ENHANCING COORDINATION IN CHOOSING A PUBLIC GOOD: AN EXPERIMENTAL STUDY

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Abstract

This paper presents how coordination of subjects' choices and actions could be enhanced by introducing a first-mover in the experimental settings of a modified standard public good game. Exposed to a range of projects differing in their marginal rate of return, subjects choose frequently, despite the coordination problems, the socially most efficient project both out of selfish reasons, and of cooperative motivation. Some first-movers express belief in the cooperative intentions of followers by contributing relatively high. Others invest a lot due to seemingly strategic reasons involving the entire game. Some followers reciprocate or conform, while others decide to free-ride. With certain probability the evolution of the game allows for a stable high average level of contributions.

Contents

I. Introduction

Situations[1] which involve collective actions are frequently complicated by coordination failures or free-riding behaviour. The provision of public goods (non-excludable and non-rival) is a prominent example of collective action which has a special relevance for modern society. Individuals' private provisions are usually greater than zero, so the expected free-riding behaviour (or the sub game-perfect-equilibrium behaviour) does not occur at the extremely high rate. However, contribution levels are still inefficiently low for the group in question or the society as a whole, so mechanisms of raising these levels are necessary for increasing total welfare.

Over-consumption of shared resources is the most popular problem in discussions about real or experimental public goods. However, almost completely ignored is the question of coordination on the specific public good which shall be supplied. Which public good of many will individuals choose to invest in? Coordination and public goods seem to be analysed together only in terms of choosing the particular level of contribution: coordinating on any one of the multiple equilibria, or coordination on the pay-off dominant equilibrium (Devetag and Ortmann, 2006). The three main factors under scrutiny are communication, reputation and leadership. One-way or two-way communication seems to have a positive effect on coordination and on the realization of the Pareto-dominant (efficient) equilibrium (Cooper et. al, 1992), which is also true for cheap talk (Farrell, 1987). Reputation building does also lead to an easier fixation on a specific level of contributions (Dale et al., 2002). Furthermore, first-movers' choices have a strong and significant effect on the behaviour of the followers (Gächter and Renner, 2004).

Interestingly enough, I found no (experimental) research on how people coordinate on one of few projects or public goods. This topic has a special relevance due to the fact that in reality the question where to contribute precedes the question of how much to contribute. On the one hand government spending is usually determined by cost-benefit analysis or political economics reasons such as maximization of vote shares or lobbying. On the other hand, spending for charity causes or for social, ecological or cultural (non-profit) projects is strongly dependant on people's choices. *Which cause* will be supported and *in what measure* is essential for its realization and total efficiency. If people fail to coordinate or to turn their efforts or expenditures in one direction, it may well be the case that no project comes through. If people coordinate on a cause with low efficiency-gains, society will not be able to use its full potential. Suspicion concerning the behaviour of others, the desire not to get the "sucker's payoff" (Wilkinson-Ryan and Hoffman, 2010) or simply the uncertainty where others will contribute will lead to lower efficiency. Even transaction costs that are low may be a hindrance to the project's success.

Before moving to the brief description of my experiment and its results, I will shortly introduce the findings of previous researchers on what solutions have been found to the free-riding problem. I have no claims at having included all scientific findings. More information on the topic could be found in the surveys of the literature in question by Chaudhuri (2011) and by Ledyard (1995). Among the traditional methods the most popular are taxation and central provision of the public good (e.g. national security); making public goods private by lifting barriers (e.g concerts); assurance contracts; using the Coasian solution in which potential beneficiaries of a public good band together and pool their resources based on their willingness to pay to create the public good (Coase 1960); government subsidies for the private sector's production of the good; joining a public good to a private good (e.g tax deductions); financial stimuli for privileged groups who benefit enough from the provision of a public good to provide it on their own (e.g. street lighting in the past, free soft-

[1] *I am heartily thankful to my friend Tatyana Mitkova whose logistic assistance and motivational help made my research possible.*

ware); intellectual property laws (copyright and patent laws which turn public goods into club goods); and social norms.

Mechanisms that improve cooperation and lead to coordination on efficient equilibria are among others minimum thresholds /PPM/ (Bagnoli and McKee, 1991), internalized social norms (Rege and Telle, 2004), voluntary association processes (Page, Putterman and Unel, 2005), a threat of expulsion (Cinyabuguma et al., 2005), contribution monitoring together with verbal communication (Cason and Khan, 1999), intergroup competition framing (Bornstein et al., 1999), nonmonetary sanctions and rewards (Dugar, 2010), authority, and tradition.

In my dissertation I will concentrate on the analysis of coordination under a simultaneous choice, free-riding-behaviour, first-mover behaviour, leadership, and crowding-in.

The experiment is an extended version of a standard public goods game in which subjects choose between 3 different projects with different efficiency but also different initial endowment. In order to succeed, a project needs the support of at least three quarters of the subjects. This framework will make the public goods situation more realistic resembling the obstacles created by a wide choice of possibilities.

During the research I could show that people's average contributions remain constant during a treatment with a first-mover which can be explained with the profits that cooperation brings with itself. With no first-mover and with coordination problems contributions do not fall neither, although they are generally at a lower level. The most reasonable explanation might be the much weaker effect of the "sucker's payoff" phenomenon. Due to the technical inability to coordinate successfully, people do not get in touch with free-riding as intensely as usual. Anyway, the results are in a contrast with the results of Ledyard (1995), where subjects started with relatively high investments but with the time contributed less and less.

Another observation is the conditional cooperation of subjects. I could confirm the results of Fischbacher, Gächter and Fehr (2001), who found that there are lots of people who contribute more to a common project as soon as others contribute more. As soon as a first-mover contributed a substantial amount of their endowment to a project, followers contributed a sum that was not seldomly as high as the leader's investment. Lower levels of first-movers' contributions received even more modest responses. These observations confirm the findings of Bardsley and Sausgruber (2005).

Surprising was the fact that as soon as people could coordinate, they coordinated on the most efficient project in more than half of the cases. It is later on shown, that this social efficiency preference is driven by both free-riding incentives, and a cooperation-motivation. The preference for efficiency and cooperation is also confirmed by first-movers' choices in the leader-treatment. Insufficient amounts of investment do, however, weaken the positive effect of the efficient projects.

A final important observation is in accordance with Gächter and Renner (2003) who found high degrees of reciprocity in leader-follower public goods games but no differences between the total contributions *when players contribute simultaneously* and *when one player moves first*. A new finding here is that almost always in the presence of a leader followers chose the same project. Despite the examples of free-riding, one can conclude that subjects generally wish to succeed with the projects in the belief that this will serve them and the group as a whole.

Due to the complex design of the experiment and the various effects that could be observed, further research is suggested with both simplifications, and extensions.

After this introduction I will continue with Section 2 presenting the Experimental Design and

Procedures and Section 3 presenting some Predictions made before the experiment on the basis of previous research by economists. In Section 4 the Experimental Results will be presented and, finally, in Section 5 a conclusion will be drawn summarizing the findings, the interpretations and the possible extensions of the experiment.

II. Experimental Design

Procedures

Participants who agreed to participate in the experiment were, firstly, informed about the basic framework. So, in advance, before the official sessions, they knew that they would participate in an economics experiment as a part of a bachelor thesis research. Although they knew the researcher personally, their identities were kept anonymous before, during and after the experiment. The communication with the other subjects was therefore only indirect, via the signals that each one's behaviour sent out. The experiment itself was conducted over the chatting platform *skype*, in four sessions (May 4-15, 2012). The 16 participants were all students, age 19-23, with majors ranging from Business Administration and Journalism to Law and Engineering.

Each session lasted approximately 75 minutes, starting with the reading of the experimental instructions (ca. 10 minutes), continuing with the answering of the control questions (ca. 20 minutes) and ending with the two stages of the experiment (Leader and No-Leader treatment, each ca. 20 minutes). The instructions (see Appendix) explained the public good problem to the participants in a neutral way. For the purpose of accurate measurement of subjects' preferences, special care was taken to explain with the help of examples and control questions the rules of the game and the incentive structure.

Design

The basic decision situation is a standard linear public good game. Although the Provision Point Mechanism is proven to lead to higher subject's contributions in most settings (Rondeau et al., 2005), I use the Voluntary Contribution Mechanism (VCM) for my experiments, which is more popular in public goods games due to its simplicity and due to the fact that the various effects could be more easily separated.

There were two treatments, Leader and No-Leader, and 4 sessions of which two had the No-Leader Treatment first and the other two the Leader treatment first.

The participants are randomly assigned to groups of four people. Each participant has to choose in the beginning of each and every round which project she would like to invest in and how big the contribution should be. Each project is marked by a different initial endowment and a different marginal rate of return.

- Choosing project A leads to an initial endowment of 20 and to a private marginal rate of return of 0,4 (the social marginal benefit is 1,6).
- Choosing project B leads to an initial endowment of 18 and to a private marginal rate of return of 0,5 (the social marginal benefit is 2).
- Choosing project C leads to an initial endowment of 16 and to a private marginal rate of return of 0,6 (the social marginal benefit is 2,4).

The payoff-functions are given as:

$$(20-c_i)+0{,}4 \cdot \Sigma c_j$$
$$(18-c_i)+0{,}5 \cdot \Sigma c_j$$
$$(16-c_i)+0{,}6 \cdot \Sigma c_j$$

where the public good is equal to the sum of the contributions of all group members.

Each group member will profit equally from the amount invested into the successful project. A project is successful only if 3 or all 4 persons invest in the same one. Otherwise, the project fails and the subject receives the contributed sum back reduced by one unit serving as a transaction cost.

