Obligations, Incentives and Cooperative Behaviour

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Abstract

Laws and other formal rules are 'obligations backed by incentives'. In this paper we explore how formal rules affect cooperative behaviour. Our analysis is based on a series of experimental public good games designed to isolate the impact of exogenously requested minimum contributions (obligations) from those of marginal incentives backing them. We find that obligations have a sizeable effect on cooperative behaviour even in absence of incentives. When non-binding incentives are introduced, requested contributions strongly sustain cooperation. Therefore, in contrast with cases in which incentives crowd-out cooperative behaviour, in our experiments obligations and incentives are complements, jointly supporting high levels of contributions. Moreover, we find that variations in obligations affect behavior even when incentives are held constant. Finally, we explore the behavioural channels of the previous results, finding that both people's beliefs about others' contributions and willingness to cooperate are called into play.

Keywords: Beliefs, Formal Rules, Human Behaviour, Incentives, Laws, Obligations, Preferences, Public Good Game.

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

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1. Introduction

Formal rules, laws and public policies play a fundamental role in regulating people's daily interactions. Traditionally, economists and rational choice social scientists have studied the design of optimal rules and laws by focusing on their enforcement and on the design of optimal incentives. In the last decade behavioral experiments provided evidence suggesting that economic incentives may be counterproductive when they signal that selfishness is an appropriate response; frame the situation as a highly competitive one; favour the adoption of self-interested motivations; undermine intrinsic motivation; or convey a message of distrust and unfair intent (Bowles 2008). In the light of this evidence it is crucial to better understand when and how formal rules work in the desired direction and can be used to enhance social welfare. Recent theory suggests that where the effect of incentives is merely blunted rather than reversed, surprisingly, either greater or lesser use of economic incentives may be optimal (Bowles and Hwang, 2008). By focusing almost exclusively on the role of incentives economics' literature neglected a crucial aspect that is usually taken into account by legal scholars interested in the design of good laws: laws and formal rules are "*obligations* backed by *incentives*".[1] The obligation part of a formal rule consists in the behaviour the rule states people should maintain, the incentives part on the consequences for maintaining or violating the requested behaviour.[2] Legal theorists and social psychologists[3] suggest that laws are effective in regulating people's behaviour not only through the enforcement structure, but also in what they ask of people or signal.[4] Under this perspective, the normative content of the rule can activate people's motivation and induce compliance even more than the material incentive enforcing the rule itself. Moreover, by stating formally how people should behave formal rules provide a focal point that helps people to coordinate. This effect is likely to be crucial for the contribution to public goods in the presence of conditional cooperators (Fischbacher and Gaechter, 2010) because in such a situation a public good game is equivalent to a coordination game (Camerer and Fehr 2002). Understanding the interaction between incentives and obligations (the content of the norm) is thus crucial for the design of public policies. In this work we experimentally

[1] See Raz (1980).

[2] Typically, a formal rule is a statement such as: "you ought to… and then you 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] See Tyler (1990).

[4] See Kahan (1997), Cooter (2000) and McAdams (2000), Croson (2009). In economics, the theoretical work by Bar-Gill and Fershtman (2004) and Bowles and Polania (2010) explore the possibility that laws affect behaviour by driving the evolution of preferences. Van der Weele (2010) explores develops a model of the signalling power of legal rules.

study how obligations work and how they interact with incentives in affecting human behaviour. In particular we explore the following questions:

i) How, ceteris paribus, do obligations affect cooperative behaviour?
ii) How, ceteris paribus, do non-binding incentives affect cooperative behaviour?
iii) How do obligations and non-binding incentives interact with each other?
iv) What are the channels through which obligations and non-binding incentives affect behaviour?

The workhorse of our analysis is a series of linear public goods experiments[5] in which we independently vary the intensity of incentives and the level of obligations. Obligations are introduced in the form of (non-binding) minimum contributions: "a minimum contribution of X tokens to the public good is required from each individual". Incentives are implemented as probabilistic punishments for contributions below the minimum and probabilistic rewards for contributions above the minimum. The incentive schemes are structured in such a way that not contributing to the public good remains the dominant strategy for payoff-maximizers. By using such a framework, we are able to keep the marginal incentives fixed across treatments. Thus the marginal incentives to contribute are independent of the minimum contribution. This aspect is crucial - our incentive structure is non-binding and marginal payoffs are independent of the minimum contribution. Hence, if we observe any difference in treatments with different minimum contributions, this cannot be imputed to the effect of incentives on payoffs but its justification should be sought elsewhere.

The overall picture emerging from our experimental results is the following. The introduction of an obligation in the absence of incentives leads to an increase in the provision of the public good. This means that the introduction of a rule, even if not enforced, positively affects people's propensity to cooperate. Instead, the introduction of incentives without an obligation does not significantly affect contributions. This result is consistent with the fact that the incentives are non-binding. When obligations and incentives are combined, cooperation is strongly reinforced: the joint effect of incentives and obligations on contributions is significantly more positive than the impact of obligations alone. This means that in our experiments obligations and incentives are complements,

[5] The choice to carry 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.

jointly supporting high levels of contribution. This last aspect is particularly relevant. As we mentioned above, in reality we observe a widespread use of non-binding incentives, i.e. weak incentives that cannot induce the desired strategies are dominant. An unexplored yet revealing pattern that emerges from the analysis of our experimental results is that obligations and non-binding incentives are complements that crucially sustain each other to make rules work. Since in our framework the incentive structure does not modify material payoffs, this means that, when combined with an obligation, incentives crowd-in reasons for behaviour other than material self-interest in sustaining cooperation.[6]

In order to provide a behavioural interpretation of these results, we analyze the possible channels driving cooperation. We find that obligations affect behaviour through two channels: i) conditional on beliefs about others' behaviour, they increase people's willingness to contribute, and ii) they increase people' beliefs concerning the contributions of others. Since most participants are conditional co-operators, both these effects raise the provision of the public good. Incentives by themselves do not affect individuals' beliefs and preferences. However, when combined with obligations, they strongly reinforce the impact of obligations through both channels.

The paper is structured as follows. Section 2 provides a review of the related literature. Section 3 reports the experimental design and the behavioural predictions. Section 4 describes and comments on the results. Section 5 provides some concluding remarks.

2. Literature

Our study relates to several strands of the literature. First, there is a large literature that developed in the last decade on the effects of institutions in the provision of public goods. Our study in particular relates to the literature focusing on exogenously imposed institutions.

