decisions of the independent subject groups. In the partners condition, we observe more variation between the group contribution levels than in the strangers condition. The high variation between the group contributions in the partners condition results from the coexistence of extremely cooperative groups and of groups where only very little is contributed to the public good. This is illustrated by the figures portraying the time paths of average contributions of the individual groups, presented in the Appendix. One might argue that this result is not interesting because in the strangers groups extremely high and low contributions are likely to cancel out due to the aggregation over 20 subjects. If this were the case, however, we should expect a higher standard deviation of contributions in the strangers groups than in the partners groups. This is, however, not what we observe (see column 4 of table 1).

Common to both the partners and the strangers condition is the observation that the decisions

[5] Note, however, that if anything, the variation in the partners condition tends to be greater than in the strangers condition. This result is in contrast to those of Palfrey and Prisbrey (1993) and Weiman (1994) but in line with the observation made by Croson (forthcoming).

of the group members in the first period are decisive for the average contribution level of the group over the remaining repetitions of the game. Indeed, we find a strongly positive correlation between the average contributions of the independent subject groups in the first period and the average contributions of the independent subject groups over all but the first periods. The Spearman rank correlation coefficient is 0.91 for the partners and 0.94 for the strangers. Both rank correlation coefficients are significantly positive at the 1 percent level (one-sided testing).

3.2 Further results

The statistical analysis of individual behavior is somewhat problematic as, with the exception of the first period, the individual decisions are not strictly independent. Therefore, in the following we remain to some extent descriptive and sometimes apply statistical tests ignoring the fact that the independence assumptions are not strictly satisfied.

Figure 2 shows, for both the partners and the strangers condition, the distribution of individual contributions over all 25 periods. In the strangers condition, we find a distribution with a unique mode at zero, while a bimodal distribution is found in the partners condition with modes at zero and ten. Applying a two-sided Kolmogorov-Smirnov test, we can reject the null hypothesis of no difference in the distributions at the 1 percent level.[6] This yields further evidence of more variation among the individual decisions of partners than among the individual decisions of strangers. Recall that we have demonstrated above that the two conditions show a significant difference in the variation of contribution levels of independent subject groups but not in the individual contributions within independent subject groups.

Another observation showing a difference between the two conditions concerns free-riding. As table 2 shows, only 1 of the 40 subjects (2.5 percent) in the partners condition and 24 of

[6] Note that the—for this test necessary—independence of observations is given in the sense that the observations of the strangers sample are independent of those of the partners sample and vice versa. However, within each sample the observations may not be considered as fully independent.

the 120 subjects (20 percent) in the strangers condition play the dominant strategy of zero contribution in all periods. We call them *strong free riders*. Moreover, another 12 of the 40 subjects (30 percent) in the partners condition and another 42 of the 120 subjects (35 percent) in the strangers condition make zero contributions in more than half but not all of the periods (i.e. in at least 13 but less than 25 periods.) We call them *weak free riders*. Thus, 33 percent of the subjects in the partners condition and 55 percent of the subjects in the strangers condition are (weak or strong) free riders making zero contributions in more than half of the periods. Dividing our subjects into (weak or strong) free riders and *others*, we apply a χ^2 test for the null hypothesis that there is no difference in the proportion of free riders in the two conditions. At the 5 percent significance level (two-sided test), we can reject the null hypothesis and conclude that free riders tend to occur more often in the strangers condition than in the partners condition.[7]

Table 2 also reports the number of subjects who contribute all ten tokens to the public good in all periods *(strong cooperators)*, as well as the number of subjects who contribute ten tokens in more than half but not in all of the periods *(weak cooperators)*. Only in the partners condition do we observe a single strong cooperator. Moreover, we find 7 weak cooperators (17.5 percent) in the partners condition and only 3 weak cooperators (3 percent) in the strangers condition. Dividing our subjects into (weak or strong) cooperators and *others*, we apply a χ^2 test for the null hypothesis that there is no difference in the proportion of cooperators in the two conditions. Since the null hypothesis is rejected at the 1 percent significance level (two-sided test), we conclude that cooperators tend to occur more often in the partners condition than in the strangers condition.[8]

[7] Using the independent subject groups as the sampling level, a similar test of the proportion of free-riding (not free riders!) is a Mann-Whitney U test based on the average per capita frequencies of zero contributions. This test allows us to reject the null hypothesis at the 5 percent level (two-sided test). We conclude that strangers tend to make zero contributions more often than partners.