Standard assumptions therefore predict that all group members choose the project with the lowest marginal rate of return but the highest initial endowment, and thus free ride completely, that is, $c_j = 0$ for all j. The socially efficient outcome would be to choose project C with the highest (social) marginal rate of return of 2,4.
This theoretic prediction does also hold for the Leader treatment and the first-mover. By backwards-induction the first-mover would set 0 as a contribution and choose A as a project because they know that the followers would rationally choose not to contribute anything. This logic holds also for the entire game as a 10-rounds repeated one-shot game.

In the case that one applies theories of bounded rationality and assumes that subjects try to guess how much and where their counterparts would invest, it is important to know how efficient each single project is. For contribution levels below 20 points in total (i.e. each of the four players contributes up to 5 points), it is socially efficient to invest in project A. For any total contribution of above 20 points, project C is socially and privately dominant. It is naïve to expect that subjects will have developed a perfect ability to calculate exactly their chances in this game, but (as it was observed) they may successfully get use of some relatively simple utility maximization strategy.

In the No-Leader treatment, the only information at the disposal of the participants in the beginning is that everyone else is in their position. In the Leader treatment a randomly-chosen first-mover makes her choice before anyone else in each of the 10 rounds. The first-mover is chosen for every next round anew. Her contribution and project choice is made public to the remaining 3 players who than have 25 seconds to announce privately to the researcher their contribution and project choice.

In order to incentivize subjects, every point won was translated into two cents in their final pay-off.

III. Predictions

Based on previous public goods experiments one can imagine that theoretically expected behaviour would not be observed. Subjects will tend to start with rather high contributions in the beginning of the experiment which will most certainly tend to fall as soon as some players start to free-ride. Beliefs, risk-aversion and simple uncertainty due to the low probability of coordination matter a lot and it is definitely a hard task to completely separate their effects.

Comparing average contributions in the No-leader treatment (NLT) and the Leader treatment (LT), one could predict that due to the lower uncertainty in respect to the behaviour of one of the players people will contribute more or, as proven in experimental papers, mimic the contribution of the first

mover. Trust is positively correlated with the level of the contributions (Berg et al., 1995), whereas risk-aversion has a negative effect on them.

Reciprocity and conformity should be major factors in both treatments. In the NLT reciprocity only matters after the players receive the feedback on their pay-offs for each single round. Higher pay-offs will always be a sign of high contributions of the others and thus provoke either a more altruistic behaviour, or lead to free-riding. Low pay-offs might either be understood as a signal for necessary action i.e. increasing of the own investments, or as a signal for a missing desire for cooperation. Reciprocity in the LT is especially important because the first stage of each round resembles vaguely an Ultimatum Game in which a first-mover's contribution might either be met with an equal response by the other side (the followers), or accepted as a possibility to free-ride.

Coordination is of central importance for this paper and is crucial in defining the size of people's contributions, as well as their beliefs about others. Assuming that people are rational and selfish and that they believe others are rational and selfish too, than everybody will choose project A and contribute nothing to it. Thus in each round (no matter what treatment or treatment order) the project A will be chosen by but there will be no efficiency gains due to the zero-contributions. Assuming a participant has a Non-Zero contribution and further assuming that she believes everybody else makes their choice at random (and not selfishly rational), then the probability of getting a project through is

P(Success | Player chooses a specific project) = 1/3^2+1/3^3 = 14,81% .

This would mean that with a chance of about 85% a participant will have to pay a transaction cost of 1 because the project they had chosen was not realized. This is an inconvenience that should have an additional adverse effect on average and total contributions. Only through building some beliefs about others' preferences concerning efficiency or their cooperation levels could one raise the success rate. A prerequisite is, of course, a match of beliefs and preferences of the players. This percentage will, however, be completely justified as a correct value only if the game is not repeated. In our case, over time participants will (at least by chance) coordinate and learn about others from experience. Once a project is realized, one can imagine that the contributors will contribute to the same project once again. Thus coordination and possibly cooperation could be established and maintained.

As usual in economic experiments the starting and the final rounds are of special importance in repeated games. One could expect that the first round in both treatments NLT and LT will be marked by a relatively high level of mistakes due to the lacking experience of players. Projects might be really chosen at random and contribution levels might be rather tentatively selected – middle ranged values expressing neither risk aversion, nor real confidence about the choice made. In the LT the first-mover will probably serve as an anchor for the remaining three players. All three would probably copy the first-movers behaviour, which under certain circumstances could lead to a series of either low-level or high-level contributions during the entire game.

The 10^{th} (20^{th}) round is interesting because any thought of future cooperation or interaction with the players will not be important. In accordance with game theory, most subjects might just act selfishly and either free-ride on the first-mover's contribution (which in fact ought to be zero) or simply choose the project with the highest initial endowment (A, 20).

Finally, I would like to draw some distinctions in the predictions about the behaviour of players in the two versions of the experiment. In the first two sessions the NLT preceded the LT, while sessions 3 and 4 had the opposite order. Starting with the NLT might be associated with higher levels of insecurity and inability to coordinate from the beginning on. Thus contribution and

cooperation values will be lower. Due to the learning effects or the feeling of dissatisfaction with the inability to realize a successful project, players might continue to act rather inefficiently also during the LT afterwards. However, it is also possible that the sudden ease of coordination and the higher efficiency gains shared by all might increase contributions step-by-step during the course of the LT.

Starting with the LT might lead to an easier initial coordination and if players get stuck in a high-efficiency, high-contribution equilibrium this could mean higher pay-offs at least in the first phase. The sudden change to NLT will either be a serious hindrance to the coordination and lead to lower investments or it might make subjects to choose the projects and levels of contributions which they associate with their own highest pay-offs from the first stage.

IV. Experimental results and interpretation

Background:

There were 16 participants in the experiment who earned on average 8,18Euro. The minimum payoff was 6,89 Euro and the maximum 9,98 Euro. The average duration of each session was approximately 75 minutes. There were two experimental treatments, No-Leader Treatment (NLT) and a Leader Treatment (LT), and they were conducted in a reversed order in two of the sessions. Below, the most essential observations will be presented and analysed.

Contribution levels:

Due to the different design of the public good game, results do not perfectly resemble findings of older researches. Average contributions were as expected non-zero, and explicit free-riding behaviour was observed only in a few cases. The contribution mean of all sessions was 5,92 points, or approximately 1/3 of a subject's endowment (30% of an investment in a project A or 37,5% of an investment in project C). The average earnings amounted to 8,18 Euro which is by 0,18 Euro more than the maximum possible earnings in a theoretic framework with completely rational and selfish subjects. The additional money is an efficiency gain through the subjects' contributions. The gain is, however, relatively low due to the frequent choice of more cooperative projects (B or more often C) without the ability to collect enough investments to compensate for the lower initial endowments. In addition, all contributions to unsuccessful projects led to pay-off reductions via the transaction costs of 1 point. There were efficiency gains in the Leader Treatments in 3 of the 4 sessions (the order had an effect on the size of the profit) and in none of the NLTs where subjects had to decide simultaneously on the project they would like to invest in.

Table 1 below clearly depicts the differences between the two treatments and the sessions in which the order of the treatments was reversed. Firstly, looking at the NLT-LT sessions (Session 1 and Session 2) we observe that contributions in both of the first treatments were about twice as high as the investments in the second part of the experiments. One can assume that people reduced their cooperativeness due to the fear of getting the "sucker's pay-off" or simple due to a relatively risk-averse first-mover behaviour in the LTs. Gains in the LTs were still higher due to much higher success rate of projects (9 of 10 in both sessions).

	Average Contribution (in points)	Average Payoff (in Euro)
Session 1	4,2875	7,567
NLT1	6,3	3,601
LT2	2,275	3,97
Session 2	5,638	7,9595
NLT1	7,25	3,914
LT2	4,025	4,05
Session1&2	4,96	7,76
Session 3	8,0375	8,847
LT1	9,7	5,09
NLT2	6,375	3,75
Session 4	5,7125	8,363
LT1	7,675	4,5
NLT2	3,75	3,86
Session3&4	6,875	8,605
Total	5,92	8,18

Table 1: Average contributions and pay-offs in all four sessions

In contrast to the NLT-LT sessions, the sessions starting with the Leader Treatment (Sessions 3 and 4) had both somewhat higher contribution levels (6,875 versus 4,96 points), and higher average pay-offs (8,605 Euro and 7,76 Euro). The pattern that the second treatment (no matter what it is) is weaker in cooperativeness and gains is true also here. Furthermore, the profit in the LT is higher than in the NLT – in accordance with the first two sessions. Concluding, it seems that the negative experience of being unable to coordinate leads to a reduction in cooperativeness as well as in mean and median contributions.

