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CONDITIONAL COOPERATION: THE EFFECT OF THE MARGINAL PER CAPITA RETURN AND THE GROUP SIZE.

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Abstract

We studied the behaviour of decisions of contribution to the public good using two questionnaires using a variant of the strategic method. Specifically, we analysed the effect on subjects decisions of a change in the marginal per capita return from 0.6 to 0.9 two subjects and games of four subjects. We find that for groups of two subjects, 50% can be classified as conditional cooperators. However, we do not obtain this result for groups of four subjects. With groups of four subjects only about 30% behave as conditional cooperators.

Key Words: *Voluntary contributions; Conditional cooperation; Free riding; Strategy-method; Experiments, Dyads.*

JEL classification: *H41; C91*

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1 REVIEW OF THE LITERATURE

Provision of public goods constitute one of the main branches in Experimental Economy. They study the subjects' behaviour in different type of situations in which many possible decisions of investment into a public good exist.

Usually, economic experiments try to study the way in which humans value the others' situation. A clear outcome of this, seen in all the economic experiments, is a heterogeneity in the way humans value welfare in the others.

It has been shown that, if the mechanism of voluntary contributions is used for the provision of a public good, there are incentives to take advantage of it. This is the main result of the subjects' behaviour observations performed in the so-called voluntary contribution mechanism games.

In these games, the subjects that can benefit from a public good, receive an initial endowment of money or tokens. Simultaneously, the subjects should state which part of that money goes to the group account or joint investments. Each contribution that the subjects in the group accounts: increases the group profits, benefits everyone equally, but it reduces the contributor's profits, except in the case in which all the subjects contribute with all the money to the common project, in that case, their benefit increases. For this reason, it is necessary to constitute a mechanism of volunteer contribution to the public goods.

Isaac and Walker (1988) demonstrated that, subject's contributions to the public goods, even though, initially they are positive, they reduce over time. Unless some incentive for the cooperation such as the communication or the punishment is incorporated to the experimental design.

In the public goods experiments it has been demonstrated that the subjects cooperate more as much as the other people do it too as in Ledvard (1995) and Chaudhuri (2011). In many experiments, it has been observed that the subjects cooperate much more than some. These theories assume that, the individuals, tend to behave selfishly.

This contribution to the public goods known as "conditional contribution", has been considered a consequence of a simple motivation of the subjects to contribute to the public goods and other aspects such as the altruism or the reciprocity.

These has been some of the more used reasoning in order to explain the subjects behaviour in the public goods contributions.

If we make a review of the game theory we observe that, it predicts three hypotheses when establishing the behaviour of the subjects in public goods games:

1) All the individuals are selfish and rational, that means, they want to maximize their own benefits. 2) All the individuals know that, likewise, all the participants in the game are selfish. 3) The game rules are understood by the participants.

Facing these hypothesis, it becomes clear that the strategy to cooperate to the “*common project*” is strictly dominated by the strategy of the no-cooperation. It means that, theory predicts that, no one would invest tokens in the common project and therefore, the provision of the public goods would not exist.

However, these are just predictions. The empirical evidence that has been obtained from many experiments showed that it is not exactly like this, but among a 40% and a 60% of the subjects are “*conditional cooperators*” in one-shot games. It means that, these subjects want to contribute more in the public goods as much as the rest of the subjects do.

Nevertheless, in the public goods experiments have been proved that not all the subjects are “*conditional cooperators*” but that other behaviours exist.

Fischbacher (2001) or Kocher (2008) have shown that in the public good games, approximately 50% of the subjects show a conditional behaviour. Or what is the same, their contribution tends to increase when they notice that the others contributions increase. On the other hand, a third of the subjects are characterized as free-riders.

Consequently, the subjects in the public goods games are divided in around the 50% of the “*conditional cooperators*” individuals whose contribution to the public goods matches with the others cooperation and a 25% “*free-riders*” that do not sacrifice anything, or what is the same, they do not contribute anything to the common good. The rest of the individuals, present another more complex behavioural pattern, such as hump-shaped contributions.

Usually, this distinction among subjects according to their contributions, has been based on the assumption that the decision of an individual in public goods’ games can be used to measure their social preferences.

However, other experts defend the idea that many of the behaviours that cannot be described under a recognizable pattern, as a conditional cooperator or free rider, are due to the fact that the subjects have not understood the experiment.

There exist a lot of reasons by which the subjects could misinterpret the game, such as the suggestive signs of the experimental environment or that the game could remind them everyday scenarios in which the cooperation or non-cooperation could favour.

For that reason, if the variation in the cooperation among the subjects in an experiment is due to the problems of understanding, this division would need to be accepted not as social preferences variations, but as a framing effect.

The argumentation that the problem in these experiments is comprehension is controversial. In some cases, there are studies that ensure that the confused subjects are responsible of the 50% of the cooperation observed, meanwhile, others believe that they just represent the 10%.

There are other authors, as it is the case with Hofstede (2001), who defend that the contribution to the public goods depend on the different geographic and cultural factors. Demonstrating that, the societies and organizations modify their behaviour according to their culture or aggrupation, due to the way they perceive their environment.

Nevertheless, this last idea does not correspond to the one that many current literature articles collect. Brandts (2004) studied the behaviour in the contributions of the public goods in four different countries and he found that, the differences among countries were indeed very small. Consequently, the behaviour did not vary according to the culture. Other authors such as Kocher (2008), Martinsson (2013) or Hermann and Thöni (2008) concluded in their experiments that the conditional cooperation is a universal behaviour, and not a behaviour modified depending on the geographical aspects.

Another factor that can affect the results obtained from the public goods' experiments is the group size. Cooper and Kagel (2005) demonstrated that groups formed with a greater number of subjects play more strictly than groups with fewer. Other authors, such as Sutter (2005), also asserted the importance of the number of subjects' idea, showing that the big groups of subjects achieve better results than the groups of two subjects, Kocher and Sutter (2005).

In this experiment, it will be examined the behaviour and the comprehension of the subjects in two different ways: first, when the subjects have to take decisions knowing they are playing in groups of two, and later, when these decisions have to be taken in groups of four members.

Apart from the mentioned aspects until this point, it has been demonstrated that the conditional cooperation also depends on the marginal return per capita (MPCR). The marginal returns per capita is the profit that every member of the group receives each unit contributed to the public good. Game theory predicts that, in front of a marginal per capita return lower than the unity, the optimum contribution would be to act as a “free-rider”. Since, if the marginal per capita return is higher than the unity, the optimum decision would be to invest everything on the common project.

Cartwright and Lovett (2015) contrasted the effect of the marginal per capita return in one of their experiments concluding that, less cooperation was seen with marginal per capita returns near zero. And this cooperation increased simultaneously with the rate of return increases.

Once again, the way the subjects modify their decisions before changes in the marginal per capita return will be studied, as well as, if this variation in the decisions is different for the experiments with couples or the case studies of four members.

Therefore, in the case of this study, the effect on the changes both in the marginal per capita return (MPCR) and in the group size that forms the group, N , it is expected that the size of the group, N , will have positive effects over the contributions level to the “common project”. It means that, on the survey that is done with four subjects group, it needs to be observed a major contribution to the “common project” than in the questionnaire done among groups of two subjects.

The variation of the size in the group, N , does not always have obvious consequences, but it can both have positive and negative effects. In that case, the starting point is the hypothesis that with the bigger size of the group, the bigger will be the contribution to the “common project”, due to the fact that if N increases, each unity invested in the “common project” makes it grow and, therefore, the social profit of an additional unity will be bigger.

On the other hand, if the changes’ effects on the marginal per capita return (MPCR) are considered, an increase of them implies that each unit that a subject contributes to the “common project” has a bigger profit. That is like this because, the initial hypothesis assumes that it is logical to wait for an increase of the contributions when the marginal per capita return increases, since the contributions’ costs of the subjects is smaller.

