The strategy method conflates confusion with conditional cooperation in public goods games: evidence from large scale replications

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Highlights

- We run 3 large studies on the strategy method in public goods games (N=845)
- All participants play twice, once with humans and once with computers
- Most participants conditionally cooperate with both humans and computers

Abstract

The strategy method is often used in public goods games to measure individuals' willingness to cooperate depending on the level of cooperation by others (conditional cooperation). However, while the strategy method is informative, it risks being suggestive and inducing elevated levels of conditional cooperation that are not motivated by concerns for fairness, especially in uncertain or confused participants. Here we make 845 participants complete the strategy method two times, once with human and once with computerized groupmates. Cooperation with computers cannot rationally be motivated by concerns for fairness. Worryingly, 69% of participants conditionally cooperated with computers, whereas only 7% conditionally cooperated with humans while not cooperating with computers. Overall, 83% of participants cooperated with computers, contributing 89% as much as towards humans. Results from games with computers present a serious problem for measuring social behaviors.

Keywords:

Confusion; fairness; inequity-aversion; strong reciprocity

JEL classification

H41 – public economics, publicly provided goods

C91 – design of experiments, laboratory, individual behavior

C72 – Non cooperative games

1. Introduction

The strategy method of Fischbacher et al. (2001) is routinely used in studies of cooperation and social preferences (Kocher et al., 2008; Thoni and Volk, 2018). The method makes individuals specify, in advance, how much they will contribute to a public good depending upon how much their groupmates contribute. Widely replicated results show that many individuals appear motivated by a concern for fairness, and positively condition their contributions upon the level of their groupmates contributions (conditional cooperation). The finding that many individuals choose not to maximize their own income but instead minimize inequity (inequity aversion (Fehr and Schmidt, 1999)), forms a keystone in the idea that human cooperation is biologically unique (Camerer, 2013; Fehr and Fischbacher, 2003; Fehr and Schurtenberger, 2018).

However, while the strategy method cleverly controls for participants' beliefs about groupmates' (Fischbacher and Gachter, 2010), it does not control for confusion, and the design prompts participants to condition their contributions (Columbus and Böhm, 2021). Consequently, the strategy method risks measuring confusion or compliance with suggestive instructions (experimenter demand, (Zizzo, 2010)) rather than accurate social preferences.

Here we expand the experiment of Fischbacher et al. (2001) to include a control treatment whereby participants also have to contribute towards computerized/virtual groupmates. Contributions towards computers cannot rationally be motivated by prosocial concerns such as inequity-aversion (Fehr and Schmidt, 1999). Therefore, designs with computerized groupmates maintain the suggestive instructions and risk of measuring confusion while

eliminating social concerns ('asocial control'). Consequently, if individuals conditionally cooperate with computers that cannot possibly benefit, their behavior violates the assumption that participants perfectly understand the game and maximize income in line with their social preferences i.e., are rational.

Our study replicates two previous studies that found high levels of conditional cooperation with computers (Burton-Chellew et al., 2016; Ferraro and Vossler, 2010). Our advance is three-fold: we (1) drastically expand the previous sample sizes of 40 and 72 to 845; (2) allow for within-participant comparisons by making all participants play twice, once with human and once with computerized groupmates, and (3) vary a range of presentation factors such as treatment order (either sequential or simultaneous), and the use of default inputs (either 0% or 100%).

2. Methods

We replicated the instructions and comprehension questions of Fischbacher & Gachter (2010) (Appendix A). The public goods game involved groups of four, with a marginal per capita return of 0.4 and an endowment of 20 Monetary Units (MU) (1 MU = 0.04 or 0.05 CHF). Each computerized groupmate contributed randomly from a uniform distribution (0-20 MU). The income maximizing contribution was to contribute 0 MU regardless of what one's groupmates contributed. We ran three studies at the University of Lausanne (UNIL), Switzerland, HEC-LABEX facility, which forbids deception.

2.1 Study 1

Study 1 involved 420 participants across 20 sessions of 20-24 participants each, but a programming error means we exclude all 64 participants from the first three sessions (N = 356 valid). We presented the two strategy methods sequentially, with either humans or computers first. Participants did not know that there would be a second task, and they received limited feedback from the first task to prevent learning. Half the participants saw contributions increasing from 0 to 20 MU, and half saw the reverse, from 20 to 0 MU. [1]

[1] Neither the order of contributions in Study 1 nor the screen position in Studies 2-3 had significant effects upon behavior, and we do not discuss them further.