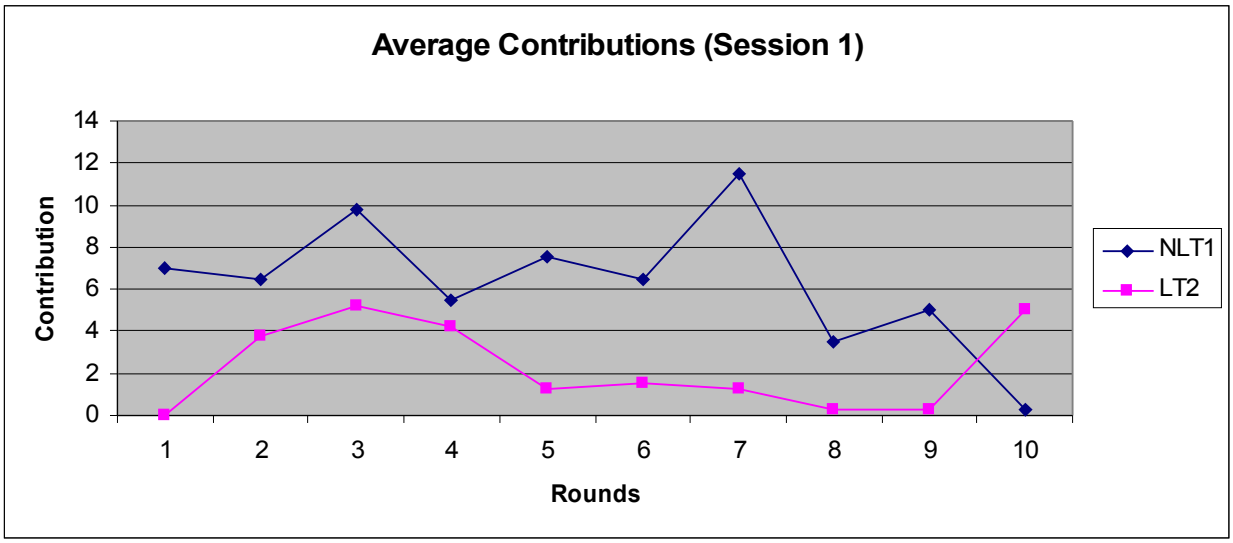

Figure 1: Average contributions in Session 1

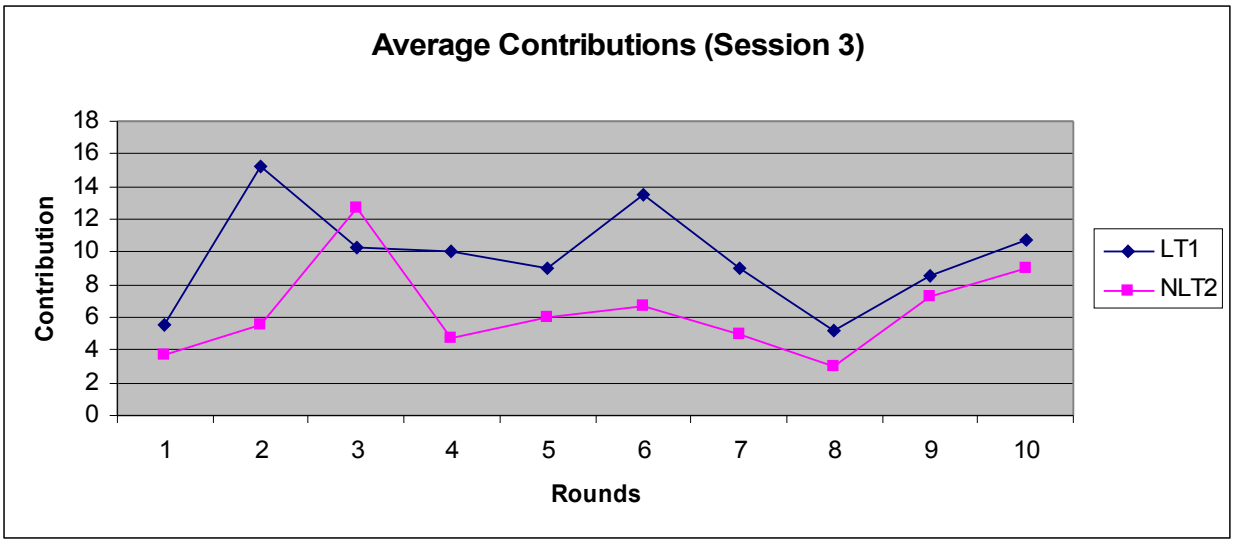

Figure 2: Average contributions in Session 3

Unlike the experiments of Fehr and Gächter (2000) in the current study there is no clear trend that subjects' contribution get lower in a single treatment with the passing rounds. There is, still, a clear reduction of investments in every of the second treatments (both in Sessions 1-2, and in Sessions 3-4). As can be expected, subjects' behaviour is not uniform. Some act more cooperatively than others, and some seem to have preferences with no simple income-maximization explanation. Details on the contribution behaviour of subjects and on the evolution of the games can be seen in the Appendix.

Transaction costs

Transaction costs were introduced in order to make the public good situation more realistic. Having in mind that lots of real-life public goods do not to get realized despite people's contributions, it is necessary to allow for this option in the experimental environment. Examples for transaction costs range from bank transaction costs to the time spent on making the effort to return the donation (in cases of charitable events) to the principal.

Theoretically, the transaction cost should not matter because nobody would rationally and selfishly invest. In reality, people contribute, so the transaction cost of 1 connected with any unsuccessful project should influence contribution levels in a negative way. Interestingly enough, the single remarkable observation concerning the transaction costs is that they seem not to affect subjects strongly. Most players contributed as already stated in the previous paragraph during the entire game in a more or less constant pattern which changed only as the treatment changed. Even the majority of the few players who soon discovered the personal benefits associated with free-riding acted rather irrationally in lots of NLT rounds contributing low sums of 1 or 2 points despite the high chance of losing them due to a coordination failure (Player 2 and 4 in Session 1 and Player 3 in Session 3).

Coordination

Of central interest for the current research is the coordination ability of subjects. The choice of a

project elicits information about both the preferences of players, and their beliefs about other subjects' behaviour.

In the NLT the simultaneous choice of a project obviously and not surprisingly makes coordination extremely complicated. But while the probability of 15% success (under the assumption that selecting a project happens at random) is prohibitively low, the actual success rate of all NLT treatments is 50%. The order of the treatments seems to have absolutely no effect on the coordination ability of subjects but only on their willingness to contribute which is higher if the NLT precedes the LT. The average contribution in the NLT-LT is 6,775 vs. 5,06 points in the LT-NLT sessions.

The explanation of why subjects show these high levels of coordination in the No-Leader treatments is not completely to be found in the evolution of the game or in some learning effects as one might be misled to believe. In 6 occasions (of 20) in which a NLT project was realized subjects opted once again for the same project which is only 30% of the cases. Thus learning is important but not crucial for success. Much more important seems to be the efficiency of the projects which is basically the single feature that differs. Project C (the most efficient one with a marginal rate of return of 2,4) has been the successful project in 50% of all cases; 15% go to project B; and the remaining 35% belong to project A.

One of the explanations for the choice of project C might be some specific preference for efficiency even though the efficiency gains in C are not extremely higher than in the two other projects. This is supported by the fact that 28,58% of all contributions in C (independent of the success of the project) were above the half of subjects' endowment – most frequently in the higher end of 16. Of course, the other explanation might be that people who choose C hope to reap someone else's profits by free-riding which is supported by the fact that in total 57,79% of all who chose project C contributed 2 points or less to it in the NLTs.

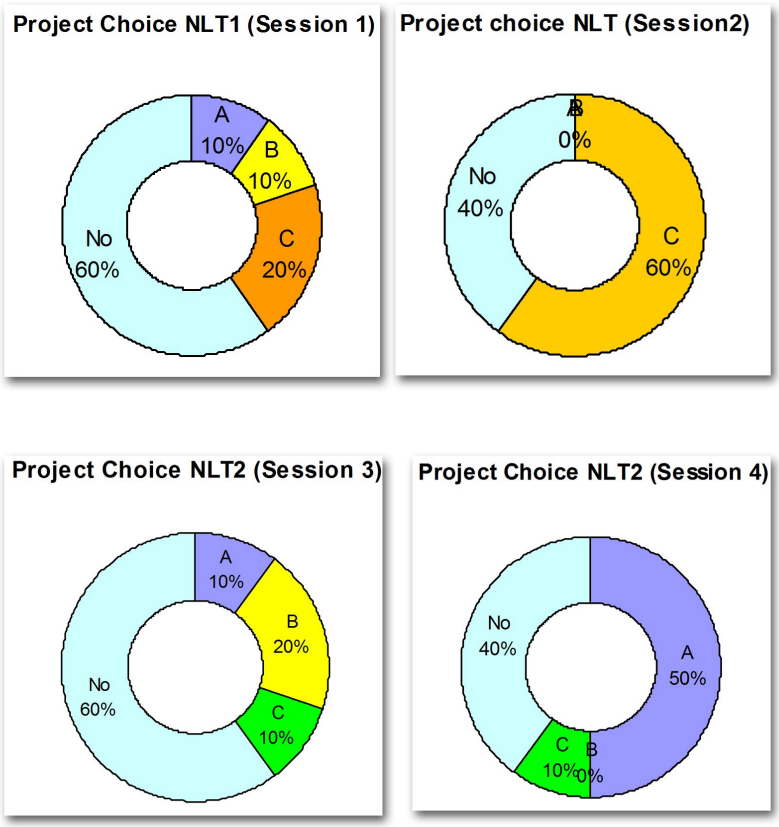

Figure 3: Distribution of (un)successful projects in the No-Leader Treatment in all four sessions

Thus independent of the exact reasons for this preference for a high-efficiency project a focal point for coordination was established.

Before moving to the observation of the behaviour of first-movers, it is interesting to look into the reasons why projects A and B were more popular in the No-Leader Treatment in sessions 3 and 4 preceded by the LTs. While A and B accounted for 51,25% of the choices in Sessions 1 and 2 (NLT) and for only 25% of the successful projects, in the NLTs in Session 3 and 4 they were chosen in 78,75% of the times and accounted for 79% of the realized projects. A reasonable explanation might be the fact that subjects have started with the treatment which is in comparison easier from a coordination point of view. Suddenly, unable to realize a project, they seem to reduce the risk associated with transaction costs and increase their safe initial endowment.

