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Behavioural Effects of Obligations

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Abstract

How formal rules affect human behaviour is a crucial issue in economics. Formal rules are defined as obligations backed by incentives. The economic literature has largely focused on the role of incentives in shaping individual behaviour. Yet, the role of obligations, i.e. what formal rules ask people to do or not to do, has been largely ignored. In this paper we run a public good game experiment to analyze the behavioural effects of obligations. We find evidence that obligations can affect cooperative behaviour both by coordinating conditional co-operators' beliefs about others' behaviour and by directly affecting preferences for cooperation. Our results shed a new light on the behavioural channels through which formal rules can affect individual behaviour. These findings suggest the opportunity to broaden the scope of analysis in order to gain a better understanding of the effects of institutions on economic outcomes.

Keywords

Beliefs, Human Behaviour, Incentives, Obligations, Preferences, Public Good Game

JEL Classification: C91, C92, H26, H41, K40

*Behavioural Effects of Obligations**

ROBERTO GALBIATI[♣] & PIETRO VERTOVA[♣]

1. Introduction

Authorities who want to influence people's behaviour usually set formal rules of conduct. Legislators, managers or parents, for instance, ask citizens, employees or children either to do or not to do something and try to induce compliance by setting incentives in the form of rewards and/or sanctions. Understanding the effects of formal rules on individuals' behaviour is a crucial issue for economics. Traditional economic theory provides powerful tools for predicting the effects of incentives based on their impact on individual material payoffs. Furthermore, recent developments in behavioural economics have provided us with a greater understanding of the non material effects of

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incentives (e.g. Benabou and Tirole, 2003 and forthcoming; Bohnet, Huck and Frey, 1997; Bowles, 2006; Falk and Kosfeld, forthcoming; Fehr and Falk, 2002; Fehr and Schmidt, 2002, Gneezy and Rustichini, 2000). Nevertheless, in order to fully understand the behavioural consequences of formal rules, it may be necessary to go beyond incentives. Indeed, according to an established Anglo-American legal tradition – the imperative theory of law – formal rules (e.g. laws) are “*obligations backed by incentives*”¹. The obligation part of a formal rule consists of the normative content established by that rule². This represents in fact a fundamental component of formal rules, but it is usually neglected by economists since it cannot alter the structure of material payoffs of individuals.

The objective of this paper is to examine the behavioural effects of obligations. We pursue this aim by isolating experimentally the impact of obligations from those of marginal incentives which back them. In particular we investigate experimentally in a social dilemma situation: i) whether obligations have any *per se* effect on people’s behaviour and ii) through which motivational channels these possible effects come into play. In particular, we search for the possible effects of obligations on people’s motives for behaviour: their beliefs and preferences for cooperation³. Our experimental results show that obligations have important behavioural effects by affecting both people’s beliefs and preferences for cooperation. The experimental design is based on a one-shot linear public good game⁴ with the peculiarity that subjects face an exogenous obligation of *minimum contribution*: “a minimum contribution of X tokens to the public good is required from each individual”. This obligation is highlighted and enforced by a structure of incentives⁵: an individual contributing less (more) than the minimum contribution is subject to a probabilistic penalty (reward). In order to isolate the behavioural effects of obligations, we let the level of minimum contribution required vary across the different treatments, while we leave the structure of marginal incentives unaltered. More precisely, we have three treatments in which the minimum required contribution is set at 0%, 20% and 80% of the initial endowment respectively. We conjecture that obligations may affect cooperative behaviour through two channels. First, as long as some individuals are *conditional co-operators* (Fischbacher et al. 2001), i.e. they are willing to cooperate if the others in their group contribute to a sufficient extent, obligations may coordinate individuals’ beliefs about others’ behaviour to a common focal point, thus affecting cooperative behaviour. Second, obligations may have direct psychological effects on preferences (and thus on behaviour) if the message

¹ See Raz (1980) and Cooter (2000).

² Typically, a formal rule is a statement such as: “you ought to... and you then will get...” (or “you ought to... or else you will pay...”). In this sentence, incentives are captured by the “and you will get/or else you will pay ...” part, and obligations by the “you ought to...” component.

³ We focus our attention on individuals’ beliefs about others’ behaviour. By preferences we mean a complex set of motives accounting for individual actions, tastes, values, the way in which a situation is framed, self-perception, emotions, and psychological dispositions (Bowles, 1998).

⁴ The choice of carrying out our experimental investigation in a public good setting is motivated by the fact that formal rules, and in particular legal rules, are often set by legislators and governments with the specific objective of overcoming social dilemmas (e.g. free-riding in income tax compliance, common pool resource management, traffic behaviour, or environmental regulation) by aligning private incentives to the common good.

⁵ We introduce a structure of incentives enforcing the minimum contribution in order to reflect the standard view that both obligations and incentives are necessary components of formal rules: a rule represents an obligation and not simply a suggestion only if the individual behaviour with respect to this rule is subject to some consequences in terms of sanctions/rewards.

conveyed by the obligation urges people to update their personal contribution norms. Our experimental design allows distinguishing between these possible channels. The experiment consists of three stages. In the first stage, individuals decide how much to contribute to the public good game (*unconditional contribution*). Next, we elicit individual *conditional contributions*: we ask people to decide how much they want to contribute for different hypothetical average group contributions⁶. Finally, we ask each subject her beliefs about the others' average unconditional contributions. Observing unconditional contributions to the public good in the presence of different levels of exogenous *minimum contribution* allows us to test whether obligations have any behavioural effect. Nevertheless, the observation of these contributions is not sufficient to understand if obligations affect beliefs about others' contributions, preferences for cooperation or both. By comparing the conditional contribution schedules which emerge in the different treatments, we are able to determine whether or not obligations have any direct effects on preferences.

We find that obligations exert a clear and significant effect on unconditional contributions to the public good, which strongly suggests that obligations have indeed a role *per se* in driving individuals' behaviour⁷. This result can be explained by the fact that, in public good experiments, some people act as conditional co-operators. By affecting their expectations about others' contributions, obligations drive individual contributions. Through the elicitation of individual beliefs about others' contributions, we corroborate this hypothesis. But is this all, or do obligations also affect individual preferences for cooperation? The second part of the experiment addresses this question. We find that conditional contribution schedules are on average significantly different across the treatments. As conditional contributions tell us how much people are willing to contribute given any possible level of contributions by others, this finding supports the idea that obligations directly affect individuals' preferences for cooperation.

In the last decade, an extensive experimental and empirical literature has focused on the unexpected effects of explicit incentives on people's behaviour. Our investigation adds to this stream of the literature by showing that, in order to fully understand the effects of formal rules, we should carefully consider the possible behavioural effects of a generally omitted element: the contents of rules as expressed by the obligations⁸. Moreover, very little is known about the motivational channels through which formal rules exert their (unexpected) consequences; our investigation contributes to filling this gap by providing experimental evidence about the ways in which formal rules may affect individual behaviour. We show that obligations influence people's behaviour by both shaping their beliefs and directly influencing their preferences for cooperation to a public good. These findings support the idea that laws have an expressive power: they affect behaviour not only by shaping the material payoffs, but also by directly influencing people's motives of behaviour (Cooter, 2000). More generally, this contribution relates to the study of formal institutions (e.g. North, 1981) by suggesting the possibility of broadening the scope of the analysis in order to understand the effects of institutions on economic outcomes.

⁶ To elicit unconditional contributions we follow the design by Fischbacher et al. (2001).

⁷ These findings are in line with those obtained by Galbiati and Vertova (2005) in a repeated public good game.

⁸ It is worth remarking that our results are in line with the experimental findings on the behavioural effects of a minimum wage obtained by Falk, Fehr and Zehnder (forthcoming).

The paper is structured as follows. Section 2 reports on the experimental design and the behavioural predictions. Section 3 describes and comments on the results. Section 4 provides some concluding remarks.

2. The Experiment

In this section we describe the experimental design. The aim of the experiment is to understand whether or not obligations have any behavioural effects independently of those of the marginal incentives backing them. To pursue this objective, we run a public good game to answer the following questions: a) do obligations affect cooperative behaviour? b) if obligations affect behaviour, how do they act? By affecting beliefs about others' behaviour, by affecting preferences for cooperation, or both? In the first subsection we outline the experimental game. In the second, we describe the experimental treatments, procedures and parameters. Finally we report our behavioural predictions.

2.1. The experimental game

The experiment consists of a one-shot linear public good game followed by a conditional contribution stage. All in all, we ask participants to make two choices. The first is a choice of 'unconditional contribution': subjects are asked to make their contributions to the public good. After all subjects have chosen their unconditional contribution, we ask participants to make their choices of a 'conditional contribution', that is to say, to select how much to contribute to the public good in correspondence to different average contributions from the other group members.⁹ Finally, we elicit individual beliefs about others' unconditional contributions. Individuals get to know the decisions made by the others and their own payoff only after all these three stages have taken place.