2.2 Study 2

Study 2 involved 240 participants across 20 sessions of 12 participants each. Three participants are excluded because they had to be replaced by an experimenter. The design presented the two versions of the strategy method simultaneously, with either humans or computers on the left. [1]

2.3 Study 3

Study 3 involved 252 participants across 16 sessions of 12-16 participants with no exclusions and replicated study 2 except we showed some participants default contributions of either 0 MU (N=64) or 20 MU (N=64). Participants could overwrite defaults for free but there was an effort cost.

2.4 Analyses

We classified free riders and conditional cooperators according to the definitions of Thoni & Volk (2018), and we classified all other responses as 'other'. Free riders always contributed 0 MU. Conditional cooperators had a positive Pearson correlation greater than 0.5 between their responses and the contributions of their groupmates, plus a contribution when their groupmates contributed fully that was higher than their mean conditional response.

3. Results

3.1 Conditional cooperation with computers

Overall, behavior was strikingly similar regardless of if participants were grouped with humans or computers (Fig. 1). The mean Pearson correlation between participant's responses and their groupmates' mean contribution was 0.68 when playing with humans and 0.60 when playing with computers (paired Wilcoxon signed rank test: $V = 106216$, $P < 0.001$, Fig. 1). Contributions towards computers were 89% as large as towards humans. Specifically, the average contribution across all scenarios in the strategy method towards humans was 34% (6.8 MU ±95% bootstrapped confidence intervals [6.71, 6.90]), and towards computers was 30% (6.0 MU ±95% bootstrapped confidence intervals [5.95, 6.14]) (paired Wilcoxon signed rank test: $V = 110110$, $P < 0.001$, Fig. 2).

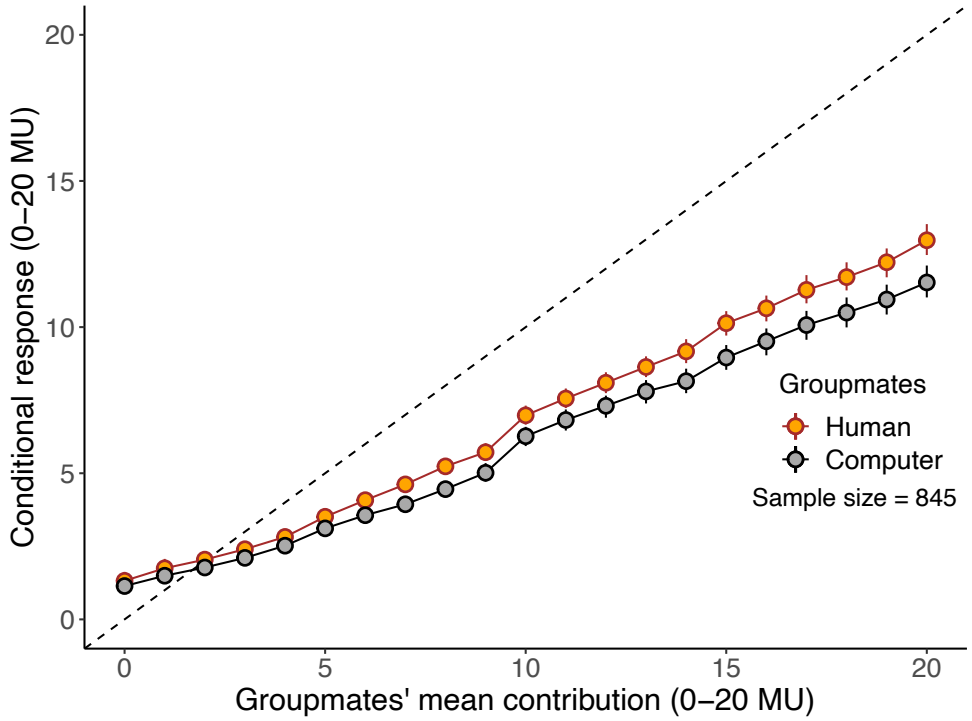

Fig. 1. Conditional cooperation with computers. *Mean conditional contributions and 95% bootstrapped confidence interval for each average contribution level of either human (orange) or computerized (grey) groupmates (dashed diagonal = perfect matching).*