[8] A Mann-Whitney U test based on the average per capita frequencies of contributing ten tokens of the independent subject groups does not permit us to reject the null hypothesis at the 5 percent level (two-sided test). We should take into account, however, that our data set is quite small for such a conservative test, and that the relatively high variation in the contributions of the independent groups in the partners condition has a strong impact on the test.

Another interesting observation, illustrated in figure 1, is that only in the strangers condition do we observe the continual downward trend in the average contribution level which is considered as typical for this type of public good game (Davis and Holt 1993, Isaac, Walker, and Williams 1994, Keser 1996a). We do not find this pattern in the partners condition, where contributions fluctuate at a relatively high level until they decrease strongly toward the end of the game. Especially in the partners condition, figure 1 leads us to expect an end-game behavior as described by Stoecker (1983) and Selten and Stoecker (1986) for finitely repeated prisoner's dilemma games. For our public good game, we define a subject's *end-game behavior* as a sequence of zero contributions at the end of the game, after having contributed positive amounts in at least half of the prior periods. According to this definition, there are 24 subjects in the partners condition and 62 subjects in the strangers condition who show end-game behavior (see the last column of table 2). Considering only those subjects who are neither strong free riders nor strong cooperators it is 63 percent of the partners and 64 percent of the strangers who exhibit end-game behavior.[9]

Figure 3 depicts the cumulative frequencies of end-game duration in both conditions. In the partners condition, 92 percent of the end games last 5 periods or less. The longest end game in the partners condition is 11 periods. In the strangers condition, we observe end games of up to 19 periods. Here, only 66 percent of all end games last 5 periods or less, while there are quite a few longer end games. Thus, end games tend to be longer in the strangers condition than in the partners condition.

4. Conditional Cooperation

[9] Applying a χ^2 test for the null hypothesis that subjects have an equal probability of showing an end-game behavior or not, we can reject the null hypothesis at the 1 percent significance level in the strangers condition. We conclude that strangers significantly tend to engage in end-game behavior. For the partners condition, however, we can not reject the null hypothesis requiring significance at the 5 percent level. If we apply a χ^2 test to compare the relative frequencies of end-game behavior in the strangers and in the partners condition, we can not reject the null hypothesis. Thus, we have no statistical evidence for a significant difference in the tendency to engage in end-game behavior in the two conditions.

So far we have given a general characterization of play in the partners and strangers conditions. Our results show that most of Croson's (forthcoming) findings are robust. On average, partners contribute more to the public good and free-ride less than strangers. Moreover, in the final period(s) of the game, both partners and strangers tend to contribute nothing to the public good. Croson argues that these results provide support for what Andreoni (1988) calls the *strategies hypothesis*. This hypothesis suggests that subjects might play strategically in the sense of Kreps et al. (1982). If a subject is not sure whether the other subjects fully understand the structure of the game, then, in early repetitions of the game, he has no interest in educating the others to play the dominant strategy. This would imply a relatively high contribution level in the early periods which decreases when the end draws near. However, observed development of play in our experiment seems not to support the strategies hypothesis. In the partners condition, group contribution levels sometimes fall in the beginning but then start to substantially increase again. Particularly illustrative of this phenomenon is the development of play of group P4, and also that of groups P5 and P6 (see Appendix). Also note that in the majority of groups contribution levels do not fall to zero in the last period.

We do not consider the strategies hypothesis a convincing explanation of behavior in public good situations. In our view, the observed development of play is better described as *conditional cooperation*. We distinguish between two aspects of conditional cooperation. One is future-oriented behavior. The other is simple reactive behavior.

Evidence of future-oriented behavior particularly shows up at the end of play in the partners sessions, where contribution levels often sharply fall in the final period(s). Possibly, subjects near the end of the game realize that investment in their relationship with other group members is not worthwhile any longer. Or subjects may anticipate such a reasoning by others. Assuming that subjects are rather myopic, they will at most look a few periods ahead when deliberating on their investments. This may be the reason why this behavior occurs only toward the end of the game.

