LEADERSHIP BY EXAMPLE AND BY PRE-GAME COMMUNICATION IN SOCIAL DILEMMA SITUATIONS*

Ganna Pogrebna† David H. Krantz‡

Christian Schade§ Claudia Keser#

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Abstract

This paper compares the effects of two leadership styles: *leading by pre-game communication* and *leading by example* using an iterated voluntary contribution game. We find that pre-game communication increases the level of individual contributions in the game and has essentially the same impact on the level of individual contributions as leading by example. Yet, followers appear to be more motivated towards achieving a socially optimal outcome in leading by example than in leading by pre-game communication. We also find that the content of pre-game communication has a higher impact on individual decisions than the *ex post* contribution of the leader. However, false messages cause an erosion of trust: participants decrease their contributions if they have received a false message from the leader in the previous period even though leaders are re-assigned in every period.

Keywords: leadership, leading by pre-game communication, leading by example, voluntary contribution game

JEL classification: **C72, C92, H41, D83**

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† Corresponding author: Columbia University, Institute for Social and Economic Research and Policy, Center for Decision Sciences, 419 Schermerhorn Hall, New York, NY 10027, USA, tel.: +1 (212) 854 8384, e-mail: gp2240@columbia.edu.

‡ Columbia University, Department of Psychology, 406 Schermerhorn Hall, New York NY 10027, USA.

§ Institute for Entrepreneurial Studies and Innovation Management, School of Business and Economics, Humboldt-Universität zu Berlin, Spandauer Strasse 1, 10178 Berlin, Germany.

Georg-August-Universität Göttingen, Faculty of Economic Sciences, Patz der Göttinger Sieben 3, 37073 Göttingen, Germany.

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1. Introduction

Leadership is frequently defined as an interpersonal influence, carried out in a particular situation and aimed at achieving a specific goal (e.g., Tannenbaum and Massarik, 1957). Yet, in an organization, group members often pursue multiple individual objectives, which may contradict the group goal. In these conditions, an important task of a leader is to consolidate the effort of individual members and direct it towards the attainment of a common goal. To accomplish this task, a leader may employ different leadership styles (e.g., Rotemberg and Saloner, 1993). For instance, one option is to set an example for the rest of the group (*leading by example*), another – to direct the group effort by sending non-binding messages to the team members (*leading by pre-game communication*).

One may reasonably be uncertain about the relative effectiveness of leading by example as opposed to leading by pre-game communication. Previous research on leadership in organizations, based on non-experimental data, has shown that different factors such as personal characteristics and charisma of the leader (e.g., Barker and Mueller, 2002), team-specific social sensitivity (e.g., Tannenbaum and Massarik, 1957), and degree of project involvement (e.g., Elkins and Keller, 2003) to name a few, create difficulties in disentangling the effects of different leadership styles. This paper uses a laboratory experiment that allows not only to compare leading by example and leading by pre-game communication, but also to examine the impact of these two styles in a social dilemma situation.

We conduct three treatments of a voluntary contribution game (e.g., Isaac et al., 1984): (a) a treatment without leadership; (b) a treatment, where a leader sets an example for the rest of the group by making first contribution to the group activity (e.g., Moxnes and Van der Heijden, 2003; Güth et al., 2007) and (c) a treatment with leadership and pre-game communication. By comparing the results from all three treatments, we explore the impact of pre-game communication on the level of individual and group contributions. In addition, we identify factors that influence individual decisions in different treatments by conducting an econometric analysis which accounts for the unobserved heterogeneity of participants.

This paper is related to two large streams of literature: (a) literature on pre-game communication and (b) literature on voluntary contribution games. Several studies investigate the impact of pre-game communication in games from a theoretical prospective. Particularly, Crawford and Sobel (1982) and Green and Stokey (1980) identify conditions when pre-game communication leads to a transfer of valuable private information in a sender-receiver environment. Farrell (1987, 1988) analyzes the communicational intentions in games with complete information. He finds that while pre-game communication does not necessarily guarantee reaching Nash equilibrium, it may serve as an efficient coordination tool. Rabin (1994) shows that in iterated play when players communicate for a long time, in every equilibrium of every game, each player receives payoff superior to her worst Pareto-efficient

Nash equilibrium.[1] Baliga and Morris (2002) examine the effects of one-sided incomplete information in pre-game communication and identify conditions when players coordinate on efficient Nash equilibria. In a recent study, Ottaviani and Sørensen (2006) explore the reputational considerations in a game with pre-game communication. They find that relative reputation is an important factor, which affects individual decisions.

From the empirical perspective, non-experimental studies of pre-game communication are very rare due to the complexity of obtaining the data from the field. For example, Genesove and Wallace (2001) show that communication fosters price collusion among companies involved in the sugar refining cartel. The impact of pre-game communication has also been studied experimentally. However, to date, experimental research in this area has primarily concentrated on coordination games with multiple equilibria. For example, Charness and Grosskopf (2004) find that pre-game communication enforces coordination in a 2x2 stag hunt game. Blume and Ortmann (2007) show that pre-game communication facilitates coordination on the Pareto-dominant equilibrium in games with many players. Weber et al. (2001) consider a weak-link game with leadership and variable group size, where small groups are more likely to reach an efficient outcome than large groups. They show that experimental participants tend to attribute success and failure of the group to the leadership ability rather than to an objective structural condition (group size).

Research on voluntary contribution games is a large and constantly growing field. Leadership, social preferences, and signaling represent only a minor fraction of aspects that are woven into the tapestry of this evolving body of literature. Several studies offer a theoretical basis for research on leadership in voluntary contribution games. For example Hermalin (1998) develops a model where a leader sets example for the rest of the group under conditions of asymmetric information. Arce (2001) and Foss (2001) provide another model where the purpose of leadership is to achieve an efficient outcome.

Experimentally, Moxnes and Van der Heijden (2003), and Güth et al. (2007), to name a few, investigate the impact of leading by example in a full information setting. Potters et al. (2007) explore leadership in a voluntary contribution game with asymmetric information where the level of a leader's contribution can signal the payoff structure to the rest of the group.[2] Yet, to date, this stream of research has largely ignored the issue of pre-game communication in voluntary contribution games with leadership.

This paper contributes to the existing literature in several ways. First, by conducting a laboratory experiment, we compare two leadership styles: leading by example and leading by pre-game communication. Second, we extend the experimental literature on pre-game communication by

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[1] Farrell and Rabin (1996) and Crawford (1997) provide detailed overview of the literature on pre-game communication.

[2] Potters et al. (2007) compare asymmetric and full information environment and find that the success of the leadership appears to be driven by signaling rather than non-pecuniary factors, such as e.g. reciprocity (Fehr and Schmidt, 1999). This study is different from Potters et al. (2007). In Potters et al. (2007) leaders make binding contributions, which may or may not convey private information. In our study, leaders have an opportunity to send a non-binding message about their future decisions.

examining the impact of pre-game communication in a social dilemma situation. Third, this paper adds a new aspect to the research on voluntary contribution games by considering a case when a leader can send a non-binding message about the amount of her contribution to the rest of the group. Finally, we analyze whether and to what extent unobserved heterogeneity of individual participants in the experiment influences the level of their contributions.

We find that participants contribute significantly higher monetary amounts to the group activity in the pre-game communication treatment than in the treatment without leadership. Furthermore, the levels of contributions are strikingly similar in two treatments with leadership, suggesting that pre-game communication has essentially the same impact on individual contributions as leading by example. Yet, our results indicate that leading by example creates more incentives for experimental participants to concentrate on achieving a socially optimal outcome than leading by pre-game communication.

We also find that pre-game communication has a statistically significant positive effect on the individual contributions. Followers tend to contribute to the group activity after observing a leader's promise to contribute. Furthermore, the content of pre-game communication appears to be a more important determinant of individual decisions than the amount of the leader's *ex post* contribution. However, participants take the trustworthiness of their leaders into account. A false message sent by the leader in the previous period precipitates a decline in contributions.

The remainder of the paper is structured as follows. Section 2 provides the design of the experiment and describes experimental procedures. Results of the empirical analysis are reported in Section 3. Section 4 concludes by discussing results of our analysis as well as their practical applications.

2. The Experiment

2.1 Experimental Design and Theoretical Predictions

We consider a simple iterated voluntary contribution game (e.g., Isaac et al., 1984). A group of N players participates in the game during $t \in [1, T]$ periods. In the beginning of period t, each player $i \in \{1, \ldots, N\}$ receives an initial endowment k and has an opportunity to make a contribution $c_i^t \in \{0, k\}$ to the group activity. In other words, in every period, players can contribute either all of their initial endowments ($c_i^t = k$) or nothing ($c_i^t = 0$). The payoff of player i in period t is given by:

$$\pi_i^t = k - c_i^t + \frac{N-1}{N} \cdot \sum_{i=1}^{N} c_i^t \quad (1)$$

This voluntary contribution game has only one Nash equilibrium in pure strategies. Since $\frac{N-1}{N} < 1$, the dominant strategy for every player is to contribute $c_i^t = 0$. If in period t all players in the group contribute nothing, the payoff of each player in this period is equal to the initial endowment ($\pi_i^t = k \; \forall \, i$). However, this outcome is not socially efficient because it fails to maximize the sum of individual payoffs of the group members ($\sum_{i=1}^{N} \pi_i^t$). Social efficiency is reached only if all players contribute $c_i^t = k$, yielding $\pi_i^t = k\,(N-1) \; \forall \, i$.

We design three treatments: (a) a baseline treatment (*BASE*); (b) a treatment with leading by example (*LBIN*); and (c) a treatment with leadership and pre-game communication (*LPGC*). In the *BASE* treatment, we conduct a simple iterated voluntary contribution game, described above. In this treatment, N players decide on the amount of their individual contribution $c_i^t \in \{0, k\}$ simultaneously, independently and without communicating with other group members. We use the *BASE* treatment as a control treatment in our analysis.

Each period of the *LBIN* treatment consists of three stages. In stage $s = 0$, one player out of N is randomly assigned the role of *leader* (l) and other $N - 1$ players – roles of *followers* ($f \neq l$). In stage $s = 1$, the leader makes a binding decision about the amount of contribution $c_l^t \in \{0, k\}$ to the group activity. In stage $s = 2$, the followers observe the amount of the leader's contribution c_l^t and decide on the amount of their individual contributions $c_f^t \in \{0, k\}$ simultaneously, independently and without communicating with other followers. The within-period timeline of the *LBIN* treatment is provided on Figure 1.