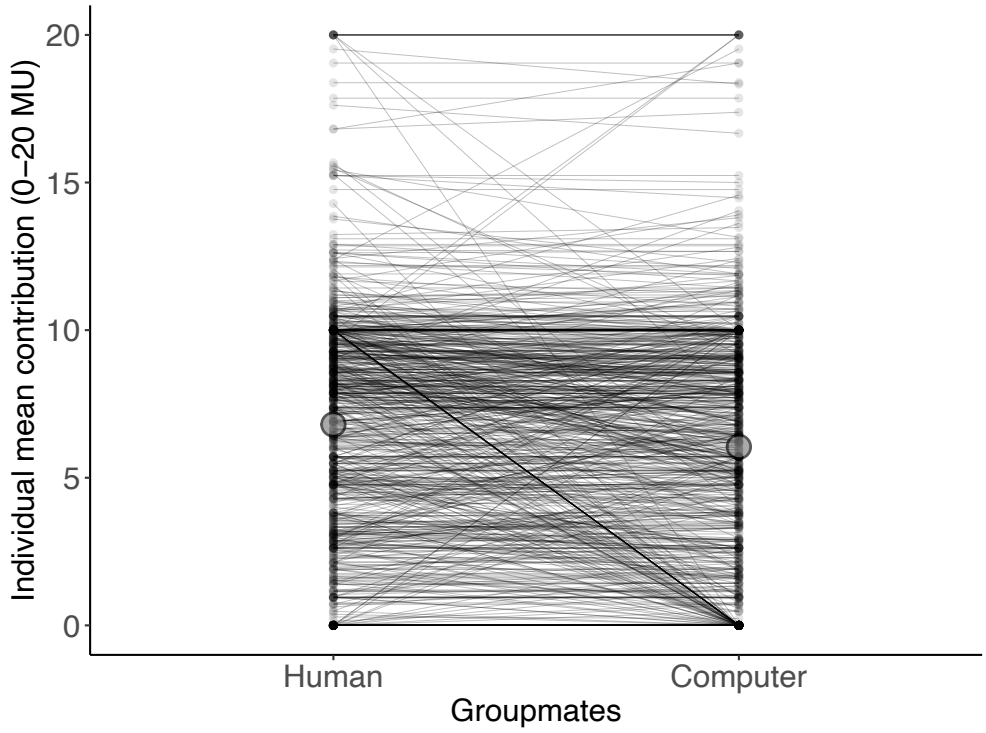

Fig. 2. Individual behavior. *Every individual's mean contribution with either Humans or Computers (N=845). Lines connect individual responses. Larger transparent circle shows the overall mean for each case.*

The distribution of types was largely similar when playing with either humans or computers (Table 1, χ^2= 42.6, df = 2, P < 0.0001). While 76% of participants expressed conditional cooperation with human groupmates (N = 638/845), consistent with concerns for fairness (inequity-aversion), 69% also expressed conditional cooperation with computerized groupmates (N = 580/845), consistent with confusion or irrationality (Table 1). Contributing zero in all cases (free riding) was 10% with humans and 17% with computers. This means that 83% of participants (N = 705/845) contributed something towards computers and failed to maximize their income even when there were no social concerns.

3.2 Treatment order and framing

Regardless of whether participants were first grouped with humans, or computers, or faced both scenarios simultaneously, most participants still conditionally cooperated with computers (62%-73%, Table 1). Even when presented with default entries of 0 MU, 58% of participants still conditionally cooperated with computers (N = 37/64) and only 30% were free riders (N = 19/64). Strikingly, of the 64 participants shown a default of 100%, only one became a free rider with computers, and none did with humans, while 81% were conditional cooperators with computers (84% with humans).

Table 1: summary statistics.