In this strand of literature, Falkinger, Fehr, Gaechter and Winter-Ebmer (2000) examine a mechanism for public good provision in which rewards and sanctions are imposed to players who contribute more and less, respectively, than the average to the public good. The authors show experimentally that the mechanism is an effective tool to implement efficient contribution levels. Andreoni (1993) presents an experimental test of the proposition that government

[6] From this point of view, this study contributes to a burgeoning literature in behavioural economics aiming to provide us with a greater understanding of the psychological effects of incentives (see among others Benabou and Tirole, 2003 and 2006; Bohnet, Huck and Frey, 1997; Bowles, 2008; Bowles and Hwang, 2008; Falk and Kosfeld, 2006; Falk, Fehr and Fischbacher, 2005; Falk, Fehr and Zehnder, 2006; Fehr and Falk, 2002; Fehr and Schmidt, 2002; Fehr and List, 2004; Frey and Jegen 2001;Gneezy and Rustichini, 2000a 2000b, Traxler and Kube, 2009, Van Der Weele, 2010).

contributions to public goods, funded by lump-sum taxation, will completely crowd-out voluntary contributions. The author finds that crowding-out is incomplete and that subjects who are taxed are significantly more cooperative. While both these papers show that it is possible to design exogenous institutions that can efficiently sustain cooperation, a related large strand of literature focuses on the crowding-out effect of incentives. Fehr and Falk (2002), Frey and Jegen (2001) and Bowles (2008) provide excellent surveys of the topic. Our paper complements this literature by showing a crowding-in effect of incentives when these are coupled with obligations. Our results show that incentives and obligations are complements and mutually sustain the effect of the other in enhancing cooperation, while when "mild" incentives are used alone they are ineffective. A further contribution of our paper goes in the direction of analyzing the channels of the experimental treatment effects. Much of the papers in this literature are not able to single out the channels of the treatment effects (i.e. the effects of introducing incentives or changing institutions). For example a much cited paper (Gneezy and Rustichini, 2000) showed that a fine for picking up children late from a day-care center actually increased late-coming but could not document the channel thorough which fines induced more late coming. Our experimental design, by eliciting participants' beliefs and conditional contributions can show how obligations and incentives affect the motivations of behaviour of experimental subjects.

Our work also relates to the literature in legal scholarship on the focal point theory of law (McAdams 2000 and McAdams and Nadler, 2005). According to this theory, laws can be used to coordinate expectations on a beneficial equilibrium. In an experiment by Bohnet and Cooter (2005), penalties for choosing the inefficient strategy in a coordination game induce more people to choose the efficient strategy. Our experimental results goes in a similar direction by showing that the basic components of formal rules (obligations and incentives) complement each other by inducing conditional cooperators to increase their contributions to the public good. A further strand of literature in law that is of interest to our paper is that on "expressive law" (e.g. Kahan 1997 , Cooter 2000). The idea here is that laws express the reigning norms in a society, and can discipline people by showing them what the majority of people deem to be `appropriate'. Funk (2007) reports field results in line with this intuition. Using Swiss panel data, she finds that the legal abolishment of the voting duty significantly decreased average turnout, even though the fines for not voting have only been minimal. Our results on obligations sustain this intuition and our analysis of conditional contribution schedules brings evidence that the willingness to contribute to the public good can be "anchored" to the level of obligations.

In a recent paper related to ours Tyran and Feld (2006) run an experiment that compares the effects of endogenously and exogenously introduced `mild' or `non-deterrent' sanctions in a

public good game. In the endogenous treatment, the subjects vote on whether to introduce the sanction. The authors show that endogenous sanctions are more effective in raising contributions than exogenously implemented sanctions. The interpretation of this result is that endogenous sanctions signal that there are many people who want to cooperate. Our results on incentives complement this result by showing that a variation in exogenously imposed mild sanctions does not affect contributions to the public good when incentives are not coupled with obligations while exogenous mild incentives complement the positive effect of obligations on cooperation when they are used together.

Finally this paper relates to a previous work of Galbiati and Vertova (2008) that documents the positive effect of obligations on cooperation in a dynamic voluntary contribution mechanism. In this paper we report and discuss the evidence from new experimental treatments designed to understand: a) the separate effect of obligations and incentives on cooperation; b) the combined effect of obligations and incentives; c) the behavioral channels driving these effects.

3. The Experiment

3.1. The experimental game

The basic experiment consists of a one-shot linear public good game followed by a conditional contribution stage. Overall, 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 '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. Finally, we elicit individual beliefs about others' unconditional contributions. Individuals know the others' decisions and their own payoff only after all three of these stages have taken place.

The linear public good game we implement differs from a standard voluntary contribution mechanism in that we exogenously fix a minimum level of contribution that each subject is required to provide for the public good. The game has two main variants. The first without incentives at all: we simply introduce the requested minimum contribution without any form of monitoring of individuals' actual behaviour. In the second variant the minimum contribution is backed by a structure of incentives: there is a probability of being monitored and a probabilistic penalty (reward) for individuals whose contributions are lower (higher) than the minimum level of contribution

required.[7] As we are interested in understanding whether the minimum contribution has a different effect in the presence and in the absence of incentives, and in the second case we want to isolate its effects from those of the marginal incentives, we keep the level of marginal incentives fixed across all treatments, i.e. the probability of being audited and the penalty/reward rate do not vary with the minimum contribution obligation. On the contrary, the level of the required minimum contribution 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 the obligation of a 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-averse to a reasonable degree. Secondly, we want to minimize the possible bias in our results caused by differences in risk preferences across samples.[8]

In the one-shot public good game (unconditional contribution stage), the expected monetary payoff for individual i is:

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

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 such that the following inequalities hold: $m > 1/n$ and $m + pg < 1$. In the variant without incentives we fix $pg = 0$.

In order to understand whether a possible effect of the minimum contribution on cooperation should be imputed to an influence on preferences, on beliefs, or on both, and if such motivational channels are affected by the presence or absence of incentives, 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 significantly varies in the different treatments. In order to pursue the latter aim, in all the treatments 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 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

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

[8] Nevertheless we check the robustness of our results by controlling for differences in risk preference (see Appendix 1).

contribute to the public good. To give subjects a material incentive 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 will select which 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 to 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 the average contribution of the other players and makes 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 the players have decided how much to contribute to the public good, the monitoring stage takes place: a player's contribution may be randomly monitored (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 her 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.