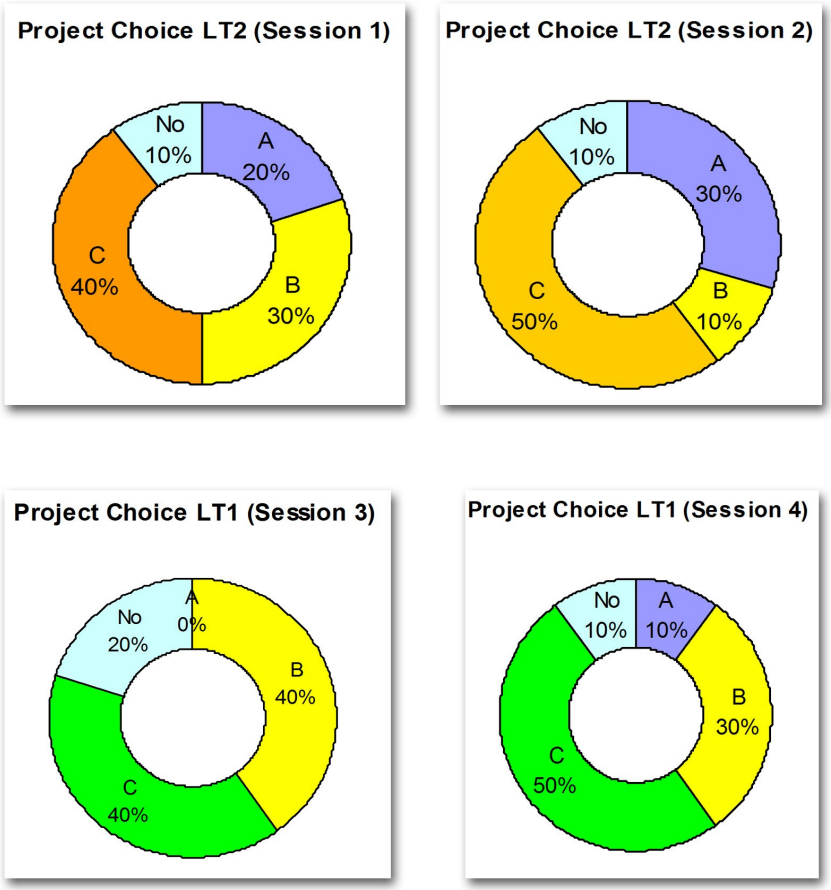

Figure 4: Distribution of (un)successful projects in the Leader Treatment in all four sessions

The Leader Treatment results strongly differ in many aspects from the NLT. To begin with, first-movers were followed in 87,5% of all cases independent of the session. Thus, variability of project choices depended almost exclusively on the preferences of the leader. As three possible reasons for the high percentage one can enlist a preference for a project realization, conformity, desire to free-ride (shown in all cases in which subjects contributed much less than the first-mover), but also cooperativeness (16,2% of the followers in Sessions 1 and 2 and 29% of the followers in sessions 3 and 4 contributed as much as or more than the leader). Furthermore, 51,4% of all realized projects were from the most efficient type C. Hence, it is proven that first-movers (despite the chance for followers to free-ride) continue to opt for the most efficient project showing trust and cooperativeness which was reciprocated frequently. Still, there was high variability in behaviour which can be easily measured via the correlations of first-movers' and followers' contributions (see Table 2). This fact can easily be explained, firstly, through the different types of players and their preferences. Secondly, the evolution of the game matters in a sense that if the group starts with two or 3 relatively high-efficiency rounds (Session 4, LT) followers will contribute more and reciprocate in a stronger way. Otherwise, if the group has problems at coordinating on a high-profit outcome

(e.g. due to a "free-rider" starting the treatment) cooperation levels will be lower. All in all, reciprocity levels can very well be recognized if the ratio Follower-to-Leader Contribution is taken which is on average 84,40% with a standard deviation of 29,6%.

	Correlation
Session 1	-0,1995
Session 2	0,095
Session 3	-0,107
Session 4	0,701

Table 2: Correlation between leaders' and followers' contributions

There are further reasons why first-mover behaviour bears important information about people's strategies, choices and beliefs. For instance, one can observe that in no cases except in two (of 40) did the leader invest zero points into a project. Mean leader contributions amounted to 3,5 points in Sessions 1 and 2 (LTs were preceded by NLTs) and to 11,55 points in Sessions 3 and 4. As was already written above first-movers expressed trust and sought for cooperation most of the time. This effect was very strong in Sessions 3 and 4 and less strong in Sessions 1 and 2. In Session 1 another observation needs some explanation: even low first-mover contributors almost always invested 1 or 2 points. Possibly, some reputation concerns are involved since although subjects are anonymous for the other players, their choice can be observed by the researcher. Also probable is that there is some special dislike for the zero contribution which might be seen as socially unacceptable even in the artificial experimental environment. A more likely explanation for some subjects is, however, that they develop some simple strategy of interaction which aims at reaping the profits from cooperation and trying not to destroy it - at the lowest cost possible. This is relevant for subjects 2 and 3 in Sessions 3 and for subject 3 in Session 4. Acting strategically, these persons invest either in the middle range or high if they happen to be the first-movers, but only 2-3 rounds after the start of the treatment they reduce their contributions as followers to zero. Thus, they manage to receive the highest pay-offs in the end of the experiment.

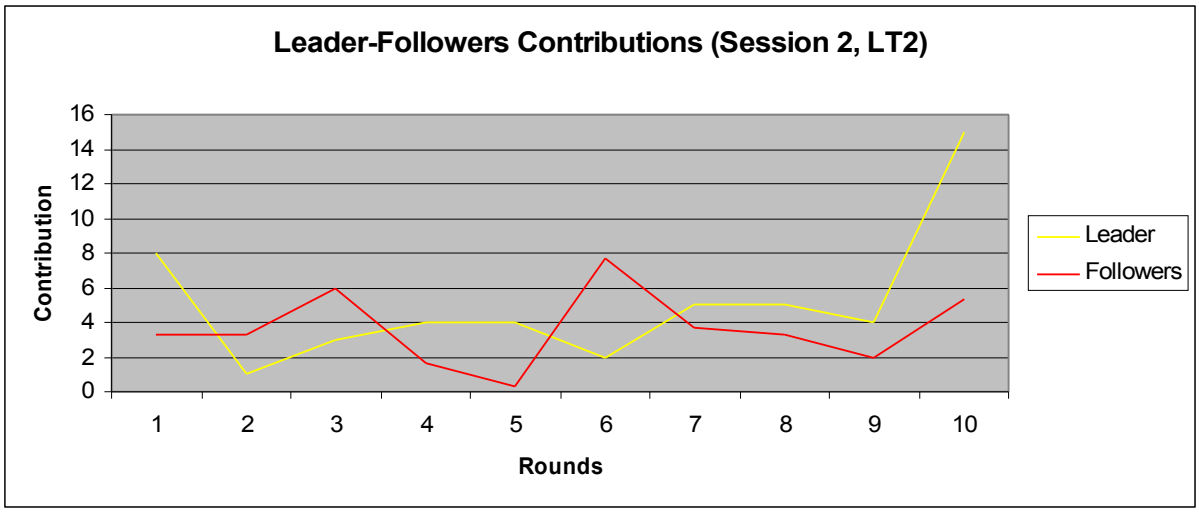

Figure 5: Leader-Follower Contributions in Session 2

First Round

First-round behaviour in the NLTs in Sessions 1 and 2 was marked by contributions in the middle range and certain randomness in the choices. Presumably, subjects were still insecure concerning their optimal or preferred actions. In comparison, subjects' behaviour in the NLTs in Sessions 3 and

4 could also be described as rather tentative. Due to the realization that coordination is harder to achieve, subjects strongly reduce their contributions after the quite cooperative rounds of the LTs.

First-round behaviour in the LTs in Sessions 1 and 2 was marked by high-levels of free-riding and obviously risk-aversion. Subjects seem to play safe in order to collect information and experience before trying other actions. In contrast, subjects in the LTs in Sessions 3 and 4 contributed about the half of their endowments in the first round being able to sustain relatively high-cooperation levels during the entire treatment.

Last Round

10^{th} (and 20^{th}) round behaviour seems quite similar in all of the 4 Sessions across all treatments. 28,125% of all final contributions equalled the entire endowment of a subject, while 43,75% invested zero. The first group seems to be led by some non-economic preferences while the second obviously assumed that nobody will contribute anyway and did not want to risk losing some share of their initial endowments. This observation is a clear confirmation that certain cross-round strategies were applied by participants who in a game-theoretic sense foresaw that nobody has an incentive to contribute in the last round.

V. Discussion and Conclusion

In this paper I examine how coordination and cooperation in public goods games can be raised through a simple first-mover mechanism. Applied was an extended version of a standard public good game with a Voluntary Contribution Mechanism. It incorporated the realistic feature of a variety of projects with a different efficiency potential among which people can choose. Conducting two treatments (a No-Leader and a Leader Treatment), I concentrated on the contribution level differences and the varying ability of subjects to coordinate. The reversed order of treatments in two of the four sessions enriches the research with more information and further insights into the nature of social choice.

To begin with, the most central observation is, probably not surprisingly, the positive effect that a first-mover has on coordination. By technically reducing the uncertainty concerning others' choices the leader's project offers a much higher chance of success. Assuming that a successful project and its gains are preferred to the highest possible initial endowment, it is rational to always choose this project. As shown before, followers have various motives to select the focal project ranging from simple one-step income-maximization and cooperativeness to a more complex income-maximization strategy over a few rounds. Moreover, contribution levels are also higher as long as there is a first-mover and the treatment is not preceded by a weak No-Leader Treatment. My findings are in accordance with the proponents of conditional cooperation and reciprocity incl. Fischbacher, Gachter, and Fehr (2001), and Hofmeyr et. al (2008) in terms of first-mover choices and contributions and follower-responses. Unlike these papers with the current design a relatively stable contribution pattern is possible. There is no convergence of average contributions to zero, so that the leader-mechanism creates a way to keep the adverse effects of free-riding under control though the different preferences or strategy channels. As soon as a free-rider has the responsibility to make a first move, she tries to maximize her pay-offs over the entire treatment and not the single round. Thus, even (a modest) free-riding of the followers, cannot destroy the efficiency gains through cooperation. One should, however, keep in mind that frustration because of problematic coordination in a NLT will reduce the benefits of cooperation in a LT that follows.

