Conditional cooperation: new evidence from a public goods experiment

Roberto M. Burlando[†] and Francesco Guala[‡]

Abstract:

We extend Fischbacher et al.'s (2001) work on conditional cooperation, comparing the results obtained by means of the Strategy Method with behaviour in a classic linear public goods environment. We find that the Strategy Method is roughly adequate as a classification device, but underestimates the contribution of conditional cooperators in the public goods game.

Keywords: public goods; experiments; strategy method; cooperation; free riding.
JEL classification: H41; C91.

The experiments reported in this paper were financed by the Cognitive Science Laboratory and the Computational and Experimental Economics Laboratory at the University of Trento. We would like to thank Marco Tecilla, Macrina Marchesin and Dino Parisi for their help in running the experiments, and Luigi Mittone, director of CEEL, for letting us use the centre's resources.

[†] University of Torino, Italy, and University of Exeter, UK; email: roberto.burlando@unito.it.

Conditional cooperation: new evidence from a public goods experiment

1. Introduction

In a recent paper Urs Fischbacher, Simon Gächter and Ernst Fehr (2001) report an attempt to observe conditional cooperation within a public-goods-like environment. Using the so-called 'Strategy Method', they classify about half of the subjects in their sample as 'conditional cooperators', and argue that the existence of this type of player, together with the presence of about one third of free riders, helps to explain the well-known phenomenon of decaying contribution in repeated public goods (PG from now on) experiments.[1] The idea, in a nutshell, is that when a conditional cooperator meets one or more free riders in such settings, her initial willingness to cooperate gets frustrated, causing the group's average rate of contribution to spiral down towards the Nash equilibrium. Behind such an argument lies the assumption that the Strategy Method is a valid instrument for the classification of players, i.e. that it correctly identifies the individual attitudes to cooperation that are at work in repeated PG games. Fischbacher et al., however, do not present any evidence supporting this assumption. We have tested the assumption by replicating Fischbacher et al.'s experiment (the Strategy Method) jointly with a standard repeated linear PG experiment. The experimental setting is illustrated in Section 2. In Section 3 we summarise our results: we find that the Strategy Method is roughly adequate as an instrument of classification, but tends to underestimate the contribution of conditional cooperators in the PG game. In Section 4 we briefly comment on these findings and highlight some further testable implications.

2. The experiment

The experiment involves 92 subjects (vs. 44 in the original study), mostly students from the University of Trento.[2] In the first stage of the experiment, subjects are introduced to the standard linear PG environment, with a payoff function

$$\pi_i = 200 - g_i + 0.5\sum_{j=1}^{4} g_j \,, \qquad (1)$$

‡ University of Exeter, UK, and University of Trento, Italy; email: f.guala@ex.ac.uk.
[1] On the robustness of this phenomenon cf. Ledyard's (1995) survey.
[2] 84% from economics, 8% from political science; 61% male and 39% female subjects.

where 200 is the total number of tokens to be shared between a 'private' (200 – g) and a 'public' account (g). The only, minor, difference with respect to the Fischbacher et al. experiment is in the marginal payoff function of contributions to the public goods, which we raise from 0.4 to 0.5 tokens. Once subjects have been made familiar with the situation,[3] they are asked to take two types of decision: first, they are asked to make an 'unconditional contribution', i.e. to decide how much they would like to contribute in a standard one-shot PG game where each player, at the moment of taking her decision, doesn't know how much the other players have contributed. Secondly, subjects are asked to fill in a 'contribution table', i.e. to indicate how much they *would* be willing to contribute *if* they knew how much the other members of their group had contributed to the public good. In other words, subjects are asked to make a 'conditional contribution' in addition to the unconditional one just indicated. Participants know that after the decisions have been made subjects will be randomly allocated to groups of 4 players, one of which will be selected at random as the one who will actually play the conditional contribution task, based on the other three's unconditional decisions. The actual rewards are then calculated (and communicated to the players) according to the payoff function above. This way, both decisions (conditional and unconditional) are made relevant for the final result, and monetary incentives are provided for all members of the group.[4]