[INSERT Figure 1 HERE]

The theoretical prediction for the *LBIN* treatment coincides with the theoretical prediction for the *BASE* treatment. Using backward induction and assuming that payoff maximization mechanism is common knowledge, since $\frac{N-1}{N} < 1$ in stage $s = 2$, the dominant strategy for each of $N - 1$ followers is to free-ride ($c_f^t = 0$). A rational payoff-maximizing leader anticipates this response and, therefore, contributes $c_l^t = 0$ in stage $s = 1$. Similar to the *BASE* treatment, a socially efficient outcome is reached when all players contribute k to the group activity.

In the *LPGC* treatment, each period incorporates three stages. Similarly to the *LBIN*, in stage $s = 0$, each of the N players in the group is assigned a role of a leader (l) or a follower (f), $f \neq l$. In stage $s = 1$, the leader sends a message $m \in \{0,1\}$ to the $N - 1$ followers. If $m = 0$, the leader promises to contribute $c_l^t = 0$ to the group activity, if $m = 1$ the leader promises to contribute $c_l^t = k$. This message is non-binding. In stage $s = 2$, all group members (including the leader) make binding decisions about the amount of their contributions simultaneously, independently and without communicating with each other. Figure 2 depicts the within-period timeline of the *LPGC* treatment.

[INSERT Figure 2 HERE]

Since the message of the leader is non-binding, the pre-game communication does not alter the prediction of the Nash equilibrium in pure strategies. In other words, all group members should contribute nothing to the group activity. Like in the *BASE* and the *LBIN* treatments, a socially efficient outcome is a situation, when all members of the group contribute k.

2.2 Experimental Procedure

We have conducted six sessions of the experiment. Twelve participants took part in each session, yielding a total of 72 participants. Two sessions were devoted to each of the three treatments (*BASE*, *LBIN* and *LPGC*). In each session of the experiment, participants took part in only one treatment of the voluntary contribution game.

All participants were recruited through the consolidated online invitation system of several departments of ___________ University. The majority of participants were students at ___________ University. Less than $^1/_5$ of participants (18.1%) studied either Economics or Business Administration and had previous exposure to game theory.

The sample was relatively balanced in terms of gender composition. 54.2% of participants were female and 45.8% - male. The average age of participants was 26 years with a median of 25 and a standard deviation of 6 years. 73.6% of participants had previous experience with experiments in decision making. However, none of them had taken part in a voluntary contribution game before. The majority of participants (86.1%) reported an annual income below €15,000.

All experimental sessions were conducted at the experimental laboratory of ___________ University. The experiment was computerized using the z-Tree software (Fischbacher, 2007). Upon their arrival at the experimental laboratory, participants were seated at individual workstations equipped with a personal computer, scratch paper and a pen. The workstation of each participant was separate and could not be overlooked by other participants and/or the experimenter.

The experiment consisted of two experimental tasks and a post-experimental questionnaire. In the first experimental task, participants were subjected to the iterated voluntary contribution game. In the second task, they took part in the Holt and Laury (2002) risk attitude elicitation procedure. Participants received hard copies of experimental instructions for each task separately.[3]

Instructions were read aloud by the experimenter. After listening to the experimenter, participants were given time to study the instructions individually and ask questions, which were answered privately. Any communication among experimental participants was strictly prohibited.

Irrespective of the treatment, in the beginning of the first task, participants were randomly divided into groups of three people each ($N = 3$). In each session, participants played 20 periods of the voluntary contribution game ($t \in [1, 20]$). However, the participants were not informed about the exact number of rounds that they were about to play. Group compositions remained constant for the duration of the first experimental task. At the end of the experiment, participants received the payoff from one randomly chosen period of the voluntary contribution game. In the beginning of every period, all participants received an initial endowment of €10 ($k = 10$).

In all three treatments of the experiment, participants received full feedback about the outcome of their decisions at the end of every round of the voluntary contribution game. Particularly, in the *BASE* treatment they received information about (a) their individual contributions, (b) individual decisions of other players in their group; (c) sum of all contributions in the group; (d) their individual payoffs in the round. To preserve confidentiality, in the beginning of the first experimental task, every player in the

[3] Experimental instructions are provided in the Appendix.

group was randomly assigned an ID (A, B or C) by the computer program. During the voluntary contribution game, players were identified only by their IDs.

In the *LBIN* treatment, participants received feedback about (a) their individual contributions; (b) ID of the leader; (c) individual contributions of other players in their group (d) sum of all contributions in their group; (e) their individual payoffs in the round. In the *LPGC* treatment, players received information about (a) their individual contributions, (b) ID of the leader; (c) the message of the leader; (d) individual contributions of players in their group (including the leader); (e) sum of all contributions in their group; (f) their individual payoffs in the round. We used neutral language to identify leaders and followers, i.e. followers were labeled as TYPE 1 players and leaders as TYPE 2 players. To explore the impact of the reputation of individual leaders, types were assigned at random by the computer program and reported to all players in the beginning of each period. In other words, in the *LBIN* and the *LPGC* treatments, followers knew the ID of the leader before they made their decisions.

To avoid wealth effects, the payoff from both experimental tasks was determined at the end of the experiment. Upon completion of the experimental tasks, participants received a questionnaire with demographic questions. The whole experimental procedure, including the questionnaire, lasted approximately one hour. Average earnings of the participants were €18.50 with a median of €18.30 and a standard deviation of €4.89.[4]

3. Results

Similarly to the findings in the previous literature on voluntary contribution games (e.g., Moxnes and Van der Heijden, 2003; Güth et al., 2007), our data suggest that participants at both the individual and group levels do not behave according to the predictions of the Nash equilibrium in pure strategies. According to Figure 3, participants in all treatments contribute positive amounts to the group activity in all rounds of the game. Interestingly, while in the later rounds of the *BASE* treatment more and more participants appear to switch to contributing nothing to the group activity, there appears to be no convergence to the equilibrium prediction in the *LBIN* and the *LPGC* treatment.

[INSERT Figure 3 HERE]

In this section, we explore treatment effects and compare the behavior of leaders and followers. In addition, we examine the content of the pre-game communication. We also identify the main determinants of individual contributions by conducting an econometric analysis of the data.

3.1 Treatment Effects

This subsection is devoted to the analysis of treatment effects. We explore relative differences among the three treatments of the voluntary contribution game in our experiment. A particular

[4] At the time of the experiment, the exchange rate was €1=$1.56.

emphasis is put on the impact of pre-game communication on individual decisions of the experimental participants.

Result 1 Pre-game communication increases individual contributions.

Our results suggest that pre-game communication precipitates an increase in individual contributions compared with the control treatment. Table 1 depicts the aggregate individual and group contributions across 20 periods in each of the three treatments of the experiment. According to Table 1, experimental participants in the *LPGC* treatment contribute almost twice as much money to the group activity as in the *BASE* treatment.

[INSERT Table 1 HERE]

Figure 4 and Figure 5 show mean and median individual and group contributions in all periods. Obviously, the amount of mean and median contributions at both the individual and the group level in the *LPGC* treatment is higher that the level of contributions in the *BASE* treatment. The results of the Wilcoxon-Mann-Whitney test (Wilcoxon, 1945 and Mann and Whitney, 1947) suggest that mean contributions are statistically significantly higher in the *LPGC* treatment than in the *BASE* treatment, both at the individual ($p < 0.0001$) and group ($p < 0.0001$) level.[5]

[INSERT Figure 4 and Figure 5 HERE]

Result 2 Pre-game communication has essentially the same effect on individual contributions as leading by example.

We replicate the finding reported in the previous literature that leading by example increases the level of individual contributions (e.g., Moxnes and Van der Heijden, 2003; Güth et al., 2007). Particularly, the results of the Wilcoxon-Mann-Whitney test indicate that mean individual ($p < 0.0006$) and group ($p < 0.0006$) contributions are statistically significantly lower in the *BASE* treatment than in the *LBIN* treatment (see Figure 4 and Figure 5).[6]

Interestingly, while we observe a significant cross-treatment effect between the *BASE* and the *LBIN* treatment and between the *BASE* and the *LPCG* treatment, the contributions in the *LBIN* and the *LPGC* treatment appear to be essentially the same. The similarity between the *LBIN* and the *LPGC* treatment is apparent on Figure 4 and Figure 5. According to the Wilcoxon-Mann-Whitney test, mean ($p > 0.2$) and median ($p > 0.4$) contributions at the individual level as well as mean ($p > 0.1$) and median ($p > 0.5$) contributions at the group level are not statistically significantly different across these two treatments. This finding suggests that pre-game communication between the leader and followers in a voluntary contribution game is sufficient to increase the level of contributions.

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[5] Median contributions are also statistically significantly larger in the *LPGC* treatment compared with the *BASE* treatment at both the individual ($p < 0.002$) and the group ($p < 0.0004$) level.

[6] Median contributions are also statistically significantly different for individuals ($p < 0.01$) and groups ($p < 0.0007$) in the *LBIN* and the *BASE* treatment.

3.2 Comparative Analysis of Leaders' and Followers' Behavior

In this subsection we consider experimental treatments with leadership (i.e., the *LBIN* and the *LPGC* treatment). We investigate whether and to what extent the role that a participant i plays in the voluntary contribution game has an impact on her decisions. Particularly, we conduct a comparative analysis of the level of individual contributions and individual payoffs of leaders and followers.

Result 3 Leaders contribute less than followers in sessions with leading by pre-game communication, while contributions of leaders and followers are very similar in sessions with leading by example.

Recall from Section 2 that in both the *LBIN* and the *LPGC* treatment leaders are randomly re-assigned in every period by the computer program. This means that each participant plays the voluntary contribution game both as a leader and as a follower several times. The results of the Wilcoxon-Mann-Whitney test conducted on the individual data reveal that leaders' contributions are only marginally statistically significantly higher than followers' contributions in the in the *LBIN* treatment ($p > 0.06$).[7] However, leaders in the *LPGC* treatment contribute statistically significantly less money to the group activity than followers ($p < 0.00001$).

This result is particularly interesting because the same participants played the game both as leaders and followers. It may have two possible explanations. First, pre-game communication fosters the impact of the roles (imposed identity) that participants play in the game, which induces different behavior when participants play as leaders and as followers. Second, in the *LPGC* treatment, leaders engage in sending false messages and tend to free-ride due to the fact that the followers observe leader's actual decision only *ex post*.

Result 4 Pre-game communication does not alter leaders' contributions but increases followers' contributions, compared with leading by example.