Thus, it is expected that both for the survey with groups of two as well as for the survey of groups of four subjects, the game with a marginal return per capita higher, will present higher levels of contribution to the "*common project*".

These effects exposed previously have been analysed many times, Isaac and Walker (1988) designed an experiment by couples to prove exactly the effect of the proposed hypothesis in that document. In that experiment, it was observed that, effectively, the contribution to the public goods increased significantly when the marginal return per capita increased, from 0.3 to 0.75 in that case. With regards to the number of subjects, Isaac and Walker could not find a clear relationship between the size of the group and the contribution to the public goods. That effects, are the ones that are pretended to be analysed on that document.

Consequently, in this document it is informed about the obtained results in a number of experiments realized online where a variable of the "*strategic method*" is applied. It means that, the subjects have to decide how much to contribute to the public goods.

The main characteristic of this experiment is that it is allowed to observe and compare the behaviour of the subjects in front of changes in the marginal return per capita, both for groups of two and groups of four subjects.

Each one of the different decisions of contribution that the subjects adopt in this experiment, cannot be treated as a social preference. The obtained data in many experiments with computers suggest that, the standard methodology of the public goods games using the strategic method may not give a trustable measure of social preferences.

According to our results, we can argue that, compared with the results obtained in other experiments that try to prove the effect of an increase of the marginal return per capita, such as Isaak and Walker (1988) or Fischbacher (2001), we did not find any evidence that an increase of the contributions to the called "*common project*" in front of an increase of the marginal return per capita.

On the other hand, in the result of this document it is found that, the groups of four subjects tend to cooperate less than the groups of two subjects. This is the opposite to the one obtained by some experimentalists, such as Cooper and Kagel (2005) or Kocher and Sutter (2005), that affirm that, the big groups obtain better cooperation results than the small groups.

2 EXPERIMENTAL DESIGN AND PROCESS

The line of decisions in which the experiment was designed is based on a standard of public goods game. During process of designing it was used a variant of the so-called "*strategic method*" to obtain the preferences of the subjects.

The main task of the subjects in the experiment is to state how much they are willing to contribute to a public good, called "*common project*". In this case, the experiment is administered online through a set of two questionnaires. These questionnaires were generated through the "*Google Forms*" platform, including all the questions that were intended to be formulated with the possible answers.

This Google tool allows the experimenter to observe the subjects responses instantaneously. The platform, being virtual, is constantly updated so that the results can be observed as the subjects finish the questionnaires. In this way, if there is any possible error, the dissemination of the questionnaire can be paralyzed immediately, the error can be modified and the questionnaires relaunched practically instantaneously.

In addition, with this Google tool, it is possible to immediately obtain an Excel sheet with all the results, individually or jointly, ordered by date of answer. Therefore, it is easy to collect the information to later work with it and analyse the results.

The two questionnaires were put into circulation on March 13, 2018 and data was being collected until March 27, 2018, closing the platform with a total of 27 samples in the questionnaire with groups of two subjects and 25 samples in the questionnaire with groups of four subjects.

In each of the questionnaires the subject faced two games. In the first of the questionnaires both games are formed by groups of two subjects while, in the second questionnaire, both games are played in groups of four subjects.

To simplify and understand in a simple way how the experiment has been structured, it will be analysed the design of each of the questionnaires separately to later compare the results.

Each of the questionnaires, as it could be seen, is composed of two games. Therefore, analysis will be concentrated on four treatments. In Table 1 below, the variables of each of the four treatments are specified.

Table 1- Variables of each treatment.

	MPCR	
	0,6	0,9
N=2	Treatment 1 (T1)	Treatment 2 (T2)
N=4	Treatment 3 (T3)	Treatment 4 (T4)

2.1 Experimental design questionnaire 1

In a first questionnaire, the subjects faced two games. In the first, they must decide how to spend 10 euros. The subjects can keep those 10 euros in their portfolio or invest them in the so-called "*common project*". The benefit function that was presented to the subjects was the following:

$$\pi = 10 - g_i + 0,6 * \sum_{j=1}^2 g_j$$

Where, g_i is the individual contribution to the so-called "*common project*" and $\sum g_j$ is the sum of contributions to the common project of the two subjects. In addition, the marginal return or marginal payment of a contribution to the public good is 0.6. This indicates that the optimal decision of the subjects would be to contribute the 10 euros to the "*common project*", if they believe that the other subjects will also contribute.

Other possibility is to behave as a "*free rider*", that is, not contribute anything to the common project, if they believe that the other subject is not going to contribute everything, that is, will not contribute ten to the "*common project*".

This marginal per capita return of 0.6 is the result of multiplying the money collected from the "*common project*" by a factor equal to 1.2 and then dividing the result, in equal parts, among all the members of the group, in this case two.

The previous function is detailed in the instructions that the subjects observed when opening the questionnaire, an example of which appears in Annex A.

In this case, the instructions that appeared in each of the questionnaires were not explained to the subjects by the experimentalists rather, the subjects simply read the instructions on their own. In this way, the experiment will allow to observe, in some way, if the results in the decisions of the subjects correspond to those obtained in other similar experiments carried out in laboratories.

Once all the subjects read the instructions, they had to answer three control questions to test the understanding of the public goods experiment they were facing. Figure 10 in Annex A illustrates one of the questionnaires presented to the subjects showing how the instructions and the different questions were presented to them.

In this study case, the subjects were presented with the following situation: "*Imagine that your friend and you contribute 0 to the common project*". With this information, the subjects had to answer three simple questions: "*How much do you have in the wallet?*", "*How much money is in the common project?*" And finally, "*How much is your profit you will obtain?*" Not all subjects responded correctly to all control questions. For this reason, only those subjects who answered these questions correctly have been taken into consideration for the analysis of the results.

In this way, it is considered that the analysed results come from the decisions of subjects which understood the mechanics and the implications of the experiment.

After the subjects answered the three control questions, they were presented with the real decision situation of the experiment. Specifically, subjects were asked to make two types of contribution decisions. The first type of contribution decision was individual, known as "*inconditional contribution*" on how many euros they willing to invest in the "*common project*".

After answering this first question, the subjects were presented ten questions representing a table of contributions where, they needed to decide how much they were willing to contribute to the "*common project*" given a certain to the contribution of the other subject, that is, it was applied a variant of the "*strategic method*". The questions were asked to the subjects to indicate, for each of the ten possible contribution decisions made by the other member of the group, how much they would be willing to contribute to the public good.

In Annex A, in the Figure 11, it can be seen an example of how these questions were posed to the subjects.

The subjects made their decisions without knowing what the decision of the other subjects was. In addition to this, no time limit was imposed so they had enough time to reflect on, since it was a one-shot game.

In the case of this experiment the subjects did not receive any type of monetary incentives. Also, unlike many other similar experiments, in this one it is possible to be played just once, there are no repetitions. The decisions of the subjects can be modified thanks to the process of learning. On the contrary, in this way we can consider the contributions of the subjects as a measure of their willingness to be conditional cooperative.

The experiment has been administered, as it was already explained, using an online questionnaire distributed using various social networks. Specifically, a google questionnaire model has been used. In this way, the subjects who respond to the questions of the experiment are totally unknown and are beyond the control of the experimenter. This is precisely one of the distinguishing characteristics of this experiment. Unlike many other similar experiments where, the experimenter observes the subjects while making their decisions, in this, the subjects are totally unknown and at no time the experimenter can see them.

All of them have been classified by age and by studies thanks to the last three questions of the experiment. An example of these questions appears in Figure 12 of Annex A.

In these last three questions the subjects are asked to indicate their age and if they study. In addition, in case of affirmative answer to this last question, what is their level of studies.