Up to this point, the experiment replicates Fischbacher et al.'s, with only minor changes in the set-up and a new (larger) sample of subjects. The second stage of the experiment extends their result by letting the same subjects play a repeated PG game with payoff function

$$\pi_i = 20 - g_i + 0.5\sum_{j=1}^{4} g_j \ , \qquad (2)$$

for 23 rounds (3 to warm up, and 20 for real). Participants were provided with a new set of instructions and were randomly re-allocated to different groups. The revenues from this stage were added to the revenues from the first stage to obtain the final rewards (eventually, subjects earned on average about 11 Euros).[5]

[3] In this phase we used (with minor adaptations) instructions and control questions provided by Fischbacher, Gächter and Fehr, whom we would like to thank.
[4] See Fischbaher et al. (2001) for a more detailed analysis of this procedure. Unlike in the original one, in our experiment the random selection mechanism was run by the computer.
[5] The software for both stages of the experiment was created by Marco Tecilla at CEEL.

3. Results

The results of the first stage (see Figure 1) replicate qualitatively Fischbacher et al.'s, with some quantitative difference. Fischbacher et al. classify individuals as free riders only if they provide a constant conditional contribution of zero; symmetrically, we label as cooperators only individuals who always contribute 200. Applying such (rather strict) criteria, we find that 8% of subjects can be classified as free riders (vs. 30% in the original study), 2% as unconditional or 'pure' cooperators (vs. 0%), 76% as conditional cooperators (vs. 50%). We also observe the rather puzzling 'hump-shaped' contribution schedules observed by Fischbacher et al., albeit to a lesser degree (6% in our sample, 14% in theirs). 6% of the subjects did not fall in any of these categories and were not classified. The main finding, then, is a higher rate of conditional cooperators, which together with two 'pure' cooperators make up more than three quarters of the sample. Although conditional cooperators overall display an 'individualistic bias', their contribution schedules are on average closer to the perfect conditional cooperation line than in the Fischbacher et al.'s study.[6]

[Figure 1 about here]

Did the classification based on the Strategy Method reflect any significant differences in contribution levels in the PG game? As shown in Table 1, free riders in the PG game contributed on average much less than conditional cooperators and pure cooperators. Moreover, on average each free rider contributed almost 3 token less than the other players in her group, whereas the contribution of the typical cooperator (both conditional and unconditional) is slightly above the group average. Interestingly, subjects with a 'hump-shaped' conditional contribution schedule free ride to a significant extent in the PG game.[7]

[Table 1 about here]

[6] This is consistent with previous studies, where Italians turned out to be more cooperative than Anglo-Saxons; cf. Burlando and Hey (1997).
[7] Again, we observe in general higher rates of contribution than in Fischbacher et al.'s experiment.

These results suggest that the Strategy Method is roughly adequate as an indicator of individual behaviour in a PG environment. However, how *precise* is it as an indicator? Fischbacher et al. strict classification criterion (free rider only if constant conditional contribution of zero, cooperator only if constant conditional contribution of 200) is likely to inflate the 'conditional cooperation' category and underestimate the number of free riders and cooperators. In fact we find that almost one half of conditional cooperators contribute more than 2 tokens above or below the group average in the PG game.

One might argue that deviations from the group mean are a consequence of the 'individualistic bias' displayed by conditional contribution schedules. But interestingly, we find that among the 31 subjects who substantially deviate from reciprocating behaviour only 13 contributed more than 2 tokens below the group average in the PG game, whereas 18 contributed more than 2 tokens *above* the group average. Contrary to what is revealed by the Strategy Method, a substantial portion of conditional cooperators are willing to sacrifice some of their income in order to promote cooperation. (In fact in the PG game conditional cooperators overall tend to contribute 0.5 tokens above the group average; see Table 1.)