In addition to the within- treatment comparisons of leaders and followers, we also conduct cross-treatment comparisons of leaders' and followers' contributions. The Wilcoxon-Mann-Whitney test conducted on the individual data shows that contributions of leaders are essentially the same in the *LBIN* and the *LPGC* treatment ($p > 0.1$). However, followers contribute statistically significantly higher monetary amounts in the *LPGC* treatment than in the *LBIN* treatment ($p < 0.002$).

[7] This result appears to be in line with the findings in the previous literature (e.g., Güth et al., 2007) that leaders tend to contribute more than followers in leading by example. However, in our experiment this result is statistically significant only at a margin. This can be explained by the fact that our design allows players to contribute only either their entire initial endowment or nothing ($c_i^t \in \{0, k\}$); whereas, for example, in Güth et al. (2007) participants may contribute any intermediate amount ($c_i^t \in [0, k]$).

Result 5 Leaders earn more than followers in the pre-game communication treatment, while leaders and followers receive similar payoffs in the leading by example treatment.

According to the results of the Wilcoxon signed-rank test (Wilcoxon, 1945), followers fail to exploit their leaders in the *LBIN* treatment. The difference between the payoff of followers and leaders in this treatment is not statistically significant ($p > 0.08$).[8] However, in the *LPGC* treatment leaders receive, on average, €3 more than followers. Wilcoxon signed-rank test shows that this difference is highly statistically significant ($p < 0.00001$). This finding suggests that leaders take advantage of the opportunity to send a non-binding message to the followers.

Result 6 Pre-game communication has positive impact on leaders' payoffs but does not change followers' payoffs compared with leading by example.

The analysis of leaders' and followers payoffs indicates that followers in both the *LBIN* and the *LPGC* treatment receive similar payoffs. The results of the Wilcoxon-Mann-Whitney test conducted on individual data shows that there is no statistically significant cross-treatment effect on the payoff of the followers ($p > 0.5$). However, pre-game communication significantly improves the earnings of leaders ($p < 0.0006$). They receive, on average, almost €2 more in the *LPGC* treatment than in the *LBIN* treatment.

3.3 Pre-Game Communication

In this section, we analyze whether and how leaders have used pre-game communication in the *LPGC* treatment. In our data set, leaders have sent false messages to the rest of their group 63 out of 160 times (in 39% of rounds). In 62 cases, leaders have promised to contribute €10 ($m = 1$), yet, have contributed nothing. There is only one case when a leader has informed the group that she has been planning to contribute €0 ($m = 0$), but has changed her mind and contributed €10. Since we consider pre-game communication in iterated play, we can formulate two mutually exclusive hypotheses about the behavior of leaders.

Hypothesis 1 In iterated play, a rational leader should randomize between sending a truthful and a false message in each period.

Recall from the experimental procedure described in Section 2 that group members are informed about the ID of the leader in the beginning of each period. In iterated play, a rational leader should be exactly indifferent between sending a truthful and a false message. In the last period of the game ($t = T$), followers will free-ride, irrespective of the message sent by the leader. Therefore, in period $t = T$ leader's reputation will not have an impact on the followers' decisions. In period $t = T - 1$, a leader does not have an incentive to send a truthful message because preserving good reputation will not alter the outcome of the game in period $t = T$. Proceeding further by backward induction yields a theoretical prediction that a rational leader should randomize between lying and telling the truth. Therefore, we

[8] This result is different from the findings in the previous literature (e.g., Güth et al., 2007) and may result from the binary structure of contribution decisions in our experimental design (see Footnote 7).

should observe a uniform distribution of frequencies of false messages across all 24 leaders. In other words, each participant in the *LPGC* treatment should resort to lying in 50% of periods when this participant plays a role of the leader.

Hypothesis 2 If leaders are only boundedly rational, the frequency of false messages should increase in the later periods.

If a leader is boundedly rational, reputation considerations in the game may become important and generate an increasing trend of false statements as the game progresses. In other words, if leaders are concerned about their reputation, they will try to send truthful messages in the beginning of the game and then gradually divert to deceiving their followers, in order to take advantage of the pre-game communication.

Figure 6 and Figure 7 provide a summary of false messages in the *LPGC* treatment across leaders and by period respectively. Figure 6 shows that there is substantial heterogeneity in leaders' propensities to deceive their followers. It is apparent that while some leaders lie all the time (frequency of false messages is equal to 1), others always send truthful messages (frequency of false messages is equal to 0). The results of the Kruskal-Wallis equality of populations rank test with 23 degrees of freedom (Kruskal and Wallis, 1952) confirm that leaders apply different tactics when deciding on whether or not to send a truthful message to the followers ($p < 0.02$). Only 4 participants (16.7%) have sent false messages in $1/_2$ of the periods when they played a role of the leader, 14 leaders (58.3%) lied to their followers less frequently and 6 (25.0%) – more frequently. In other words, the majority of leaders do not seem to behave rationally. Therefore, we can reject Hypothesis 1.

[INSERT Figure 6 and Figure 7 HERE]

The analysis of the number of false messages in iterated play (see Figure 7) demonstrates that there appears to be no particular trend in leaders' decisions to resort to deception. We observe that the frequency of false messages has a U-shape distribution. Moreover, the results of the Kruskal-Wallis test with 19 degrees of freedom show that there are no statistically significant differences among the frequencies of lying across 20 periods ($p > 0.9$). This means that leaders seem to be unconcerned about their reputation. Therefore, the data do not appear to provide support for Hypothesis 2.

These results may suggest two possible explanations. The first explanation might be that leaders behave irrationally when they decide on whether or not to send a truthful message to the rest of the group. Another explanation is that leaders learn to use pre-game communication during almost half of the game (9 periods). They start by lying frequently in early periods, but then after realizing the damage to their reputation, they try to rehabilitate their image in the middle of the game by telling the truth. Nevertheless, towards the end of the game leaders increase the frequency of false messages to take advantage of the pre-game communication.

3.4 The Determinants of Individual Contributions

In this subsection we identify the determinants of individual contributions in all treatments of the experiment. Since the decision variable $c_i^t \in \{0, k\}$ is binary, we use a random intercept logistic regression (e.g., Longford, 1994) to explore factors that influence individual decisions. The dependent variable is a dummy variable y_i^t, specified as follows:

$$y_i^t = \begin{cases} 1, if\ c_i^t = k \\ 0, if\ \ c_i^t = 0 \end{cases} \quad (2)$$

The probability that that an individual i opts for contributing $c_i^t = k$ in period $t \in [1, T]$ is given by:

$$P(y_i^t = 1) = \frac{exp(\beta_1 X1_i^t + \beta_2 X2_i^t + \cdots + \beta_M XM_i^t + \alpha_i)}{1 + exp(\beta_1 X1_i^t + \beta_2 X2_i^t + \cdots + \beta_M XM_i^t + \alpha_i)} \quad (3),$$

where $X1_i^t \ldots XM_i^t$ are explanatory variables described in Table 2; $\beta_1 \ldots \beta_M$ are regression coefficients and α_i is a vector capturing unobserved individual heterogeneity. The conditional log-likelihood function of the random intercept logit regression has the following form:

$$LL = \prod_{i=1}^{N} \int_{-\infty}^{+\infty} \prod_{t=1}^{T} \left(\frac{exp(\beta_1 X1_i^t + \beta_2 X2_i^t + \cdots + \beta_M XM_i^t + \alpha_i)}{1 + exp(\beta_1 X1_i^t + \beta_2 X2_i^t + \cdots + \beta_M XM_i^t + \alpha_i)} \right) f(a) da \quad (4)$$

The log-likelihood function (4) is approximated using the adaptive quadrature method (Rabe-Hesketh et al., 2002).[9] Results of the random intercept logit regression estimated with different number of explanatory variables are reported in Table 3, Table 4, and Table 5 for treatments *BASE*, *LBIN* and *LPGC* correspondingly.

[INSERT Table 2, Table 3, Table 4, and Table 5 HERE]

According to Table 3, one variable influences participants' decisions in the *BASE* treatment. The propensity to make a positive contribution is higher in the early periods of the game (variable **PERIOD**). In other words, in the *BASE* treatment, participants take into account incentive consequences of playing in a certain period of the game when deciding on the amount of their contributions. They are more likely to contribute $c_i^t = k$ in the early periods and switch to $c_i^t = 0$ towards the end of the game even though they do not receive information about the exact number of periods.

Table 4 reports that in the *LBIN* treatment, the propensity to make a positive contribution decreases as the game progresses (variable **PERIOD**). Followers are more likely to contribute their entire

[9] The estimation has been conducted using the GLLAMM plug-in for the Stata 10.0 package. In addition to the two-level model with unobserved individual heterogeneity, specified above, we have estimated a two-level model with a random intercept at the level of a group in all treatments. We have also estimated three-level models with random intercepts at the level of individual participants and their respective roles (leader or follower) in the *LBIN* and the *LPGC* treatment. Results of these estimations are essentially the same as the results of estimations reported in the paper. Programming code, additional estimations' results as well as the data are available from the corresponding author upon request.

initial endowment than leaders (variable **ROLE**). Most importantly, the leader's binding contribution amount has a highly statistically significant effect on the individual contributions in the group (variable **LCONTR**). Particularly, the higher the contribution of the leader, the more likely group members are to contribute $c_i^t = k$.

According to Table 5, five explanatory variables have a significant impact on participants' contributions in the *LPGC* treatment. Participants in the *LPGC* treatment appear to take more factors into account than in the *BASE* and the *LBIN* treatment. This suggests that they face a more complex decision problem in the *LPGC* treatment than in the other two treatments. Similarly to the *BASE* and the *LBIN* treatment, participants are more likely to contribute their entire initial endowment to the group activity in early periods of the game (variable **PERIOD**) in the *LPGC* treatment. Furthermore, like in *LBIN* treatment, followers are more likely to contribute than leaders (variable **ROLE**).

The content of the pre-game communication (variable **PGC**) is one of the important factors that influence participants' decisions. Particularly, participants are more likely to contribute $c_i^t = k$ if a leader has promised to contribute k to the group activity. At the same time, the value of the leader's final contribution in the previous period (variable **LPREVCONTR**) is not a statistically significant determinant of individual behavior. This finding suggests that pre-game communication has a higher impact on the individual decisions than the *ex post* observation of the leader's contribution.

It may seem that participants do not condition their contributions in the current period on the previously observed leader's contribution since leaders are determined at random in every period. Since leaders change very often, followers may hope that the leader in the current period is more truthful than the leader in the previous period. Therefore, they may ignore the outcome of the previous period when making decisions. If this conjecture is correct, the implication is that participants should neglect the institutional reputation of leaders by not taking into account whether the leader has sent a truthful or a false message in the previous period. However, the data fails to confirm this implication. Despite rotating leadership, participants are less likely to make positive contributions to the group activity if the leader has sent a false message in the previous period (variable **FALSE**).

