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Conditional cooperation experiment proposal

1. Introduction and related literatures

In public good games there is always a dominant strategy which is the subjects choose to invest nothing to the public good. But in practice, people have observed cooperation is heterogeneous (conditional cooperation, humped shape and free riding) and declining over time.

The experiment used a standard linear public goods game proposed by Ledyard (1995), the payoff function is as follows:

$$\pi_i = 20 - g_i + 0.4 \sum_{j=1}^4 g_j$$

One of the possible explanations to this phenomenon is the idea that people want to contribute more if they observe others contribute more.

The conditional cooperation proposed by Fischbacher et al. (2001), which still use the above formula, shows that every candidate has an endowment of 20 tokens, and then they need to decide how much they should contribute to the public account which only gives the marginal return rate of 40%.

Basically, Fischbacher et al. used 2 methods:

The first method is unconditional contribution which means people can choose their contribution with respect to their own endowment without knowing other three subjects' information, such as endowment and contributions.

In the meantime, the second method asks every subject about their contributions and then, experimenters construct a contribution table which contains the choice for each subject based on average (rounded) contributions of the other 3 subjects.

Others' avg contrib	0	1	2	18	19	20
Yours contribution									

Contrary to the predictions of the Nash equilibrium, Fischbacher et al. find subjects deviate from both free riding or totally contribution. They find that 50% of their participants are conditional cooperators. However, the slope of the contributions profile for these participants lies below the 45-degree line.

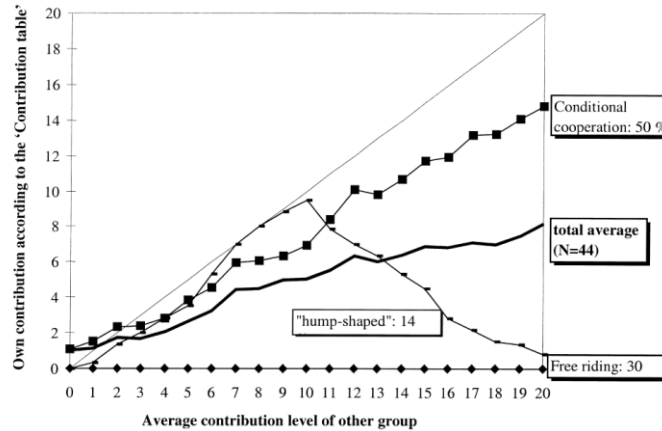


Fig 1. Three different type of subjects

Frey and Meier (2004) pointed out that the behavior behind conditional cooperation consistent with 3 theoretical approaches. People tend to conform a social norm (David M. Messick, 1999); people want to pursuit social fairness, such as reciprocity and inequity averse (Matthew Rabin, 1993); and contributions by others may serve as a signal of the quality of the public good.

From our experimental design, we will try to figure out whether there exists a conditional cooperation effect or not; besides, it is also prompted us to figure out which pattern the conditional cooperators are mimicking (dominate pattern in our samples as shown above). We also collected the perceived value from the normal public good games to see if there is any deviation from actual value and perceived values.

Some further existing papers, in cross-culture studies, even show ambiguous results. The previous study which are carried out by Brandts et al. (2004), picked subjects from Japan, Netherlands, Spain and USA, suggest little differences in contributions across these locations.

But when Kocher et al. (2008) replicate the experiment of Fischbacher in USA, Austria and Japan, only to find that the CCs in America has a dominant proportion(81%) compared with this in Austria (44%) or Japan (42%). They suggested the nature of CC may vary from culture to culture.

As a suggestion, this also recommend us to run the experiment in different cultures and countries.

2. Conditional cooperation experiment proposal

Inspired by Fischbacher's experiment and mentioned others, we propose our experiment with one shot public good game to figure out whether the conditional cooperation and the belief of perceived others' contribution affects the player' choice of contribution, in compared to normal public game. Furthermore, from the data we collect, we hope to find some interesting possible influences of conditional cooperation and the belief.

Our experiment was programed by zTree software. In our experiment, we design:

- the selected subjects are chosen randomly in each group. In group 2 and 4, we call the selected subjects as artificial selected subjects. Each non-selected subject receives an initial endowment and then choose his or her contribution. The selected subject chooses his or her contribution with knowing all the information about others' endowment and contribution.

- Group 1 and group 3, which have the same design, play conditional cooperation in a one-shot public good game, meaning that the selected subjects will decide contributions with all information about other subjects' endowments and contributions.

- Group 2 and group 4, which have the same design, play a normal one-shot public good game but in the end, we ask the selected subjects, called artificial selected subjects, about their perceived contributions of other non-selected subjects by a question: "Please tell us how much, in your opinions, will they contribute".