Other evidence of future-oriented behavior, but now regarding the beginning of play, is provided by Keser (1996b). In this study, subjects designed complete strategies for playing a public good game in a computer tournament. The strategies suggest that the majority of subjects signal an interest in cooperation in the first period. Thereafter, behavior is simply oriented toward the observed average contribution of the other group members in the previous period until in the final periods end-game behavior takes over. From a cognitive point of view, it is plausible that the propensity to signal a willingness to cooperate is stronger in the partners sessions than in the strangers sessions. This might explain why already in the first period we observe a significant difference in the contribution levels of the two conditions. Moreover, the literature points at another factor. According to this literature, individuals have a propensity to identify with the group they belong to. As a consequence, an interest in group success is substituted for or added to their interest in individual success (for discussion and experimental evidence see Dawes and Thaler 1988, Ledyard 1995, Offerman 1996, Simon, 1993, Taylor and Moghaddam 1994). Obviously this factor is more relevant for the partners sessions than for the strangers sessions. This might also provide an explanation of the difference in initial contribution levels. All in all, these results suggest that cooperation is dependent on the subjects' perception of future interaction. The tendency to cooperate is greater when subjects anticipate prolonged interaction with others as members of a group, as holds for the partners sessions up to the final periods of play.[10]

In addition to future-oriented behavior, there appears to be a second aspect of conditional cooperation, namely reactive behavior. Supportive in this respect is Keser's (1996b) finding, noted above, that behavior in a public good game is oriented toward the average behavior of the other group members in the previous period. This kind of behavior is in line with the "principle of reciprocity" that is often referred to in the literature (see, e.g., Fehr et al. 1993, Hoffman et al. 1996, Sugden 1984). Our hypothesis is that also in our experiment reciprocity is at work.

To test this hypothesis, we need to define reciprocity. Recall that in our experiment subjects

[10] Further support is provided by Cotterell et al. (1992, p.658): "It has been found that more resources are allocated to partners with whom future interaction is expected."

have information about the total contribution of the others in the group, but not about the individual contributions. Thus, a natural way to formalize reciprocity in our environment seems to be the following qualitative decision rule: If a subject intends to change his decision from one period to the next, he changes it in the direction of the other group members' average contribution in the previous period. This means that he increases his contribution if it was below the average of the others, and he decreases his contribution if it was above the average. We do not, however, specify neither the absolute nor the relative extent to which the contribution is changed. In our experiment more than half of the observations are of no change (52 percent in the partners condition and 62 percent in the strangers condition). However, in cases where a change occurs, our rule yields a remarkably good prediction of the direction of the change. This can be seen in tables 3 and 4. The first three columns of these tables show—for the partners and the strangers condition, respectively—how often a subject could observe that his or her own contribution was above (*situation 1*), below (*situation 2*), or equal to (*situation 3*) the average contribution of the others. The last three columns show how often it occurred that a subject reacted with an increase, a decrease, or no change in each situation. To test our simple qualitative decision rule, which predicts the direction of a change if a change is intended at all, we consider the reactions increase and decrease in situation 1 and situation 2. If the decision rule makes the right predictions, we should observe relatively more increases than decreases in situation 2, and relatively more decreases than increases in situation 1. Applying the χ^2 test for the null hypothesis that right and wrong predictions are equally likely, we may reject the null hypothesis for each condition at the 1 percent significance level. We conclude that our simple qualitative decision rule significantly tends to make the right predictions in both the partners and strangers conditions. Apparently, reactive behavior in this simple form of reciprocity is an important aspect of behavior.

Interestingly, this evidence of reciprocity appears equally strong in the partners condition and in the strangers condition. In the two conditions about 80 percent of the observed changes in both situation 1 and situation 2 are in the predicted direction. Furthermore, in the situation that one's own contribution was equal to the average contribution of the other subjects (situation 3), we observe that if a change occurred it was significantly more often an increase than a decrease in both conditions. According to Gouldner (cited in Pruitt 1968) reciprocity

can be attributed to norm reciprocity and/or tactical reasoning. In the latter case, reciprocity is considered to serve a strategic purpose which is to encourage others to provide further. Pruitt tested both hypotheses and found experimental evidence for norm reciprocity only. Our results seem to support Pruitt's findings. If the reciprocity observed in our experiment were mainly due to tactical reasoning, then it should have been more apparent in the partners than in the strangers condition.

A noticeable difference between partners and strangers concerns the number of times that subjects are observed to change their contributions in situation 1 and situation 2. In the partners condition, subjects change their contributions almost equally often in situation 1 (230 times) and situation 2 (193 times). In the strangers condition, however, there are many more observations of a change in situation 1 (619) than in situation 2 (378). An obvious reason is the relative large number of free riders in the strangers condition (see above) which explains the relatively large number of the no change cases in situation 2 of this condition. Incidentally, this asymmetry offers an explanation for the observed continual decay in the average contribution level in the strangers condition, and the absence of such a decay in the partners condition.