Note, however, that in the voluntary contribution game, not contributing is an equilibrium strategy for all players. Therefore, it is also likely that followers do not expect the leader to make a positive contribution to the group activity simply because it is irrational. Yet, it is important to them whether the leader is trustworthy or not, i.e., whether the leader's announced action coincides with her implemented action. In this case, followers are more likely to be disappointed when the leader sends a false message and tries to deceive other group members than when the leader contributes nothing to the group activity.

Table 4 and Table 5 report an interesting cross-treatment effect. When making decisions, participants in both the *LBIN* and the *LPGC* treatment take into account the sum of individual contributions in their group in the previous period (variable **GCONTR**). However, while participants in the *LBIN* treatment are more likely to contribute $c_i^t = k$ to the group activity after observing a relatively low sum of contributions, participants in the *LPGC* treatment are more likely to contribute $c_i^t = 0$ to the group activity after observing a relatively low sum of contributions. This result suggests that pre-game communication influences the way individuals think about the contribution game.

It appears that participants are more likely to focus on reaching social efficiency in leading by example than in leading by pre-game communication. One of the possible implications of this result is that when the intentions of the leader are observable, a relatively low sum of contributions in the previous period fails to discourage followers from trying to achieve a socially efficient outcome. Therefore, they contribute to the group activity in hopes that other players will cooperate with them. In other words, when the leader fails to set a good example, followers in the next period try to take on the leadership role and try to receive higher payoffs without relying on the leader. However, when the intentions of the leader are unobservable, a relatively low sum of contributions in the previous period (especially when the leader tries to deceive the group by sending a false message) has a negative impact on followers' desire to attain a social optimum. Instead, they focus on preserving their endowment.

In order to explore this possible implication, we conduct additional random intercept logit regressions. In these additional estimations, we check whether the sum of individual contributions in the previous period (**GCONTR**) as well as the leader's final contribution in the previous period (variable **LPREVCONTR**) have different impacts on participants' decisions when they play roles of leaders and followers. Results of these additional estimations are reported in Table 6.

[INSERT Table 6 HERE]

According to Table 6, when participants play the roles of followers in the *LBIN* treatment, they are more likely to contribute to the group activity if they have observed low leader's contribution and low sum of individual contributions in the previous period. In contrast, **GCONTR** and **LPREVCONTR** are not significant determinants of participants' decisions if they play the roles of leaders in the *LBIN* treatment. However, in the *LPGC* treatment, participants are more likely to contribute positive amounts to the group activity after observing a relatively high sum of individual contributions in the previous period, irrespective of the role. Yet, while **LPREVCONTR** is not an important determinant of the followers' behavior in the *LPGC* treatment, after observing a relatively high leader's final contribution in the previous period, the leader in the current period is more likely to contribute a positive amount to the group activity. Therefore, the data confirms our suggested implication. On the one hand, followers in the *LBIN* treatment indeed engage in adopting informal leadership roles. They do so by making positive contributions to the group activity when the leader fails to set a good example as well as when they observe a relatively low sum of individual contributions in the previous period. On the other hand, followers in the *LPGC* treatment are less likely to contribute after observing a relatively low sum of individual contributions in the previous period.

In all estimations, we control for individual unobserved heterogeneity of the experimental participants. By incorporating unobserved heterogeneity into our analysis, we insure that regression results are reliable and robust and obtained estimates are unbiased and efficient. Table 3, Table 4 and Table 5 suggest that in all treatments unobserved individual heterogeneity has an important impact on contributions. Particularly, the standard deviation of the random intercept at the level of individual participants ranges between 0.7348 and 0.9327 in the *BASE* treatment, between 0.4126 and 0.6442 in the *LBIN* treatment and between 0.4749 and 0.8149 in the *LPGC* treatment. This finding indicates that apart from factors measured in the experiment, other individual characteristics such as, e.g., cultural socio-economic and psychological parameters may have an impact on individual contributions. Developing efficient techniques that would allow measuring with high degree of precision a large menu of possible determinants of individual decisions in the laboratory (through incentivized procedures as well as questionnaires) is a very important endeavor for the future research in economics and psychology.

Recall from Section 2 that in the second experimental task, participants have taken part in the Holt and Laury (2002) risk attitude elicitation procedure. This procedure offers ten consecutive pairwise choices between a relatively safe and a relatively risky lottery. The probabilities of payoffs in each of these two lotteries are varied in such a way that at some point, an individual should switch from opting for a relatively safe lottery to a relatively risky lottery. The number of "safe" choices made before this switch point is often used as a proxy of an individual's risk attitude.

According to the procedure, more than half (59.7%) of participants in our experiment are at least slightly risk averse. The average risk attitude rank in the experiment is 5.6 with the median of 6 and a standard deviation of 1.8. Table 7 provides a cross-treatment comparison of risk attitude ranks. According to the results of the Kruskal-Wallis equality of populations rank test with two degrees of freedom, experimental participants are homogeneous in terms of their risk attitudes in all three treatments ($p > 0.2$).

[INSERT Table 7 HERE]

In addition to the Holt and Laury (2002) procedure, we ask participants to indicate their attitude towards risk in the post-experimental questionnaire. We include an indicator of an individual risk attitude obtained from the second experimental task (variable **INRA**) as well as the self-reported measure of the risk attitude (variable **SRRA**) in all estimations. Notably, neither of these two measures appear to be statistically significant in any of the estimated models. This finding suggests that individual risk attitude does not play an important role in the determination of individual decisions in the voluntary contribution games.

4. Discussion and Conclusion

This paper compares the impact of leading by pre-game communication and leading by example. It also studies the impact of pre-game communication in social dilemma situations. We consider a simple voluntary contribution game with leadership where a leader sends a non-binding message about her intended action to the rest of the group. Our results show that this message significantly increases the level of individual contributions compared with the control treatment without leadership.

We also find that pre-game communication appears to be a more important determinant of the individual decisions than the *ex post* contribution of the leader. Moreover, the levels of contributions are essentially the same in the leading by example and the leading by pre-game communication treatment. This finding suggests that in an organization, it might not be necessary for a leader to set an example for others in order to reach a certain goal. Rather, it might be sufficient to send a non-binding message that will influence the behavior of the followers and lead to essentially the same result.

Yet, our results suggest that individual group members are more likely to be focused on reaching a social optimum in leading by example than in leading by pre-game communication. This finding makes two important points. First, individuals exhibit different behavior in a situation when they play roles of leaders compared with a situation when they play roles of followers. This difference is especially apparent in the *LBIN* treatment where participants tend to make positive contributions if they play roles of followers and zero contributions if they play roles of leaders after observing that the leader has contributed nothing in the previous period.

Early experimental research in social psychology has suggested that roles may force people to behave in a ways they otherwise would not. A group of researchers from Stanford University have designed a simulated prison experiment (e.g., Haney et al., 1973), where undergraduate students have been randomly assigned roles of guards and prisoners. The experiment has shown that experimental participants have quickly adopted their role with guards exhibiting sadistic behavior and prisoners being obedient and depressed. Research in social psychology and sociology has also indicated that not only do individuals with similar characteristics behave differently when they are assigned different roles, but also the same individual may exhibit different behavior when assigned different roles (e.g., Pollay, 1968; Callero, 1994).

This paper relates the psychological literature on the influence of role on behavior with the economics research on leadership in social dilemma situations. We show that when promoted to leadership positions, individuals are more likely to take into account the actions of their predecessors even if these actions are not aimed at achieving a social optimum. This result has an important implication for leadership in teams since it suggests that team success depends not only on the individual reputation of the current leader, but also on the institutional reputation and decisions of previous leaders.

Second, in contrast to the leading by pre-game communication, leadership by example appears to provide additional motivation for the followers to work towards achieving a socially optimal outcome. Interestingly, even if the leader fails to set a good example for the rest of the group, followers try to act as informal leaders. This point relates our analysis to the literature on social goals in individual and group decision making.

Recent developments in decision theory emphasize the importance of group goals and social motives on individual decision making (e.g., Krantz and Kunreuther, 2007). In the laboratory experiments, Charness et al. (2007) and Chen and Li (2008) find that group membership influences individual behavior in many ways. Our results contribute to this stream of literature by suggesting that not only group membership *per se*, but also the context in which this group operates has an impact on individual decision making. When the leader sets an example rather than simply communicating her intentions to the rest of the team, the other team members become more engaged in group activity as well as more interested in reaching the group goal.

In leading by pre-game communication, false messages not only tend to hurt a reputation of a particular leader, but also negatively influence leadership as an institution. Particularly, when participants observe that a leader has lied in the previous period, they decrease the level of their contributions even though the leader has been re-assigned in the beginning of the current period. This finding indicates that deceptive pre-game communication creates an erosion of trust. It discourages followers from believing the leader even under conditions of rotating leadership.

Our results have several possible applications to different aspects of leadership in organizations. At the level of internal leadership within organizations, our analysis suggests that group decision processes may be facilitated by means of communication, even if personal goals of the individual members of the group are at odds with the group goal. This finding confirms previous results from marketing research conducted using non-incentivized questionnaires in business organizations (e.g., Souder, 1977).

This paper stresses the value of communication between leaders and followers. This result is of particular importance because in organizations, leaders do not always have an opportunity to set an example for their subordinates. Rather, their primary means of influence is communication. Our results indicate that leaders have the capacity to alter individual behavior of subordinates and direct this behavior towards the attainment of the organizational objectives even without exerting personal effort and setting an example for others. Yet, our results suggest that if a leader sets an example, this might provide an additional motivation for the other members of the team to work towards achieving organizational goals.

Our results are also applicable to other domains such as political campaigning, military conflict and sports. Particularly, our finding of the erosion of trust may often be observed in the developing countries with unstable democracies, where deceptive statements made by the political elite may cause apathy towards participating in the political process and have negative consequences for the society as a whole.

We also show that individual risk attitudes do not appear to influence individual choices in the strategic environment of voluntary contribution games. However, our econometric analysis suggests that unobserved heterogeneity plays an important role in the determination of individual responses. Exploring the robustness of these findings is an important direction for the future research agenda of the literature on voluntary contribution games.