3.2. Treatments, parameters and procedures

To investigate our research questions we implement six different experimental treatments: two treatments without incentives, three treatments with the same incentive structure and finally a treatment with a very low level of incentives. Table 1 summarizes the experimental treatments:

TABLE 1
EXPERIMENTAL TREATMENTS

		Obligation (Required minimum contribution)		
		No (0)	Low (4)	High (16)
Incentives	No(0)	PG		H (no-i)
(Detection Probability)	Low(1/100)			H(low-i)
	High(1/12)	0	L	H

Treatment PG is a baseline public good game without a material incentive to contribute. In treatment H(no-i) we introduce a required minimum contribution equal to 80% of an individual's total endowment. This second treatment simply works as a baseline voluntary contribution mechanism with a suggested contribution that we can consider as third-party cheap talk. The treatments with monitoring structure are the following. We have three treatments with a probability of monitoring p=1/12: a 0 treatment, where no minimum contribution is required and subjects obtain a reward if they are monitored and their contributions to the public good are higher than zero; a low minimum contribution treatment (L), where subjects are required to contribute at least 20% of their initial endowment; and a high minimum contribution treatment (H), where the minimum contribution required corresponds to 80% of an individual's total endowment. In both these last treatments individuals' contributions can be monitored. If they contribute less (more) than the required contribution they get a penalty (reward). 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 fixes 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. In the last treatment (H(low-i)) the level of minimum contribution is fixed to a level closer to zero (detection probability p=1/100) to allow us to further investigate the role of incentives and to be sure that the effects we find depend on their presence and not on their level. A comparison between the two high obligation conditions with different incentive levels and the baseline condition without obligation provides us with information about the effect of varying marginal incentives on levels of cooperation.

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 being monitored is $p = 1/12$[9] (but $p = 1/100$ in the H(low-i)), 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 treatment L, and $\hat{a} = 16$ in treatment H, respectively.

The experiment was conducted in a computerized laboratory where subjects interacted with each other anonymously.[10] No subject was ever informed about the identity of the other group members. We did not provide information about other individuals' contributions in the same group. At the end of the game subjects were only provided with information on their own payoff. This should rule out emotional elements related to stigma and shame in the explanation of the results. We conducted six sessions, one for each treatment. In each session participants were divided into 6 groups of size 6 for a total number of 210 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. The experiment was conducted in the experimental laboratory of the University of Siena (Italy) in different sessions from December 2005 to April 2008. Each session lasted about one hour and the average earnings for each subject were 14 Euros (about 20 US dollars).

3.3. Predictions and testing

Hereafter we report the kind of comparisons that we make in order to answer each of the questions reported in the introduction together with some predictions of expected behaviour.

i) How, ceteris paribus, do obligations affect cooperative behaviour?

In order to answer this questions we compare: a) unconditional contributions in the H(no-i) treatment to contributions in the PG treatment and b) unconditional contributions in the H, L and 0 treatments respectively.

If we assume common knowledge of rationality, risk neutrality and selfishness of all players, we 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

[9] This probability results from the following procedure: given a group of 6 players, first the group is selected with probability 1/2, and then, in the positive case, one of the six individuals in the group is selected. Notice that anonymity of audit is guaranteed.

[10] To conduct the experiment we used the experimental software 'z-Tree' developed by Fischbacher (2007).

consider in our setting the optimal choice of a risk-neutral and fully self-interested individual. Her optimal contribution, a_i^*, is the value of a_i which maximizes (1). The first order condition of the maximization problem yields:

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

Hence the dominant strategy for a (risk-neutral) self-interested individual is always full free-riding: $a_i^* = 0$. This result depends crucially 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 oneself. Notice that the level of minimum contribution obligation $\hat{a}$ does not affect the optimal choice of a self-interested individual. This is straightforward since minimum contributions 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 we had instead applied only a probabilistic penalty (or only a probabilistic reward) for individuals who contribute less (more) than $\hat{a}$, we would have obtained two distinct first-order conditions for the maximization problem, one for the interval $a_i \le \hat{a}$ and the other for the interval $a_i > \hat{a}$. However, in this case different levels of $\hat{a}$ would have implied different marginal monetary payoffs, which we want instead to keep fixed in order to isolate the effect of different minimum contributions.[11]

If individuals were all merely self-interested, minimum recommended contributions 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 at the margin the requested minimum contribution cannot affect monetary incentives. Nevertheless, if individual reasons for behaviour depart from the traditional assumption of self-interest,[12] some individuals may make positive contributions (as usually observed in experimental public good games), and minimum recommended contributions may have some effect on individual behaviour. Since the structure of

[11] It is worth noting that there are cases in the real world in which penalties are given to those breaking the law and rewards are given to those who follow the law. For instance, in Italy, penalties (in the form of a reduction in points on the driving licence) are implemented for those who violate the highway code, while rewards (in the form of more points added to the driving license) are given to those who for two consecutive years do not violate the highway code. This case is very similar to ours, since road safety could easily be thought of as a public good.

[12] A huge amount of empirical and experimental literature shows that in social dilemmas many individuals are driven 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).

our game rules out any possible effect of minimum contribution rules on marginal incentives, any effect needs to be explained on the basis of their behavioural effects.

ii) How, ceteris paribus, do non-binding incentives affect cooperative behaviour?

In order to answer this question we compare: a) unconditional contributions in treatment 0 to those in treatment PG; b) unconditional contributions in H(no-i) to those in H(low-i) and H; and c) unconditional contributions in H to those in H(low-i). These comparisons allow us to evaluate: a) the impact of the introduction of incentives on contributions to the public good in the absence of obligations; b) the impact of the introduction of incentives on contributions to the public good in the presence of a recommended minimum contribution; c) the impact of a variation in the level of incentives in the presence of a recommended minimum contribution.

As incentives are set at a non-binding level we expect that varying them will not affect cooperation.

iii) How do obligations and non-binding incentives interact with each other?

To answer this question we compare contributions in treatment PG to contributions in H(no-i), H(low-i) and H respectively. The results of these comparisons help to shed light on the relation between incentives and obligations; in particular we investigate the role of the presence/absence of incentives in making obligations effective. The question to ask is whether the fact that a contribution is required is enough to exert a behavioural effect, or whether it is necessary to have an incentive structure (though non-binding) for the requirement to have a significant effect. If the latter is the case, we may conclude that incentives not only shape payoffs but they also complement obligations; in particular, non-binding incentives, far from being redundant, play a crucial role in making formal rules work.

iv) What are the channels through which obligations and non-binding incentives affect behaviour?

Finally, in order to provide a behavioural interpretation of the possible effect of obligations (incentives) on cooperation, we compare the average beliefs about others' contributions and conditional contributions in different treatments. We can advance some conjectures. First, if some individuals are conditional co-operators (Fischbacher, Gaechter and Fehr, 2001 and Fischbacher and Gaechter, 2010), 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, minimum contributions may coordinate individuals' beliefs to common focal points, thus affecting cooperative behaviour.

Second, minimum contributions, being perceived as obligations, may have direct psychological effects on preferences (and thus on behaviour) if they affect individual personal contribution norms.