The classification of the subjects by their level of studies and, more specifically, in three categories "*No studies*", "*Other studies*" and "*Economics or Business Administration*" can be interesting when analysing the results. It will allow to observe if those subjects with knowledge of economics and, therefore, of the strategic method, make different decisions to other subjects that do not possess this knowledge. That is, if these subjects bring their decisions closer than the rest to what we would theoretically assume as optimal. In this case, 27 subjects answered to the first questionnaire. Their classification according to their studies is detailed in Table 2.

Table 2-Classification of the subjects of Treatment 1 (N = 2, MPCR = 0.6) and Treatment 2 (N = 2, MPCR = 0.9) by their level of studies.

Nº Subjects	Level of studies
6	No studies
7	Other studies
14	Economics or Business Administration

Thus, a total of 27 subjects participated in the experiment. However, from 27, only 22 correctly answered the control questions. Therefore, the remaining five were eliminated under the assumption that they did not understand the experiment. The subjects that we consider that did not understand the experiment represent, therefore, 18.16%. A total of 22 groups of two subjects were formed, always bearing in mind that the second subject of each group is fictitious. In addition, since each treatment is played only once, the 22 decisions are independent observations.

Once the subjects have reached this point, it was presented to them, in that same questionnaire, a second game slightly different from the previous one.

Again, subjects needed to decide between keeping an endowment of 10 euros in the wallet or investing them in the so-called "*common project*". However, there is a small modification with respect to the first game. In this case, the benefit function that is explained to the subjects is the following:

$$\pi = 10 - gi + 0,9 * \sum_{j=1}^2 gj$$

The conditions posed by the benefit function are exactly the same as those of the previous function, g_i represents the individual contribution to the so-called "*common project*" and $\sum g_j$ is the sum of contributions to the "*common project*" of the two subjects. However, the marginal per capita return was modified. Now, the marginal payment of a contribution to the public good was 0.9.

In this situation, the optimal decision of the subjects would still be to contribute zero to the so-called "*common project*", regardless of the decision of the other subject. Unless the other subject decides to contribute 10 to the "*common project*". In that case, the optimal decision of the subject would be to contribute 10 to the "*common project*".

Again, this marginal per capita return of 0.9 is the result of multiplying the total collection of the "*common project*" by one factor and dividing it equally between the two members of the group. In this case, the factor by which the collection of the "*common project*" is multiplied is 1.8.

Therefore, through the strategic method, rational players should not submit contributions to the "*common project*" in any of the questionnaire questions, except in the case where the other subject contributes everything to the "*common project*". That is, the answer to all the questions in the table of contributions of the rational subjects should be zero, except for the hypothetical situation in which the other subject contributes all his money to the "*common project*". In that case, the contribution of the subjects should be ten.

Again, there were presented to the subjects two decision situations. A first situation of individual decision and, subsequently, decisions to contribute to the so-called "*common project*" through the ten questions that represent a table of contributions.

The questions used in this second set of the questionnaire were exactly the same as those used in the first and described above except that, in this case, the marginal return per capita was modified. Moving from a marginal payment to the contribution of the public good of 0.6 in the first game to 0.9 in the second game.

Therefore, this questionnaire design will allow us to analyse if we observe a modification in the contribution decisions of the subjects in the "*table of contributions*", represented by ten questions, before an increase in the marginal return per capita.

2.2 Experimental design questionnaire 2

In a second questionnaire the subjects took part in the two games. These games are structured exactly like the games in the first questionnaire, with exception that, in this case, the subjects play in groups of four. In addition, it is relevant to know that both questionnaires have not necessarily been answered by the same subjects. The questionnaires were sent through social networks so that one subject could answer the two questionnaires or just one.

In the first game of this second questionnaire, subjects must decide again how to spend 10 euros. They can, again, keep them in their wallet or invest them in the "*common project*". The benefit function that was presented to the subjects was the following:

$$\pi = 10 - gi + 0,6 * \sum_{j=1}^4 gj$$

Again, to simplify, g_i is the individual contribution to the so-called "*common project*" and $\sum g_j$ is the sum of contributions to the common boat of the four subjects. In addition, the marginal return or marginal payment of a contribution to the public good is 0.6. Therefore, the optimal decision, again, for a rational subject would be to contribute the ten euros to the "*common project*" if they believe that the rest will also contribute. Other possibility is to behave as a "*free rider*", that is, not contribute nothing to the "*common project*", if they believe that the other three subjects are not going to contribute everything, that is, they will not contribute ten to the "*common project*".

Again in this case, the marginal per capita return is the result of multiplying a factor, in this case 2.4, by the total collection of the "*common project*" and dividing it among all the members of the group, in this case four.

The benefit function is detailed in the instructions of the questionnaires that arrived at the subjects. An example of these instructions appears in Figure 9 of Annex A of this work. As in the first questionnaire explained above, the experimentalists were not present to explain the experiment to the subjects.

Once the subjects read the instructions, they found three control questions: "*How much do you have in the portfolio?*", "*How much money is in the pot?*" And finally, "*How many benefits do you get?*" To be able to, again, identify in some way those subjects who have not understood the experiment and thus avoid having their answers influence the analysis of the results.

In this case, a total of 25 subjects answered the questionnaire. However, only 22 answered the control questions correctly. The rest have been eliminated, as in the first questionnaire, to avoid changes in the results. The subjects that we consider that did not understand the experiment represent, therefore, 12%.

Once the subjects answered the control questions, the real situation of the experiment was presented to them. This is exactly the same as the one described in the first questionnaire. The subjects must first make an individual decision and, subsequently, answer ten questions that represent each of the ten possible ways of contribution of the other three members of the group. These ten questions, again, represent a "*table of contributions*".

The rest of the game was designed exactly like the first game of the first questionnaire. The subjects do not receive any type of monetary incentive and the experiment does not present repetitions.

In addition, the last three questions of the experiment are exactly the same as the ones posed in the first questionnaire and, again, they allow us to classify the subjects by their age and by the level of studies.

The classification of the subjects who answered this second questionnaire in the three categories of studies is detailed in Table 3. Where the "Other studies" category includes studies such as Veterinary, Engineering, Teaching or Law.

Table 3-Classification of the subjects of Treatment 3 (N = 4, MPCR = 0.6) and Treatment 4 (N = 4, MPCR = 0.9) by their level of studies.

Nº Subjects	Level of studies
6	No studies
9	Other studies
11	Economic or Business Administration

Finally, after answering the questions for the first game, the subjects were presented to the second questionnaire. As in the first questionnaire, a second game slightly different from the previous one. In this case, the function of benefits observed by the subjects was the following:

$$\pi = 10 - gi + 0,9 * \sum_{j=1}^4 gj$$

Where g_i is the individual contribution to the so-called "common project" and $\sum g_j$ is the sum of contributions to the "common project" of the four subjects.

The experimental design of this second game of the questionnaire is exactly the same as the first one. However, the marginal per capita return has been increased from 0.6 to 0.9. So, the optimal decision for the subjects is still not to contribute anything to the "common project" independently of the contributions of the rest of the subjects of the group.

Now, the marginal per capita return is the result of multiplying the total collection of the "common project" by a factor equal to 3.6 and dividing the resulting amount equally among the four members of the group.

The questions posed were exactly the same as those presented in the first game, as well as the control questions and the classification questions by their age and the level of studies.

Therefore, both questionnaires present exactly the same experimental design structure. In both, the first game has a marginal return per capita of 0.6 and in the second game, said marginal return is increased to 0.9.

The only difference between the two questionnaires is the number of subjects. The two games of the first questionnaire are carried out with groups of two subjects. While, the two games of the second questionnaire are carried out with groups of four subjects

The design of these two experiments will allow to observe subjects' decisions on their contributions vary depending on the marginal per capita return. It can be tested whether this change in behaviour is different when the experiment is carried out with groups of two subjects and when it is carried out with groups of four subjects.