4. Conclusions and suggestions for further research

Fischbacher et al.'s tentative explanation of the decay of contribution in PG experiments is corroborated by our data: subjects participating in these experiments can be usefully divided into categories, an important one being that of 'conditional cooperators'. Our findings, however, suggest that the Strategy Method invites too pessimistic conclusions about the behaviour of conditional cooperators in the linear PG setting. Despite the fact that their conditional contribution schedules lie on average *below* the perfect conditional contribution line, conditional cooperators in the PG game tend to contribute *more* than the average of the group they belong to. This fact has some interesting consequences that can be tested on their own: if we could form groups of conditional cooperators 'depurated' from free riders, we should expect to observe a stable rate of contributions in the PG game, instead of decay as implied by the results of the Strategy Method used by Fischbacher et al.

References

Burlando, R.M. and J.D. Hey, 1997, Do anglo-saxons free ride more? Journal of Public Economics 64, 41-60.

Fischbacher, U., S. Gächter, and E. Fehr, 2001, Are people conditionally cooperative? Evidence from a public goods experiment. Economics Letters 71, 397-404.

Ledyard, J.O., 1995, Public goods: a survey of experimental research. In: Kagel, J.H., and A.E. Roth (eds.), Handbook of Experimental Economics. Princeton University Press, Princeton.

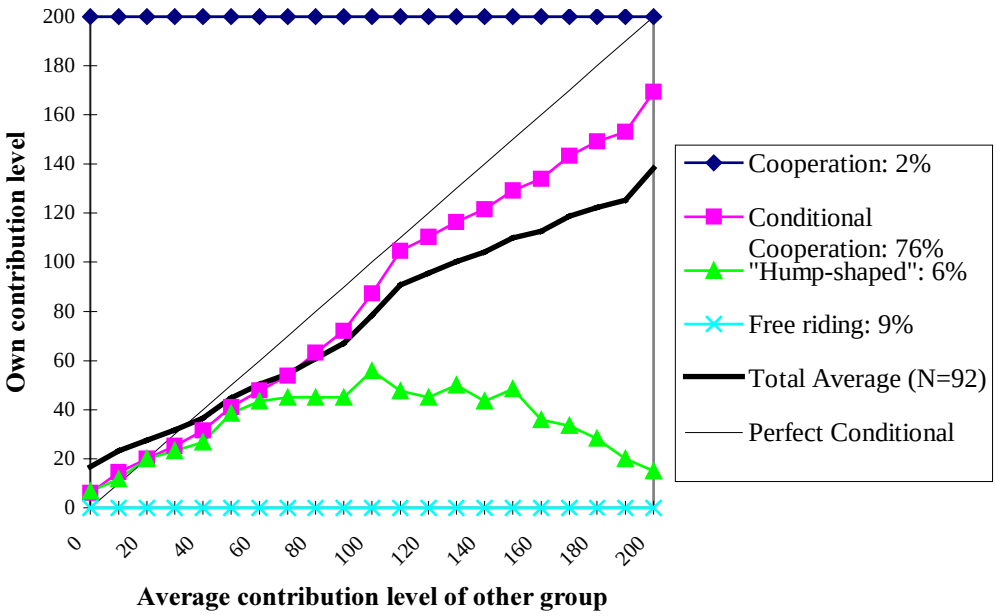


Figure 1: Strategy Method, conditional contribution per category

Strategy Method (tokens = 200)			Public Goods Experiment (tokens = 20)	
Type of player	No. of players	Uncond. contr.	Avg. Contr.	ind. contr. – group avg.
Free Rider	8	68.75 (34.37%)	4.77 (23.85%)	-2.98
Conditional Cooperator	70	107.21 (53.6%)	10.53 (52.62%)	0.55
Cooperator	2	200 (100%)	15.5 (77.5%)	0.61
Hump-Shaped	6	81.66 (40.83%)	6.89 (34.45%)	-0.89
Other	6	118.33 (59.16%)	6.46 (32.3%)	-1.53

Table 1: Behaviour in the PG game according to type

Appendix for the referees: experimental instructions (originally in Italian)

You are about to take part in an experiment for research purposes. If you read the following instructions carefully, you can, depending on your decisions, earn a considerable amount of money. It is therefore very important that you read these instructions with care.
The instructions which we have distributed to you, are solely for your private information. The experiment is in two stages. During each stage of the experiment your entire earnings will be calculated in 'tokens'. Each token is worth one cent of Euro. At the end of the experiment you will be given a sum of money (in Euros) equivalent to the sum of tokens you have accumulated during the experiment. You earnings are exclusively your business and you are not obliged to tell anyone how much you have earned.