If obligations affect beliefs, we expect to observe significant differences in beliefs stated about others' contributions across treatments. If they affect preferences, we 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 the minimum contribution rules.

4. Results

4.1. *Question 1*: How, *ceteris paribus*, do obligations affect cooperative behaviour?

In order to answer this question we compare: a) unconditional contributions in the H(no-i) treatment to contributions in the PG treatment and b) unconditional contributions in the H, L and 0 treatments respectively.

The first step of our analysis aims to clarify whether variations in the requested minimum contribution significantly affect cooperative behaviour. In this respect we have two possibilities. First, an obligation is introduced in the absence of incentives. Second, an obligation is introduced and varies in the presence of incentives. This analysis gives us information about whether obligations *per se* have any effect on behaviour and how obligations and non-binding incentives interact. In particular, we try to understand whether the response to a recommended minimum contribution to the public good in the case that there is not any incentive structure differs from the response in the case that there is a non-binding enforcement structure.

In Figure 1 we report the average unconditional contributions in all the six treatments. Thus we have an overall picture of the effects of variations in obligations and non-binding incentives on the average cooperative behaviour across treatments. In order to better interpret the results on average contributions, we also construct Figure 2, which represents cumulative average contributions in all treatments (with average contributions on the horizontal axis and the proportion of individuals on the vertical one).

To investigate how the introduction of a minimum recommended contribution affects giving to the public good in the absence of a non-binding incentive structure, we initially focus on the PG and on the H(no-i) treatments. The first treatment is the baseline treatment: the one-shot linear public good game without a requested minimum contribution or incentives coupled with the elicitation of conditional contributions and beliefs. The second treatment introduces a high requested minimum contribution (16 tokens) without a penalty or reward structure. From Figure 1 we observe that in the PG treatment we replicate the finding in public good experiments that average contributions are positive but far from efficient. In the treatment with a requested minimum contribution the average unconditional contributions to the public good increases by 41% with respect to the baseline PG treatment (from 8.02 in PG to 11.33 in H(no-i)). Thus, the introduction of a minimum requested contribution per se increases efficiency. To test the statistical significance of the differences in the contributions in the two treatments we run a Mann-Whitney rank-sum test.[13] The results of this (test z=-1.746; p-value=0.08) show that the difference in the average contributions in the two treatments is significant at the 8% level. This shows that suggested obligations affect average contributions to the public good, although in a weakly statistically significant way.

To better understand how obligations affect unconditional contributions, we now analyze the effect of different levels of obligation for a given structure of incentives. From Figure 1 we notice that in the treatment where the obligation is 4 tokens (L) and in the treatment where no minimum contribution is required (0), we observe 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 obligation is 16 tokens (H) is remarkably higher (15.1 tokens) than in the other two treatments. By running a Mann-Whitney rank-sum test to test the statistical significance of the differences in contribution levels between the treatments we find that mean contributions in treatment H are higher at significant statistical levels than mean contributions in both the other treatments, while we do not find a significant difference between the average contributions in the 0 and in the L treatment.

This second result is in line with the findings obtained by Galbiati and Vertova (2008)[14] in a repeated public good game: for given marginal incentives, obligations can affect the average propensity to cooperate for the public good. In particular, when the minimum contribution required

[13] The unit of observation in the statistical test is the average group contribution.

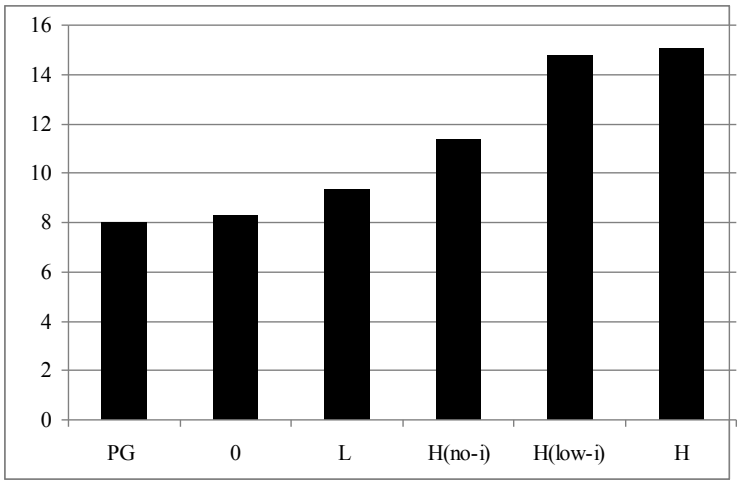
[14] Galbiati and Vertova (2008) focus on the effect of obligations in a repeated public good game. Unlike this paper, they do not analyze the determinants of the effects of obligations but rather their dynamic effects on cooperation.

is sufficiently high (treatment H), 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 (treatment L), 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 exists.[15]

This evidence can be summarized as follows:

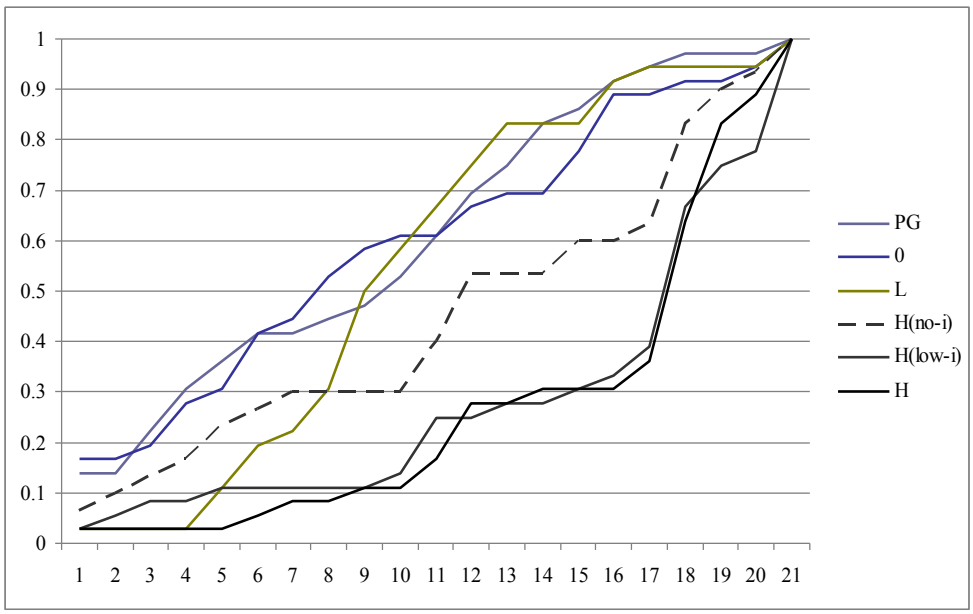
Result 1. *The introduction of a minimum recommended contribution (in the absence of incentives) leads to an increase in the provision of the public good. In the presence of a non-binding incentive structure, average contributions are significantly higher when the minimum contribution required by obligation is sufficiently higher than the average contributions in the 'no obligation' case.*

FIGURE 1
UNCONDITIONAL CONTRIBUTIONS
(Average contribution in each treatment)



[15] 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. See, among others, Fischbacher et al. (2001).