5. Conclusion

Our results show statistically significant differences of aggregate and individual behavior in the partners and the strangers condition. Among the subjects in the strangers condition, we find significantly more free riders and fewer cooperators than among the subjects in the partners condition. In the aggregate, strangers contribute less to the public good than partners. The basis for this difference in contributions is created in the first period. The first period contribution level in an independent subject group appears to be decisive for the contribution level in that group in the remaining periods.

We suggest that typical individual behavior in our experiment is a manifestation of conditional cooperation, characterized by future-oriented and simple reactive behavior. After

the first period, qualitatively the same behavior is observed in both the partners and the strangers condition. It seems that the significant difference between the two conditions regarding the average contribution levels is largely due to the significant behavioral difference in the first period. In our view, the clue to this difference is to be sought in the different motivational and cognitive processes triggered by the partners and strangers environments, which lead to relatively more cooperative behavior in the partners condition and more free riding in the strangers condition.

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Table 1: Average contribution and standard deviation of each independent subject group, partners groups (P1 to P10) and strangers groups (S1 to S6), ordered with respect to the average contribution level

group	average contribution	absolute deviation from average	standard deviation of contribution	group stability measure*
S1	2.61	0.71	3.90	1.56
S2	2.60	0.70	3.51	1.31
S3	2.02	0.12	3.07	1.49
S4	1.98	0.08	2.83	1.34
S5	1.24	0.66	2.38	0.86
S6	0.98	0.92	1.78	0.76
average	1.90	0.52	2.92	1.22
P1	9.45	4.92	2.22	0.36
P2	7.30	2.77	3.83	2.08
P3	5.80	1.27	2.73	2.28
P4	5.36	0.83	4.20	1.68
P5	5.32	0.79	3.10	2.33
P6	3.89	0.64	3.21	1.66
P7	3.08	1.45	3.67	2.43
P8	2.69	1.84	2.18	1.85
P9	1.37	3.16	2.40	0.96
P10	1.00	3.53	2.76	0.85
average	4.53	2.12	3.03	1.65

* For definition, see text.

Table 2: Overview of some observed characteristics of individual behavior

condition	total # subjects	total # subjects contributing				
		always zero	mostly* zero	always ten	mostly* ten	with end game**
partners	40	1	12	1	7	24
strangers	120	24	42	-	4	62

* In more than half of the periods but not in all periods.
** For definition of end-game behavior, see text.

Table 3: Partners Condition: Number of times that a subject observed his contribution above (situation 1), below (situation 2) or equal to (situation 3) the average contribution of the others, and subjects' reactions in these situations

situation	own contribution	# observations	increase	decrease	no change
1	> others'	387	42	188	157
2	< others'	379	161	32	186
3	= others'	194	30	10	154

Table 4: Strangers condition: Number of times that a subject observed his contribution above (situation 1), below (situation 2) or equal to (situation 3) the average contribution of the others, and subjects' reactions in these situations

situation	own contribution	# observations	increase	decrease	no change
1	> others'	926	111	508	307
2	< others'	1491	320	58	1113
3	= others'	463	69	15	379