The linear public good game we implement differs from a standard voluntary contribution mechanism, as we fix exogenously an obligation of minimum contribution. This obligation indicates a minimum level of contribution that each subject is required to provide for the public good. The obligation is enforced by a structure of incentives: in particular there is a probability of control and a probabilistic penalty (reward) for individuals whose contributions are lower (higher) than the level of minimum contribution required¹⁰. As we are interested in the effects of obligations *per se*, we keep the level of marginal incentives fixed across all treatments, i.e. the probability of being audited and the penalty/reward rate. On the contrary, the level of the minimum contribution required by obligation changes across the treatments. The incentives are fixed at a very low level. This choice is for two reasons: firstly, we aim to test whether or not an obligation of minimum contribution affects cooperation when incentives are such that the optimal strategy for self-interested individuals is full free-riding, even if they are risk-adverse to a reasonable degree. Secondly, we want to minimize the possible bias in our results caused by differences in risk preferences across samples¹¹.

⁹ We apply here a modified version of the strategy method (see Selten, 1967).

¹⁰ The penalty (reward) is proportional to the negative (positive) difference between the actual contribution and the minimum contribution required.

¹¹ Nevertheless we check the robustness of our results by controlling for differences in risk preferences (see Appendix 1).

In this one-shot public good game, the expected monetary payoff for individual i is:

$$X_i = y - a_i + m \sum_{j=1}^n a_j - pg(\hat{a} - a_i) \quad (1)$$

where y is the individual endowment, m indicates the marginal per capita return to the public good $A \equiv \sum_{j=1}^n a_j$, p is the probability of audit, and g is the penalty/reward rate.

We set the parameters so that the following inequalities hold: $m > 1/n$ and $m + pg < 1$.

In order to understand whether the possible effect of obligations on cooperation should be imputed to an influence on preferences, on beliefs, or on both, we need to understand: a) if individuals' beliefs about others' contributions are significantly different in the different treatments; b) if, given the others' hypothetical contributions, individuals' conditional behaviour varies significantly in the different treatments. In order to pursue the latter task, we elicit subjects' conditional contributions by applying a variant of the so-called "strategy method" (Selten, 1967), as developed in the experimental design by Fischbacher et al. (2001). After the unconditional contribution stage, subjects are asked to report on their conditional contributions. In particular, each subject has to fill in a conditional contribution table: for each possible level of average contribution in the group, and given the level of minimum obligation, she has to declare how much she wants to contribute to the public good. To give subjects the material incentives to take their conditional contribution decisions seriously, we adhere to the procedure designed by Fischbacher et al. (2001). Subjects are told that, after they have taken both decisions, a random mechanism would select which one of the two decisions becomes effective in determining their payoffs. In each group, one subject is randomly selected. For this subject the conditional contribution table determines her actual contribution to the public good, whereas for the other group members the relevant decision is the unconditional contribution. This mechanism ensures that all entries in the conditional contribution table are potentially relevant in determining the payoffs of each subject. The procedure described above is equivalent to the following game: first, nature selects $n-1$ players who make their unconditional contribution decisions simultaneously given the payoff structure described above. The n -th player learns of the average contribution of the other players and takes her contribution decision. Each player knows if she is the n -th player and, if she is not, she does not know who this player is.

After all players have decided how much to contribute to the public good, the control stage takes place: a player's contribution may be randomly controlled (with probability p) and the player may get a monetary reward (sanction) if she has contributed more (less) than the minimum contribution required by the obligation.

Finally, in order to have a proxy of people's beliefs about the others' contributions, in each treatment we ask each subject what she expects the others in their group have contributed on average in the unconditional contribution decision. In order to give an incentive to take this decision seriously, those who actually make the right prediction gain an additional monetary payment.

2.2. Treatments, parameters and procedures

We implement three different experimental treatments for the minimum contribution: a '0 condition', where no minimum contribution is required by obligation, a 'low obligation condition' ('L condition') where subjects are required to contribute at least a

fraction of 20% of their total endowment, and a ‘high obligation condition’ (‘H condition’), where the minimum contribution required corresponds to 80% of an individual’s total endowment. As we are interested in the effects of obligations *per se*, we keep the level of marginal incentives (i.e. the probability of being audited and the penalty/reward rate) fixed across all treatments.

In the instructions we stress that the obligation establishes a minimum contribution required from each individual, but that the feasible contribution for each participant varies between 0 and her overall endowment. We also explain in detail the consequences of each choice on individual payoffs.

The parameters of the game are set as follows. The initial endowment is $y = 20$, the number of subjects per group is $n = 6$, the marginal per capita return to the public good is $m = 0.3$, the probability of control is $p = 1/12$, the sanction/reward rate is equal to $g = 1.2$ (this ensures that: $m > 1/n$ and $m + pg < 1$), the minimum contributions fixed by obligation are $\hat{a} = 4$ in the ‘L condition’, and $\hat{a} = 16$ in the ‘H condition’, respectively.

The experiment was conducted in a computerized laboratory where subjects anonymously interacted with each other¹². No subject was ever informed about the identity of other group members. We conducted three sessions, one for each treatment. In each session participants were divided into 6 groups of size 6 for a total number of 108 subjects. Subjects were undergraduate students from different faculties. Each subject participated in one session only and nobody had previously participated in other public good experiments before. The experiment was conducted in the experimental laboratory of the University of Siena (Italy). Each session lasted about one hour and the average earning for each subject was 14 euros (about 17 US dollars).

2.3. Behavioural predictions

If we assume common knowledge of rationality, risk neutrality and selfishness of all players, we can expect that in every treatment the unconditional contribution of each subject will be equal to zero, and that conditional contribution entries will all be zero for each subject. For example, let us consider the optimal choice of a risk-neutral and fully self-interested individual in our setting. Her optimal contribution, a_i^* , is the value of a_i which maximizes (1). The first order condition of the maximization problem yields:

$$\frac{\partial X_i}{\partial a_i} = -1 + m + pg < 0 \quad (2)$$

Hence the dominant strategy for a (risk-neutral) self-interested individual is always free-riding: $a_i^* = 0$. This result crucially depends on the assumption that $m + pg < 1$, meaning that the monetary incentives are not sufficiently high to make the expected return from one unit of contribution higher than one unit kept for herself. Notice that the level of minimum contribution \hat{a} required by obligation does not affect the optimal choice of a self-interested individual. This is straightforward since obligations do not affect marginal monetary payoffs. In order to satisfy this condition, our setting presents both a probabilistic penalty for those who contribute less than the minimum contribution and a probabilistic reward for those who contribute more. Notice that if

¹² To conduct the experiment, we used the experimental ‘z-Tree’ software developed by Fischbacher (1999).

only a probabilistic penalty (or only a probabilistic reward) had been applied for the individuals who contributed less (more) than \hat{a} , we would have obtained two distinct first-order conditions for the maximization problem, one for the interval $a_i \leq \hat{a}$ and the other for the interval $a_i > \hat{a}$. But in this case, different levels of \hat{a} would have implied different marginal monetary payoffs, which we want to keep fixed in order to isolate the effect of different obligations.

If individuals were all merely self-interested, obligations would not have any effect for two reasons: first, because the optimal contribution for a self-interested individual is always the null contribution; second, because obligations cannot affect monetary incentives. Nevertheless, as long as individual reasons of behaviour depart from the traditional assumption of self-interest¹³, some individuals may make positive contributions (as usually observed in public good games), and obligations may entail some effect on individual behaviour. Since the structure of our game rules out any possible effect of obligations on marginal incentives, any effect of obligations needs to be explained in terms of their behavioural effects. We can advance some conjectures. First, as long as some individuals are conditional co-operators, i.e. they are willing to cooperate (despite monetary incentives to free-ride) if the other members of their group cooperate to a sufficient extent, obligations may coordinate individuals' beliefs to common focal points, thus affecting cooperative behaviour. Second, obligations may have direct psychological effects on preferences (and thus on behaviour) insofar as they affect individual personal norms of contribution.

If obligations affect beliefs, we can expect to observe significant differences in stated beliefs about others' contributions across treatments. If obligations affect preferences, we can expect to find significant differences in the conditional contribution schedules. In particular, if people make different contributions for the same hypothetical average contributions of other group members, it means that preferences for cooperation are directly shaped by obligations.