From now on it is forbidden to speak to the other participants, or communicate in any other way. If you want to ask a question, just raise your hand.

STAGE ONE
All participants will be divided in groups of four members. Except us, the experimenters, nobody knows who is in which group.

Situation
Each member has to decide on the division of 200 tokens. You can keep these 200 tokens in an individual account or you can invest them fully or partially into a project. Each token you do not invest into the project will automatically be transferred to your individual account.

Income from the private account:
For each token you put on your individual account you will earn exactly one token. For example, if you put 200 tokens on your individual account (which implies that you do not invest anything into the project) you will earn exactly 200 tokens from the individual account. If you put 120 tokens into the individual account, you will receive an income of 120 tokens from the individual account. Nobody except you earns something from your individual account.

Income from the project
From the token amount you invest into the project each group member will get the same payoff. Of course, you will also get a payoff from the tokens the other group members invest into the project. For each group member the income from the project will be determined as follows:

$$\text{Income from the project} = (\text{sum of contributions to the project} \times 2) / 4,$$
or, in other words:
$$\text{Income from the project} = \text{sum of contributions to the project} \times 0.5.$$

For example, if the sum of all contributions to the project is 600 tokens, then you and all other group members will get a payoff of $600 \times 0.5 = 300$ tokens from the project.

If the four group members together contribute 100 tokens to the project, you and all others will get a payoff of $100 \times 0.5 = 50$ tokens from the project.

Important: Notice that each member of the group always participates to the profits of the project (i.e., always receives one quarter of the profits), regardless of how much she has contributed (even if she does not put anything into the project).

Total income
Your total income results from the summation of your income from the private account and your income from the project.

Questions
Please answer the following questions. Their purpose is to make you familiar with the calculation of incomes that accrue from different decisions about the allocation of the 200 tokens. The answers you provide to these questions will not affect your final earnings. (If you want, you can write with a pen in the dotted area, or if you prefer you can do your calculations by heart.)

1. Each group member has 200 tokens at his or her disposal. Assume that none of the four group members (including you) contributes anything to the project. What will your total income be?……..
What is the total income of the other group members?……..

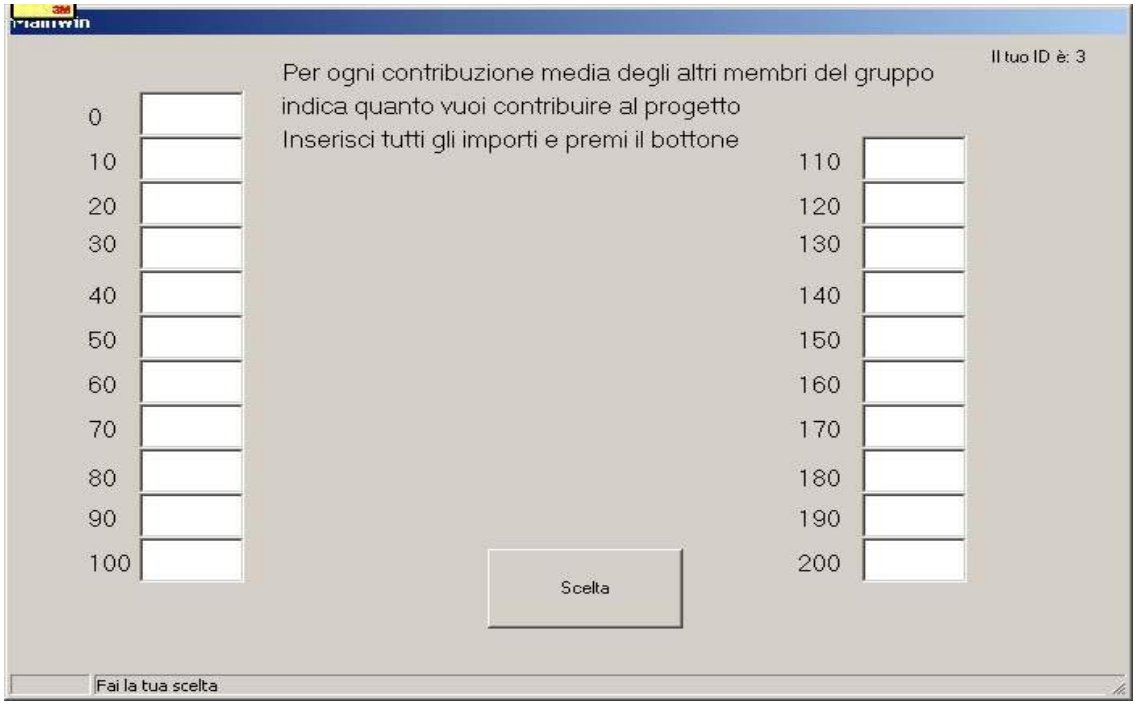
2. Each group member has 200 tokens at his or her disposal. Assume that you invest 200 tokens into the project and each of the other group members also invests 200 tokens. What will be your total income?……
What is the total income of the other group members?……