	Overall		Human first [1]		Computer first [1]		Simultaneous [2]		Default 0% [3]		Default 100% [3]		No default [3]	
Response	Human	Comp.	Human	Comp.	Human	Comp.	Human	Comp.	Human	Comp.	Human	Comp.	Human	Comp.
Cond. coop. [4]	76%	69%	74%	62%	69%	73%	78%	69%	72%	58%	84%	81%	84%	76%
Free rider	10%	17%	7%	18%	14%	15%	10%	17%	14%	30%	0%	2%	4%	11%
Other	15%	15%	18%	20%	17%	13%	11%	14%	14%	13%	16%	17%	12%	13%
mean corr. [5]	0.68	0.62	0.66	0.57	0.61	0.65	0.71	0.62	0.68	0.55	0.77	0.74	0.74	0.68
mean cont. [6]	6.8	6.0	7.1	5.6	6.2	6.0	6.7	6.0	6.5	5.3	8.7	8.2	7.6	6.7
Sample size	845	/	164	/	192	/	361	/	64	/	64	/	124	/

[1] Study 1.

[2] Studies 2 and 3: excludes the participants we showed default contributions.

[3] Study 3 only.

[4] Conditional cooperators. The overall percentages of all participants that were 'perfect' conditional cooperators were 10% and 8% respectively.

[5] Pearson correlation (0-1).

[6] Contribution (0-20 MU).

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3.3 *Homo confusus*

We classified individuals according to how they behaved with both humans and computers. *Homo economicus* would maximize their income by contributing only zero towards both human and computerized groupmates. True conditional cooperation, based on a concern for fairness, would cooperate conditionally with humans but would free ride with computers. In contrast, if conditional cooperation is driven by confusion or the suggestive instructions, then confused or irrational individuals ('*Homo confusus*') will cooperate conditionally with both humans and computers.

Our results challenge the notion that humans are mostly conditional cooperators motivated by concerns for fairness (Table 2). Instead, we found that 65% of participants classified as *Homo confusus* (N = 550/845), 9% as *Homo economicus* (N = 73/845), and only 7% as true conditional cooperators (N = 61/845).

Table 2: *Homo confusus.* Behavioral types according to classification when grouped with Humans and when grouped with Computers.

Label	Humans / Computers	% (N)
True FR [1] (*Homo economicus*)	FR / FR	9% (73)
True CC [2]	CC / FR	7% (61)
Confused CC (*Homo confusus*)	CC / CC	65% (550)
Other [3]	none of the above	19% (161)

[1] FR = free rider.

[2] CC = conditional cooperator.

[3] 155 of 'Other' cooperated with computers in some way (18% of total sample).

4. Concluding discussion

Our large-scale replication confirmed that conditional cooperation with computers is common and that most participants are either confused or irrational. In contrast, our results strongly suggest that true conditional cooperation, motivated by concerns for fairness, is

rare. Our results show the benefit of control treatments when measuring social behaviors (Weber and Camerer, 2006) and suggest that public-goods experiments often measure levels of confusion rather than accurately document social preferences (Burton-Chellew and West, 2013; Burton-Chellew and West, 2021).

Acknowledgements

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Appendix A: Experiment instructions

(analysis code and data as separate files).

Stage 1 screen 1 – general instructions about the public good game decision

You are now taking part in an economic experiment, which has been financed purely for academic research purposes.

If you read the following instructions carefully, you can, depending on your decisions, earn a reasonable 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.

You are not allowed to communicate during the experiment.

If you have any questions, please ask us. Violation of this rule will lead to your exclusion from the experiment and all payments.

If you have questions, please raise your hand. A member of the experimenter team will come to you and answer them in private.

During the experiment we shall not speak of CHF but rather of MU (Monetary Units).

During the experiment your entire earnings will be calculated in MU.

At the end of the experiment the total amount of MU you have earned will be converted to CHF at the following rate:

1 MU = 0.05 CHF, so 20 MU = 1 CHF and 100 MU = 5 CHF. [Exchange rate was 0.04 in Study 1]

At the end of the experiment your entire earnings from the experiment will be immediately paid to you in cash.

We describe the experimental process below.

Stage 1 screen 2

The decision situation

You will learn how the experiment will be conducted later. We first introduce you to the basic decision situation. You will find control questions at the end of the instructions that help you to understand the decision situation.

You will be in a group consisting of **4 people**. Each group member has to decide on the allocation of 20 MU. You can put these 20 MU into your **private account** or you can invest them **fully or partially** into a project. Each point you do not invest into the project, will automatically remain in your private account.