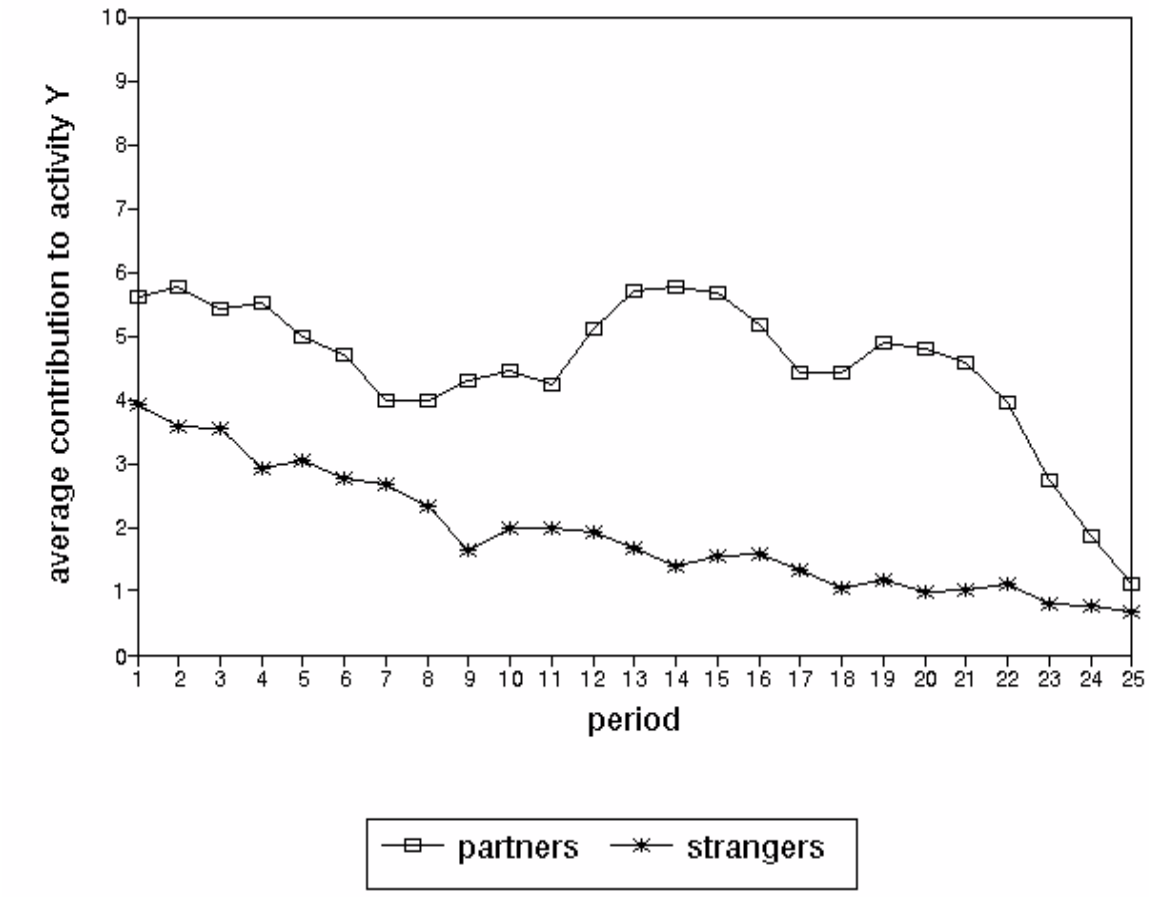

Figure 1: Time paths of average contributions to the public activity Y (partners / strangers)