We collect the average contribution ratio, which is the ratio between contribution and endowment, in each group:

- From data of group 1 and group 3, we collect CR_{1,3_s} is a dependent variable, called for the average contribution ratio of selected subjects, who play conditional cooperation in a one-shot public good game. CR_{1,3_others} is an independent variable, called for the average contribution ratio of non- selected subjects.

We have a regression 1:

$$CR_{1,3_s} = \alpha_1 + \beta_1 CR_{1,3_others} + \varepsilon$$

- From data of group 2 and group 4, we collect CR_{2,4_s} is a dependent variable, called for the average contribution ratio of artificial selected subjects, who play a normal one-shot public good with the question about perceived contributions of others. CR_{2,4_others_belief} is an independent variable, called for the average perceived contribution ratio of non-selected subjects collected from the selected subject's answers.

We have a regression 2:

$$CR_{2,4_s} = \alpha_2 + \beta_2 CR_{2,4_others_belief} + \varepsilon$$

- From data of group 2 and group 4, we collect CR_{2,4_s} is a dependent variable, called for the average contribution ratio of artificial selected subjects, who play a normal one-shot public good. However, CR_{2,4_other_actual} is an independent variable, called for the average actual contribution ratio of non-selected subjects. Those data represent the data of normal public good game when each subject choose contribution without any information about others' choices.

We have a regression 3:

$$CR_{2,4_s} = \alpha_3 + \beta_3 CR_{2,4_other_actual} + \varepsilon$$

The hypothesis:

Ho: $\beta_1 = \beta_2 = \beta_3$ (the conditional cooperation and perceived belief do not affect)

H1: $\beta_1 \neq \beta_2 \neq \beta_3$ (the conditional cooperation and perceived belief do affect)

We expect that we reject Ho, and therefore accept H1, meaning the conditional cooperation and perceived belief do affect. From the data, we can know the magnitude of $\beta_1, \beta_2, \beta_3$; these values could be useful for further findings and implications for researches in the future.

3. The z-Tree designed program:

Our z-Tree program's structure:

- Background: set up the general parameters with 16 clients, called subjects, and 1 period, called a one-shot game, and furthermore generate some global's and subject's variables. At the beginning, we assign the group using matching partner rules, having 4 groups of clients.

- The first stage, called None-selected subjects' contributions: show random endowments to none-selected subjects in group 1 and group 3 respectively and to all subject in group 2 and group 4 respectively and then, collect the data of their contributions.

- The second stage, called Selected subject's decision: show all information about others' choices such as endowments and contribution to the selected subject in group 1 and group3 respectively and his or her random endowment and then, collect the data of his or her contribution.

- The third stage, called Perceived values of two control groups: show the endowments of non-selected subjects in group 2 and group 4 to the artificial selected subjects respectively, then ask them how much endowments they think others had contributed, called perceived beliefs about others' contributions.

- The final stage, called Profit Display: show each subject his or her total profit, endowment, and contribution.

3.1 Background

In our z-Tree program, we set up Background with 16 subjects playing 1 period (one-shot game), based on our proposed experiment. We assign 16 subjects into 4 groups of four by matching partner function.

In term of a global variable, we generate:

- "Selected" by roundup command to get the random integer value from 1 to 4, which stands for the id of the selected subject in our experiment. For example, if "Selected" = 2, it means that the selected subject in our experiment is the subject has the id of 2.

- series of Global Variables: "Endowment_1", "Endowment_2", "Endowment_3" and "Endowment_4" by roundup command to get the random integer value from 10 to 30. Later, we will assign them to each subject's endowment, respectively.

In term of subject variables, we generate:

- "EfficiencyFactor" = 1,6. It is based on our proposed experiment.

- "Selection", a subject variable, is equal to the value of "Selected", a global variable. Because "Selection" is a subject variable assigned the fixed value of "Selected", its value being equal for all subject will be shown in the subject table. For example, in the subject table, column Selection has all the value of 2. In this case, we will know who are selected subject. If we generated "Selected" as a subject variable instead of a global one, in the subject table, the column would have randomly different integer values from 1 to 8 for each subject. Therefore, it is impossible to distinguish who is the selected subject. This is the reason why we have "Selected" global variable and "Selection" subject variable although the two variables are set being equal.

- "id" is assigned to each subject according to the value of "subject" variable, respectively. We use "id" variable to identify inter-group subjects who have the same role in their groups. In fact, subject 1 in group 1, subject 5 in group 2, subject 9 in group 3 and subject 13 in group 4 have the same role in our experiment; therefore, we assign them to "id" 1. The same explanation is for other values of "id" variable. It is important to notice that we set up the initial value of "id" being equal to 0, helping the series of commands work.