Below are the main results obtained in each of the treatments aforementioned as well as a comparison between them and between the main results obtained in similar experiments.

3 RESULTS

The main objective of this study is to analyse the decisions of the subjects in each of the two questionnaires. That is, their willingness to contribute based on the level of contribution of the others.

Therefore, we will analyse the contributions of the subjects in each of the questionnaires individually. In other words, the decisions of the subjects for each marginal per capita return when they cooperate in groups of two, corresponding to Treatment 1 and Treatment 2 and, later, the decisions of the subjects for each level of marginal per capita return when they cooperate in groups of four, corresponding to Treatment 3 and Treatment 4.

Once the results have been analysed individually for each of these questionnaires, it will be possible to establish a comparison for each level of marginal per capita return between the questionnaire with a two-player group and the questionnaire with groups of four.

This analysis of the results will allow us to observe the behaviour in the decisions of the individuals before an increase in the marginal per capita return when the number of subjects in the group is not modified. Therefore, it will create opportunity to observe if the decisions of contribution to the same level of marginal per capita return are different for groups of two subjects and groups of four subjects.

We will start by analysing the contribution decisions of the subjects in Treatment 1 and Treatment 2. That is, the decisions of contribution of the subjects to the "contribution table" with a marginal per capita return equal to 0.6 and a marginal per capita return equal to 0.9.

3.1 Effect of the MPCR in small groups (dyads)

Figure 1 contains the average contribution subjects to the "common project" as a function of a given contribution of the other subjects. With groups of two subjects and a marginal per capita return equal to 0.6.

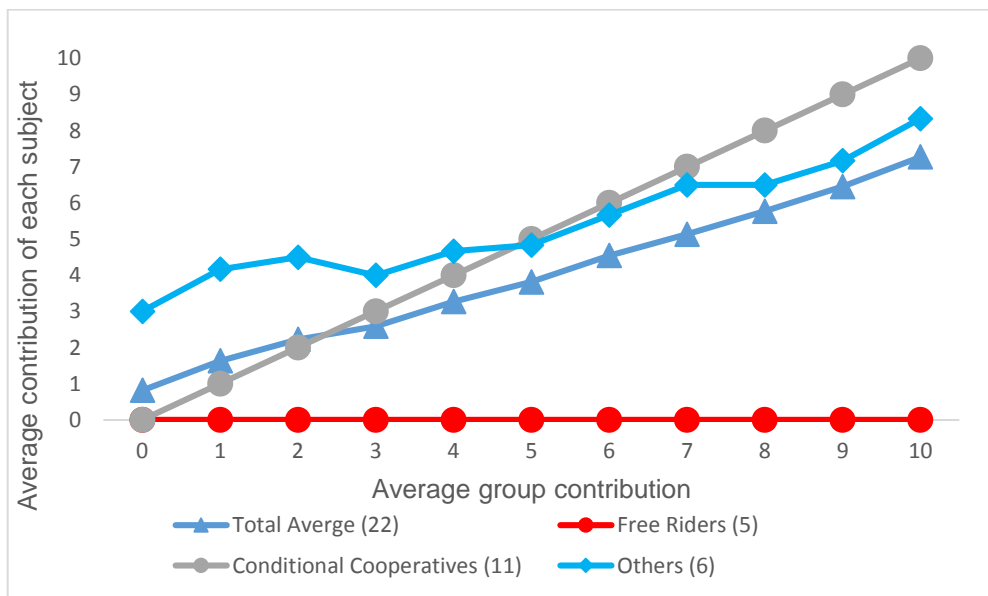


Figure 1-Average contribution of each subject for each contribution level of the other subject of the group. Treatment 1 (N = 2, MPCR = 0.6).

The main result observed is that, also in small groups, subjects tend to behave as conditional cooperative. This exact behaviour is represented by the grey line with circular markers in Figure 1.

In fact, 11 out of 22 subjects who participated in the experiment, showed conditional cooperative behaviour in their decisions. Which means that their contribution is exactly on the diagonal, always equalling the contribution decision of the other member of the group. In this case, the conditional cooperation is positioned exactly on the diagonal, without any deviation, we do not observe therefore a selfish tendency in the contribution decisions of conditionally cooperative subjects.

We can also identify five subjects who behave as "*Free rider*" or purely selfish, that is, subjects who did not contribute at all to the "*common project*", despite of other subject's contribution. This is the trend observed if we look at the red line with circular markers in Figure 1.

The contribution patterns of the six remaining subjects, classified as other, do not coincide with any recognizable pattern.

Figure 2 shows the individual contributions of the 22 subjects who participated in the investigation, these contributions are divided into three different categories. In each of these graphs, the horizontal axis represents the average of contributions of the group and, the vertical axis, the contribution of each subject individually.



Figure 2-Individual contribution of each subject as a function of the contribution of the other subject ¹

¹ Conditional Cooperatives: subjects no.3,7,8,9,10,11,13,14,18,19,21. Free Riders: subjects no.15, 16,17,20,22. Others: subjects no. 1,2,4,5,6,12. Horizontal axis represents the average of contributions of the group and, the vertical axis, the contribution of each subject individually.

In conclusion, the distribution of subjects according to their stated contribution pattern in Treatment 1 with a marginal per capita return of 0.6 and groups of two subjects has been:

Table 4-Distribution of subjects among the different categories. Treatment 1 (N = 2, MPCR = 0.6).

Contributors	Number of subjects	Distribution
Conditional Cooperatives	11	50%
Free Riders	5	22,72%
Others	6	27,27%

Continuing with the analysis of the first questionnaire, with groups of two subjects, Figure 3 shows the average contribution of the subjects to the "common project" according to the contribution of the other subject in the group. In Treatment 2, for groups of two subjects and a marginal per capita return of 0.9. In this instance, there has been an increase in the marginal per capita return with respect to the Treatment 1.

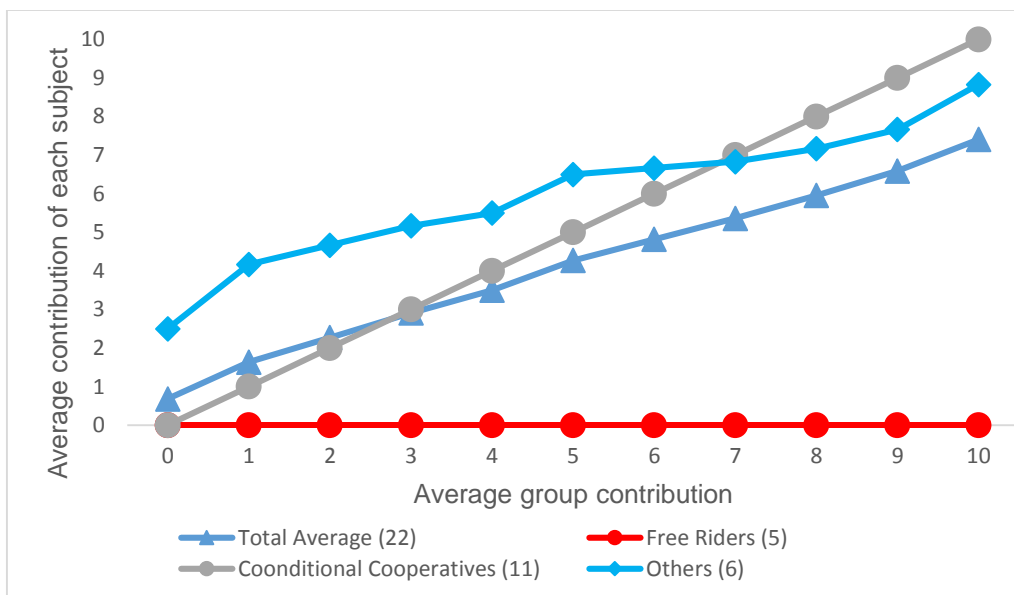


Figure 3-Average contribution of each subject for every level of contribution of the other subject of the group. Treatment 2 (N = 2, MPCR = 0.9).