FIGURE 2
UNCONDITIONAL CONTRIBUTIONS
(Cumulative average contributions)



These results tell us that *ceteris paribus* an increase in the minimum contribution requested positively affects cooperative behaviour. Moreover, by observing differences between cooperation levels in the presence and absence of incentives it emerges that the presence of an incentive structure seems to reinforce the effect of obligations. The next step in our analysis focuses on the effect of *ceteris paribus* variations in incentives. Afterwards, we will come back to this last observation to analyze how incentives and obligations interact.

4.2. *Question 2*: How, *ceteris paribus*, do non-binding incentives affect cooperative behaviour?

In order to answer this question we compare: a) unconditional contributions in treatment 0 to those in treatment PG; b) unconditional contributions in H(no-i) to those in H(low-i); and c) unconditional contributions in H to those in H(low-i). These comparisons allow us to evaluate: a) the impact of the introduction of incentives on contributions to the public good in the absence of obligations; b) the impact of the introduction of incentives on contributions to the public good in the presence of a recommended minimum contribution; c) the impact of a variation in the level of incentives in the presence of a recommended minimum contribution. It is worth remarking that we are not interested in an investigation into the effects of binding incentives: a binding incentives

scheme would in fact change the game's payoff structure and make full contribution a dominant strategy for all players.

We start by analyzing the effect of the introduction of non-binding incentives in the absence of obligations. By comparing the unconditional contributions in the 0 and PG treatments we can better observe how incentives work. These two treatments, characterized by the absence of a recommended minimum contribution, differ because in the 0 treatment we have a probabilistic reward system while in the PG treatment there is no incentive to give to the public good. We do not observe any significant difference between the unconditional contributions in the two treatments (see Figure 1). In the absence of obligations, the introduction of weak incentives does not have any effect on cooperative behaviour. A comparison between the 'PG condition' and '0 condition' provides us with further insight into the behavioural effect of incentives. Note that the game played in the '0 condition' is a basic linear public good game with a non-binding incentive to contribute. In our case, we observe neither crowding-in nor crowding-out of contributions in the absence of obligation. A plausible reason for this result is that here the incentives are exogenously fixed by a third party with respect to the behaviour of others, and hence they do not provide any information about others' motivations. This suggests that incentives activate or crowd-out social preferences when they are endogenous with respect to group behaviour. In this last case they are able to convey relevant information about others' behaviour and intentions.[16]

Our second purpose is to analyze whether there is any difference in average contributions between the treatment with high obligation and no incentives (H(no-i)) and the treatment with high obligation and a very low level of non binding incentives (H(low-i)). Graphical evidence in Figure 1 shows that average unconditional contributions are different (11.3 and 14.8 tokens in H(no-i) and H(low-i) respectively: 30% higher in the presence of incentives). A Mann-Whitney rank-sum test corroborates the hypothesis of a significant difference (at 5% level) in group contributions between the two treatments (Mann Whitney results: $z=-2.032$; $p=0.042$). This means that, in the presence of an obligation of minimum contributions, even a very small incentive tending to 0 positively shapes cooperative behaviour. By comparing the H(no-i) and the H treatment (equivalent to H(low-i) but with higher yet still weak incentives) the same results hold.

[16] This evidence is consistent with the results of Tyran and Feld (2006) showing that exogenous mild sanctions do not anchor contributions in public good games while endogenously voted mild sanctions affect contributions significantly.

Finally, we evaluate the impact of a variation in the level of incentives in the presence of a minimum requested contribution to the public good. To investigate this question we compare unconditional contributions in treatment H, where the probability of monitoring parameter and the sanction/reward rate are fixed at $p = 1/12$ and $g = 1.2$ respectively, to contributions in treatment H(low-i), where we set the expected sanction (reward) parameters as follows: $p = 1/100$ and $g = 1.2$. In this second case, the monitoring probability is almost only 1/10 of its probability in treatment H and the per-unit reward (sanction) is 0.012 tokens (the monetary equivalent is 1/3 of a eurocent). Graphical evidence in Figure 1 shows that average unconditional contributions in the two treatments are very close to each other (15.1 and 14.8 in H and H(low-i) respectively). By applying a Mann-Whitney rank-sum test we cannot reject the hypothesis that the average unconditional contributions in the two high-obligation treatments are the same at any conventional level (Mann Whitney results: z=-0.484; p=0.6285).

This evidence can be summarized as follows:

Result 2. *The introduction of a non-binding incentive structure in the absence of obligations does not affect contributions to the public good. In the presence of a minimum recommended contribution, the introduction of non-binding incentives induces a significant increase in the provision of the public good. An increase in the level of non-binding incentives in the presence of obligations does not affect average contributions.*

Taken together, results 1 and 2 suggest that there is a positive interaction between non-binding incentives and obligation affecting cooperative behaviour. In the next section we further explore this hypothesis.

4.3. *Question 3*: How do obligations and non-binding incentives interact with each other?

The results of the previous two sessions suggest the existence of a positive interaction between non-binding incentives and obligations affecting contributions to the public good. In the presence of a high recommended minimum contribution, the introduction of extremely low incentives helps to increase contributions. Moreover, the effect of introducing an obligation is stronger in the presence of incentives than in their absence (the difference between unconditional contributions in H and 0 treatments is higher than the difference between PG and H(no-i). We now further explore this issue. We compare the differences between contributions in the baseline PG treatment and the

treatment with obligations without incentives (H(no-i)) to the difference in contributions between PG, H(low-i) and H, where both incentives and obligations are present. We observe that while the simple introduction of an obligation increases contributions by about 40% (H(no-i) vs. PG), the introduction of an obligation jointly supported by non-binding incentives increases contributions by more than 80% (contributions in H(low-i) and H are respectively 84% and 87% higher than in PG).

This means that the effects of obligation on cooperative behaviour are much stronger when they are supported by incentives. This result is particularly important as it shows a major alternative role of incentives. Incentives are crucial not only when they can enforce rules by changing people's dominant strategies. From our analysis, a complementary relation between obligations and incentives emerges: obligations are more effective when an incentive is provided, even if this incentive is non-binding with respect to individuals' payoffs.