3. Results

3.1. Unconditional cooperation

The first step of our analysis is to understand whether or not obligations affect unconditional contributions. In figure 1 we report average unconditional contributions in the three treatments, characterised by three different levels of minimum contribution required by obligation (respectively 0, 4 and 16 tokens). Notice that the treatment where the minimum contribution required is 4 tokens ('L condition' 'MC=4' in tables and figures), and the treatment where no minimum contribution is required ('0 condition' – 'MC=0' in tables and figures) present similar levels of average contribution to the public good (9.36 and 8.30 tokens respectively). On the other hand, the average contribution in the treatment where the minimum contribution required is 16 tokens ('H condition' – 'MC=16' in tables and figures) is remarkably higher (15.05 tokens) than in the two other treatments.

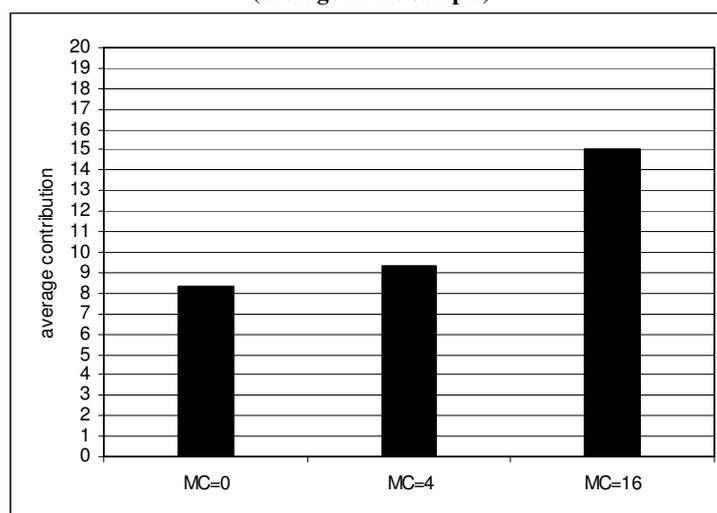
¹³ A huge amount of empirical and experimental literature shows that in social dilemmas many individuals are characterized by social preferences, i.e. having other-regarding or process-regarding preferences (for a survey on social preferences see Camerer and Fehr, 2002; Fehr and Schmidt, 2002).

A Mann-Whitney rank-sum test¹⁴ is applied in order to test the statistical significance of the differences in contribution levels between treatments¹⁵. Results are reported in Table 1. Mean contributions under the ‘H condition’ are higher at significant statistical levels than mean contributions in both other treatments, while we do not find a significant difference between average contributions under the ‘0 condition’ and under the ‘L condition’.

These results confirm the findings obtained by Galbiati and Vertova (2005) in a repeated public good game: for given marginal incentives, obligations can affect the average propensity to cooperate to the public good. In particular, when the minimum contribution required is sufficiently high (‘H condition’), the level of cooperation is significantly higher than in the presence of low or null obligation. Instead, when the minimum contribution required by obligation is low (‘L condition’), there is no significant difference with respect to the no obligation case. A straightforward interpretation of this last result is that, with low obligation, conditional co-operators find confirmation (on average) of their preferences and beliefs when no obligation exists¹⁶.

Figure 2 reports the frequencies of contributions in the three samples. The distribution of individual contributions under the ‘L condition’ is not very different from the distribution of individual contributions under the ‘0 condition’, even if in this last case the distribution is more concentrated towards an intermediate value (around 8 tokens). However the distribution of contributions under the ‘H condition’ is very different, being more right-shifted, with individual contributions concentrated around the level of 16-18 tokens. Figure 2 suggests that, in the presence of a higher level of minimum contribution required by obligation, conditional co-operators tend to cooperate more.

FIGURE 1
UNCONDITIONAL CONTRIBUTIONS
(average in the sample)



¹⁴ The unit of observation in the statistical test is the average group contribution.

¹⁵ We report both the values of the test (z) and the p -values (p).

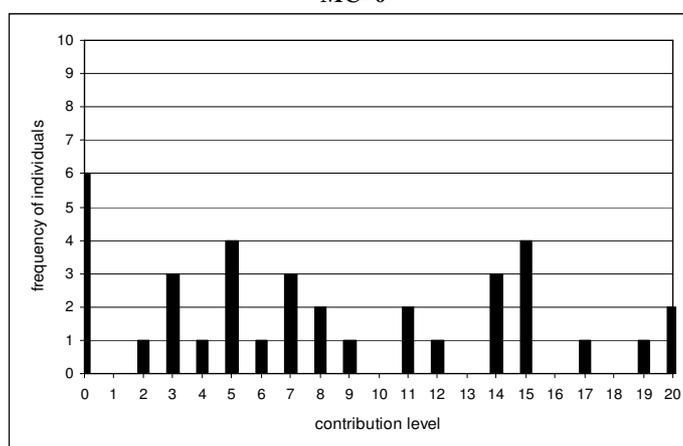
¹⁶ Indeed in one-shot public good games with no obligations, average contributions tend to be around 40-50% of the overall endowment because of the behaviour of conditional co-operators.

TABLE 1
MANN-WHITNEY TEST ON UNCONDITIONAL CONTRIBUTIONS

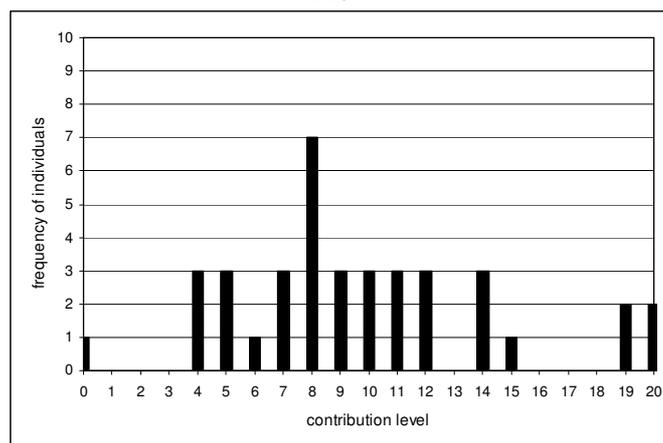
Treatment Conditions	MC=4	MC=16
MC=0	Z=-0.321; p=0.7483	z=-2.887; p=0.004
MC=4		z=-2.402; p=0.016

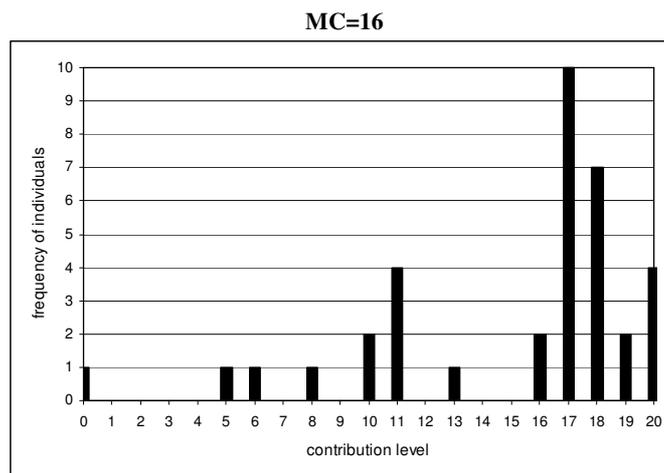
FIGURE 2
UNCONDITIONAL CONTRIBUTIONS
(frequency of contributions in the sample)

MC=0



MC=4





This evidence can be summarized as follows:

Result 1. *Obligations affect the levels of average contributions to a one-shot public good. In particular, average contributions are significantly higher when the minimum contribution required by obligation is sufficiently higher than the average contributions in the 'no obligation' case.*

3.2. Beliefs

Our next step is to study how obligations affect beliefs about others' contributions. Figure 3 shows, for the three treatments, the average beliefs about average unconditional contributions in the group. It should be noted that the average beliefs under the '0 condition' and the 'L condition' are similar (9.44 and 8.69 tokens respectively), whereas under the 'H condition' they are definitely higher (14.67). The results of the Mann-Whitney test¹⁷, reported in Table 2, show that the previous descriptive comparison has statistical significance. This means that obligations affect expectations about others' contributions. In particular, when the minimum contribution set up by obligation is sufficiently high, individuals expect other group members will contribute more.

¹⁷ The unit of observation in the statistical test is the average group contribution.