In Figure 3 it is again observed that, from the group of 22 subjects that participated in the game, 11 had a conditional cooperative behaviour, contributing to the "common project" an amount equal to the contribution of the other member of the group. This behaviour is represented by the grey line with round markers of Figure 3.

The subjects presenting a conditional cooperative behaviour in the second round of the first questionnaire are exactly the same subjects who presented exactly the same behaviour as in the first game, with one exception. Subject number ten presented a behaviour of conditional cooperative in the first game of the questionnaire, with a marginal per capita return of 0.6 while, in the second game of the questionnaire, its decision of contribution was classified as a non-recognizable pattern.

In the same way, subject six presented in the first experiment, with a marginal per capita return of 0.6, a behaviour that cannot be classified under any recognizable pattern. While, in the second one, with a marginal per capita return of 0.9, it presents a conditional cooperative behaviour.

If we look at Figure 2 and Figure 4 we can verify that, indeed, the subjects that behave as conditional cooperative are the same, taking into account aforementioned exceptions.

On the other hand, five of the subjects presented a "*Free rider*" behaviour, with null contributions to the "*common project*". This behaviour is represented by the red line with circular markers, located on the horizontal axis of Figure 3.

In this case, the subjects that present a behaviour of "*Free rider*" with a marginal return per capita of 0.6 in the first case are exactly the same ones that present this behaviour with a marginal return per capita of 0.9. Again, we can check it by looking at Figure 2 and Figure 4.

Finally, the remaining six subjects present another behavioural pattern that we cannot identify with any recognizable pattern. The contribution of this subjects is represented by the blue line with diamond-shaped markers of Figure 3.

Figure 4 shows the individual contributions of the 22 subjects who participated in the case study, these contributions were divided into three different categories. In each of these graphs, the horizontal axis represents the average of contributions of the group and, the vertical axis, the contribution of each subject individually.



Figure 4-Contribution trend of each individual subject ²

The distribution of subjects according to their contribution pattern Treatment 2, for a marginal per capita return of 0.9 has been, therefore:

Table 5-Distribution of subjects among the different categories. Treatment 2 (N = 2, MPCR = 0.9)

Contributors	Number of subjects	Distribution
Conditional Cooperatives	11	50%
Free Riders	5	22,72%
Others	6	27,27%

² Conditional Cooperatives: subjects no.3,6,7,8,9,11,13,14,18,19,21. Free Riders: subjects no.15, 16,17,20,22. Others: subjects no. 1, 2, 4, 5, 10, and 12. Horizontal axis represents the average of contributions of the group and, the vertical axis, the contribution of each subject individually.

Therefore, the main result we achieved with our experiment, when comparing an increase in the marginal return per capita with the groups of two subjects, is that the pattern of contribution decisions of these subjects has not changed at all in the face of an increase in the marginal per capita return from 0.6 to 0.9.

The subjects who present in the first case a behaviour of conditional cooperative, also present it in the second one. The same occurred with subjects who exhibit "*free rider*" behaviour. So, in our case, for a sample of 22 subjects, an increase in the marginal per capita return in the groups of two subjects, did not generate any notable effect on the decisions of contribution of these subjects.

An explanation for this result could be that the subjects are not taking into account, when making their decisions, the increase in the marginal per capita return between the first game and the second game of each questionnaire.

The reason they do not take this increase into account could be that, they simply have not understood how the experiment works and therefore, do not understand what effect the marginal per capita return has on their final benefit.

Another possible explanation for this result could be that the subjects consider that the change in their benefit is low and, therefore, they do not modify their behaviour when making the decisions.

3.2 The effect of the MPCR in groups of four subjects

We now propose the same analysis for the second questionnaire. In this case, there is again an increase in the marginal per capita return from 0.6 in the first try, to 0.9 in the second one. However, in this case the groups are formed by four participants.

Figure 5 contains the average contribution of the subjects to the "*common project*" as a function on the average contribution of the other three group members, with groups of four subjects and a marginal per capita return of 0.6.

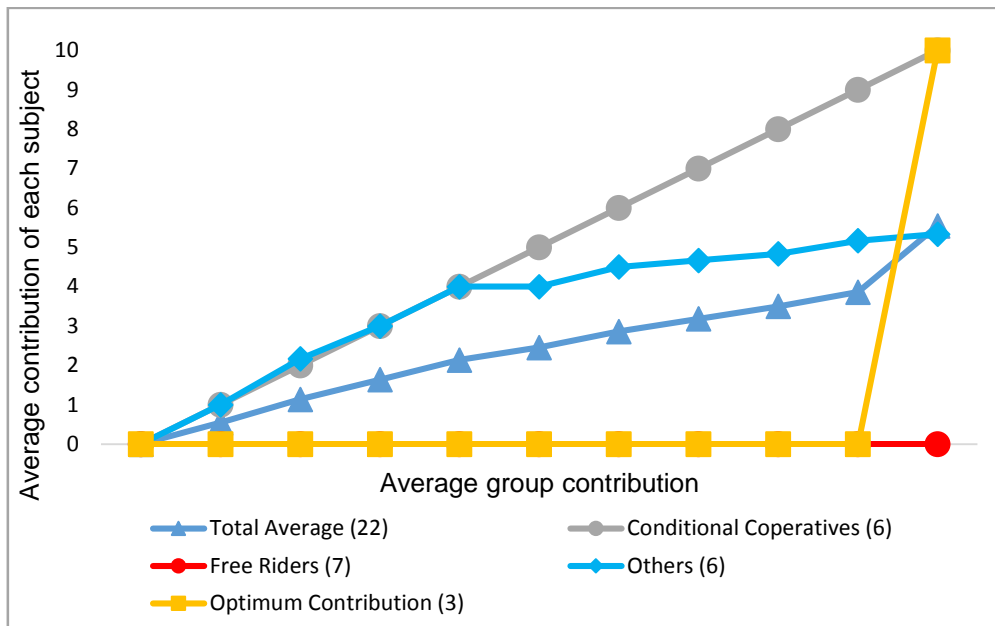


Figure 5-Average contribution of each subject for every contribution level of the rest of the subjects of the group. Treatment 3 (N = 4, MPCR = 0.6).

In this case, of the 22 subjects who participated in the experiment, only six have a conditional cooperative behaviour. These are represented in Figure 5 by the grey line with round markers.

The decisions of contribution to the “*common project*” of the subjects that we can classify as conditional cooperative corresponded, in all the cases, with the average of decision of contribution of the other three members of the group. The conditional cooperative, is located exactly on the diagonal.

On the other hand, seven subjects showed a “*free rider*” behaviour. These are represented in Figure 5 by the red line with round markers. This line is located exactly on the horizontal axis of the graph. This indicates that the contribution to the “*common project*” from these seven subjects is always zero, whatever the average contribution of the other three members of the group.

We can also identify three subjects that make their decisions according to the established optimum. These are represented in Figure 5 by a yellow line with square markers.

The subjects that represent a “*free rider*” behaviour in their contribution decisions, except in the case where the average contribution of the group is ten. In this case, these subjects contribute everything to the “*common project*”.

This is the decision of contribution that we propose in the experimental design as optimal. Contribute 10 euros to the "common project" if they believe that the other group members will also contribute and behave as a "free rider", that is, not contribute anything to the "common project", if they believe that the rest of the subjects will not contribute everything, that is, they will not contribute ten.

Finally, we observed six subjects with a behaviour in their decisions that we cannot classify. These are represented in Figure 5 by a blue line with diamond-shaped markers.

Figure 6 shows the individual contributions of the 22 subjects who participated in the case study, these contributions are divided into four different categories. In each of these graphs, the horizontal axis represents the average of contributions of the group and, the vertical axis, the contribution of each subject individually.