Your income from the private account:

You will earn one MU for each MU that you put into your private account.
For example, if you put 20 MU into your private account (and therefore do not invest into the project) your income will amount to exactly 20 MU out of your private account.
If you put 6 MU into your private account, your income from this account will be 6 MU.
No one except you earns something from your private account.

Stage 1 screen 3

Your income from the project:

Each member of the group will also benefit from the amount you invest in the project.
On the other hand, you will also gain from the other group members' investments.
The income for each group member will be determined as follows:

Income from the project = *sum of all contributions x 0.4*

If, for example, the sum of all contributions to the project is 60 MU, then you and the other members of your group each earn 60 x 0.4 = 24 MU out of the project.
If four members of the group contribute a total of 10 MU to the project, you and the other members of your group each earn 10 x 0.4 = 4 MU.

Total income:

Your total income is the sum of your income from your private account and that from the project:

Income from your private account (= 20 - contribution to the project)
+ Income from the project (= 0.4 x sum of all contributions to the project)
= Your Total Income

We then presented the same four hypothetical scenarios and corresponding 10 control questions as used in Fischbacher & Gachter 2010. Participants could use a calculator and there was a copy of the instructions detailing how payoffs are calculated in a help box at the bottom of each screen.

In Study 1, if a participant answered a question incorrectly, they were asked to try again. Then, regardless of if they were correct or not, we showed all participants the correct answer to that question. In Studies 2 and 3, we only let them try one time before showing them the correct answers to reduce the time spent on instructions.

Stage 1 screen 4

Please answer the following four control questions. They will help you to gain an understanding of the calculation of your income, which varies with your decision about how to distribute your 20 MU.

There is a calculator available.
To access the calculator, click on the image in the bottom right of your screen.
Please enter your answers into the spaces provided and press Continue when done.

Question 1: Each group member has an endowment of 20 MU. Nobody (including yourself) contributes any MU to the project.

What is *your* total income (in MU)? [answer box, correct answer is 20]

What is the total income of each of the *other* group members? [answer box, correct answer is 20]

Stage 1 screen 5

Here is the second question.

Question 2: Each group member has an endowment of 20 MU. You invest 20 MU in the project. Each of the other three members of the group also contributes 20 MU to the project.

What is *your* total income (in MU)? [answer box, correct answer is 32]

What is the total income of each of the *other* group members? [answer box, correct answer is 32]

Stage 1 screen 6

Here is the third question.

Question 3: Each group member has an endowment of 20 MU. The other three group members contribute a total of 30 MU to the project.

What is *your* total income (in MU), if you - in addition to the 30 MU - invest 0 MU into the project? [answer box, correct answer is 32]

What is *your* total income (in MU), if you - in addition to the 30 MU - invest 10 MU into the project? [answer box, correct answer is 26]

What is *your* total income (in MU), if you - in addition to the 30 MU - invest 15 MU into the project? [answer box, correct answer is 23]

Stage 1 screen 7

Here is the final question.

Question 4: Each group member has an endowment of 20 MU. Assume that you invest 8 MU to the project.

What is *your* total income (in MU) if the other group members together - in addition to your 8 MU - contribute another 7 MU in total to the project? [answer box, correct answer is 18]

What is *your* total income (in MU) if the other group members together - in addition to your 8 MU - contribute another 12 MU in total to the project? [answer box, correct answer is 20]

What is *your* total income (in MU) if the other group members together - in addition to your 8 MU - contribute another 22 MU in total to the project? [answer box, correct answer is 24]

STRATEGY METHOD STAGE

Example instructions taken from study 1 – with sequential presentation: humans then computers

Strategy method - Screen 1

You will now take this decision for a special case. Rather than simply making an unconditional contribution, **you will ALSO make a list of contributions** conditioned by the contribution of the partners.

Your task consists of indicating the number of MU you want to invest in the project **based upon each possible average contribution from the other members of the group** (rounded to the nearest whole number).

You can vary your contribution according to the contributions of other members of the group.

A member of your group will then be selected to implement their **conditional contribution**, while the other 3 members of the group will implement their **non-conditional contribution**. Thus, for one of the members of the group, their earnings will be calculated according to the average contribution of the other 3 members of the group, as well as the amount of their own conditional contribution corresponding to this average amount.