FIGURE 3
BELIEFS ABOUT OTHERS' UNCONDITIONAL CONTRIBUTION
 (average in the sample)

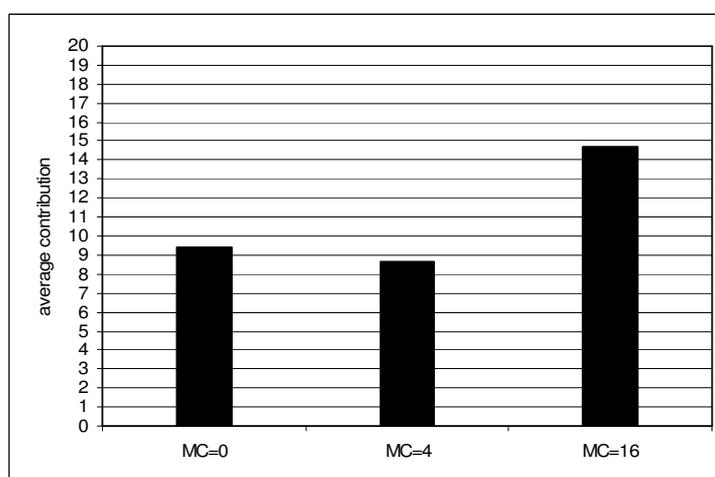


TABLE 2
MANN-WHITNEY TEST ON BELIEFS

Treatment Conditions	MC=4	MC=16
MC=0	Z=0.485; p=0.679	z=-2.882; p=0.004
MC=4		z=-2.732; p=0.016

This demonstrates that obligations anchor beliefs: beliefs are coordinated towards higher (or lower) levels of expected co-operation when the minimum level of contribution required by obligation is higher (lower). Therefore, when the level of minimum contribution is sufficiently high, conditional co-operators, i.e. those people who want to cooperate when they expect others to contribute to a sufficient extent, will cooperate more to the public good because of the effects of obligations on their beliefs. Result 2 summarizes the evidence on beliefs.

Result 2. *Obligations affect average beliefs about others' unconditional contributions. In particular, average beliefs are significantly higher under the condition that the minimum contribution required by obligation is sufficiently high.*

3.3. Conditional cooperation

We now analyze the patterns of conditional contributions under (the?) different conditions. On average, across the 21 choices (where each choice corresponds to each hypothetical average contribution in the group from 0 to 20), conditional contributions are different in the three treatments (see figure 4). In particular, average conditional contributions correspond to 7.81 tokens in the '0 condition', 10.31 tokens in the 'L condition' and 12.62 in the 'H condition'. A Mann-Whitney test¹⁸ is applied in order to measure the significance of the differences in average conditional contributions between each pair of treatments. Table 3 reports the corresponding results: for all comparisons

¹⁸ The unit of observation in the statistical test is the average group contribution.

(between ‘0’ and ‘L’, ‘L’ and ‘H’, and ‘0’ and ‘H’ respectively), average conditional contributions are significantly higher when the minimum contribution required by obligation is higher.

FIGURE 4
CONDITIONAL CONTRIBUTIONS
 (average in the sample across 21 choices)

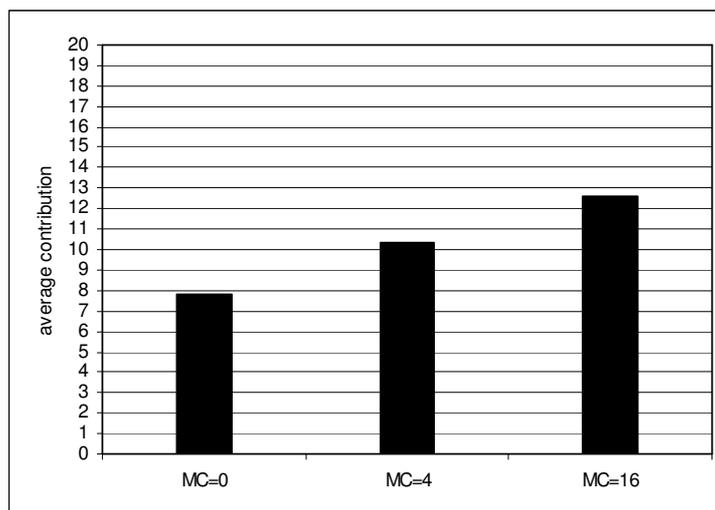
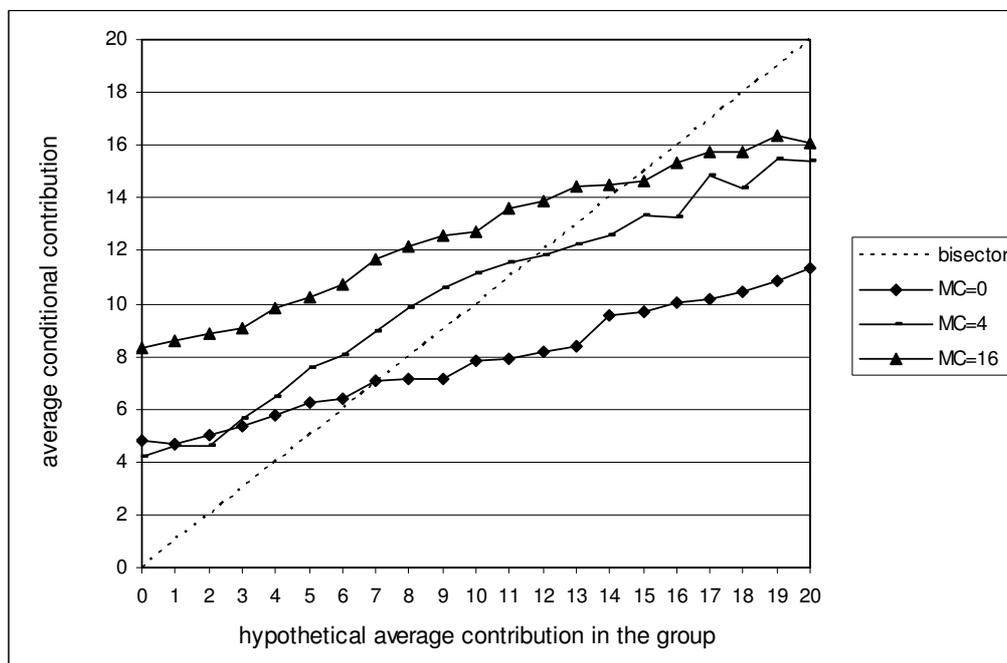


TABLE 3
MANN-WHITNEY TEST ON CONDITIONAL CONTRIBUTIONS

Treatment Conditions	MC=4	MC=16
MC=0	$z=-2.242$; $p=0.025$	$z=-2.882$; $p=0.004$
MC=4		$z=-2.242$; $p=0.025$

Figure 5 reports the patterns of conditional contributions under the three different conditions. The curves corresponding to the ‘H condition’ and the ‘0 condition’ differ noticeably over the entire interval between 0 and 20. In particular, the conditional contribution schedule corresponding to the ‘H condition’ is clearly above the one corresponding to the ‘0 condition’. The ‘L condition’ curve differs from the other two curves: with respect to the ‘0 condition’ curve the difference is particularly marked in correspondence to high levels of other people’s hypothetical average contributions, whereas with respect to the ‘H condition’, the difference is more relevant for low levels of others’ hypothetical average contributions. The differences among the conditional contributions schedules highlight that, even if we control for beliefs about others’ contributions by means of the strategy method, average cooperation turns out to be triggered by the level of minimum contribution required by obligation. This means that on average the preference structure is shaped by the obligation imposed in the treatment. In particular, a stronger obligation entails a stronger preference for cooperation.

FIGURE 5
CONDITIONAL CONTRIBUTIONS SCHEDULES



In conclusion, our main result is the following:

Result 3. *Conditional contribution schedules are significantly different across the different treatments. This suggests that obligations directly affect people's preferences for cooperation.*

3.4. Conditional co-operators

In order to interpret the previous results more accurately, it is worth analyzing the behaviour of conditional co-operators. In order to do this, for each treatment we extract from the overall sample the sub-sample of conditional co-operators, i.e. those individuals whose contributions increase progressively. In particular, following Fischbacher et al. (2001), we select as 'conditional co-operators' all the subjects with a positive and highly significant ($p\text{-value} < 0,001$) Spearman rank correlation coefficient (between their own and others' contributions). These sub-samples are composed of 17, 29 and 23 conditional co-operators for the '0 condition', 'L condition' and 'H condition' treatment respectively. Figure 6 shows how average unconditional contributions for these sub-samples are very similar to the ones emerging from the overall samples (compare to figure 1). Using the Mann-Whitney test¹⁹ to compare unconditional contributions, we find similar results to the overall samples: there is a significant difference in average unconditional contributions between the '0 condition' and the 'H

¹⁹ Since the subjects have been selected from all the groups, (in this case) the unit of observation in the statistical test is the individual average contribution. For this reason, the level of significance of the coefficients is different with respect to the overall sample case.

condition' and between the 'L condition' and the 'H condition', whereas there is not a significant difference between the '0 condition' and the 'L condition' (table 4).