Figure 6-Individual contribution trend of each subject³

³ Conditional Cooperatives: subjects no.1, 3, 4, 10, 18, and 22. Free Riders: subjects no.11, 14, 15, 17, 19, 20, and 21. Others: subjects no. 2, 5, 6, 7, 8, 9. Optimum: subjects no. 12, 13, 16. Horizontal axis represents the average of contributions of the group and, the vertical axis, the contribution of each subject individually.

The distribution of subjects according to their contribution pattern in Treatment 3, for a marginal per capita return of 0.6 has been, therefore:

Table 6-Distribution of subjects among the different categories, Treatment 3 (N = 4, MPCR = 0.6).

Contributors	Number of Subjects	Distribution
Conditional Cooperative	6	27.27%
Free Riders	7	31.81%
Optimum	6	27.27%
Others	3	13.63%

Analyse of the second case of the second questionnaire, with groups of four subjects and a marginal per capita return of 0.9. The average contribution of each subject based on the contribution of the rest of group members is shown in Figure 7.

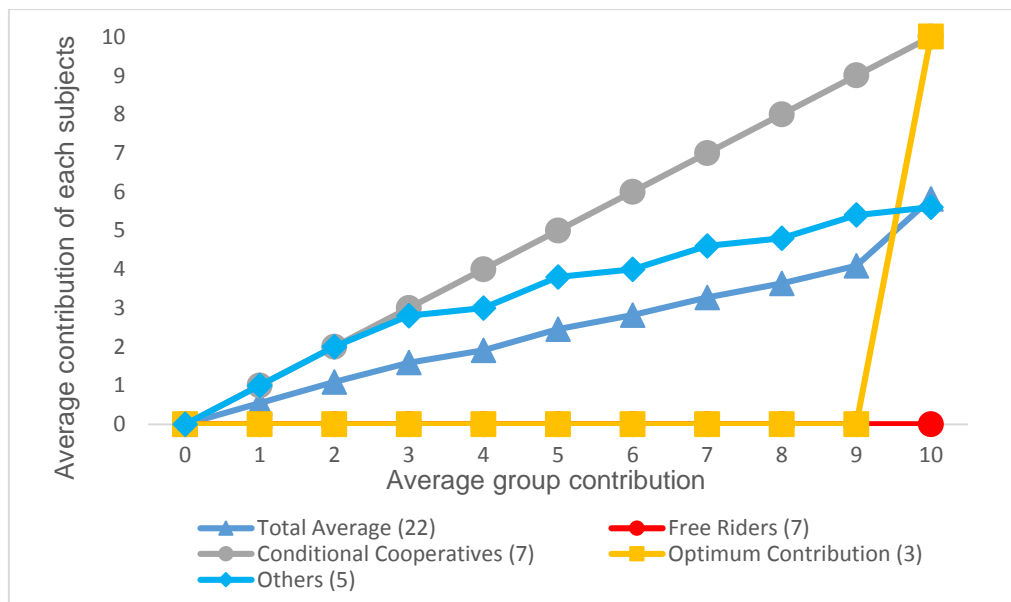


Figure 7-Average contribution of each subject for each contribution level of the rest of the subjects of the group. Treatment 4 (N = 4, MPCR = 0.9).

We observe that seven of the 22 subjects have a conditional cooperative behaviour. These subjects are represented in Figure 7 by a grey line with circular markers. These subjects are exactly the same that present a conditional cooperative behaviour in the first game of the questionnaire, with a marginal per capita return of 0.6. In addition, by increasing the marginal per capita return from 0.6 to 0.9, we observe that the subject 6, who in the first game had a decision behaviour that could not be classified under any average, now presents a behaviour of conditional cooperative.

It is also possible to distinguish seven subjects that show a "*Free rider*" behaviour. These subjects are represented in Figure 7 by a red line with circular markers that is located exactly above the horizontal axis.

Again, three subjects presented a decision behaviour that can be classified as optimal. The average contributions of these subjects are represented in Figure 7 by a yellow line with square markers. These subjects were the same ones which presented this kind of behaviour in the first part of the questionnaire.

The fact that these subjects have made the same decisions that correspond to the optimum may be due to the fact that all three are classified as economics students. Therefore, they may have theoretical knowledge about public goods games and that their decisions are based on such knowledge.

Finally, the remaining five subjects are represented by the blue line with diamond-shaped markers. These subjects presented contribution decisions that cannot be classified under any recognizable model.

Figure 8 shows the individual contributions of the 22 subjects who participated in the experiment, these contributions are divided into four different categories. . In each of these graphs, the horizontal axis represents the average of contributions of the group and, the vertical axis, the contribution of each subject individually.

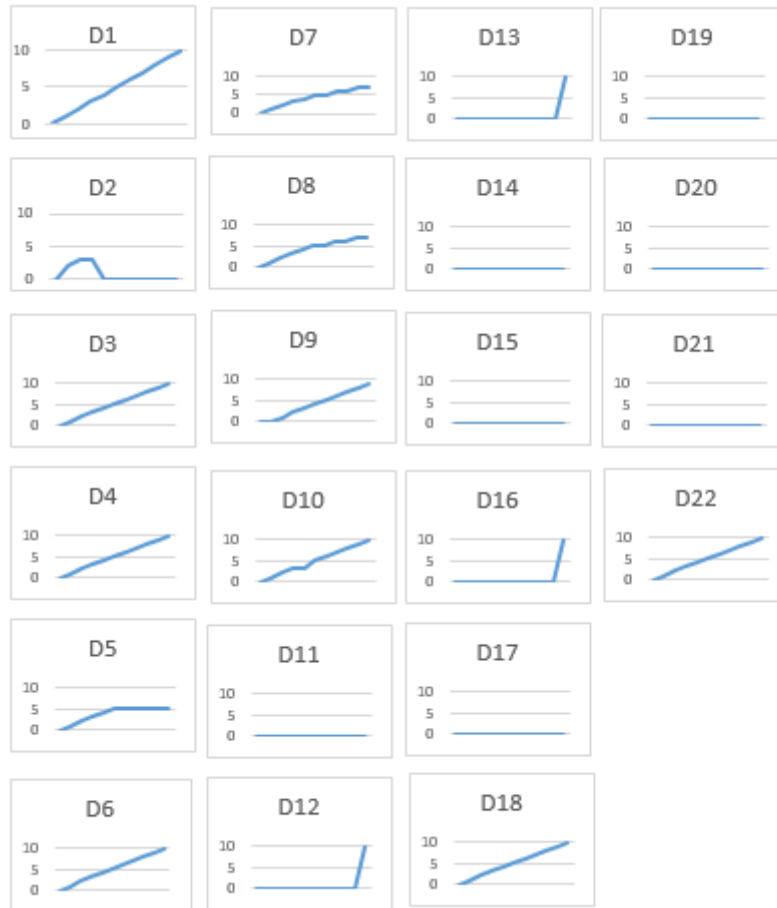


Figure 8- Contribution trend of each individual subject⁴

The distribution of subjects according to their contribution pattern in Treatment 4, for a marginal per capita return of 0.9 has been, therefore:

Table 7-Distribution of subjects among the different categories, Treatment 4 (N = 4, MPCR = 0.9).

Contributors	Number of subjects	Distribution
Conditional Cooperatives	7	31,81%
Free Riders	7	31,81%
Optimum	3	13,63%
Others	5	22,72%

⁴ Conditional Cooperatives: subjects no.1, 3, 4, 6, 10, 18, and 22. Free Riders: subjects no.11, 14, 15, 17, 19, 20, and 21. Others: subject no. 2, 5, 7, 8, 9. Optimum: subjects no. 12, 13, 16. Horizontal axis represents the average of contributions of the group and, the vertical axis, the contribution of each subject individually.