3. Each group member has 200 tokens at his or her disposal. Assume that the other three group members together contribute 300 tokens to the project.
What is your total income if you - in addition to the 300 tokens - contribute 0 tokens to the project?……..
What is your income if you - in addition to the 300 tokens - contribute 80 tokens to the project?……
What is your income if you - in addition to the 300 tokens - contribute 150 tokens to the project?……..
4. Each group member has 200 tokens at his or her disposal. Assume that you invest 80 tokens to the project.
What is your total income if the other group members - in addition to your 80 tokens - together contribute 70 tokens to the project?……..
What is your total income if the other group members - in addition to your 80 tokens - together contribute 120 tokens to the project?……
What is your income if the other group members - in addition to your 80 tokens- contribute 220 tokens to the project?……

The Experiment: Part One
This part of the experiment contains the decision situation that we have just described to you. At the end of the experiment you will get paid according to the decisions you make in this part of the experiment. This part of the experiment will only be conducted once. As you know you will have 200 tokens at your disposal. You can put

them into a private account or you can invest them into a project. In this experiment each subject has to make two types of decisions. In the following we will call them "unconditional contribution" and "contribution table".
With the unconditional contribution to the project you have to decide how many of the 200 tokens you want to invest into the project. You will enter this amount into the following computer screen:

After you have determined your unconditional contribution you press the 'Choice' ('Scelta') button. Your second task is to fill out a 'contribution table'. In the contribution table you have to indicate for each possible average contribution of the other group members (rounded to the next integer) how many tokens you want to contribute to the project. You can condition your contribution on the contribution of the other group members. This will be immediately clear to you if you take a look at the following screen. This screen will show up immediately after you have determined your unconditional contribution. The numbers next to the input boxes are the possible (rounded) average contributions of the other group members to the project. You simply have to insert into each input box how many tokens you will contribute to the project - conditional on the indicated average contribution. You have to make an entry into each input box. For example, you will have to indicate how much you contribute to the project if the others contribute 0 tokens to the project, how much you contribute if the others contribute 1, 2, or 3 tokens etc. In each input box you can insert all integer numbers from 0 to 20. If you have made an entry in each input box, press the 'Choice' button.



After all participants of the experiment have made an unconditional contribution and have filled out their contribution table, in each group a random mechanism will select a group member. For the randomly determined subject only the contribution table will be the payoff-relevant decision. For the other three group members that are not selected by the random mechanism, only the unconditional contribution will be the payoff-relevant decision. When you make your unconditional contribution and when you fill out the contribution table you of course do not know whether you will be selected by the random mechanism. You will therefore have to think carefully about both types of decisions because both can become relevant for you. Two examples should make that clear.