The fairly stable contribution levels in the No-Leader treatments can probably be explained with the much slower process of arriving at the equilibrium. The reason is technical: if usually, high-contributors are frustrated by the behaviour of the free-riders relatively soon, here the frustration comes through the channel of coordination failure. Being unable to coordinate, subjects will not lose more than the value of the transaction costs. Thus, free-riding is under cover, gains are low or not existent, but the losses are also negligible. The persistence of lots of subjects to contribute richly until the end of the treatment is caused by either some (justified) feeling of safety or by the hope to finally realize a project with high gains. The exact answer could be found by including more rounds that could show whether the contribution level will finally fall.

The other quite central finding of the current research is the importance of efficiency as a factor in the preferences of all subjects. The observation that the project with the highest marginal rate of return is chosen the most frequently is an evidence of optimistic beliefs about others. People seem to believe that others will not only choose exactly this project but will also contribute enough so that they can jointly get a compensation for their lower initial endowments associated with it. On the other hand, the share of free-riders who would like to use the chance for high selfish gains is not insignificant and has a major role especially in the No-Leader treatment. This is the traditional reason why frustrated previous contributors stop investing: out of fear of getting (again) the "sucker's pay-off".

In order to distinguish better across effects and influences and clarify their strength in people's preferences, some extensions and modifications of the experimental design are necessary and herewith suggested.
Firstly, one should reduce the risk that there is a researcher demand effect. Subjects might be inclined to contribute more, only because they would like to please the person that conducts the experiment. In this particular case this effect could be somewhat stronger because subjects were personal friends of the experimenter. Since observations were in general systematic and not necessarily in conflict with previous experimental literature, one can assume that if there are some researcher demand issues they are of a rather mild character. Still, a repetition of the experiment in a more neutral economic laboratory environment is recommended. This will also ensure that anonymity in respect to the researcher is present. Of course, having in mind Andreoni et. al (2004), anonymity might actually make the situation of giving less realistic. Lots of charitable organizations actually do insist on making their contributors public and thus obviously manage to intensify giving by others.

Secondly, a rather standard addition to the experiment – a strategy elicitation method (Selten, 1967) - could be borne into consideration. This experimental instrument involves asking subjects specifically about their responses to some actions. One could thus collect more information on situations that did not occurred often enough. An example would be to look into people's strategy for the situation that a beneficial project is realized twice in a row (NLT). Would the subjects continue contributing as strongly or rather decide to free-ride and put the cooperation under a threat?
Furthermore, a few simplifications of the experiment might facilitate the distinction of specific motives behind subjects' choices and actions. Removing transaction costs for projects that are not realized will make participants concentrate more on the interaction with the other subjects. Any concerns of losses due to transaction costs will be removed, so it will be possible to see by how much (if at all) the investments and the investment choices of people change. Another simplification would be to include a traditional VCM treatment before (or after) the No-Leader Treatment with three projects. Presenting participants at first with a single project and a more intensive interaction with their counterparts and then reducing interaction but extending the project choice might provide further information about public good games evolution.

Lastly, since the experiment as conducted now is a repeated game of 20 rounds, one could be interested about how players would act in a one-shot game. The settings would be the same, except for the duration of the experiment. In the NLT a completely risk-averse behaviour might be expected (all choose the project with the highest initial endowment and invest nothing) while in the LT one can imagine that the type of the first mover will be decisive for the game. Theoretic rationality and complete cooperativeness seem equally possible.

In conclusion, I should reiterate that an increase in the number of sessions is encouraged in order to achieve significance for the results. Still, specific patterns could clearly be observed even in this smaller sample so the data and the findings seem to hold at least for the current design of the experiment. Having this in mind, one can consider possibilities of applying the knowledge gained or confirmed in this experiment to real-life situation e.g. in organizational motivation schemes or in charities. For instance, charities already use methods of implicit leadership by encouraging famous people to support their causes or simply by enlisting previous contributors so that possible new contributors have them as an example. Non-governmental organizations led in a democratic way often have to cope with the problem of limited resources and so coordination on the essential priorities is central for the achievement of the organizational goals. A first-mover who is not necessarily officially appointed as a leader might easily facilitate the choice of others and crowd-in more contributions in terms of money or efforts. Shifting responsibility to colleagues who usually have low-effort levels might also have positive effect on total welfare of the organization.

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Appendix

I. Experimental Instructions

You are now taking part in an economics experiment financed by the University of Mannheim. If you **read the instructions carefully**, you can – depending on your decisions – earn some amount of money compensating you for the time spent on the experiment. The entire amount of money which you earned with your decisions will be paid to you in cash after the experiment. These instructions are solely for your private information. We ask you not **to communicate during the experiment with anyone but with the researcher.** If you have any questions, please write them down in the chat-window.
Your whole income will first be calculated in points. At the end of the experiment, the total amount of points you earned will be converted into Euros at the following rate:

1 point = 2 cents.

All participants will be divided in groups of four members. **Except for us - the experimenters - no one knows who is in which group. Your identity will remain anonymous.**

The experimental situation

You will be a member of a group consisting of **4 people**. Each group member has to decide on the allocation of his or her points ("endowment"). You can put these points into your **personal account** or you can invest them **fully or partially** into **one of three projects** given below. Each point you do not invest into a project, will automatically remain in your personal account. **Your total income is the sum from your personal account and that from the project.**

Your income from the personal account:

You will earn one point for each point you put into your personal account. For example, if you put 20 points into your personal account your income will amount to exactly 20 points out of your personal account. If you put 3 points into your personal account, your income from this account will be 3 points. **No one except you earns something from your personal account.**

Your income from the project:

Each group member will profit equally from the amount you invest into the project if the project is successful and if the group member has invested in the same project as you. You will profit from others' contributions in the same way. A project is successful only if 3 or all 4 persons invest in the same project. Otherwise, the project fails and you receive the **contributed sum back reduced by one unit**.

The income for each group member will be determined as follows:

- ***Income from project A*** = *sum of all contributions* × *0.4*
- ***Income from project B*** = *sum of all contributions* × *0.5*
- ***Income from project C*** = *sum of all contributions* × *0.6*

If, for example, project B is successful and the sum of all contributions to the project is 50 points, then you and the others who chose project B each earn 50 × 0.5 = 25 points out of the project.

It is also important to know **that the 3 projects differ in the initial endowment you would start with**. *If you choose project A, you have 20 points at your disposal in the beginning of each round which you can put into your personal account or invest fully or partially into the project. In project B you start with 18 points and in project C with 16.*

Total income:

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

Project A
*Total income = Income from your personal account (= **20** – contribution to the project)*
*+ Income from the project (= **0.4** × sum of all contributions to the project)*

Project B
*Total income = Income from your personal account (= **18** – contribution to the project)*
*+ Income from the project (= **0.5** × sum of all contributions to the project)*

Project C
*Total income = Income from your personal account (= **16** – contribution to the project)*
*+ Income from the project (= **0.6** × sum of all contributions to the project)*

In each of the first 10 rounds there will be **one randomly selected first-mover** in your group who will announce his or her choice for a particular project and investment size **before everyone else**. This choice will be made public to the entire group right before the remaining three persons state their investment decision.

After every participant has made their choice, you will be informed about your payoff of this particular round. You will also know whether the project you contributed to is successful in this round or not. Only the researcher will be aware of your choice. After 10 rounds there is going to be a change you are going to be informed about.

Examples:

These examples will only serve the better understanding of the experiment and have no direct relevance to how exactly you and the others in your group should or will behave.

If you choose project C and invest your entire endowment of 16 points and all other players choose the same project but invest nothing, you will end up with 16 x 0,6 = 9,6 points. The others would each have 16 + 9,6 = 25,6 points.

Otherwise if once again all choose the same project C and all contribute their entire endowments, everybody is going to end up with 38,4 points. If, however, you do not contribute anything under these circumstances you will get 44,8 points (and the others 28,8 points each).
Similarly, if all choose project A and all invest everything in the project, the pay-off of each and everyone will be 32 points.

Control Questions:

Please answer the following control questions. They will help you to gain an understanding of the calculation of your income, which varies with your decision. Please answer all the questions and send the answer via the chat window to the researcher.

1. You choose project A (initial endowment of 20) and do not contribute anything to the project. Players 2 and 3 choose project B (initial endowment of 18) and do not contribute anything to the project. Player 4 chooses project C (initial endowment of 16) and does not contribute anything to the project.

   a) Is there a project that will be realized?
   b) What will your total income be?
   c) What will the total income of each other group member be?

2. You choose project B (initial endowment of 18) and do not contribute anything to the project. The other players choose project B as well (initial endowment of 18) and contribute their entire endowment of 18 to the project.

   a) What will your total income be?
   b) What will the total income of each other group member be?

3. Player 3 chooses project C (initial endowment of 16) and invests his or her entire endowment of 16 to the project. You and the other two players choose project B (initial endowment of 18) and contribute each 5 points.

   a) Which project will be realized?
   b) What will your total income be?
   c) What will be the total income of player 3?

Treatment 2 (Sessions 1 and 2):

We will now repeat this experiment with one change. As before, the experiment consists of ten rounds and in each round you have to make a decision about how many of the points at your disposal you want to invest to a project (and so, how many you keep for yourself).

The change:

In each round there will be one randomly selected first-mover in your group who will announce his or her choice for a particular project and investment size before everyone else. This choice will be made public to the entire group right before the remaining three persons state their investment decision.
Everything else remains the same as in the first part of the experiment.