FIGURE 6
UNCONDITIONAL CONTRIBUTIONS
(CONDITIONAL COOPERATORS ONLY- average in the sample)

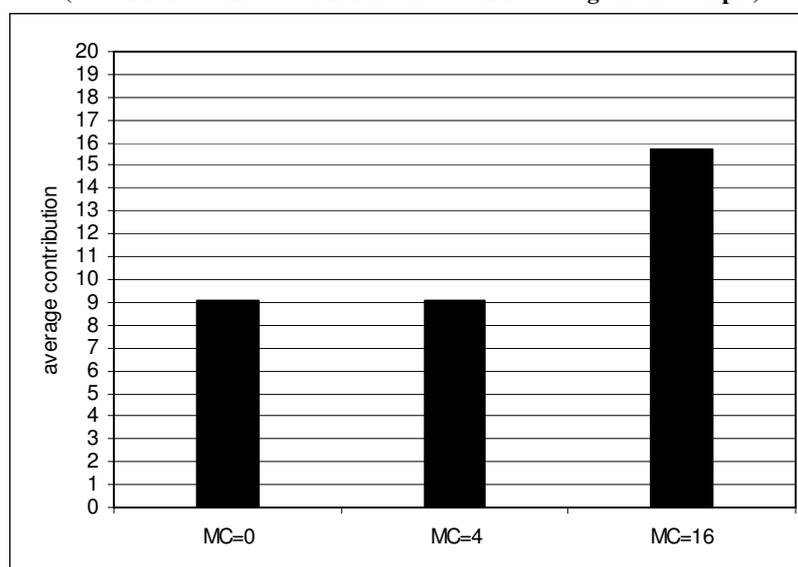


TABLE 4
MANN-WHITNEY TEST ON UNCONDITIONAL CONTRIBUTIONS
(CONDITIONAL COOPERATORS ONLY)

Treatment Conditions	MC=4	MC=16
MC=0	$z=-0.263$; $p=0.7483$	$z=-4.068$; $p=0.000$
MC=4		$z=-4.727$; $p=0.000$

Figure 7 and Table 5 show how average beliefs for these sub-samples of individuals are very similar with respect to the overall samples. Figure 8 reports the conditional contribution schedules for the sub-samples of conditional co-operators in the three treatments (whereas in Figure 9 we report average conditional contributions across the 21 choices). As one can see, they correspond to three parallel, increasing and monotonic curves. The results of the Mann-Whitney test²⁰ (Table 6) show that these differences are statistically significant. This last result is particularly interesting: obligations shape the preference structure of conditional co-operators. Conditional co-operators are willing to cooperate more when a higher minimum contribution is required by obligation. In other terms, obligations can affect the mechanism which is at the basis of cooperation in social dilemmas, i.e. reciprocation among those individuals that are inclined to cooperate as long as others cooperate to a sufficient extent as well. Indeed, given a certain level of average cooperation from the others, a higher minimum contribution

²⁰ The unit of observation in the statistical test is the average individual contribution.

required by obligation entails, on average, higher contributions from conditional co-operators.

FIGURE 7
BELIEFS ABOUT OTHERS' UNCONDITIONAL CONTRIBUTION
(CONDITIONAL COOPERATORS ONLY)

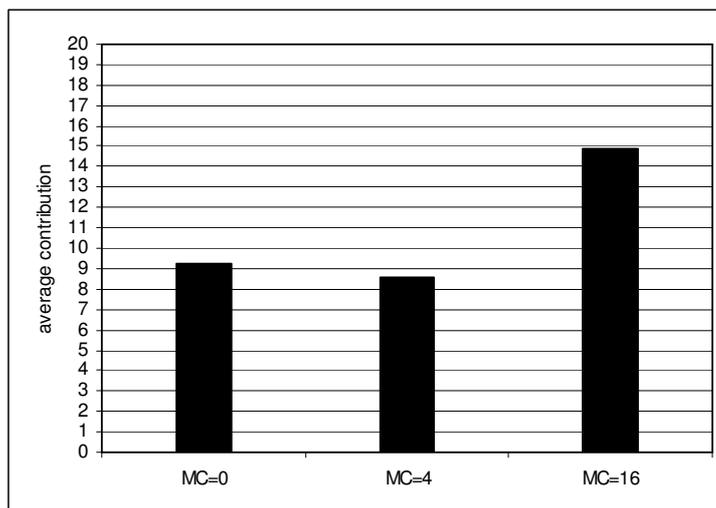


TABLE 5
MANN-WHITNEY TEST ON BELIEFS
(CONDITIONAL COOPERATORS ONLY)

Treatment Conditions	MC=4	MC=16
MC=0	Z=0.526; p=0.599	z=-3.705; p=0.000
MC=4		z=-4.830; p=0.000

FIGURE 8
CONDITIONAL CONTRIBUTIONS SCHEDULES (CONDITIONAL COOPERATORS ONLY)

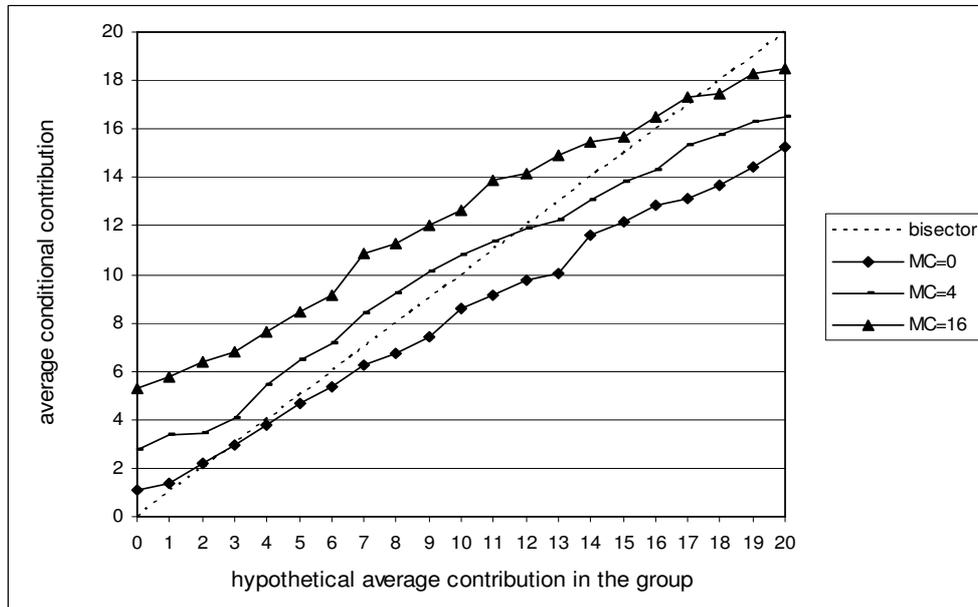
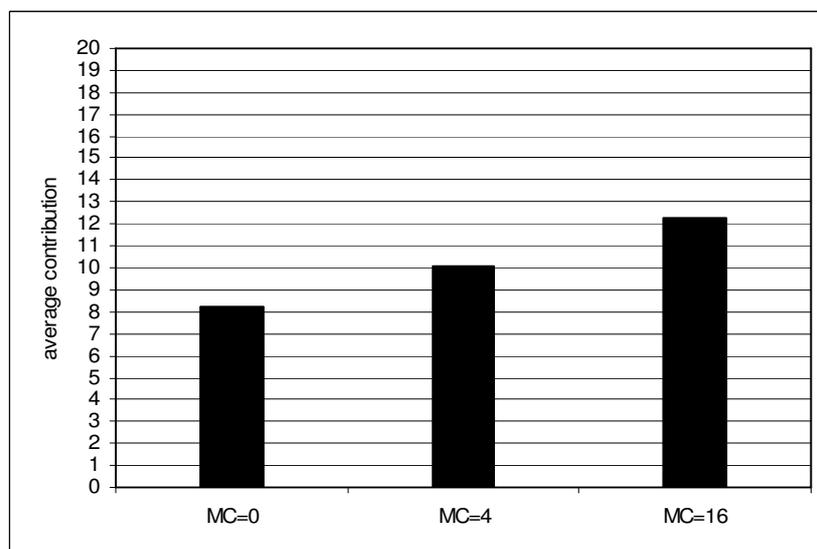


TABLE 6
MANN-WHITNEY TEST ON CONDITIONAL CONTRIBUTIONS
(CONDITIONAL COOPERATORS ONLY)

Treatment Conditions	MC=4	MC=16
MC=0	$z=-1.878$; $p=0.060$	$z=-3.297$; $p=0.001$
MC=4		$z=-2.147$; $p=0.032$

FIGURE 9
CONDITIONAL CONTRIBUTIONS (CONDITIONAL COOPERATORS ONLY)
(average in the sample across 21 choices)



4. Comments and concluding remarks

Understanding how formal rules (i.e. “obligations backed by incentives”) affect human behaviour represents a fundamental task for economic theory and for policy makers. The economic literature has largely studied the role of incentives in shaping people’s choices. Yet, the effects of obligations (i.e. what rules ask people to do or not to do) on human behaviour is still a black box. The traditional assumption of self-interested individuals explains why obligations represent the “hidden side of rules”. Indeed, since obligations do not *per se* affect material payoffs, self-interested people are completely neutral to them. However, an extensive experimental literature has shown how people’s preferences depart from mere self-interest. This is a new starting point for the study of the impact of obligations on human behaviour.