In this paper, we consider situations where leaders directly participate in group output by taking part in the group activity. Leadership in teams often implies that the leader performs similar tasks as her subordinates. However, leaders in a hierarchical organization may play qualitatively different roles than the other team members. Such leaders generate ideas, formulate objectives and coordinate information streams within the organization without being directly involved with the goal attainment. Exploring the role of communication in situations where leaders and followers have qualitatively different decision tasks is one of the interesting endeavors for the future theoretical and experimental studies on leadership with pre-game communication. Other possible extensions of our research include relaxing the restriction on individual contributions, exploring the impact of different content of pre-game communication and conducting experiments in the field with business professionals.

Tables and Figures

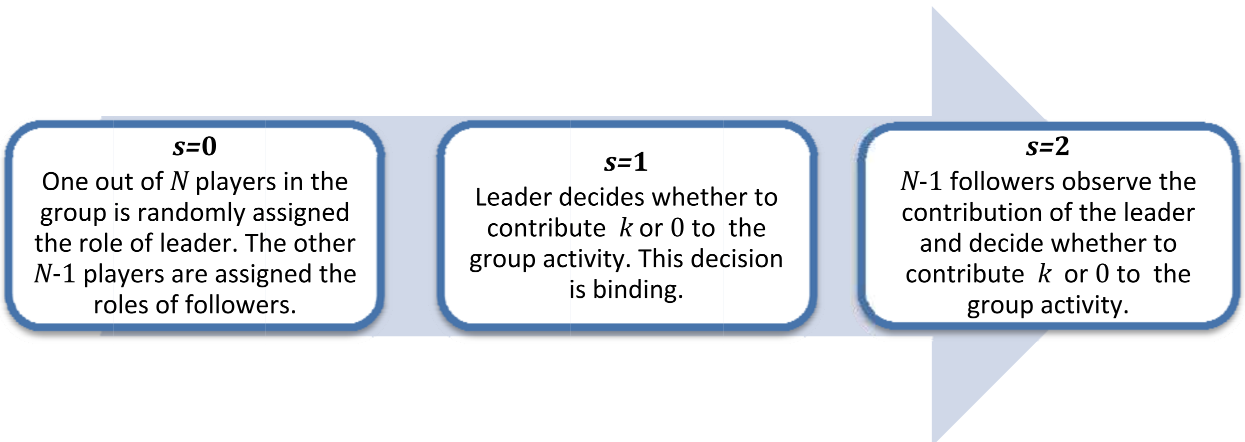

Figure 1 Within-period Timeline of the *LBIN* Treatment

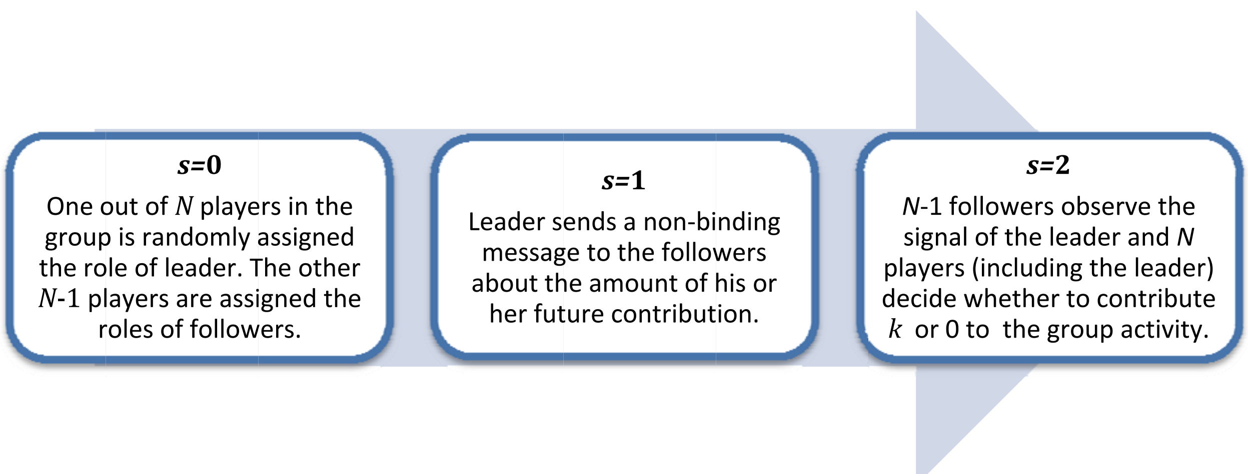

Figure 2 Within-period Timeline of the *LPGC* Treatment

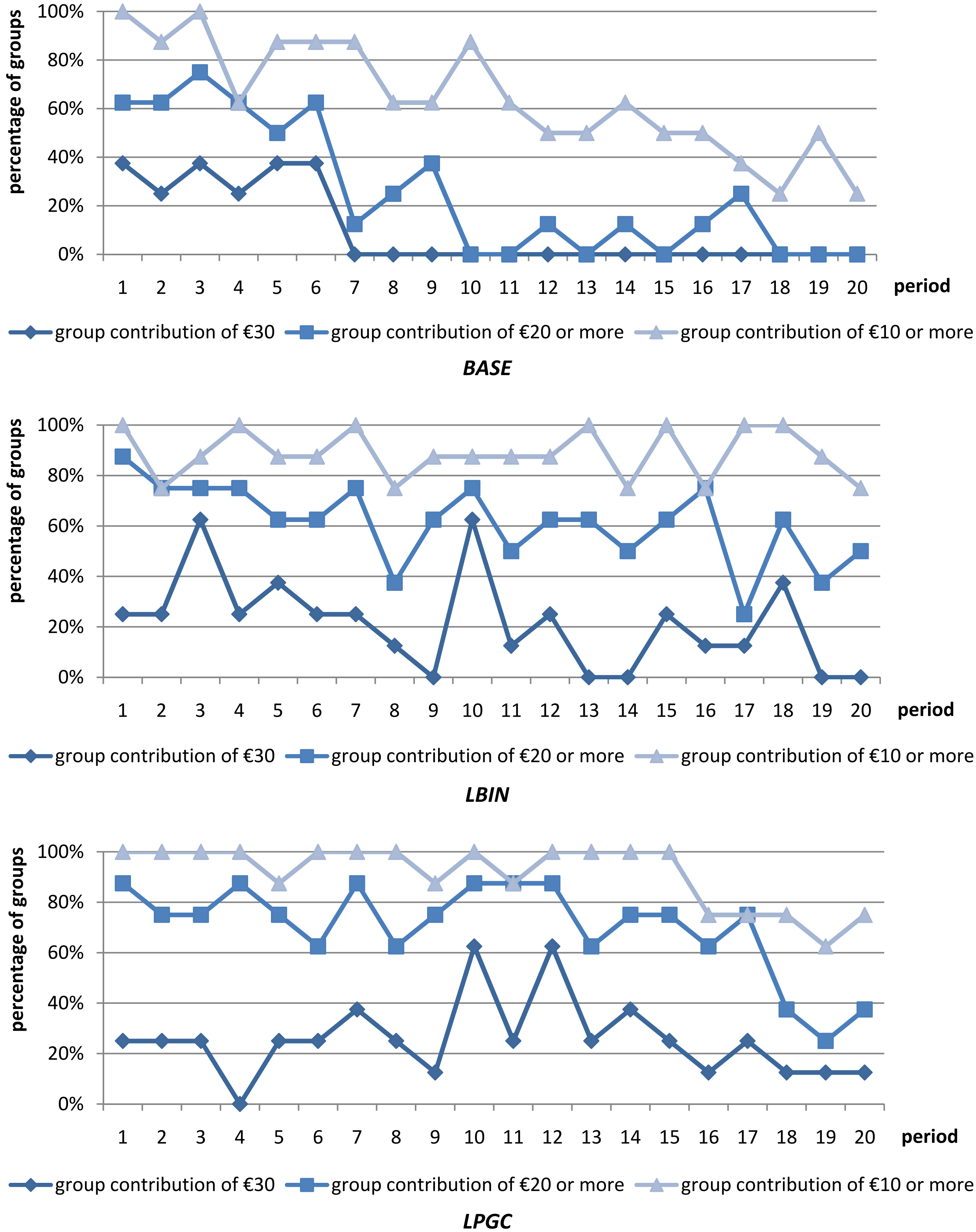

Figure 3 Observed Positive Group Contributions in Iterated Play[10]

[10] Group contribution of 0 or more is not shown since all observed group contributions fall under this category.

Table 1 Aggregate Contributions

	Treatment		
	BASE	***LBIN***	***LPGC***
Mean individual contribution (standard error)	3.33 (0.22)	5.70 (0.23)	6.23 (0.22)
Standard deviation of individual contributions	4.72	4.95	4.85
Mean group contribution (standard error)	10 (0.44)	17.19 (0.42)	18.69 (0.41)
Standard deviation of group contributions	9.56	9.17	8.96

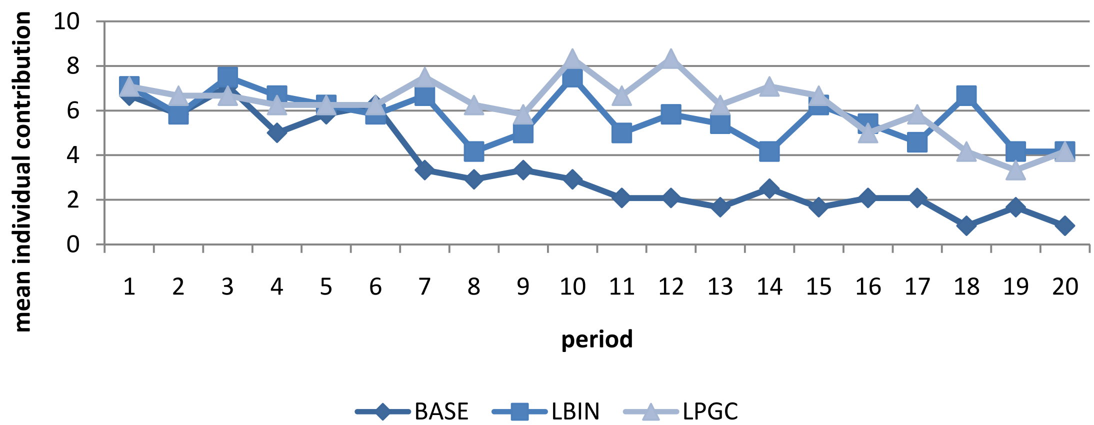

Figure 4 Mean Individual Contributions in the *BASE*, *LBIN* and *LPGC* Treatments