Therefore, the main result that can be observed is that comparing the two treatments of this second questionnaire, in both cases of an increase in the marginal per capita return from 0.6 to 0.9, with groups of four subjects does not have a significant effect on the contribution decisions of the subjects. Virtually, all subjects have the same behaviour of contribution decisions in the third and fourth treatment.

We can consider that, the reasons why the subjects do not change their behaviour trend are the same as the reasons that have been raised in the analysis of the results of the first questionnaire.

3.3 Effect of the group size

If there exists established comparison between the two questionnaires, it can be observed that, for a marginal per capita return of 0.6, the groups of two subjects are more cooperative than the groups of four subjects. While for groups of two subjects it was possible to observe eleven conditional cooperative, for groups with four subjects there were only six that exhibited conditional cooperative behaviour.

The tendency to be a "*Free rider*" was greater in the larger groups, in this specific case, formed by four subjects. In the groups of two subjects it was observed that five presented this kind of behaviour while, with groups of four subjects, the number increased to seven.

It is possible to make the same comparison for a marginal per capita return of 0.9. It was observable that the number of subjects presenting a conditional cooperative behaviour decreased from 11, in the case of groups of two subjects, to seven in the case of groups of four subjects.

While analysing those subjects that exhibit "*Free rider*" behaviour, it was possible to observe that exactly the same happened, with a marginal return per capita of 0.6. Larger groups had more "*Free rider*" subjects than small groups. That is, with groups of two subjects, there were five that exhibit this behaviour while, with groups of four, there were seven subjects that behave as "*Free rider*".

All these results are included in Table 8, where the number of subjects classified according to their contribution decisions in each of the treatments appear. As well as, the percentage that each group of subjects represented within each treatment.

Table 8-Classification of subjects according to their contribution decisions for each of the treatments.

	MPCR=0,6		MPCR=0,9	
	N=2	N=4	N=2	N=4
Conditional Cooperative	11 (50%)	6 (27,27%)	11 (50%)	7 (31,81%)
Free Rider	5 (22,72%)	7 (31,81%)	5 (22,72%)	7 (31,81%)
Other	6 (27,27%)	3 (13,63%)	6 (27,27%)	5 (22,72%)
Optimum	0	6 (27,27%)	0	3 (13,63%)

Thus, both for a marginal per capita return of 0.6 and for a marginal per capita return of 0.9 it is noticeable that the groups of two subjects were more cooperative than the groups of four subjects. Also, a "*Free rider*" behaviour was observed higher in the groups compound of four subjects.

Although the "*Free rider*" contribution behaviour was greater in the case of groups with four subjects, it was still much lower than that observed in other similar experiments, such as the results obtained by Fischbacher, Gächter and Fehr (2000). They conducted a similar experiment to the one described in this document. They designed an experiment model based on the strategic method with groups of four subjects and a marginal per capita return of 0.4.

In Figure B1 of Annex B it can be seen graphically the average of contributions that they obtained as a result in their experiment. The results show that, out of a total of 44 subjects, 30 showed a "*Free rider*" behaviour. Therefore, on average, they obtained a much larger number of subjects who behaved as "*Free rider*" than in our case.

A simple and logical explanation to this result could be that, in experiment described in this case study, the subjects did not receive any kind of economic compensation therefore, they may not have enough incentives to behave as "*Free rider*".

On the other hand, Figure B1 in Annex B, shows that Fischbacher, Gächter and Fehr (2000) obtained a classification in their results that we did not obtain in experiment conducted and described in this paper. In their case, 14 out of the 44 subjects can be classified according to their contribution decisions as "*hump-shaped*". In Figure B2 of Annex B it is possible to see the individual contribution to the public good of each of the 44 subjects. In it, it is distinguishable that the subject 5 or the subject 27 presented this contribution in the form of a hump that it was not perceptible in the individual contribution of any of subjects tested in this experiment.

On the other hand, Fischbacher, Gächter and Fehr (2000) obtained in their results that around 50% of the subjects behave as conditional cooperative while, a third, behave as "Free rider". In this case, this result was obtained for Treatment 1 and Treatment 2 but it was not observed in Treatment 3 and Treatment 4. With groups of four subjects, it was detected that subjects showed less conditional cooperative behaviour than in their case.

Now, the most outstanding result was that it is possible to notice that the contribution decisions of the subjects to the "common project" did not present practically any type of variation before an increase in the marginal per capita return from 0.6 to 0.9.

More specifically, it is noticeable that there was no type of variation in the contribution behaviour of the subjects between Treatment 1 and Treatment 2 and that, there was a very small variation in the contribution behaviour of the subjects between Treatment 3 and Treatment 4.

Therefore, we have obtained as a result that there are no significant variations in the decisions of contribution of the subjects before an increase in the marginal per capita return.

This result has been tested through a chi-square contrast, obtaining precisely the results presented.

The result of the chi-square statistic between Treatment 1 and Treatment 2 is equal $\chi^2 = 0$, with a p-value = 1 and df= 2 so, the changes in the decision behaviour of the subjects are not significant between Treatment 1 and Treatment 2.

On the other hand, the result of the chi-square statistic when comparing Treatment 3 and Treatment 4 is $\chi^2 = 1.576$ with a p-value = 0.664 and df= 2. So, again, the variations in the behaviour of contribution decisions of the subjects are not statistically significant between both treatments.

4 CONCLUSIONS

A large number of articles that attempt to analyse the contributions of subjects to public goods through a variant of the strategic method have shown, as described above, that 50% of the subjects behave as conditional cooperative and, a third, as "*Free rider*".

In our object of study, this has not been the result obtained. The results obtained in this experiment differ from those obtained in similar experiments in which a variant of the strategic method is also applied, as is the case of Fischbacher, Gächter and Fehr (2000).

It has been obtained in this analysis that for groups of two subjects, that 50% of them presented conditional cooperative behaviour. While, for groups of four subjects this was not the case. The obtained information show that, with a marginal per capita return of 0.6 and groups of four subjects, 27.27% of the subjects behaved as a conditional cooperative while, with a marginal per capita return of 0.9 and groups of four subjects, this proportion increased to 31.81%. Without being able to reach, in neither of the two cases, the 50% that is obtained in a large part of similar experiments.

In addition, the most recent literature has shown that, increasing the marginal return per capita, the cooperation of the subject's increases. This is the result that some experimentalists have obtained in their analyses, as in the case of Isaak and Walker (1988) or Fischbacher, Gächter and Fehr (2000).

This was precisely the starting hypothesis proposed in this document. Thus, it was expected that in the two questionnaires, an increase in the marginal per capita return from 0.6 to 0.9 will increase the proportion of subjects that behave as a conditional cooperative, that is, the contribution of the subjects to the called "*common project*" will increase.

However, the results obtained showed a different conclusion that goes against this hypothesis. In this case study, both for groups of two subjects and for groups of four subjects, it was not possible to find any evidence of an increase in cooperation in the face of an increase in the marginal per capita return.

Neither there was found any evidence in favour of the second hypothesis raised in the introduction to this document. In the second hypothesis, it was proposed that groups of four subjects should be more cooperative than groups of two subjects.

These results would be consistent with the results obtained in other analyses such as Kocher and Sutter (2005) who found that large groups are more cooperative than small groups.

In the results obtained in this experiment, it was not observed that the groups of four subjects cooperate more than the groups of two subjects. In fact, exactly the opposite happened. It was observable in greater degree cooperation in the groups of two subjects. The groups of four subjects showed a conditional cooperative behaviour of 27.27% while, in the groups of two subjects, this behaviour was recorded at 50%.

The reasons why these results differ from the results obtained in other similar analyses can be various. On the one hand, unlike the rest of similar experiments, in this case the subjects do not receive any kind of economic compensation. This may be one of the reasons why the same behavioural trends in contribution decisions are not observed.