Result 3. *Obligations and non-binding incentives are complementary in supporting cooperation in public good games.*

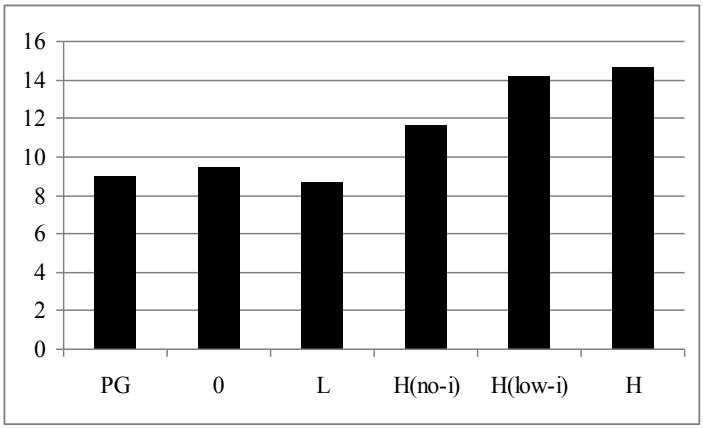
The next step in our analysis is to provide some evidence on how obligations and non-binding incentives work in shaping cooperative behaviour. Since material payoffs are not affected, other behavioural channels must come into play: we investigate expectations about others' contributions and social preferences.

4.4. *Question 4*: Channels through which obligations and non-binding incentives affect behaviour

4.4.1 Beliefs

Our next step is to study how obligations and non-binding incentives affect beliefs about others' contributions. Figure 3 shows, for all treatments, the average beliefs about the average unconditional contributions in the group.

FIGURE 3
BELIEFS ABOUT OTHERS' UNCONDITIONAL CONTRIBUTIONS



This evidence can be summarized as follows. First, beliefs about others' average contributions are coordinated towards higher levels of expected co-operation when the minimum level of contribution required by an obligation is higher. Second, non-binding incentives shape individuals' beliefs (indeed, notice the difference in beliefs between treatments H(no-i) and H(low-i); Mann Whitney results: z=-2.202; p=0.0277). Third, obligations and non-binding incentives have a complementary effect on individuals' expectations about others' behaviour.

In sum, the results on cooperative behaviour seem to be valid for our expectations about cooperative behaviour. This suggests that the effect of obligations and non-binding incentives on cooperation may be partially trigged by beliefs about conditional co-operators, i.e. people who want to cooperate if they expect others to contribute to a sufficient extent. Result 4 summarizes the evidence on beliefs.

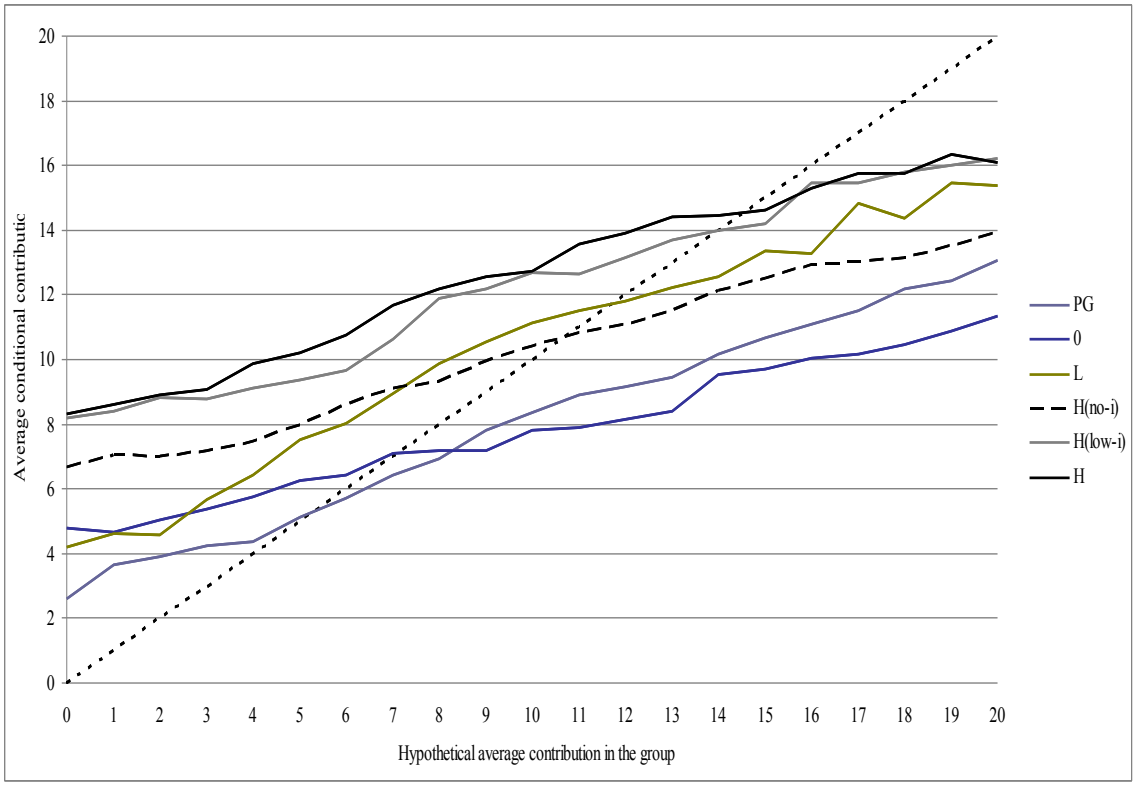
Result 4. *Obligations and non-binding incentives affect beliefs about others' unconditional contributions.*

4.4.2 Analysis of conditional contributions

We now analyze the patterns of conditional contributions under the different conditions. The idea here is that conditional contribution schedules catch the full range of individual strategies to control for beliefs about others' contributions by means of the strategy method (Fischbacher, Gaechter and Fehr, 2001). Significant differences in conditional contribution schedules across treatments would suggest that obligations and non-binding incentives may affect contributions through an effect on motives for behaviour other than beliefs about others' contributions.

Figure 4 reports the patterns of conditional contributions under the six different treatments. 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 with 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 contribution schedules highlight the fact 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.

FIGURE 4
CONDITIONAL CONTRIBUTION SCHEDULES



Moreover, we notice that the conditional contribution schedule in treatment H(no-i), where the obligation is not sustained by an incentive, is only slightly higher than in the baseline public good

game. Nonetheless, by adding a non-binding incentive structure, we observe a great difference between conditional contribution schedules in the presence and in the absence of an obligation. Finally, we find a relevant difference between schedules in the H(no-i) and H(low-i) cases, suggesting that in the presence of an obligation, the existence of an incentive, even if non-binding and very small, has a direct effect on individual willingness to cooperate once we control for beliefs.