- "Endowment" will be assigned the value from the series global variables "Endowment_1;_2;_3;_4". To do these assignments, we use "function if" but it is important to set up the initial value of "Endowment" (here we assign the initial value of 0 to it but it can be any number). As we said before, the inter-group subjects who have the same role in their groups will share the same endowment by using "id" variable to identify these subjects.

Period	Subject	Group	Profit	TotalProfit	Selection	id	Endowment	Contribution	Notselected	Num_others	Cont
1	1	1	28.4	28.4	2	1	16	12	1	1	
1	2	1	29.4	29.4	2	2	23	18	0	0	
1	3	1	26.4	26.4	2	3	19	17	1	2	
1	4	1	26.4	26.4	2	4	16	14	1	3	
1	5	2	28	28	2	1	16	14	1	4	
1	6	2	27	27	2	2	23	22	0	0	
1	7	2	29	29	2	3	19	16	1	5	
1	8	2	29	29	2	4	16	13	1	6	
1	9	3	26.8	26.8	2	1	16	14	1	7	
1	10	3	28.8	28.8	2	2	23	19	0	0	
1	11	3	28.8	28.8	2	3	19	15	1	8	
1	12	3	26.8	26.8	2	4	16	14	1	9	
1	13	4	28	28	2	1	16	12	1	10	
1	14	4	27	27	2	2	23	20	0	0	
1	15	4	29	29	2	3	19	14	1	11	
1	16	4	26	26	2	4	16	14	1	12	

Example 1: Showing the "Selection" being subject 2; "id", "endowment" and "contribution" of each subject.

3.2 The first stage, called None-selected subjects' contributions

We set up the first stage, None-selected subjects' contributions, where:

- In group 1, none-selected subjects will choose their contributions based on their random endowments and the selected subject waits.
- In group 3, the same process in group 1 happens.
- In group 2, all subjects will choose their contributions based on their random endowments.
- In group 4, the same process in group 2 happens.

3.3 The second stage, called Selected subject's decision

We set up the second stage, Selected subject's decision, where:

- only the selected subjects in group 1 and in group 3 decide his or her contributions, based on all shown information about other subjects' contributions.

In term of subject variables, we generate the following variables:

- "Notselected" is assigned the value of 1 for being a none-selected subject and the value of 0 for being the selected subject. For example, in "Notselected" column, only the value of the selected subject is 0, and the others are 1. The reason for generating "Notselected" is to create the important variable, "Num_others", which will be explained later.

- "Num_others" is assigned integer ordered value from 0 to 12, in which four numbers of 0 are for the selected subjects in four groups and other discrete numbers, from 1 to 12 for the other none-selected

subjects. For example, "Num_others" column has four numbers of 0 for subjects having "id" of 2. "Num_others" plays the role as the new id of subjects, helping us distinguish specific clients in each group. For example, we know the clients having "Num_others" of 4, 5 and 6 belong to group 2. With "Num_others", we can use the "find command", which is used later, to identify specific subject's value.

Subject	Group	Selection	id	Endowment	Contribution	Notselected	Num_others	Contribution_P4	Contribution_P5	Contribution_P6	Contribution_P10	Contribution_P11	Contribution_P12
1	1	2	1	16	12	1	1	0	0	0	0	0	0
2	1	2	2	23	18	0	0	0	0	0	0	0	0
3	1	2	3	19	17	1	2	0	0	0	0	0	0
4	1	2	4	16	14	1	3	0	0	0	0	0	0
5	2	2	1	16	14	1	4	0	0	0	0	0	0
6	2	2	2	23	22	0	0	14	15	10	0	0	0
7	2	2	3	19	16	1	5	0	0	0	0	0	0
8	2	2	4	16	13	1	6	0	0	0	0	0	0
9	3	2	1	16	14	1	7	0	0	0	0	0	0
10	3	2	2	23	19	0	0	0	0	0	0	0	0
11	3	2	3	19	15	1	8	0	0	0	0	0	0
12	3	2	4	16	14	1	9	0	0	0	0	0	0
13	4	2	1	16	12	1	10	0	0	0	0	0	0
14	4	2	2	23	20	0	0	0	0	0	0	0	0
15	4	2	3	19	14	1	11	0	0	0	0	0	0
16	4	2	4	16	14	1	12	0	0	0	0	0	0

Example2: Showing "Notselected" with 4 values of 0, "Num_others" with 4 values of 0 and discrete 1 to 12, the perceived contributions in group 2: "Contribution_P4", "Contribution_P5" and "Contribution_P6".

3.4 The third stage, called Perceived values of two control groups

We set up the third stage, called Perceived values of two control groups, where:

- after all four selected subjects in 4 groups had contributed, we ask the two selected subjects in group 2 and in group 4, called Artificial selected subjects, one more question: "Please tell us how much, in your opinions, will they contribute". The value they choose is their perceived belief of others' contributions.