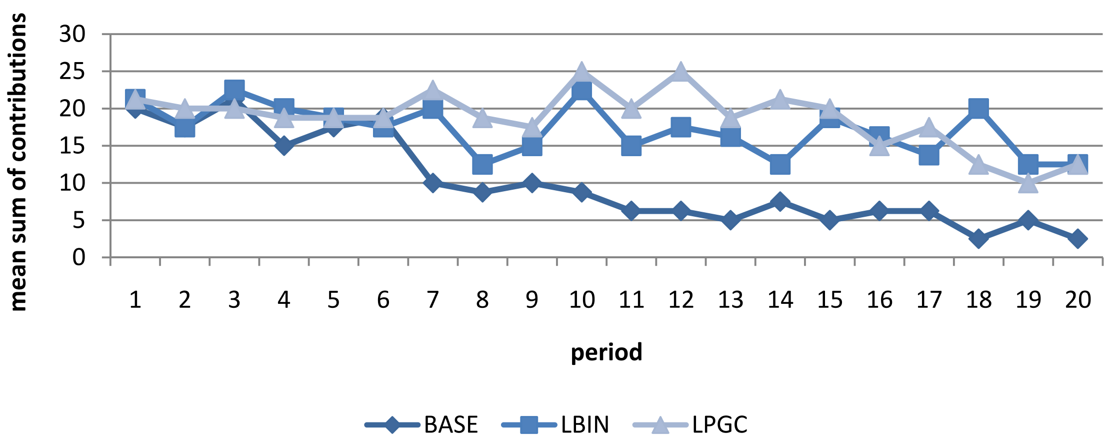

Figure 5 Mean Group Contributions in the *BASE*, *LBIN* and *LPGC* Treatments

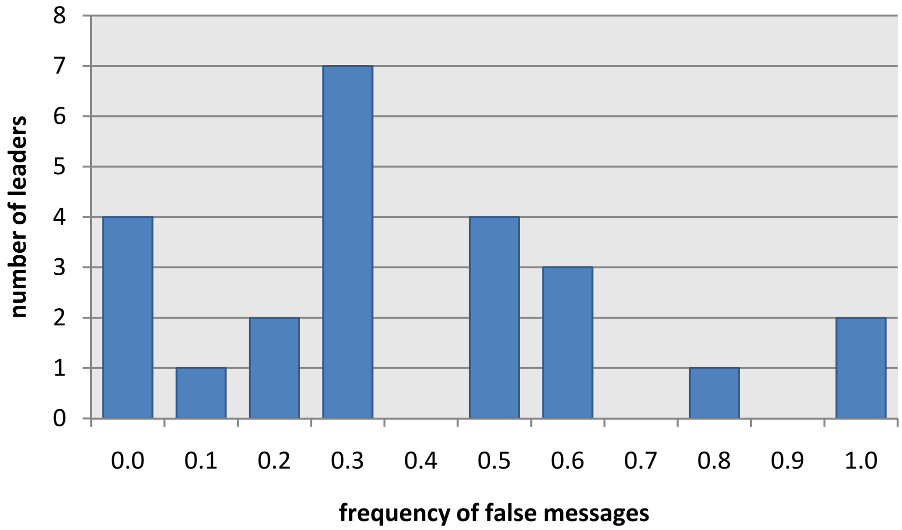

Figure 6 Frequency of False Messages Across Leaders in the *LPGC* Treatment

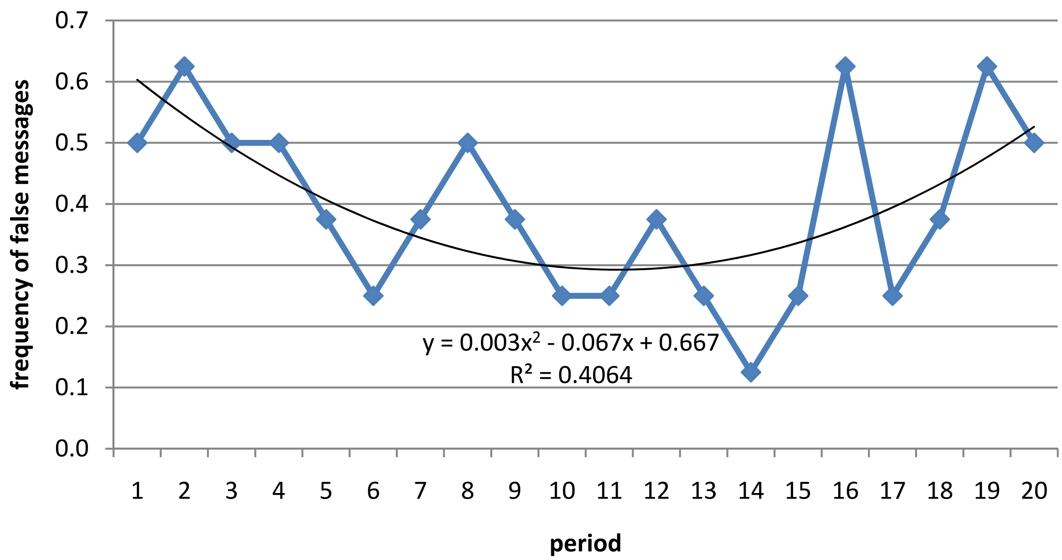

Figure 7 Frequency of False Messages by Period

Table 2 Variable Description

Explanatory variable	Description
CONST	Constant
PERIOD	Linear order effect : period from 1 to 20
GCONTR	Group contribution: sum of individual contributions in a group in the previous period (0 - €0; 1 - €10; 2 - €20; and 3 - €30)
PAYOFF	Payoff dummy : payoff in the previous period (0 – if the payoff was lower than initial endowment k and 1 otherwise)
GENDER	Gender dummy: 0 – male; 1 - female
AGE	Age: self-reported age
INRA	Incentivized risk attitude: a scale from 0 (risk seeking) to 10 (extremely risk averse), based on the number of safe choices made in the Holt and Laury (2002) risk attitude elicitation procedure
SRRA	Self-reported risk attitude: self-reported individual risk attitude on a scale from 1 (very risk seeking) to 6 (very risk averse)
LANGUAGE	Language dummy: 0 – not a native speaker of the ________ language; 1 - otherwise
MAJOR	Major dummy: 0 – not a student of Economics or Business Administration; 1 - otherwise
EXPERIENCE	Experience: self-reported number of times, when a participant has taken part in economic experiments before (0 – never before; 1 – one time; 2 – from 2 to 5 times; 3 – more often)
INCOME	Self-reported annual income: 1 – less than €15,000; 2 - from €15,001 to €30,000; 3 – from €30,001 to €45,000; 4 – from €45,001 to €60,000; 5 – more than €60,000
SESSION	Session dummy: 0 – session 1; 1 – session 2
ACQUAINTANCES	Acquaintances: self-reported number of other players in the session, whom a participant knows personally
LCONTR	Leader's contribution: amount of the leader's contribution in the current period
LPREVCONTR	Leader's previous contribution: amount of the leader's contribution in the previous period
ROLE	Role dummy: 0 – follower; 1 - leader
PGC	Content of the pre-game communication dummy: 0 – m=0; 1 – m=1
FALSE	False message dummy: 0 – truthful message in the previous period; 1 – false message in the previous period

Table 3 Results of the Random Intercept Logit Regression (*BASE* treatment)

Explanatory variable	Marginal effect (standard error)			
	Model 1	***Model 2***	***Model 3***	***Model 4***
CONST	0.9312** (0.2942)	0.2725 (1.3843)	-0.0585 (1.5799)	0.6297 (1.7102)
PERIOD	-0.1799*** (0.0223)	-0.1568*** (0.0288)	-0.1573*** (0.0288)	-0.1577*** (0.0288)
GCONTR	-	0.1774 (0.1565)	0.1731 (0.1565)	0.1711 (0.1577)
PAYOFF	-	0.3046 (0.3517)	0.3087 (0.3520)	0.3202 (0.3544)
GENDER	-	0.6011 (0.4113)	0.6759 (0.4522)	0.5467 (0.4658)
AGE	-	0.0068 (0.0482)	0.0079 (0.0483)	0.0149 (0.0470)
INRA	-	-	0.0395 (0.1393)	0.0316 (0.1464)
SRRA	-	-	-0.1343 (0.2169)	-0.1813 (0.2277)
LANGUAGE	-	-	-	-0.2177 (0.7041)
MAJOR	-	-	-	0.8335 (0.8321)
EXPERIENCE	-	-	-	-0.1260 (0.2339)
INCOME	-	-	-	-0.3322 (0.5097)
SESSION	-	-	-	0.1484 (0.4650)
Log-likelihood (*LL*)	-254.8158	-240.1869	-239.9855	-238.9711
Standard deviation (standard error) for the random intercept (level 2)	0.9327 (0.1844)	0.7861 (0.1305)	0.7835 (0.1291)	0.7348 (0.1116)
Number of level 1 units (Contribution decision)	456			
Number of level 2 units (Individual)	24			
Number of level 2 units (Group)	-			

** - significant at 0.01 level; *** - significant at 0.001 level

Table 4 Results of the Random Intercept Logit Regression (*LBIN* treatment)

Explanatory variable	Marginal effect (standard error)			
	Model 1	*Model 2*	*Model 3*	*Model 4*
CONST	-0.5618** (0.1949)	0.5754 (0.4092)	0.3314 (0.9148)	1.7005 (1.2256)
LCONTR	1.8146*** (0.2231)	1.7853*** (0.2311)	1.7439*** (0.2313)	1.7441*** (0.2316)
PERIOD	-	-0.0428* (0.0203)	-0.0448* (0.0203)	-0.0453* (0.0204)
GCONTR	-	-0.2865* (0.1262)	-0.2776* (0.1307)	-0.2790* (0.1304)
ROLE	-	-0.4905* (0.2393)	-0.5064* (0.2407)	-0.4824* (0.2398)
PAYOFF	-	-	-0.3368 (0.4026)	-0.3336 (0.4050)
GENDER	-	-	-0.1445 (0.3065)	0.0112 (0.3531)
AGE	-	-	0.0297 (0.0235)	0.0198 (0.0243)
INRA	-	-	-0.1233 (0.0928)	-0.1240 (0.1013)
SRRA	-	-	0.1695 (0.1291)	0.0578 (0.1453)
LANGUAGE	-	-	-	0.2102 (0.5032)
MAJOR	-	-	-	0.0555 (0.5044)
EXPERIENCE	-	-	-	-0.3175 (0.2426)
INCOME	-	-	-	-0.4170 (0.5213)
SESSION	-	-	-	-0.5012 (0.3814)
ACQUAINTANCES	-	-	-	0.3743 (0.6365)
Log-likelihood (*LL*)	-284.4809	-266.6920	-263.9947	-261.8404
Standard deviation (standard error) for the random intercept (level 2)	0.6442 (0.0663)	0.6207 (0.0632)	0.5002 (0.0407)	0.4126 (0.0281)
Number of level 1 units (Contribution decision)	456			
Number of level 2 units (Individual)	24			