Treatment 2 (Sessions 3 and 4):

We will now repeat this experiment with one change. As before, the experiment consists of ten rounds and in each round you have to make a decision about how many of the points at your disposal you want to invest to a project.

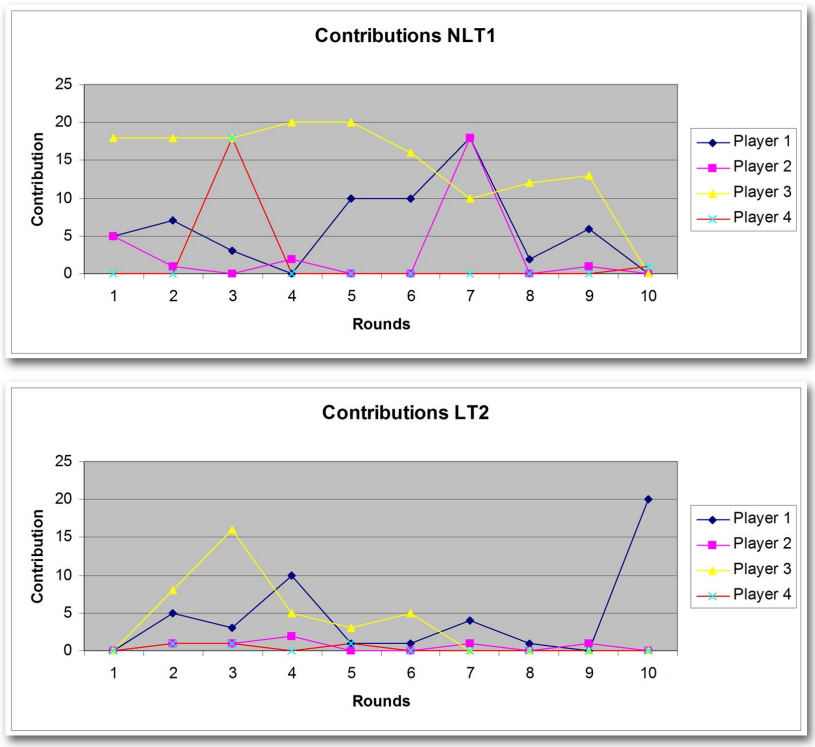
The change:

There is going to be **no first-mover** now. All four persons will make their choice **simultaneously**, so nobody's contribution will be made public first. After every participant made their choice, you will be informed about your payoff of this particular round. You will also know whether the project you contributed to is successful in this round or not. Only the researcher will be aware of your choice.

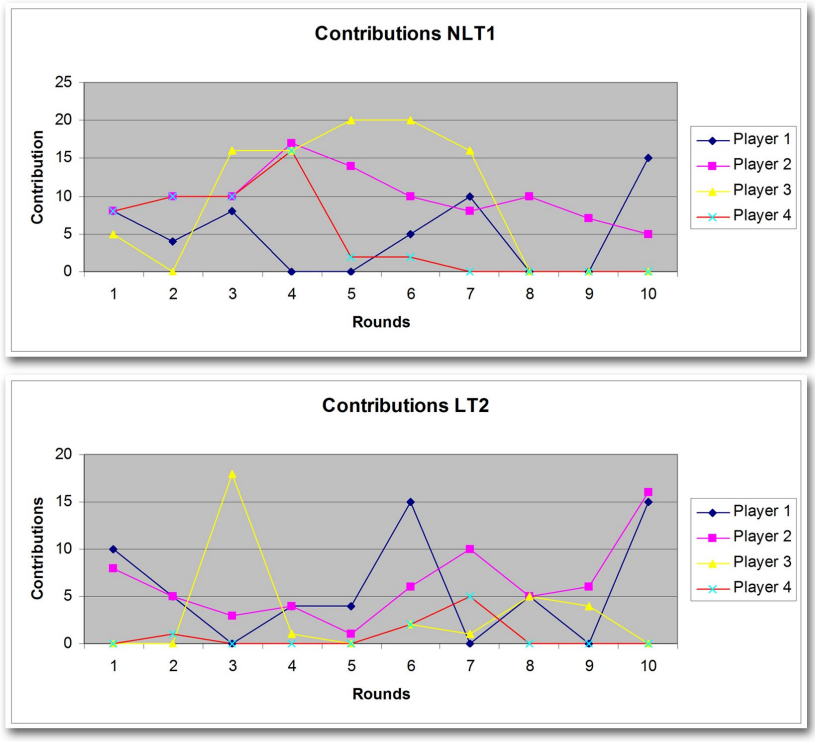
Everything else remains the same as in the first part of the experiment.

II. Tables and Figures

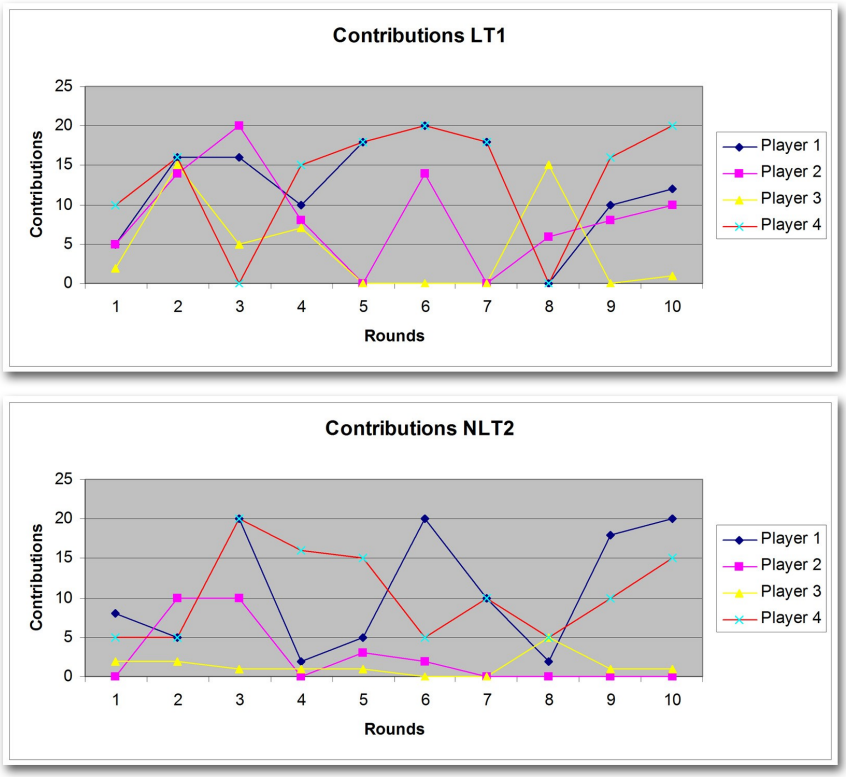
1. Subjects' Contributions



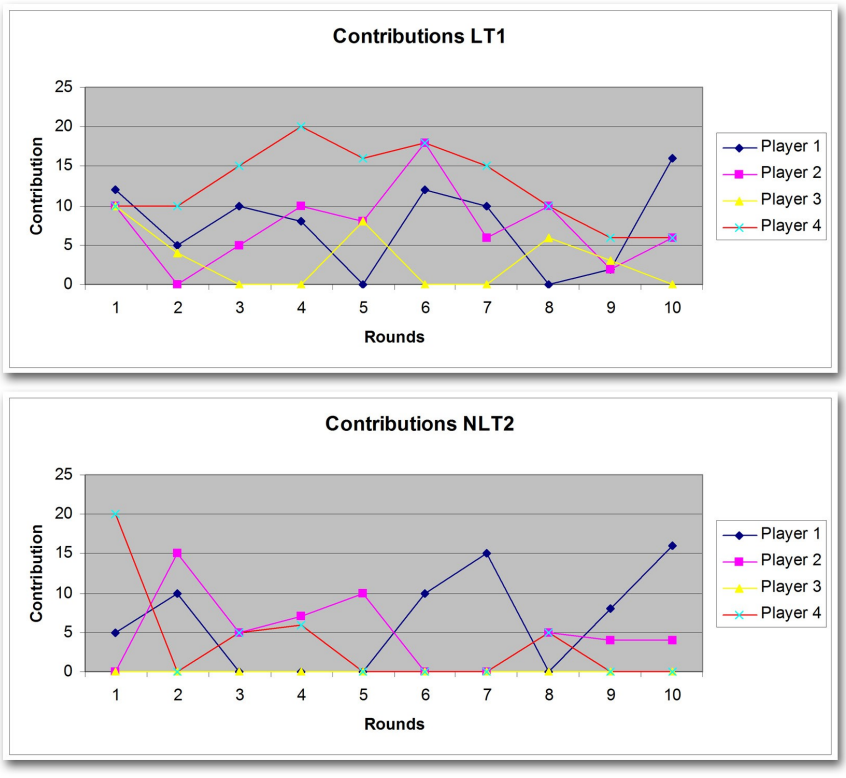
Session 1: Subjects' Contributions in No-Leader and Leader Treatments



Session 2: Subjects' Contributions in No-Leader and Leader Treatments



Session 3: Subjects' Contributions in No-Leader and Leader Treatments



Session 4: Subjects' Contributions in No-Leader and Leader Treatments

Contributions (Session 1)

	Project A (20)				Project B (18)				Project C (16)			
	P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4
	No leader				No leader				No leader			
Round												
1		5		0	5		18					
2							18		7	1		0
3	3					0	18	18				
4			20						0	2		0
5			20		10			0		0		
6	10	0		1							16	
7					18	18					10	0
8				0		0			2		12	
9				0	6					1	13	
10		0			0						0	1
	Leader				Leader				Leader			
11									0	0	0	0
12					5	1	8	1				
13									3	1	16	1
14									10	2	5	0
15	1	0	3	1								
16									1	0	5	0
17					4	1	0	0				
18					1	0	0	0				
19	0	1	0	0								
20	20			0		0	0					