To summarize this analysis, our main result is the following:

Result 5. *In the presence of higher obligations coupled with non-binding incentives we observe an upward shift in conditional contributions.*

This finding can be interpreted as an indication of the fact that some people have a preference for compliance with norms (Lopez-Perez 2008). Under this view, the introduction of obligations anchors individual preferences for norm compliance.

5. Comments and concluding remarks

Understanding how formal rules affect human behaviour is a fundamental task for economic theory and for policy makers. The economics literature has studied the role of incentives in shaping people's choices extensively. Incentives can modify the payoffs for individuals' actions, thus inducing desired behaviours. Nonetheless, formal rules are often backed by weak incentives and deviations from behaviours recommended by formal rules are characterized either by low probabilities of monitoring or small sanctions for undesired behaviours. Despite such a widespread presence of weak incentives, people often abide by the rules.

Explaining why people comply with rules in the presence of weak incentives is a major puzzle in economics. Other disciplines such as legal theory and social psychology suggest that obligations, that is to say the normative contents of rules, play a crucial role in driving individuals' behaviour. Yet, we still know very little about how obligations affect behaviour and how they interact with the incentives part of a rule. In this paper, by running a series of modified public good games we have contributed to clarifying these issues, thus providing a more complete view of how formal rules work.

We have found that obligations have a sizeable effect on cooperative behaviour even in the absence of incentives. When non-binding incentives are introduced, requested contributions strongly sustain cooperation. Our results suggest that, in public good situations, obligations and non-binding incentives are complements, jointly supporting high levels of contributions. Since in our framework the incentive structure does not modify material payoffs, this means that, combined with an obligation, incentives crowd-in reasons for behaviour other than self-interest in sustaining cooperation. One potential criticism of this interpretation relates to prospect theory. Despite incentives never being binding in our treatments, when we introduce incentives in the absence of obligations, they only take the form of rewards (i.e. the presence of an incentive does not involve the danger of a loss). However, if incentives are introduced in the presence of obligations, then they come in the form of both rewards and punishments, so that the danger of a loss is introduced. Thus, in principle, incentives may affect behaviour not only by reinforcing the salience of norms but also by introducing the possibility of losses. However, the H(Low-i) treatment shows that even very weak incentives (a detection probability of 1/100) reinforce the impact of obligations on contribution behaviour. In this case, the explanation related to loss aversion is not very likely: where punishment is so improbable, it is not really plausible that the behavioural changes are caused by the fear of loss.

Furthermore, through a strategy based on the elicitation of beliefs and conditional contributions to the public good, we have found 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 individual willingness to cooperate.

These results add to the literature on the effects of institutions on behaviour in two ways. First, they support the idea that formal rules and laws have an expressive power: they can affect behaviour not only by shaping material payoffs for individuals, but also by directly influencing people's motives for behaviour (Cooter, 2000) and by acting as focal points (McAdams, 2000). Second, they suggest some important behavioural effects of incentives. Our experimental results show that incentives may affect cooperative behaviour not only by changing payoffs, but also by complementing obligations.

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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 the 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 in the lottery (see Table A2).

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 coiches

In table A3 we report the frequencies of subjects by classes of risk preference in the three treatments with different levels of obligation

TABLE A3
FREQUENCIES OF SUBJECTS BY CLASS OF RISK PREFERENCES

Class of risk preferences	0 condition (MC=0)	L condition (MC=4)	H condition (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 subdivide our sample into three groups: the first group is composed of risk-neutral individuals, the second composed of risk-adverse individuals and the third one is composed of highly risk-averse individuals[17]. Moreover we compute for each subject an index given by the difference between her unconditional contribution and the minimum contribution required in the treatment. We then apply a Mann-Whitney rank-sum test[18] 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 to not 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 behaviours 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 both the probability of being audited in each round and the penalty rate are very low.

[17] 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.

[18] The unit of observation in the statistical test is the individual.

Appendix 2: Instructions

NOT FOR PUBLICATION

The following instructions were originally written in Italian. We document the instructions used in the treatment 'H condition' (both for the public good game and the lottery).

2A - The public good game

Instructions

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

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

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

How will your income be paid?

During the experiment your entire 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 tokens = 1 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 immediately paid to you in cash.

How long is the experiment? How many people take part to it?

The experiment is divided into three steps. In all three steps participants are divided into groups of six people. Therefore you will be in a group with 5 other participants. The composition of the groups will not change during the experiment. Therefore 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 all the members of your group, 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 minus your contribution) are kept for yourself.

What is the aim of the project?

The project returns to the group a *common product*. The *common product* is an number 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:

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

where:

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

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 number of tokens will be equally redistributed among the group members. Hence, each member of the group earns 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 an income from each token contributed by the other members. For each token contributed by any other member you will earn 0.3 tokens. Remember that your feasible contribution is any integer number between 0 and 20.

The minimum contribution

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

The input screen

The following input screen will appear:

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 about your contribution. Your decision must be made before the time displayed is 0 seconds. In the middle of the screen the minimum contribution is shown. Below this, 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 corner there is an OK button for you to confirm your choice.

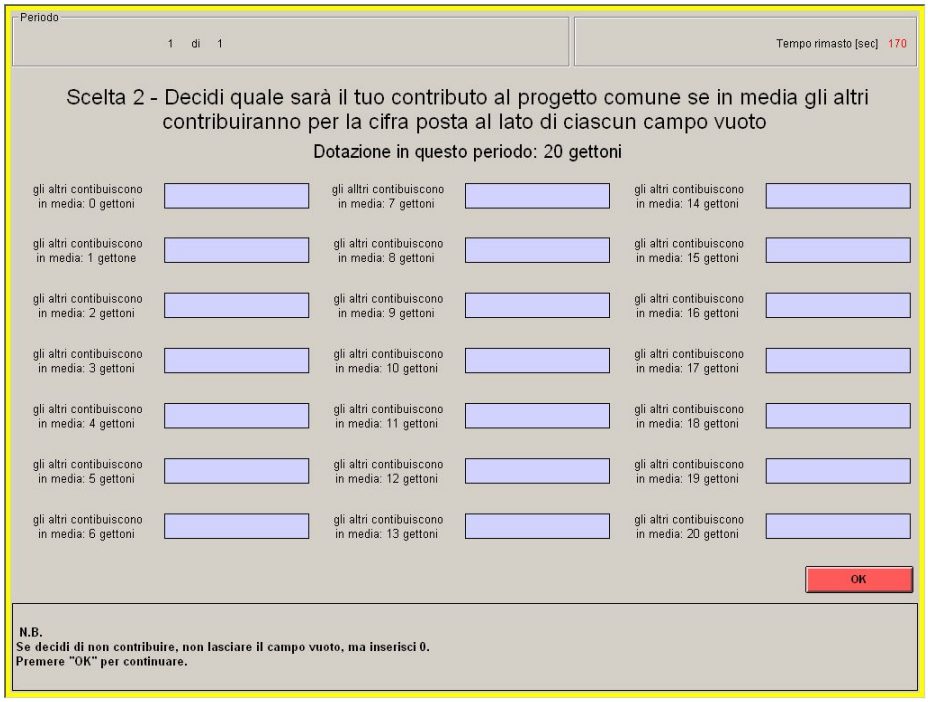
To sum up the procedure, you have to decide how much to contribute to the project by writing a number between 0 and 20 in the input field. By deciding how much to contribute, you also decide how much you keep for yourself, that is to say: (20 minus your contribution). After having written your contribution,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