- we create the two grid boxes for the two Artificial selected subjects, showing other endowment and ask Artificial selected subjects for their beliefs. In group 2, the perceived beliefs toward subject id 4, 5 and 6 are assigned to variables: "Contribution_P4", "Contribution_P5" and "Contribution_P6". In group 3, we use the same process with variables "Contribution_P10", "Contribution_P11" and "Contribution_P12".

3.5 The final stage, called Profit Display

We set up the final stage, Profit Display, where:

- show the client his or her total profit, initial endowment and contribution.

In term of subject variables, we generate the following variables:

- "SumC" calculates the sum of subject's contributions for each group.
- "N" counts the number of subjects in the experiment for each group, 4 in this case.
- "Profit" shows the subject's profit calculated by the public good game's formula.
- "Contribution_ratio" is the ratio between Contribution and Endowment. We calculate this ratio silently without showing the subjects, and then, we will use this ratio, collected from an excel file, for our data analyses.
- "SumCR" is the sum of contribution ratios of all subject for each group.

- "SumCR_Group1_others", "SumCR_Group2_others", "SumCR_Group3_others", "SumCR_Group4_others" are the averages of the sum of contribution ratios of the none-selected subjects in group 1, group 2, group 3 and group 4, respectively.

- "CR_G1_Selected", "CR_G2_Selected", "CR_G3_Selected" and "CR_G4_Selected" are the contribution ratio of selected subjects in group 1, group 3 and artificial selected subjects in group 2 and group 4, which ratios we mainly focus for our data analyses. These are generated by using the "find" function.

- "Contribution_Pother_G2" and "Contribution_Pother_G4" are the averages of perceived contributions of other which we ask the artificial selected in group 2 and group 4 before.

Selection	id	T	I	N	T	Contribution_ratio	SumCR	SumCR_Group1_others	SumCR_Group2_others	SumCR_Group3_others	SumCR_Group4_others	CR_G1_Selected	CR_G3_Selected	CR_G2_A_Selected	CR_G4_A_Selected	Cc
2	1					0.75	3.30	0.84	0.84	0.85	0.79	0.78	0.83	0.96	0.87	
2	2					0.78	3.30	0.84	0.84	0.85	0.79	0.78	0.83	0.96	0.87	
2	3					0.89	3.30	0.84	0.84	0.85	0.79	0.78	0.83	0.96	0.87	
2	4					0.88	3.30	0.84	0.84	0.85	0.79	0.78	0.83	0.96	0.87	
2	1					0.88	3.49	0.84	0.84	0.85	0.79	0.78	0.83	0.96	0.87	
2	2					0.96	3.49	0.84	0.84	0.85	0.79	0.78	0.83	0.96	0.87	
2	3					0.84	3.49	0.84	0.84	0.85	0.79	0.78	0.83	0.96	0.87	
2	4					0.81	3.49	0.84	0.84	0.85	0.79	0.78	0.83	0.96	0.87	
2	1					0.88	3.37	0.84	0.84	0.85	0.79	0.78	0.83	0.96	0.87	
2	2					0.83	3.37	0.84	0.84	0.85	0.79	0.78	0.83	0.96	0.87	
2	3					0.79	3.37	0.84	0.84	0.85	0.79	0.78	0.83	0.96	0.87	
2	4					0.88	3.37	0.84	0.84	0.85	0.79	0.78	0.83	0.96	0.87	
2	1					0.75	3.23	0.84	0.84	0.85	0.79	0.78	0.83	0.96	0.87	
2	2					0.87	3.23	0.84	0.84	0.85	0.79	0.78	0.83	0.96	0.87	
2	3					0.74	3.23	0.84	0.84	0.85	0.79	0.78	0.83	0.96	0.87	
2	4					0.88	3.23	0.84	0.84	0.85	0.79	0.78	0.83	0.96	0.87	

Example 3: Show series of contribution ratios variable: "SumCR_Group1_others", "SumCR_Group2_others", "SumCR_Group3_others", "SumCR_Group4_others" and "CR_G1_Selected", "CR_G2_Selected", "CR_G3_Selected" and "CR_G4_Selected"

After the experiment finished, we can collect the experiment's data which is stored in an excel file created by our z-Tree program. The result that we focus on:

- the averages of contributions of the selected subjects in each group, represented by "CR_G1_Selected", "CR_G2_Selected", "CR_G3_Selected" and "CR_G4_Selected".

- the averages of contributions of the non-selected subjects in each group, represented by "SumCR_Group1_others", "SumCR_Group2_others", "SumCR_Group3_others", "SumCR_Group4_others".

- the averages of perceived contributions of non-selected subjects in group 2 and group 4, represented by "Contribution_Pother_G2" and "Contribution_Pother_G4"

By using some excel functions, we can collect all the needed ratios and do some analyses such as regressions and graphs.

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