On the other hand, for the other 3 members of the group, their respective earnings will be calculated using their **non-conditional** contribution.

We will not disclose your earnings to you now, but you will receive the corresponding amount the end of the experiment. After the experiment, only the experimenter will be aware of your conditional and non-conditional contributions, and your decisions will remain anonymous.

To clarify, your table of conditional contributions will have absolutely no future consequences after this decision-making round.

Strategy method - Screen 2

You must make two decisions.

The first decision is to play *unconditionally* with the members of your group.
You will not know what they will do with their decision. There is a 75% chance that this will be your real contribution the end of the round.
However, there is a 25% chance that your real contribution will be determined from your second decision, as follows.
For the second decision, you have the possibility to condition your contribution, in the table of contributions, in relation to what the members of your group would decide.
Enter the amount you want to contribute to the project, in case where the members of your group contribute the average **contribution** which is left of the input field.
This decision is binding and final. When you have finished completing the tables press the "Confirm" button.

Strategy method - Screen 3

Participants then saw the contribution schedule.

Enter your **non-conditional** contribution to the project (0-20 MU) for when you do not know the contribution of your group members.

Enter your **conditional** contribution to the project (contribution table)

If the members of your group contribute, on average, X MU. [X = 0-20]
If the members of your group contribute, on average, X MU. [X = 0-20]
If the members of your group contribute, on average, X MU. [X = 0-20]
And so on…

Strategy method - Screen 4

Your earnings are being calculated.

The average contribution of your groupmembers was X MU.
Consequently, your **conditional** contribution was X MU (this contribution had a 25% chance of being realised).

Your **non-conditional** contribution was X MU (and this had a 75% chance of being realised).

Your actual contribution was X MU.

Your earnings are being calculated.
There is no other information for this decision, but the money you have earned will be added to your final income.

Strategy method - Screen 5

You will now again face the same decisions you have just taken, but in a new **special case**.
In this case, you will be in a group composed only of you and the COMPUTER.
Everything else will take place in the same way as before, the only difference being that instead of 3 other people, you will play only with **the computer**.

The computer will take the decisions instead of the other 3 members of the virtual group.
The decisions of the computer will be taken **in a random and independent way** (each virtual player will therefore make its own decision at random).

You are **the only real human member in your group**, and only you will receive money from the outcome of this round.
Your income will be calculated as explained during the initial instructions.
Your income will be determined as if the other members of your group were using real money, although they are really only a computer playing randomly.
You will now play this special case in a single round.

You will not receive any information about your earnings obtained during this round until the experiment is over, but it is a real decision with real money.
Only the experimenter will be aware of your decision, and this will have no consequence for you later in the experiment apart from the fact you create additional income depending on the outcome of this round.
Your income obtained in this round will be added to your final income today.

Strategy method – screen 6

You must make two decisions.

For the first decision, you will play **non-conditionally** with the computer.
You will not know what the computer contributes, but it will contribute at random. Like before, there is a 75% chance that this will be your real contribution.
On the other hand, there is a 25% chance that your real contribution will be determined according to your second decision, as follows.

For the second decision, you have the possibility to vary your contribution, in the table of contributions, according to the decision of the computer.
Enter the amount you want to contribute to the project if your group members (virtual players on the computer) contribute the **average** contribution to the left of the input field.
This decision is binding and final. When you have finished completing the table, press the "Confirm" button

Enter your **non-conditional** contribution to the project (0-20 MU) for when you do not know the how much the computer contributes.

Enter your **conditional** contribution to the project (contribution table)

If the computer contributes, on average, X MU. [X = 0-20]
If the computer contributes, on average, X MU. [X = 0-20]
If the computer contributes, on average, X MU. [X = 0-20]
And so on…

Strategy method – screen 7

Your earnings are being calculated.

The average contribution of the computer was X MU.
Consequently, your **conditional** contribution was X MU (this contribution had a 25% chance of being realised).

Your **non-conditional** contribution was X MU (and this had a 75% chance of being realised).

Your actual contribution was X MU.

Your earnings are being calculated.
There is no other information for this decision, but the money you have earned will be added to your final income.