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 fellow group members contribute on average certain numbers 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 contribute for any hypothetical average contribution by your fellow group members from 0 to 20. You have 3 minutes to fill in the table.

The input screen will appear as follows:



To the left of each square you can see the hypothetical average contribution by your fellow group members (from 0 in the top left to 20 in the bottom right). Given that, you have to write in the corresponding square how much you would contribute to the common project. You have to fill in all squares. You have 3 minutes to do this. After checking 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 choices, in each group one player will be randomly selected. For this player the actual contribution to the project will be selected on the basis of the conditional contribution schedule: in particular, her actual contribution will be the conditional contribution corresponding to the average unconditional contributions actually made by the other 5 players in the first step. Instead, for the other 5 players the relevant contributions to the common project are their unconditional ones 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. Then the computer will randomly choose an integer between 1 and 6: the player corresponding to the number extracted will be selected and her actual contribution will be the conditional one. Instead, for all the 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 decided 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 of 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 x 0.3=6.9 tokens from the common project. If instead you have declared yourself willing to contribute 10 tokens in the case that the others contribute on average 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 MONITORING STAGE

The monitoring stage

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

$$p = \frac{1}{2} \times \frac{1}{6} = \frac{1}{12} \cong 8.33\%$$

What are the effects of your contribution being checked?

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

If the contribution of the member is lower than the minimum contribution required, an amount of 1.2 tokens will be subtracted from her endowment for each token less than the minimum contribution actually contributed.

If instead the contribution by the member is higher than the minimum contribution required, an amount of 1.2 tokens will be added to her endowment for each token more than the minimum contribution actually contributed.

Notice that the tokens subtracted from the subjects monitored 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 checked, 2.4 more tokens will be subtracted from her endowment, that is to say:

$1.2\times$ (minimum contribution – 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:

$1.2\times$ (actual contribution of the subject–minimum contribution) = $1.2\times(5-3)=2.4$.

How will your income be calculated?

After all the group members have made their unconditional and conditional contributions and after a possible check, your income is calculated by summing three components**:**

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

   Endowment minus your actual contribution

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

   $$\textit{Total group contributions} \times \frac{1.8}{6}$$

3. The effect of the monitoring:

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

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

   $$(\textit{minimum contribution minus your actual contribution})\times 1.2$$

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

   $$(\textit{your actual contribution} - \textit{minimum contribution})\times 1.2$$

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

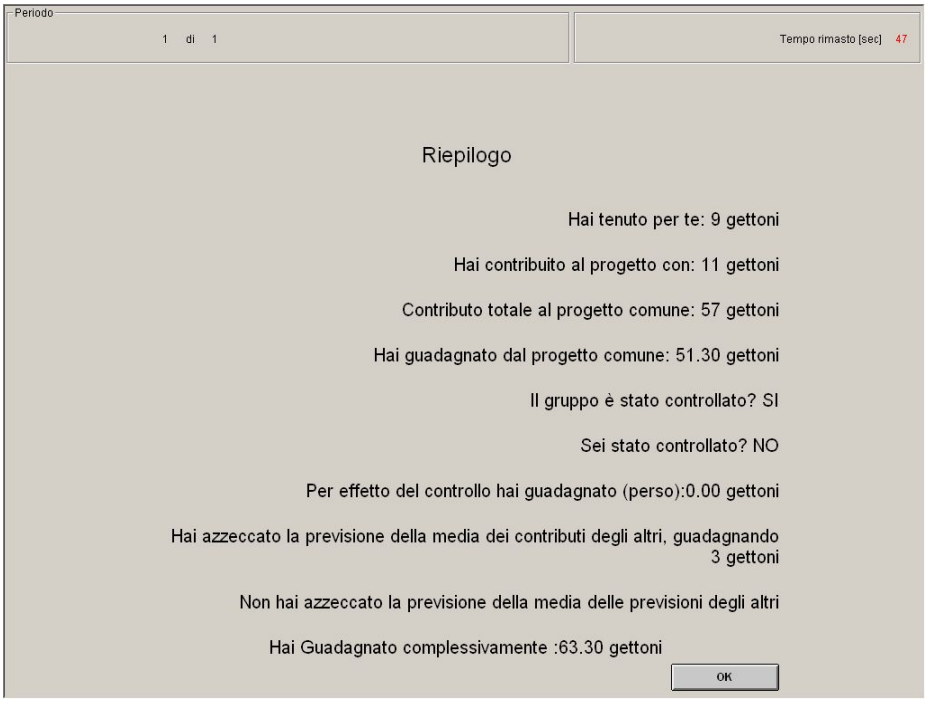
In this third step you can obtain a further gain from the experiment. You have to guess what the average unconditional contribution by your group members (i.e. the mean of the first step contributions) is. You have to fill in this screen:

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

If the average unconditional contributions of your 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 find out the sum of the contributions by the members of your group to the common project (including your contribution), your gain from the common project, whether or not the group has been monitored, whether or not you have been checked, the effect of the possible check, 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 is expired, please press the OK button.

2B - The lottery

Instructions

You are now going to take part in the last 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. Hereafter the experiment is described in detail.

If you have not perfectly understood the rules of the experiment, 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 tokens = € 1

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

In this experiment you are not part of any group. Your decisions do not influence the others' income and the others' decisions do not influence your income.

What do you have to decide in the experiment?

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

Let's give an example of the possible choice:

	Lottery A		**Lottery B**
CHOICE 1	70% 50 tokens	**or**	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 thus 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, given the chosen lottery, the computer will extract your gain according to the probability indicated by this lottery.

Example. Suppose the computer extracts the following lottery (one of those you have chosen):

60% 100 tokens

40% 180 tokens

At this point the computer will extract your gain from the experiment: with a probability of 60% it will extract a gain of 100 tokens, and 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.