In this paper we have analyzed the independent effect of obligations on individuals’ reasons of behaviour in a public good game. Our results, in line with Falk et al. (forthcoming) on the behavioural effects of a minimum wage, show that obligations *per se* (for given marginal incentives) can affect people’s behaviour. In particular, we find that the propensity to cooperate to a public good is significantly higher when the minimum contribution required by obligation is sufficiently high. Furthermore, through a strategy based on the elicitation of beliefs and conditional contributions to the public good, we find that the effect of obligations on behaviour depends not only on their impact on people’s beliefs about others’ contributions, but also on their direct effect on individuals’ preferences for cooperation.

These results add to the literature concerning the effects of institutions (i.e. the formal rules of the game) on human behaviour. They complement the literature on the behavioural effects of incentives by showing that obligations entail some behavioural effects on individual choices as well. Furthermore, our research has been able to highlight the channels through which formal rules influence individual willingness to cooperate. This aspect of our research is particularly important. Indeed, recent contributions have analyzed how changes in rules (e.g. in the structure of incentives) affect individual behaviour in an unexpected way (e.g. Gneezy and Rustichini, 2000); nonetheless, very little is known (at least empirically) about the channels of transmission by which rules exert their effects on behaviour. Our investigation shows that rules can affect both beliefs about others’ behaviour and people’s preferences for cooperation. This is particularly interesting, as it provides some indication on how institutions are able to influence the very determinants of people’s choices.

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Appendix 1: Controlling for differences in risk preferences

In order to control for the possible effect of risk preferences, at the end of the public good experiment we run a lottery to single out subjects' risk preferences. This lottery is similar to that implemented by Holt and Laury (2001). The experimental test is based on five choices between the paired lotteries reported in Table A1.

TABLE A1
PAIRED LOTTERY CHOICES

Option A	Option B	Payoff Differences (A-B)
1/10 100 tokens; 9/10 80 tokens	1/10 170 tokens; 9/10 10 tokens	56
3/10 100 tokens; 7/10 80 tokens	3/10 170 tokens; 7/10 10 tokens	28
5/10 100 tokens; 5/10 80 tokens	5/10 170 tokens; 5/10 10 tokens	0
7/10 100 tokens; 3/10 80 tokens	7/10 170 tokens; 3/10 10 tokens	-28
9/10 100 tokens; 1/10 80 tokens	9/10 170 tokens; 1/10 10 tokens	-56

In each paired lottery, subjects choose between an alternative A and an alternative B. Once all subjects have made their choice, a pair of lotteries is randomly chosen and the computer assigns to each subject the option (A or B) she has chosen. Finally the lottery is run in order to determine each subject's payoff. Following the method proposed by Holt and Laury (2001), we classify individual risk preferences according to the sequence of choices taken/made? in the lottery (see table 3).

TABLE A2
RISK PREFERENCES ASSOCIATED TO LOTTERY CHOICES

Sequence of Choices	Risk type
A-A-A-A-A	highly risk averse
A-A-A-A-B	risk averse
A-A-A-B-B or A-A-B-B-B	risk neutral
A-B-B-B-B	risk lover
B-B-B-B-B	highly risk lover
Other Sequences	inconsistent choices

In table A3 we report the frequencies of subjects by classes of risk preference as obtained by running the experiment described in paragraph 2.3.

TABLE A3
FREQUENCIES OF SUBJECTS BY CLASSE OF RISK PREFERENCES

Classes of risk preferences	Session 1 (MC=0)	Session 2 (MC=4)	Session 3 (MC=16)
Highly risk averse	6	1	2
Risk averse	5	3	6
Risk neutral	14	23	16
Risk lover	1	2	0
Highly risk lover	1	1	1
Inconsistent choices	9	6	11

It is worth noting that the frequencies are similar across the different samples. Furthermore, we notice that the number of risk-lover or highly risk-lover individuals is very small.

In order to test whether or not differences in risk preferences are relevant in explaining differences in contributions, we have subdivided our sample into three groups: the first group is composed of risk-neutral individuals, the second is composed of risk-averse individuals and the third one is composed of highly risk-averse individuals²¹. Moreover we compute for each subject an index given by the difference between her unconditional contribution and the minimum contribution required in her treatment. Then we apply a Mann-Whitney rank-sum test²² of the difference in this index between each pair of groups. The test between risk neutral and highly risk-averse individuals yields $z = -1.295$, which is not statistically significant at conventional levels. The same test applied to the difference in this index between risk-neutral and risk-averse individuals yields $z = -0.627$, which is certainly not statistically significant. Finally, the difference between highly risk-averse and risk-averse individuals is also found not to be statistically significant ($z = -0.539$).

Hence, differences in subjects' risk preferences across the different samples do not affect our results for two reasons. First, the distribution of subjects by class of risk preference is very similar in the different sessions. Second, there is no significant difference in individual behaviour with respect to the minimum contribution between highly risk-averse, risk-averse and risk-neutral individuals. This last result can be explained by the fact that the probability of being audited in each round, and the penalty rate, are very low.

²¹ We have not considered risk-lover or highly risk-lover individuals, who represent a negligible fraction of subjects in the sample, nor individuals whose choices are inconsistent.

²² The unit of observation in the statistical test is the individual.

Appendix 2: Instructions

The following instructions were originally written in Italian. We document the instructions used in session 3 (both for the public good game and the lottery).

2A - The public good game (treatment MC=4)

Instructions

Welcome to the Lab and thank you for participating in this experiment. You are now taking part in an economics experiment in which, depending on your decisions, you may earn a considerable amount of money.

From now on, communication with the other participants in the experiment is prohibited. If you violate this rule you will be excluded from the experiment and from all payments.

We will now describe the experiment in detail. Please read the following instructions carefully. It is in your own, and our best interest that you fully understand the them, so please feel free to ask any questions.

How will your income be paid?

During the experiment your earnings will be calculated in tokens. At the end of the experiment the total amount of tokens you have earned will be converted to euros at the following rate:

$$3 \text{ tokens} = 1 \text{ euro}$$

Each participant receives a lump sum payment of 3 Euros for participating. At the end of the experiment your earnings from the experiment and the 3 Euros for participating will be paid to you immediately in cash.

How long does the experiment last? How many people take part in it?

The experiment is divided into three steps. In each step participants are divided into groups of six people. Therefore you will be in a group with 5 others. The composition of the groups will not change during the experiment and so in each step your group will consist of the same participants (whose identity you do not know).

First step

In this step you have to decide the amount of your contribution to a *common project* for your group. Like your fellow group members, you will receive an *endowment* of 20 tokens. Your task is to decide how to use your *endowment*. In particular, you have to decide how many of the 20 tokens you want to contribute to the *project* (notice that you have to choose a natural number between 0 and 20). The remaining tokens (20 - your contribution) are kept for yourself.

What is the aim of the project?

The project returns a *common product* to the group. The *common product* is an amount of tokens higher than the total sum of the contributions to the project made by the members of your group. The *common product* is divided equally among all the group members. Each group

member obtains an *individual product*. In particular, the sum of the individual contributions to the project will be multiplied by 1.8 before being divided equally among the six group members.

The individual product can be represented by this simple expression:

$$\text{individual product} = \frac{G \times 1,8}{6}$$

where:

G = sum of the individual contributions of all group members to the project;

6 = number of group members.

An example.