On the other hand, the data obtained in this experiment have been compared, at all times, with data obtained in other similar experiments. However, despite presenting a very similar experimental design, experiment conducted for this case study had a particularity, has been carried out through the Internet. This may be another reason why the results differed from the results obtained by the rest of the experimentalists.

Thus, this experiment allowed to observe the average contributions to the public goods of a set of 44 subjects. As well as, its behaviour before an increase in the marginal return per capita. All this, through two questionnaires designed according to a variant of the strategic method and administered in an uncommon way in this type of experiments, through the internet. The results obtained during a process of analysis, were contrary to the hypotheses stated in the introduction of the document. Therefore, the results have not been as expected.

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Annexed A

Experimental Instructions

¿Estás seguro de saber manejar tu dinero?

Imagina que te vas de copas con tu amigo y que cada uno lleva 10€ en la cartera para pagar las consumiciones. Podéis decidir si pagarse las copas cada uno o aportar una cantidad de dinero en un bote común que servirá para pagar las consumaciones de los dos.

Una vez los dos decidís cuánto aportar al bote común, multiplicaremos por 1,2 y lo dividiremos a partes iguales entre los dos, independientemente de cuánto haya aportado cada uno. De este modo el dinero del que dispones es:

DINERO TOTAL= DINERO EN LA CARTERA + DINERO DEL BOTE

DINERO EN LA CARTERA= 10€ - DINERO QUE APORTES AL BOTE

DINERO DEL BOTE= [(TU APORTACIÓN + APORTACIÓN DE TU AMIGO)*1.2] /2

Figure 9- Example of experiment instructions

Control Questions

Antes de empezar...

Queremos asegurarnos de que has entendido cómo funciona el juego. Para ello debes contestar a la siguiente pregunta de control.

PREGUNTA DE CONTROL: Asume que tu amigo aporta al bote común 0 y tú también aportas 0:

¿Cuánto dinero tienes en la cartera? *

La vostra resposta _____

¿Cuánto beneficio obtienes del bote común? *

La vostra resposta _____

Y, por último, ¿cuánto dinero tienes en total? *

La vostra respo... _____

Figure 10-Example of experiment control questions

The Experiment

Empieza el juego!

A partir de ahora intenta contestar las siguientes preguntas con la mayor sinceridad posible, como si se tratase de una situación real.

¿Cuánto estás dispuesto a aportar al bote común? *

0 1 2 3 4 5 6 7 8 9 10

¿Cuánto estarías dispuesto a aportar al bote común si tu amigo ha decidido aportar 0€? *

0 1 2 3 4 5 6 7 8 9 10

¿Y si ha aportado 1€? *

0 1 2 3 4 5 6 7 8 9 10

Figure 11-Example of experiment questions

Final Questions

Y para finalizar...

El experimento ha terminado! Muchas gracias por habernos ayudado. Por favor, contesta a las últimas tres preguntas.

¿Estudias o has estudiado? *

Sí

No

En caso de responder sí a la pregunta anterior ¿Qué estudias o has estudiado ?

La vostra resposta _____

¿Qué edad tienes?

Menos de 25 años.

Entre 25 y 50 años.

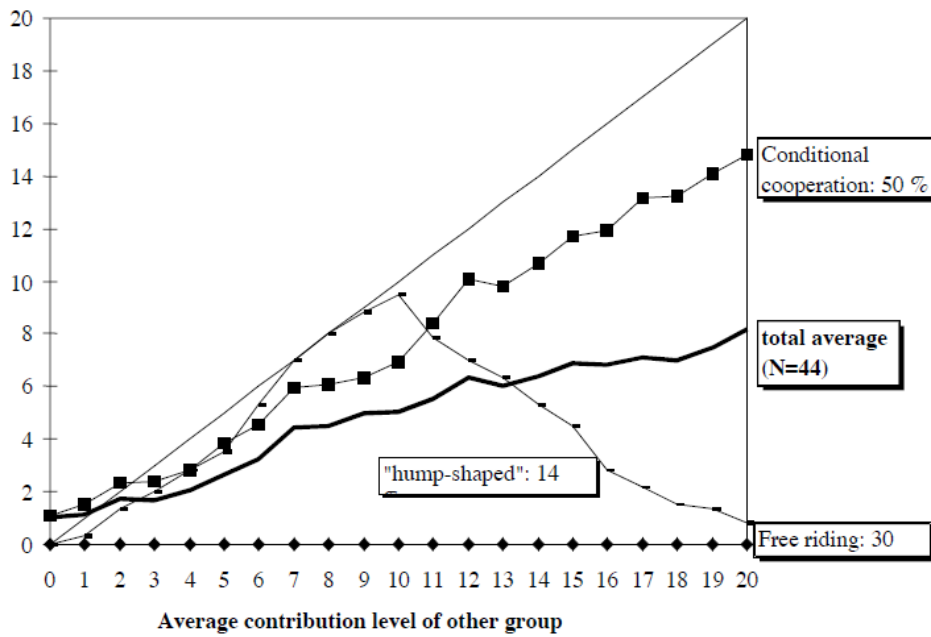
Más de 50 años.

Muchas gracias!

Figure 12-Example of final questions

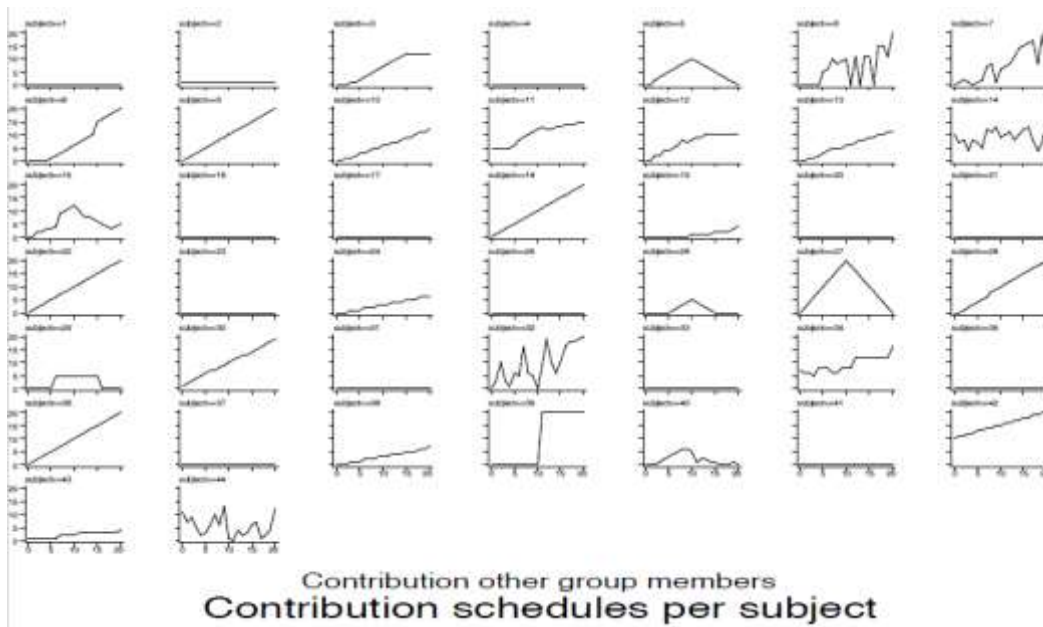
Annexed B

Figure B 1



Source: Fischbacher, U; Gächter, S; Fehr, E. (2000). Are People Conditionally Cooperative? Evidence from a Public Goods Experiment. *Economics Letters*, No. 16, 13.

Figure B 2



Source: Fischbacher, U; Gächter, S; Fehr, E. (2000). Are People Conditionally Cooperative? Evidence from a Public Goods Experiment. *Economics Letters*, No. 16, 14.