Contributions (Session 2)

	Project A (20)				Project B (18)				Project C (16)			
	P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4
	No leader				No leader				No leader			
Round												
1	8			8		8	5					
2		10						10	4		0	
3								10	8	10	16	
4		17							0		16	16
5			20						0	14		2
6			20		5	10						1
7					10					8	16	0
8					0					10	0	0
9		7			0						0	0
10				0					15	5	0	
	Leader				Leader				Leader			
11									10	8	0	0
12			0	1					5	5		
13					0	3	18					0
14									4	4	1	0
15		1							4		0	0
16	15	6	2	2								
17		10	1	5					0			
18									5	5	5	0
19		6	4	0					0			
20									15	16	0	0

Contributions (Session 3)

	Project A				Project B				Project C			
	20				18				16			
	P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4
	Leader				Leader				Leader			
Round												
1	5									5	2	10
2									16	14	15	16
3		20		0					16		5	
4	10					8	7	15				
5					18	0	0	18				
6					18	14	0	18				
7					18	0	0	18				
8									0	6	15	0
9									10	8	0	16
10	12		1	20		10						
	No leader				No leader				No leader			
11					8		2	5		0		
12	5	10						5			2	
13	20			20		10	1					
14		0							2		1	16
15		3			5			15			1	
16	20							5		2	0	
17		0		10	10		0					
18	2	0	5					5				
19		0			18		1	10				
20	20	0					1	15				

Contributions (Session 4)

	Project A				Project B				Project C			
	20				18				16			
	P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4
	Leader				Leader				Leader			
Round												
1	12					10	10					10
2					5					0	4	10
3					10	5	0	15				
4				20					8	10	0	
5									0	8	8	16
6	12					18	0	18				
7	10	6	0	15								
8					0	10		10			6	
9									2	2	3	6
10									16	6	0	6
	No leader				No leader				No leader			
11			0	20	5	0						
12	10	15	0	0								
13		5	0	5					0			
14			0						0	7		6
15			0	0	0					10		
16		0	0	0					10			
17	15		0	0		0						
18		5	0	5					0			
19		4	0		8			0				
20			0	0					16	4		

2. Descriptive Statistics (Tables)

	Average Contribution (in points)	Average Payoff (in Euro)	Standard Deviation (contributions)	Average follower contribution	Average leader contribution	Max payoff	Min payoff	Median of medians of all rounds	Total choice of projects			Distribution of successful projects				Follower-to-Leader Contributions	Correlation (follower-to-leader contributions)
									A	B	C	A	B	C	No		
Session 1	4,2875	7,567				8,19	6,89		21	27	32	3	4	6	7		
NLT1	6,3	3,601	7,35					4,5	11	13	16	1	1	2	6		
LT2	2,275	3,97	3,15	2,4	1,9			0,5	10	14	16	2	3	4	1	126,30%	-0,1995
Session 2	5,638	7,9595				8,3	7,58		21	12	47	3	1	11	5		
NLT1	7,25	3,914	5,77					7,75	8	9	23	0	0	6	4		
LT2	4,025	4,05	4,56	3,67	5,1			3	13	3	24	3	1	5	1	71,90%	0,095
Session1&2	4,96	7,76		3,035	3,5	8,3	6,89		42	39	79	6	5	17	12		
Session 3	8,0375	8,847				9,98	7,83		22	33	25	1	6	5	7		
LT1	9,7	5,09	6,89	8,2	14,2			9	7	16	17	0	4	4	2	57,75%	-0,107
NLT2	6,375	3,75	6,16					4,5	15	17	8	1	2	1	6		
Session 4	5,7125	8,363				9,67	7,81		32	19	29	6	3	6	5		
LT1	7,675	4,5	5,44	7,3	8,9			8	7	13	20	1	3	5	1	81,65%	0,701
NLT2	3,75	3,86	5,54					2,25	25	6	9	5	0	1	4		
Session3&4	6,875	8,605		7,75	11,55	9,98	7,81		54	52	54	7	9	11	12		
Total	5,92	8,18				9,98	6,89		96	91	133	13	14	28	24	84,40%	

3. Descriptive Statistics (Figures and Graphs)

Session 1

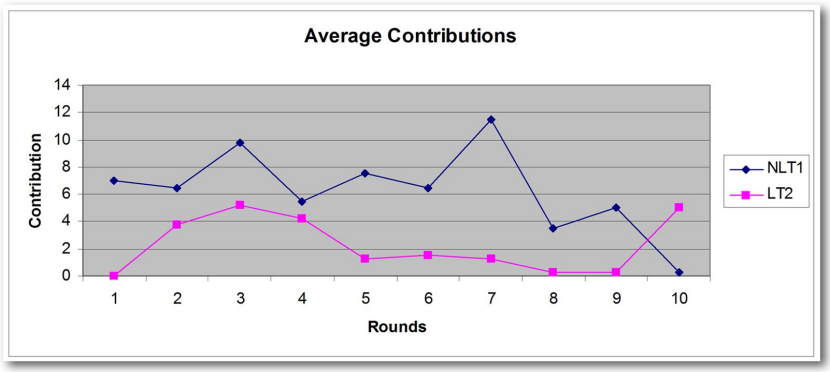


Figure 1: Average Contributions in No-Leader Treatment (1) and in Leader Treatment (2) in comparison.

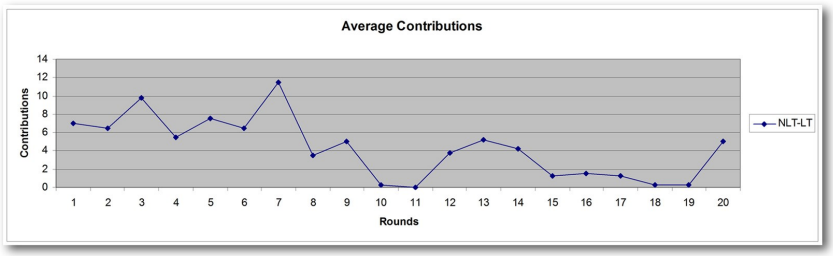


Figure 2: Average Contributions in No-Leader Treatment (1) and in Leader Treatment (2) continuous.

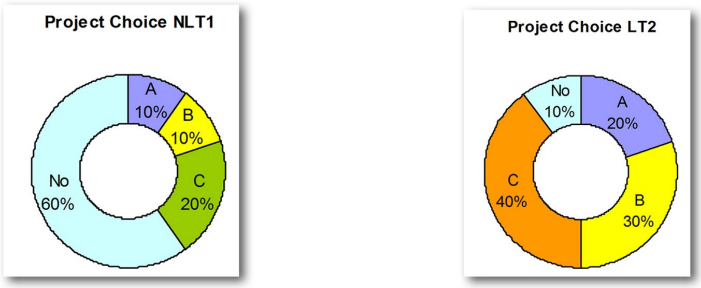


Figure 3: Distribution of Project Choice in No-Leader Treatment and in Leader Treatment

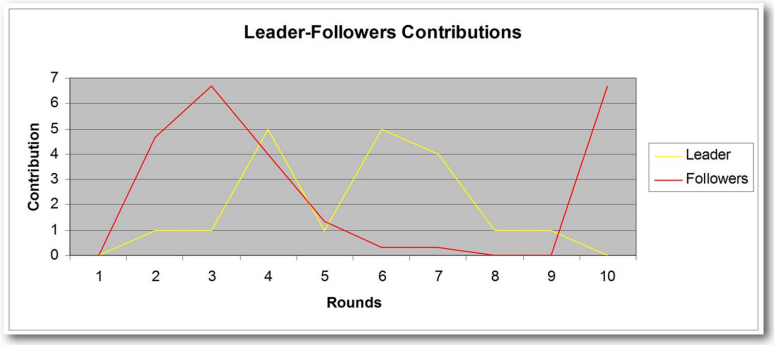


Figure 4: Comparison of first-mover's and followers' contributions in Leader Treatment

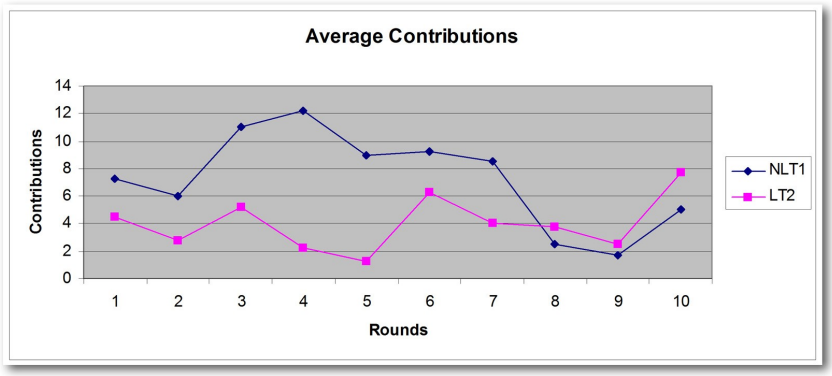


Figure 1: Average Contributions in No-Leader Treatment (1) and in Leader Treatment (2) in comparison.