Suppose that the sum of the contributions to the project from all the group members is 60 tokens. The project returns a total amount of:

$$60 \times 1.8 = 108 \text{ tokens}$$

This amount will be redistributed equally among the group members. Hence, each member of the group earns the following from the project:

$$\frac{60 \times 1.8}{6} = 60 \times 0,3 = 18 \text{ tokens.}$$

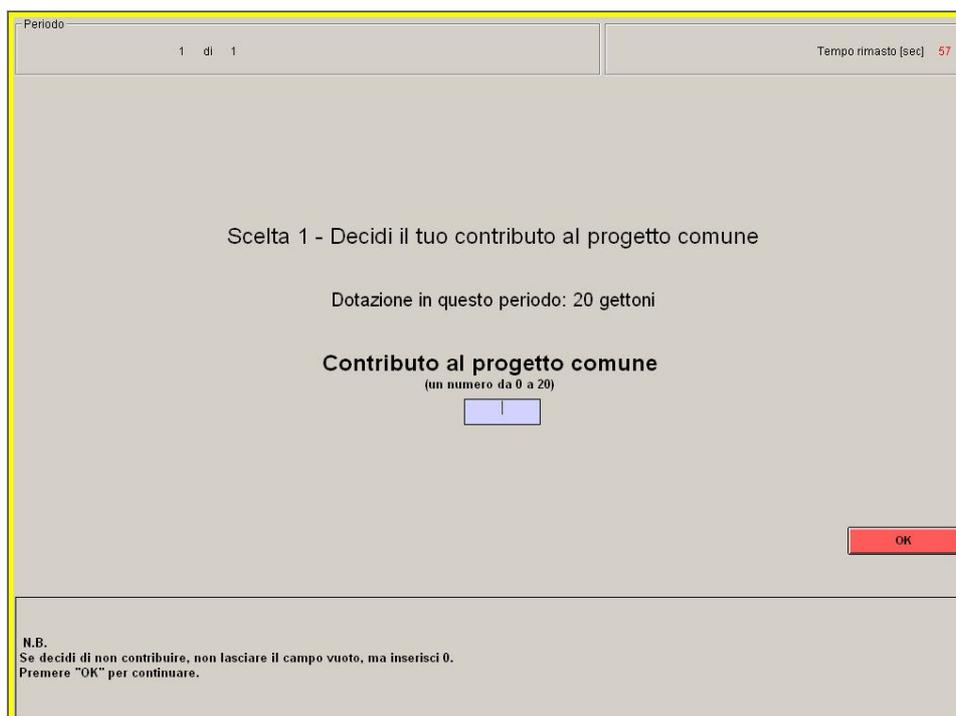
Therefore, your contribution to the project also raises the income of the other group members. On the other hand, you earn income from each token contributed by the other members. For each token contributed by another member you will earn 0.3 tokens. Remember that your possible contribution is any integer between 0 and 20.

The minimum contribution

A *minimum contribution* to the project equal to 4 tokens is required of each individual.

The input screen

The following input screen will appear:



Periodo 1 di 1

Tempo rimasto [sec] 57

Scelta 1 - Decidi il tuo contributo al progetto comune

Dotazione in questo periodo: 20 gettoni

Contributo al progetto comune
(un numero da 0 a 20)

OK

N.B.
Se decidi di non contribuire, non lasciare il campo vuoto, ma inserisci 0.
Premere "OK" per continuare.

You have 1 minute to make this choice. In the top right-hand corner you can see how many more seconds remain for you to decide on your contribution. Your decision must be made before the time displayed reaches 0 seconds. In the middle of the screen, the minimum contribution appears. Below it, you can see your endowment and then the input field where you have to write a number between 0 and 20. In the bottom right-hand corner there is a button for you to confirm your choice.

To sum up, you have to decide how much to contribute to the project by writing a number between 0 and 20 in the input field. By deciding how much to contribute, you also decide how much you keep for yourself, that is to say: $(20 - \text{your contribution})$. After having entered your contribution, click on the OK button. Once you have done this, your decision can no longer be changed.

Second step

In the second step you have to declare your *conditional contributions*, i.e. you have to decide how many of your 20 tokens you would contribute to the common project given the information that your group members contribute on average certain amounts of tokens and given that a minimum contribution of 4 tokens is required.

Technically, you have to fill in the table of conditional contributions declaring how much you would like to contribute for any hypothetical average contribution of your group members from 0 to 20. You have 3 minutes to fill in the table.

This is how the input screen will appear:

Periodo 1 di 1 Tempo rimasto [sec] 170

Scelta 2 - Decidi quale sarà il tuo contributo al progetto comune se in media gli altri contribuiranno per la cifra posta al lato di ciascun campo vuoto

Dotazione in questo periodo: 20 gettoni

gli altri contibuiscono in media: 0 gettoni	<input style="width: 100%;" type="text"/>	gli altri contibuiscono in media: 7 gettoni	<input style="width: 100%;" type="text"/>	gli altri contibuiscono in media: 14 gettoni	<input style="width: 100%;" type="text"/>
gli altri contibuiscono in media: 1 gettone	<input style="width: 100%;" type="text"/>	gli altri contibuiscono in media: 8 gettoni	<input style="width: 100%;" type="text"/>	gli altri contibuiscono in media: 15 gettoni	<input style="width: 100%;" type="text"/>
gli altri contibuiscono in media: 2 gettoni	<input style="width: 100%;" type="text"/>	gli altri contibuiscono in media: 9 gettoni	<input style="width: 100%;" type="text"/>	gli altri contibuiscono in media: 16 gettoni	<input style="width: 100%;" type="text"/>
gli altri contibuiscono in media: 3 gettoni	<input style="width: 100%;" type="text"/>	gli altri contibuiscono in media: 10 gettoni	<input style="width: 100%;" type="text"/>	gli altri contibuiscono in media: 17 gettoni	<input style="width: 100%;" type="text"/>
gli altri contibuiscono in media: 4 gettoni	<input style="width: 100%;" type="text"/>	gli altri contibuiscono in media: 11 gettoni	<input style="width: 100%;" type="text"/>	gli altri contibuiscono in media: 18 gettoni	<input style="width: 100%;" type="text"/>
gli altri contibuiscono in media: 5 gettoni	<input style="width: 100%;" type="text"/>	gli altri contibuiscono in media: 12 gettoni	<input style="width: 100%;" type="text"/>	gli altri contibuiscono in media: 19 gettoni	<input style="width: 100%;" type="text"/>
gli altri contibuiscono in media: 6 gettoni	<input style="width: 100%;" type="text"/>	gli altri contibuiscono in media: 13 gettoni	<input style="width: 100%;" type="text"/>	gli altri contibuiscono in media: 20 gettoni	<input style="width: 100%;" type="text"/>

N.B.
Se decidi di non contribuire, non lasciare il campo vuoto, ma inserisci 0.
Premere "OK" per continuare.

On the left of each square you can see the hypothetical average contribution of the other members of your group (from 0 in the top left to 20 in the bottom right). On this basis you have to write in the corresponding square how much you would like to contribute to the common project. You have to fill in all the squares and you have 3 minutes in which to do it. After having taken all your decisions, please click on the OK button.

What is the actual contribution to the common project?

Once all players have made their first and second choice, one player will be randomly selected in each group. This player's actual contribution to the project will be selected on the basis of her conditional contribution schedule: her actual contribution will be her conditional contribution corresponding to the average unconditional contributions actually made by the other 5 players in the first step. For the other 5 players instead, their relevant contributions to the common project are the unconditional ones they made in the first step.

ATTENTION: The probability of being selected (in which case your actual contribution is your conditional contribution) is 1/6. Each member of the group receives an identification number from 1 to 6 and the computer randomly chooses an integer between 1 and 6: the player corresponding to the extracted number will be selected and her conditional contribution becomes her actual one. Instead for all other players the unconditional contributions are the relevant ones.

An example

Suppose that your identification number is extracted. This means that your relevant contribution is the conditional one taken in the second step. Instead, for the other five members of the group the relevant choice is the unconditional one taken in the first step. Suppose that these five players have contributed respectively 0, 2, 4, 9 and 5 tokens to the common project. Their average unconditional contribution is therefore 4 tokens. If in your conditional contribution

table you have declared yourself willing to contribute 3 tokens in the case that the others in the group contribute 4 tokens, your actual contribution to the common project will be 3 tokens and the total contributions to the project will be equal to $0+2+4+9+5+3=23$ tokens such that each member of the group gets $23 \times 0,3=6,9$ tokens from the common project. If instead you have declared you are willing to contribute 10 tokens if the others contribute an average of 4 tokens, your actual contribution to the common project is 10 tokens and the total contribution to the project will be $0+2+4+9+5+10=30$ tokens. Hence each member of the group gets 9 tokens from the common project.