* - significant at 0.05 level; *** - significant at 0.001 level

Table 5 Results of the Random Intercept Logit Regression (*LPGC* treatment)

Explanatory variable	Marginal effect (standard error)			
	Model 1	*Model 2*	*Model 3*	*Model 4*
CONST	-0.1082 (0.2841)	0.4826 (0.5262)	-1.0553 (1.1457)	0.2094 (1.5730)
PGC	0.8583*** (0.2640)	0.9383** (0.3008)	0.9219** (0.3021)	0.9061** (0.3027)
LPREVCONTR	-	-0.2914 (0.3890)	-0.2903 (0.3885)	-0.3087 (0.3886)
PERIOD	-	-0.0572** (0.0220)	-0.0578** (0.0220)	-0.0580** (0.0220)
GCONTR	-	0.5103** (0.1824)	0.5485** (0.1881)	0.5528** (0.1887)
ROLE	-	-1.4980*** (0.2426)	-1.5243*** (0.2442)	-1.5302*** (0.2441)
FALSE	-	-0.8179* (0.3360)	-0.8401* (0.3382)	-0.8320* (0.3424)
PAYOFF	-	-	-0.6170 (0.4640)	-0.6232 (0.4664)
GENDER	-	-	0.5084 (0.3355)	0.2002 (0.3878)
AGE	-	-	0.0340 (0.0259)	0.0372 (0.0297)
INRA	-	-	0.1120 (0.1155)	0.1051 (0.1488)
SRRA	-	-	0.0913 (0.1549)	0.0352 (0.1880)
LANGUAGE	-	-	-	0.2158 (0.6663)
MAJOR	-	-	-	-0.6872 (0.4951)
EXPERIENCE	-	-	-	-0.0450 (0.2071)
INCOME	-	-	-	-0.8990 (0.7765)
SESSION	-	-	-	-0.0211 (0.4957)
ACQUAINTANCES	-	-	-	0.0946 (0.6664)
Log-likelihood (*LL*)	-298.9613	-247.5143	-244.0384	-242.3313
Standard deviation (standard error) for the random intercept (level 2)	0.8149 (0.1158)	0.7292 (0.0962)	0.5570 (0.0549)	0.4749 (0.0401)
Number of level 1 units (Contribution decision)	456			
Number of level 2 units (Individual)	24			

* - significant at 0.05 level; ** - significant at 0.01 level; *** - significant at 0.001 level

Table 6 The Impact of Sum of Individual Contributions and Leader's Final Contribution on Individual Decisions by Role

	Explanatory variable	Treatment			
		LBIN		*LPGC*	
		Leaders	**Followers**	**Leaders**	**Followers**
Random intercept logit regression 1	**CONST**	0.2695 (0.4679)	0.9097** (0.2992)	-2.5583*** (0.7712)	-0.3362 (0.2983)
	GCONTR	-0.1004 (0.2078)	-0.2735* (0.1381)	1.1142*** (0.3147)	0.7083*** (0.1534)
	Log-likelihood (*LL*)	-99.8907	-201.1406	-82.4932	-169.3637
	Standard deviation (standard error) for the random intercept (level 2)	1.0553 (0.3649)	0.5288 (0.0528)	1.8912 (1.8400)	0.1536 (0.0107)
	Number of level 1 units (Contribution decision)	152	304	152	304
	Number of level 2 units (Individual)	24	24	24	24
Random intercept logit regression 2	**CONST**	0.0182 (0.3837)	0.8003*** (0.2139)	-1.0741* (0.4528)	0.7423*** (0.1827)
	LPREVCONTR	0.1382 (0.3837)	-0.6956** (0.2510)	1.5832*** (0.4613)	-0.5385 (0.2766)
	Log-likelihood (*LL*)	-99.9435	-199.2426	-84.0258	-178.4541
	Standard deviation (standard error) for the random intercept (level 2)	1.0240 (0.3409)	0.4906 (0.0459)	1.6657 (1.3030)	0.3386 (0.0279)
	Number of level 1 units (Contribution decision)	152	304	152	304
	Number of level 2 units (Individual)	24	24	24	24

Table 7 Risk Attitudes of Experimental Participants

Constant relative risk aversion (CRRA) characteristic			Number of participants (%)		
Risk attitude rank*	**CRRA coefficient *r***	**Description**	***BASE***	***LBIN***	***LPGC***
0-1	$r < -0.95$	highly risk seeking	1 (4.2)	0 (0.0)	0 (0.0)
2	$-0.95 < r \leq -0.49$	very risk seeking	0 (0.0)	0 (0.0)	1 (4.2)
3	$-0.49 < r \leq -0.15$	risk seeking	0 (0.0)	2 (8.3)	1 (4.2)
4	$-0.15 < r \leq 0.15$	risk neutral	1 (4.2)	5 (20.8)	5 (20.8)
5	$0.15 < r \leq 0.41$	slightly risk averse	4 (16.7)	4 (16.7)	4 (16.7)
6	$0.41 < r \leq 0.68$	risk averse	7 (29.2)	2 (8.3)	7 (29.2)
7	$0.68 < r \leq 0.97$	very risk averse	3 (12.5)	4 (16.7)	1 (4.2)
8	$0.97 < r \leq 1.37$	highly risk averse	3 (12.5)	0 (0.0)	1 (4.2)
9 or 10	$r > 1.37$	stay in bed	0 (0.0)	2 (8.3)	1 (4.2)
Kruskal-Wallis equality-of-populations rank test			p=0.2856		
Average rank			5.8	5.6	5.3
Median rank			6	5	5
Standard deviation			1.8	2.0	1.6
Inconsistent[11]			5 (20.8)	5 (20.8)	3 (12.5)

*** -** Number of safe choices made in the Holt and Laury (2002) procedure

[11] In the econometric analysis, inconsistent subjects were assigned a median rank (6 – in the *BASE* treatment and 5 – in the *LBIN* and the *LPGC* treatment).

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Appendix (NOT INTENDED FOR PUBLICATION)

Experimental Instructions

Dear participant,

Welcome to our experiment in decision making! If you carefully follow these simple instructions, you may earn a considerable amount of money. The money you will earn in this experiment is yours to keep and will be paid to you **privately** and **in cash** at the **end of the experiment**. The experiment will last approximately 1 **hour**. **Your payoff will depend only on your decisions and the realization of random events.**

The experiment consists of two parts. You will receive separate instructions in the beginning of each part. These instructions will be read to you aloud and then you will have an opportunity to study them on your own. If you have a question about the content of the instructions, please raise your hand and the experimenter will answer your question **in private**. Please do not talk or communicate with other participants during the experiment.

At the end of the experiment, you **alone** will be informed about your private payoff from all parts of the experiment.

Good luck and thank you for your participation!

Confidentiality

You will not receive any information about payoffs and identities of other participants in this experiment. Likewise, other participants will not receive any information about your identity and your payoff in this experiment. Information about participants in this experiment (names and identifying information) will be kept separate from the study data in a locked cabinet in a locked office both with keys that only the research staff will have access to.

The study data will include only a study identification number for each participant. At the end of the experiment, you will need to verify the receipt of your payoff by signing the payment form. This form will be used only for accounting purposes to report to our sponsor the ____________. The _________ will not receive any other data from the experiment.

Part 1 (*BASE* TREATMENT)

In this part of the experiment you will make decisions in a group. Your group will consist of **3 players**. Two other players, who will join you in the game, will be chosen by the computer program at random. They will be in the laboratory at the same time as you. However, you will not know who they are nor be able to communicate with them. Your group will stay the same for the duration of Part 1 of the experiment.

Before the game starts, you will be randomly assigned an ID by the computer program: **Player A, Player B** or **Player C. During the experiment, you will be identified ONLY by your ID to ensure anonymity of all players.**

You will play **several rounds** of the following game:

- At the beginning of **every round** of the game each player (including you) will receive an initial endowment of **€10**.
- Your task is to decide how to use your endowment.
- You have to decide whether you want to contribute your **€10** to the joint project with your group mates or to keep your **€10** to yourself.
- The consequences of your decisions are explained in detail below.
- In the beginning of each round, the following input screen will appear:

Your initial endowment in this round is: **€10**

Your contribution to the project is: **€0** **€10**

- You will have a choice between contributing either **€0** or **€10** to the joint project.
- As soon as you have decided how many euros to contribute to the project, press either

€0 or **€10**

button. **Once you have done this your decision can no longer be revised!**

- Your hypothetical payoff in every round will be calculated according to the following formula:

(initial endowment) - (contribution to the project)+ 2/3*(the sum of contributions of all players in your group)

- Therefore, if you decide to contribute **€0**, your hypothetical payoff in this round will be:

€10 (initial endowment) - €0 (contribution to the project)+ 2/3*(the sum of contributions of all players in your group)

- If you decide to contribute **€10**, your hypothetical payoff in this round will be:

€10 (initial endowment) - €10 (contribution to the project)+ 2/3*(the sum of contributions of all players in your group)

- **The income of each group member from the project is calculated in the same way.**
- **All players in your group will make decisions simultaneously.**

The table below depicts all possible hypothetical payoffs dependent on the number of players, contributing €10 to the project:

Your contribution	Number of other group members, who have contributed **€10** to the project	Your hypothetical payoff in this round	Profit calculation
€0	0	**€10**	**€10-€0+2/3*€0=€10**
	1	**€16.66**	**€10-€0+2/3*€10=€16.66**
	2	**€23.33**	**€10-€0+2/3*€20=€23.33**
€10	0	**€6.66**	**€10-€10+2/3*€10=€6.66**
	1	**€13.33**	**€10-€10+2/3*€20=€13.33**
	2	**€20.00**	**€10-€10+2/3*€30=€20.00**

- At the end of every period, after all players in your group have made their decisions, you will receive detailed information about: (a) your contribution, (b) individual decisions of other players in your group (**Note: all players will be identified by their IDs! For example, if you are Player A, players B and C will receive information about your individual contribution, as well as you will know how much Player B and Player C have contributed individually. However, you will not know the names or any other personal information such as seat number and etc. of your group mates at any point of the experiment.**); (c) sum of contributions of all players in the group; (d) your hypothetical payoff in this round.
- At the beginning of each round, the scenario starts anew. In other words, you receive **€10 at the beginning of each round, irrespective of what has happened in the previous rounds.** However, you cannot accumulate your payoffs across rounds.
- Your payoff is called **hypothetical**, because at the end of the experiment **one round out of all rounds played in Part 1** of the experiment will be chosen by the computer program at random and **you will receive your payoff from this round only**.
- **Your decisions will remain anonymous at all times. No other player will find out which decisions you have made.**

Part 1 (*LBIN* TREATMENT)

In this part of the experiment you will make decisions in a group. Your group will consist of **3 players**. Two other players, who will join you in the game, will be chosen by the computer program at random. They will be in the laboratory at the same time as you. However, you will not know who they are nor be able to communicate with them. Your group will stay the same for the duration of Part 1 of the experiment.