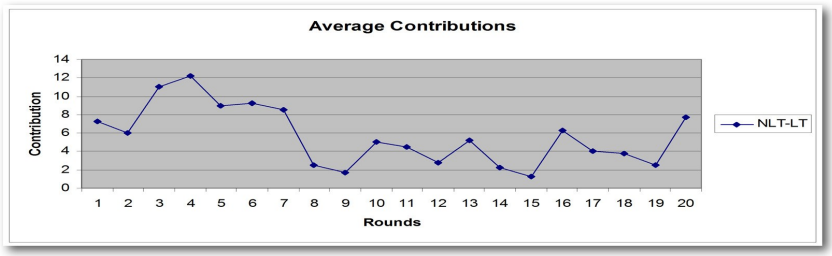
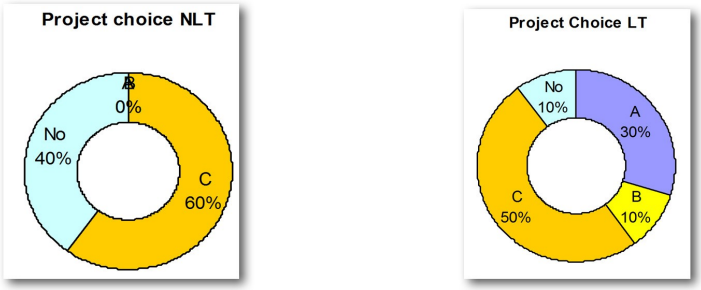


Figure 2: Average Contributions in No-Leader Treatment (1) and in Leader Treatment (2) continuous.



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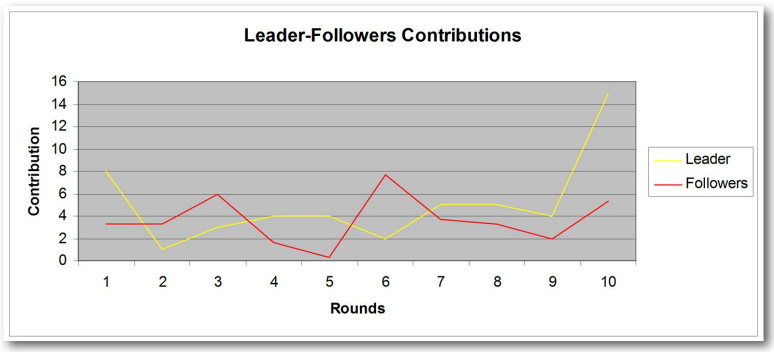
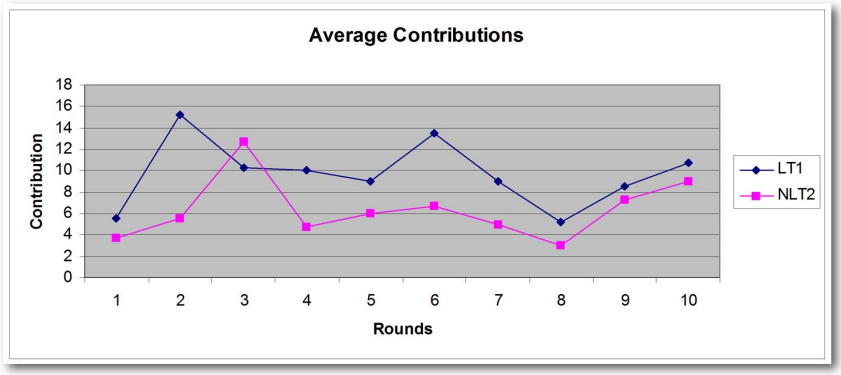


Figure 4: Comparison of first-mover's and followers' contributions in Leader Treatment



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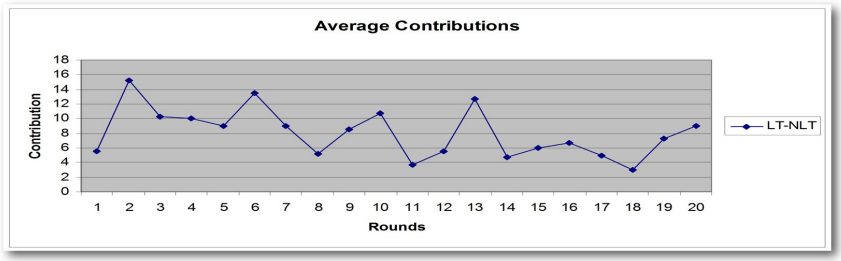


Figure 2: Average Contributions in Leader Treatment (1) and in No-Leader Treatment (2) continuous.

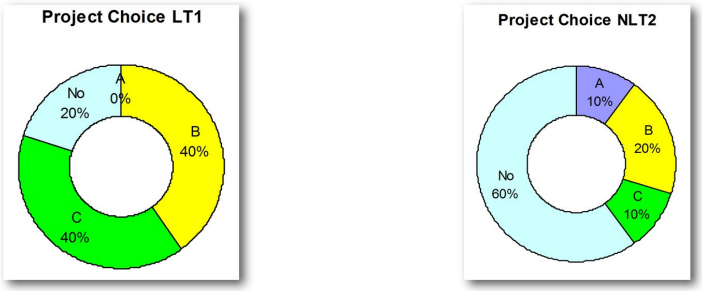


Figure 3: Distribution of Project Choice in Leader Treatment and in No-Leader Treatment

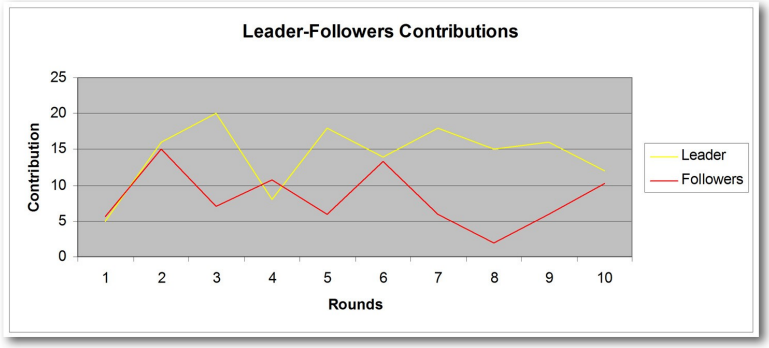
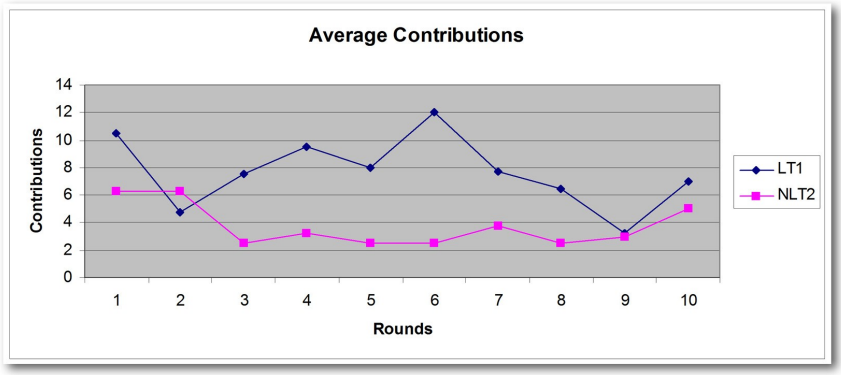


Figure 4: Comparison of first-mover's and followers' contributions in Leader Treatment



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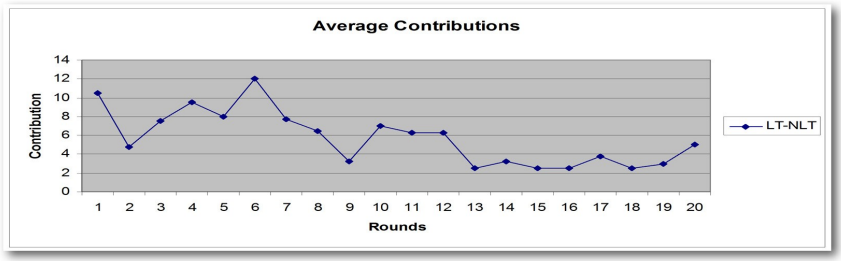

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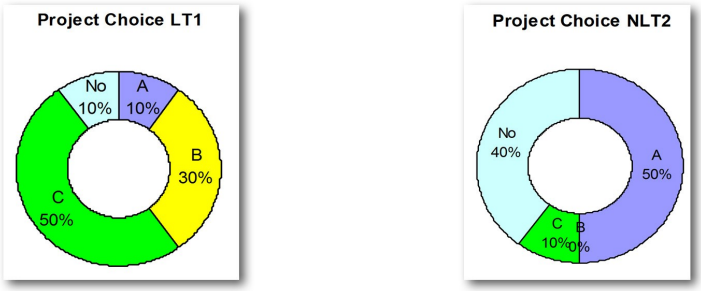

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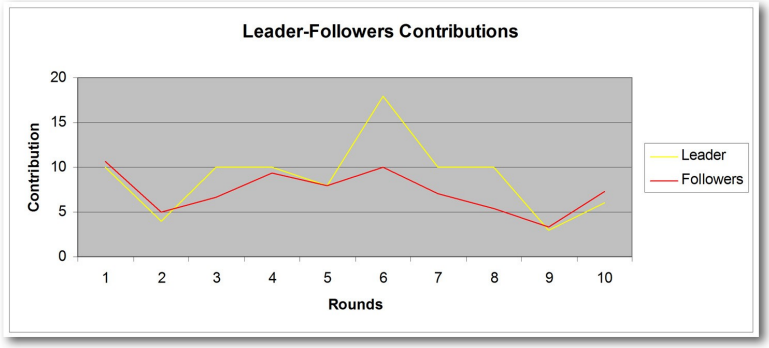

Figure 4: Comparison of first-mover's and followers' contributions in Leader Treatment

Eidesstattliche Erklärung

Ich versichere, dass ich meine Diplomarbeit ohne Hilfe Dritter und ohne Benutzung anderer als der angegebenen Quellen und Hilfsmittel angefertigt und die den benutzten Quellen wörtlich oder inhaltlich entnommenen Stellen als solche kenntlich gemacht habe. Diese Arbeit hat in gleicher oder ähnlicher Form noch keiner Prüfungsbehörde vorgelegen.

Mannheim, den 10.06.2012

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