AT THE END OF THESE TWO STEPS, THERE WILL BE A CHECK

The check

After the two contribution stages, there is the possibility that the actual contribution of one group member will be audited. The choice will be random. The computer will randomly select an even or odd number. The extraction of an even number means that there will be an audit of the contributions; on the other hand if the result of the extraction is an odd number the contributions will not be audited. If the contributions within the group are audited, the computer will randomly choose an integer between 1 and 6, corresponding to the identification number of the subject to be audited. Notice that for each member of the group the probability of being audited in a certain period will be the probability of the extraction of an even number multiplied by the probability of being extracted out of a group of six members, that is to say:

$$p = \frac{1}{2} \times \frac{1}{6} = \frac{1}{12} \cong 8,33\%$$

What is the effect of the control?

If the contribution of the audited member is equal to the minimum contribution required, the control will not have any effect on her earnings.

If the contribution of the audited member is lower than the minimum contribution required, an amount of 1,2 tokens will be subtracted from her endowment for each token of the difference between the minimum contribution and her actual contribution.

If instead the contribution of the audited member is higher than the minimum contribution required, an amount of 1,2 tokens will be added to her endowment for each token of the difference between the minimum contribution and her actual contribution.

Notice that the tokens subtracted from the audited subjects who contribute less than the minimum contribution will not be added to the common project and the tokens received by the audited subject whose contribution is higher than the minimum will not be subtracted from the common project.

An example

Suppose that the minimum contribution is fixed at 3 tokens

- Suppose that the subject contributes 1 token. If her contribution is audited, 2,4 more tokens will be subtracted from her endowment, that is to say:

$$1,2 \times (\text{minimum contribution} - \text{actual contribution of the subject}) = 1,2 \times (3 - 1) = 2,4 .$$

- Suppose now that the subject contributes 5 tokens. If her contribution is audited, she will receive 2,4 more tokens, that is to say:

$$1,2 \times (\text{actual contribution of the subject} - \text{minimum contribution}) = 1,2 \times (5 - 3) = 2,4 .$$

How will your income be calculated?

After all group members have made their unconditional and conditional contributions and after an eventual control, your income is calculated by summing the following three components:

1. The tokens you have kept for yourself, that is to say:

$$\text{Endowment} - \text{your actual contribution}$$

2. The *individual product* from the common project:

$$\text{Total group contributions} \times \frac{1,8}{6}$$

3. The effect of a possible audit:

- a. 0, if you have not been audited or if you have been audited but you have contributed exactly 10 tokens (the minimum contribution).

- b. if you have been audited and you have contributed less than the minimum contribution required, your income will be reduced by:

$$(\text{minimum contribution} - \text{your actual contribution}) \times 1,2$$

- c. if you have been audited and you have contributed more than the minimum contribution, your income will be increased by:

$$(\text{your actual contribution} - \text{minimum contribution}) \times 1,2$$

The income can be expressed by the following expression:

$$s = D - c + \frac{G \times 1,8}{6} + (c - m) \times 1,2$$

where: s = income; D = initial endowment; c = your contribution to the project; G = total group contribution to the project; m = minimum required contribution.

BEFORE FINDING OUT YOUR EARNINGS FROM THE EXPERIMENT, THERE IS A THIRD STEP.

Third step

In the third step you can make a further gain from the experiment. You have to guess the average unconditional contributions of your fellow group members (i.e. the mean of their first step contributions). You have to fill in this screen:

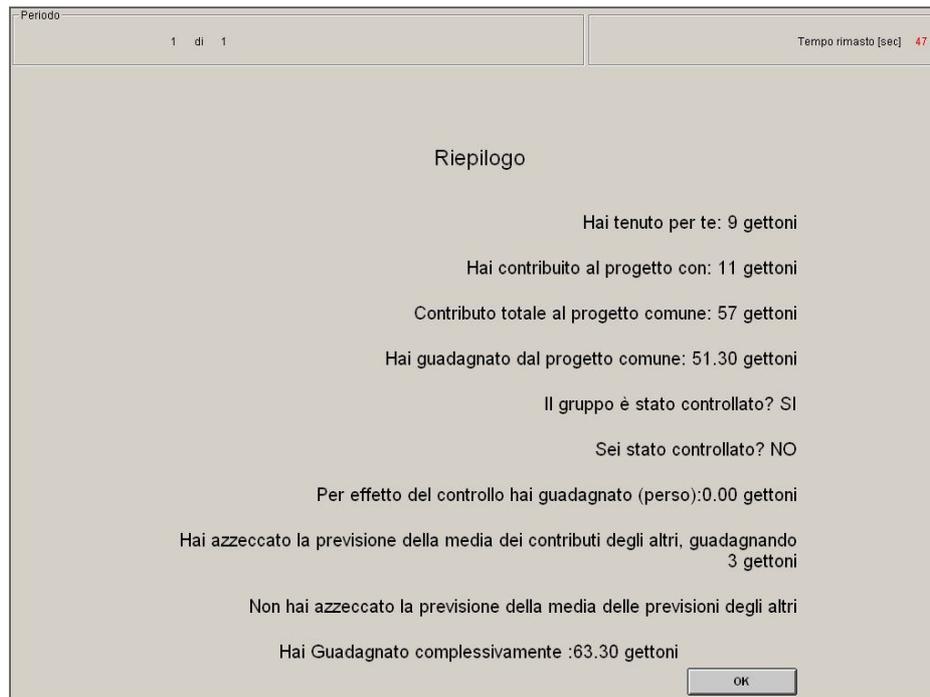
The screenshot shows a survey window with a grey background and a yellow border. At the top left, it says "Periodo" followed by "1 di 1". At the top right, it says "Tempo rimasto [sec] 0". Below this, in red text, it says "Per favore, prendi una decisione.". The main text in the center asks "Previsione1 - Quanto credi che contribuiranno gli altri in media?". Below this is the instruction "Media dei contributi degli altri al progetto comune" followed by "(un numero da 0 a 20)". There is a small blue square input field. At the bottom right, there is a red "OK" button. At the bottom left, there is a note: "N.B. Se decidi di non contribuire, non lasciare il campo vuoto, ma inserisci 0. Premere 'OK' per continuare."

You have to write a number between 0 and 20 in the square and then click on OK. You have 1 minute.

If the average unconditional contributions of the group members (approximated to the nearest integer) is equal to your guess, your total gain will be increased by 3 tokens.

The income screen

After all three steps are completed, the following screen ('income screen') will appear:



On the income screen, you will see your previous choices and you will discover the sum of the contributions of the members of your group to the common project (including your own contribution), your gain from the common project, whether or not the group has been audited, whether or not you have been audited, the effect of the possible control, whether or not your guess about the others' average unconditional contribution was correct and, finally, your overall income.

You have 45 seconds to look at the income screen. If you have finished with it before the time expires, please press the OK button.

2B - The lottery

Instructions

You are now taking part in a final experiment in which, depending on your decisions, you can earn an additional sum of money. We ask you not to talk with the others until the end of the experiment. We will now describe the experiment in detail.

If you do not understand the rules of the experiment perfectly, do not hesitate to ask the experimenters for further explanations.

What is the income from the experiment?

In the experiment your income is calculated in tokens. At the end of the experiment, your income in tokens will be converted to euros at the rate of:

$$100 \text{ tokens} = \text{€ } 1$$

The income will be paid to you in cash together with the show up fee of € 3 and the income gained from the previous experiment.

In this experiment you are no longer part of any group. Your decisions do not influence others' income and others' decisions do not influence your income.

What do you have to decide in the experiment?

You will see a screen with a sequence of 5 choices you have to make. For each choice you have to indicate if you prefer lottery A or lottery B.

Here's an example of the possible choice:

	Lottery A	or	Lottery B
CHOICE 1	70% 50 tokens		50% 90 tokens
	30% 200 tokens		50% 100 tokens

Lottery A gives a gain of 50 tokens with a probability of 70% and a gain of 200 tokens with a probability of 30%. Lottery B gives a gain of 90 tokens with a probability of 50% and a gain of 100 tokens with a probability of 50%. You have to indicate if you prefer lottery A or lottery B.

You must make 5 choices, where each choice is between a lottery A and a lottery B.

How are your earnings calculated?

Once you have made the five choices (and therefore indicated five lotteries, one for each pair A-B), the computer will randomly extract one of the five lotteries you have chosen. At this point, for the chosen lottery, the computer will extract your gain accordingly to the probability indicated for this lottery.

Example. Suppose the computer extracts the following lottery (which is one of your choices):

60% 100 tokens
40% 180 tokens

The computer will extract your gain from the experiment: with a probability of 60% it will extract a gain of 100 tokens, whereas with a probability of 40% a gain of 180 tokens.

The equivalent in euros of your gain will be paid to you in cash at the end of the experiment together with the show up fee (€ 3) and your income from the previous experiment.