Before the game starts, you will be randomly assigned an ID by the computer program: **Player A, Player B** or **Player C. During the experiment, you will be identified ONLY by your ID to ensure anonymity of all players.**

In addition to the ID, a computer program will randomly assign a **TYPE** to each participant. Every group will consist of two **TYPE 1** players and one **TYPE 2** player. You will be informed about your own TYPE as well as about the TYPES of other players in your group. **Every round, TYPES will be randomly re-assigned. However, since the procedure is random, you may be assigned the same TYPE for several rounds in a row. Nevertheless, you will be assigned TYPE 2 at least once during this part of the experiment.**

You will play **several rounds** of the following game:

- At the beginning of **every round** of the game each player (including you) will receive an initial endowment of **€10**.
- Your task is to decide how to use your endowment.
- You have to decide whether you want to contribute your **€10** to the joint project with your group mates or to keep your **€10** to yourself.
- The consequences of your decisions are explained in detail below.
- In the beginning of each round, the following input screen will appear:

Your initial endowment in this round is: **€10**

Your contribution to the project is: **€0** **€10**

- You will have a choice between contributing either **€0** or **€10** to the joint project.
- As soon as you have decided how many euros to contribute to the project, press either

€0 or **€10**

button. **Once you have done this your decision can no longer be revised!**

- Your hypothetical payoff in every round will be calculated according to the following formula:

(initial endowment) - (contribution to the project)+ 2/3*(the sum of contributions of all players in your group)

- Therefore, if you decide to contribute **€0**, your hypothetical payoff in this round will be:

€10 (initial endowment) - €0 (contribution to the project)+ 2/3*(the sum of contributions of all players in your group)

- If you decide to contribute **€10**, your hypothetical payoff in this round will be:

€10 (initial endowment) - €10 (contribution to the project)+ 2/3*(the sum of contributions of all players in your group)

- **The income of each group member from the project is calculated in the same way.**

The table below depicts all possible hypothetical payoffs dependent on the number of players, contributing €10 to the project:

Your contribution	Number of other group members, who have contributed **€10** to the project	Your hypothetical payoff in this round	Profit calculation
€0	0	**€10**	**€10-€0+2/3*€0=€10**
	1	**€16.66**	**€10-€0+2/3*€10=€16.66**
	2	**€23.33**	**€10-€0+2/3*€20=€23.33**
€10	0	**€6.66**	**€10-€10+2/3*€10=€6.66**
	1	**€13.33**	**€10-€10+2/3*€20=€13.33**
	2	**€20.00**	**€10-€10+2/3*€30=€20.00**

- **However, players in your group will decide how much to contribute to the project sequentially.**
- **First, player of TYPE 2 will made his or her decision about how much he or she wants to contribute to the project. This decision will be communicated to the entire group.**
- **After observing the contribution of the TYPE 2 player, TYPE 1 players will make their decisions about their individual contributions.**

- At the end of every period, you will receive detailed information about: (a) your contribution, (b) ID of the TYPE 2 player; (c) individual contributions of other players in your group (**Note: all players will be identified by their IDs! For example, if you are Player A, players B and C will receive information about your individual contribution, as well as you will know how much Player B and Player C have contributed individually. However, you will not know the names or any other personal information such as seat number and etc. of your group mates at any point of the experiment.**); (d) sum of contributions of all players in the group; (e) your hypothetical payoff in this round.

- At the beginning of each round, the scenario starts anew. In other words, you receive **€10 at the beginning of each round, irrespective of what has happened in the previous rounds.** However, you cannot accumulate your payoffs across rounds.
- Your payoff is called **hypothetical**, because at the end of the experiment **one round out of all rounds played in Part 1** of the experiment will be chosen by the computer program at random and **you will receive your payoff from this round only**.
- **Your decisions will remain anonymous at all times. No other player will find out which decisions you have made.**

Part 1 (*LPGC* TREATMENT)

In this part of the experiment you will make decisions in a group. Your group will consist of **3 players**. Two other players, who will join you in the game, will be chosen by the computer program at random. They will be in the laboratory at the same time as you. However, you will not know who they are nor be able to communicate with them. Your group will stay the same for the duration of Part 1 of the experiment.

Before the game starts, you will be randomly assigned an ID by the computer program: **Player A, Player B** or **Player C. During the experiment, you will be identified ONLY by your ID to ensure anonymity of all players.**

In addition to the ID, a computer program will randomly assign a **TYPE** to each participant. Every group will consist of two **TYPE 1** players and one **TYPE 2** player. You will be informed about your own TYPE as well as about the TYPES of other players in your group. **Every round, TYPES will be randomly re-assigned. However, since the procedure is random, you may be assigned the same TYPE for several rounds in a row. Nevertheless, you will be assigned TYPE 2 at least once during this part of the experiment.**

You will play **several rounds** of the following game:

- At the beginning of **every round** of the game each player (including you) will receive an initial endowment of **€10**.
- Your task is to decide how to use your endowment.
- You have to decide whether you want to contribute your **€10** to the joint project with your group mates or to keep your **€10** to yourself.
- The consequences of your decisions are explained in detail below.
- In the beginning of each round, the following input screen will appear:

Your initial endowment in this round is: **€10**

Your contribution to the project is: **€0** **€10**

- You will have a choice between contributing either **€0** or **€10** to the joint project.
- As soon as you have decided how many euros to contribute to the project, press either **€0** or **€10** button. **Once you have done this your decision can no longer be revised!**

- Your hypothetical payoff in every round will be calculated according to the following formula:

(initial endowment) - (contribution to the project)+ 2/3*(the sum of contributions of all players in your group)

- Therefore, if you decide to contribute **€0**, your hypothetical payoff in this round will be:

€10 (initial endowment) - €0 (contribution to the project)+ 2/3*(the sum of contributions of all players in your group)

- If you decide to contribute **€10**, your hypothetical payoff in this round will be:

€10 (initial endowment) - €10 (contribution to the project)+ 2/3*(the sum of contributions of all players in your group)

- **The income of each group member from the project is calculated in the same way.**

The table below depicts all possible hypothetical payoffs dependent on the number of players, contributing €10 to the project:

Your contribution	Number of other group members, who have contributed **€10** to the project	Your hypothetical payoff in this round	Profit calculation
€0	0	**€10**	**€10-€0+2/3*€0=€10**
	1	**€16.66**	**€10-€0+2/3*€10=€16.66**
	2	**€23.33**	**€10-€0+2/3*€20=€23.33**
€10	0	**€6.66**	**€10-€10+2/3*€10=€6.66**
	1	**€13.33**	**€10-€10+2/3*€20=€13.33**
	2	**€20.00**	**€10-€10+2/3*€30=€20.00**

- **All players in your group will make decisions simultaneously.**
- **However, before the group members make their decisions, TYPE 2 player will have an opportunity to send a message to the others about how much he or she is planning to contribute to the project. Particularly, TYPE 2 player will see the following screen in the beginning of the game:**

I would like to send the following message to the other group members:

I am planning to contribute: **€0** **€10**

- If you are a TYPE 2 player, you will have a choice between sending a message that you are planning to contribute either **€0** or **€10** to the joint project.
- As soon as you have decided between the two options, press either

€0 or **€10**

button. **Once you have done this your message will be sent to the entire group!**

- **Note, however, that this message is not binding.**
- **After observing the message from the TYPE 2 player, all players in the group (including the TYPE 2 player) will have an opportunity to make a decision about their individual contributions. Therefore, the TYPE 2 player has an opportunity to change his or her mind and select a different alternative. Note that while the message is not binding, the decision is binding!**

- At the end of every period, you will receive detailed information about: (a) your contribution, (b) ID of the TYPE 2 player; (c) the message of the TYPE 2 player; (d) individual contributions of other players in your group (**Note: all players will be identified by their IDs! For example, if you are Player A, players B and C will receive information about your individual contribution, as well as you will know how much Player B and Player C have contributed individually. However, you will not know the names or any other personal information such as seat number and etc. of your group mates at any point of the experiment.**); (e) sum of contributions of all players in the group; (f) your hypothetical payoff in this round.
- At the beginning of each round, the scenario starts anew. In other words, you receive **€10 at the beginning of each round, irrespective of what has happened in the previous rounds.** However, you cannot accumulate your payoffs across rounds.
- Your payoff is called **hypothetical**, because at the end of the experiment **one round out of all rounds played in Part 1** of the experiment will be chosen by the computer program at random and **you will receive your payoff from this round only**.
- **Your decisions will remain anonymous at all times. No other player will find out which decisions you have made.**
- **Your payoff will be paid out in cash at the end of the experiment along with your earnings from Part 2.**

Part 2

You will be given **10 problems.** In each problem you need to choose between two lotteries. All 10 problems will appear on your computer screen at once. The example of a typical problem is given below:

Sample Problem

Lottery X yields: 9 EUR with probability 1/3 2 EUR with probability 2/3	**Lottery Y** yields: 4 EUR with probability 2/3 3 EUR with probability 1/3
Which of the two lotteries would you choose?	
Lottery X	**Lottery Y**

Your **payoff** in this part is determined, based on the outcome of the lotteries that you have chosen. First, the computer program will generate a random number from 1 to 10. This number will determine one of 10 problems. This selected problem (together with your choice) will reappear on your computer screen. Then the computer program will simulate the lottery you have chosen and reveal the outcome on your screen. The outcome of this lottery will determine your payoff.

For **example**, suppose that the computer program has generated a random number and the sample problem (presented above) reappears on your screen. Suppose that you have chosen Lottery X in this problem. Then the computer program will simulate Lottery X and reveal your payoff (either 9 EUR or 2 EUR). **Your payoff will be paid out in cash at the end of the experiment along with your earnings from Part 1.**

At the end of the experiment you will be asked to fill out a short statistical questionnaire.