EXAMPLE 1: Assume that you have been selected by the random mechanism. This implies that your relevant decision will be your contribution table. For the other three group members the unconditional contribution is the relevant decision. Assume they have made unconditional contributions of 0, 20, and 40 tokens. The average contribution of these three group members, therefore, is 20 tokens. If you have indicated in your contribution table that you will contribute 10 token if the others contribute 20 tokens on average, then the total contribution to the project is given by 0 + 20 + 40 + 10 = 70 tokens. All group members, therefore earn $0.5 \times 70 = 35$ tokens from the project plus their respective income from the private account. If you have instead indicated in your contribution table that you will contribute 190 tokens if the others contribute 20 tokens on average, then the total contribution of the group to the project is given by 0 + 20 + 40 + 190 = 250. All group members therefore earn $0.5 \times 250 = 125$ points from the project plus their respective income from the private account.

EXAMPLE 2: Assume that you have not been selected by the random mechanism which implies that for you and two other group members the unconditional contribution is taken as the payoff-relevant decision. Assume your unconditional contribution is 160 tokens and those of the other two group members is 180 and

200 tokens. The average unconditional contribution of you and the two other group members, therefore, is 180 tokens. If the group member who has been selected by the random mechanism indicates in her contribution table that she will contribute 10 token if the other three group members contribute on average 180 tokens, then the total contribution of the group to the project is given by 160 + 180 + 200 + 10 = 550 tokens. All group members will therefore earn $0.5 \times 550 = 275$ points from the project plus their respective income from the private account. If instead the randomly selected group member indicates in her contribution table that she contributes 190 if the others contribute on average 180 tokens, then the total contribution of that group to the project is 160 + 180 + 200 + 190 = 730 tokens. All group members will therefore earn
$0.5 \times 730 = 365$ points from the project plus their respective income from the private account. The random selection of the participants will be implemented automatically by the computer. The results will appear on the screen, together with your payoff, when all participants will have completed the unconditional contribution task.

STAGE TWO (this set of instructions was distributed once the first stage (Strategy Method) was over.)

In the second part of the experiment you will have to take decisions in a situation that is very similar to the one you have just faced. The following instructions will help to refresh your memory. Again, one token is worth one cent of Euro at the end of the experiment. All participants will be divided in groups of four members. Except us, the experimenters, nobody knows who is in which group.

Situation
Each member has to decide on the division of 20 tokens. You can keep these 20 tokens in an individual account or you can invest them fully or partially into a project. Each token you do not invest into the project will automatically be transferred to your individual account.

Income from the private account:
For each token you put on your individual account you will earn exactly one token. For example, if you put 20 tokens on your individual account (which implies that you do not invest anything into the project) you will earn exactly 20 tokens from the individual account. If you put 12 tokens into the individual account, you will receive an income of 12 tokens from the individual account. Nobody except you earns something from your individual account.

Income from the project
From the token amount you invest into the project each group member will get the same payoff. Of course, you will also get a payoff from the tokens the other group members invest into the project. For each group member the income from the project will be determined as follows:

Income from the project = (sum of contributions to the project $\times$ 2) / 4,
or, in other words:
Income from the project = sum of contributions to the project $\times$ 0.5.

For example, if the sum of all contributions to the project is 60 tokens, then you and all other group members will get a payoff of $60 \times 0.5 = 30$ tokens from the project. If the four group members together contribute 10 tokens to the project, you and all others will get a payoff of $10 \times 0.5 = 5$ tokens from the project.

Important: Notice that each member of the group always participates to the profits of the project (i.e., always receives one quarter of the profits), regardless of how much she has contributed (even if she does not put anything into the project).

The Experiment (Part two)
For 23 rounds, at each round you will be asked how much you want to invest in the project. When you will share the tokens between your individual account and the project, you will not know how much has been invested by the other members of the group. After each round, however, you will be told how much, on average, has been invested by the other members of the group. The first 3 rounds are just for training, and their outcome will not be used to calculate the final payoffs. After the third round you will be informed that the payoffs are 'for real' from then on. Press the 'OK' key when you are ready to begin.