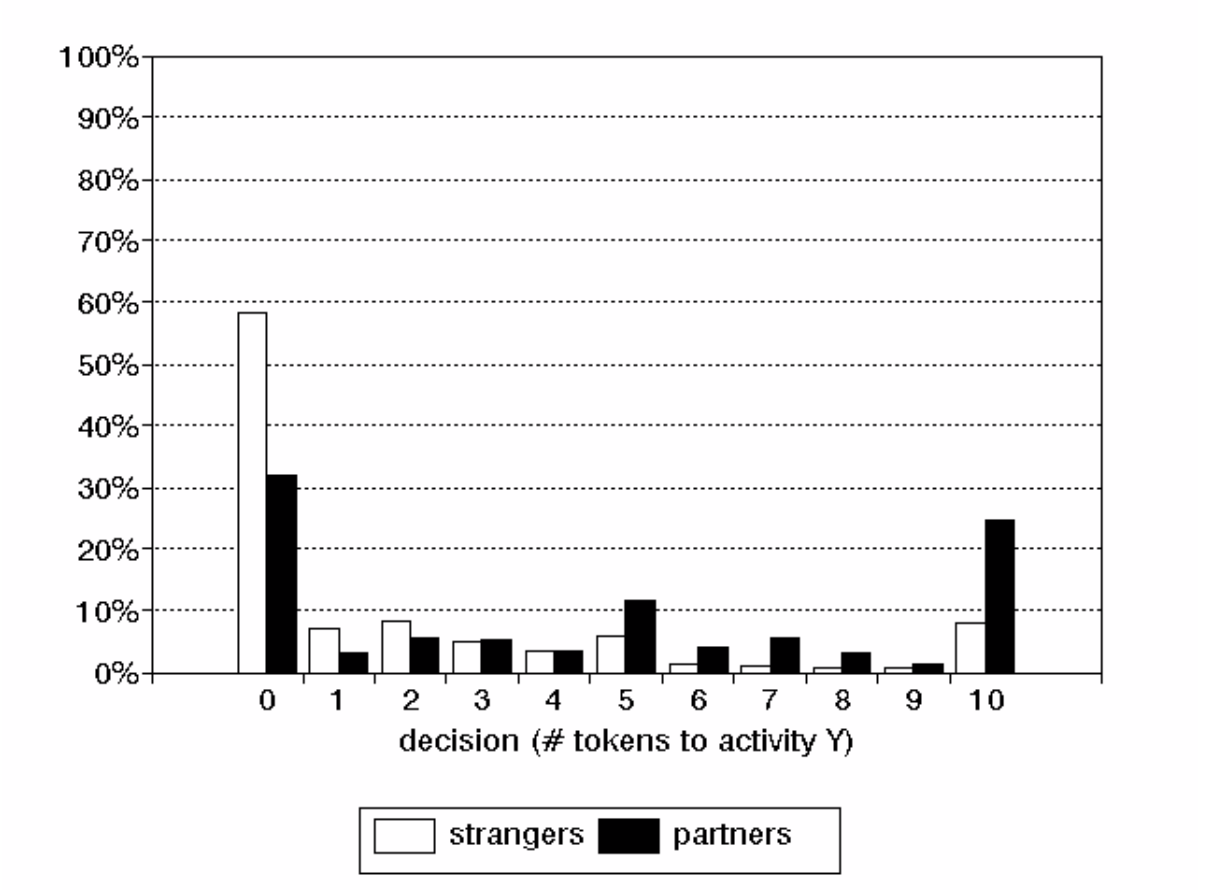

Figure 2: Individual contribution decisions over all periods (partners /strangers)

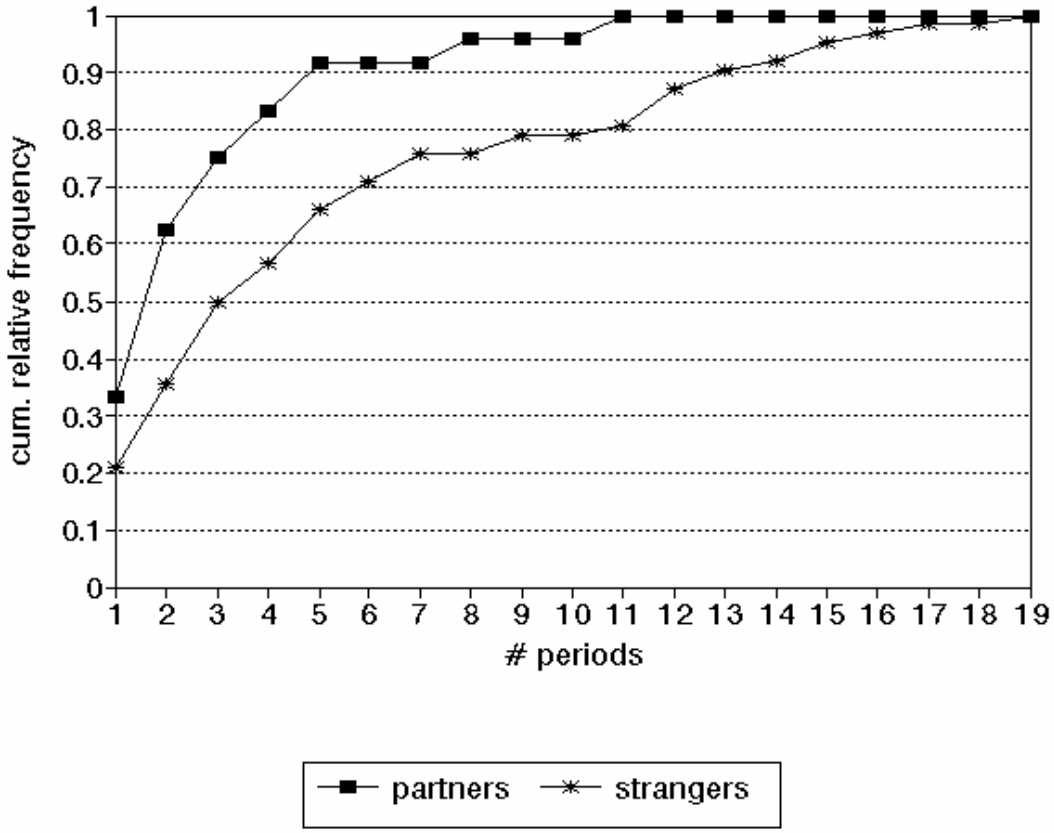

Figure 3: Length of end games (partners /strangers)

APPENDIX

Time paths of average contributions to the public activity Y
of the independent subject groups
in the strangers condition (S1 to S6)
and the partners condition (P1 to P10)