The pen is migthier than the sword: How third-party advice or sanction impact on pro-environmental behavior

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Abstract

It is well recognized that incentives can influence the cooperation of individuals in providing public goods. The aim of this study is to experimentally adapt a Public Good Game (PGG) to the environmental issue of waste management. We report an experiment in which players have to cooperate in order to reduce the cost of waste sorting treatment. We consider a traditional PGG with groups of 4 players, and where an additional player that plays the role of the third-party is introduced in each group in the incentivized treatments. The third-party has either the possibility to advise on the desirable individual contribution (Treatment 1), or to collectively punish the non cooperative behaviors by increasing the tax rate (Treatment 2). Furthermore, participants are asked to perform an effort task to increase their given initial endowments, and a measure of social preferences through a Social Value Orientation test (SVO). We find that both the advice and the threat of sanction increase significantly the average level of individual contributions. However, we see that once the sanction is applied, it has no significant effect in increasing cooperation, quite the contrary. Moreover, we find results in line with (Becker, 1974)'s altruism hypothesis that high income individuals contribute more in absolute value compared to low income ones.

Keywords: Public good game, Advice, Sanction, Pro-social behavior, Motivation, Waste sorting

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1 Introduction

In daily life, situations where an individual's self interest is in direct conflict with others' are commonplace. Economics referred to these situations as social dilemma, and defined them as cases where an individual must allocate a given resource between herself and another person. An example of a social dilemma at the municipality level is the environmental issue of waste management. This issue is typically dealt with by economists as a case of a public good problem where first-best allocation of resources cannot be reached due to free-riding behavior in particular. Since the beginning of the 1980s', experiments of public good games (henceforth PGG) have been designed in order to investigate individual behavior in diverse institutional settings. As described by Ledyard (1995, p. 116) a very simple institution that has been tested is the *Voluntary Contributions Mechanism* (VCM) in which each subject is told to contribute to a common good (in our case, an efficient waste management system) an amount of a private good (or a certain level of effort) privately and without any information about what others are doing. In such a context, the total amount of common good equals that producible with the total private goods contributed. It is also the result of both the mechanism rules and the choices made by subjects. Many variants of this simple institutional setting may be investigated: introducing the possibility of ex-ante or ex-post communication between subjects, rendering public the private individual contributions or allowing punishment (by group members or third-party) in order to enhance cooperation (see Fehr and Gächter (2000)).

For instance, Fischbacher et al. (2001) show that individuals contribute more to the public good when they are informed that contributions of others increase. They also observe declining contributions in almost all public good experiments, explaining that : firstly, a non-negligible fraction of subjects free-ride regardless of others' contribution and secondly, that conditionally cooperative individuals contribute according to their beliefs of contributions of others, and then contribute less than others.

Considerable research has been devoted to the impact of punishment opportunities in maintaining high levels of contributions to a public good. The literature suggests that the opportunity to punish group members can usually help, even if it is costly, and even if is implemented by a third-party (see Fehr and Fischbacher (2004) in dictator games or prisoner's dilemma). Bowles et al. (2001) following Fehr and Gächter (2000) design a repeated PGG experiment where group members can assign points to punish non-contributors (which play the dominant strategy). Results show that a considerable fraction of communities members are willing to engage in the costly punishment in order to enforce a cooperative norm even when there is no reasonable expectation of being personally repaid for their effort. This behavior is labelled as *strong reciprocity*, i.e., a predisposition to "co-operate with others and punish non cooperators, even when this behavior cannot be justified in

term of self-interest" Bowles et al. (2001, p. 425). They also show that shirker's responses to punishment by increasing their level of contribution cannot be fully explained by their desire to avoid the reduction in payoffs which punishment causes. They suggest that the behavior of shirkers is also motivated by the shame which is felt when one is punished for violating a norm. Andreoni (1993) focuses on a PGG with an interior Nash equilibrium and explores the complete crowding-out hypothesis, i.e., the proposition that a flat-rate tax, used to increase government spending on a public good will reduce an altruist's voluntary contributions by the amount of the tax. The principal result iof their experimental test is that crowding-out is incomplete. The tax makes subjects much more likely to choose cooperative moves rather than Nash equilibrium moves. Moreover, taxed subjects are significantly more cooperative than non taxed subjects. In a series of experiments, Fehr and Fischbacher (2004) examine the characteristics and relative strength of second and third-party sanctions but also the enforcement mechanisms behind social norms. They hypothesize that third parties may be willing to apply these norms (egalitarian distribution and cooperation norms apply in their experiences) even if sanctioning is costly for them and do not provide any economic benefit. Results show that 2/3 of the third-parties voluntarily punish the violation of distribution norm and the more the norm is violated the stronger the punishment, whereas 60% of third-party punish the violation of cooperation norm.

A second strand of this literature focuses on the trade-off between increased cooperation induced by costly punishment and welfare as well as hidden costs associated to punishment. Nikiforakis and Normann (2008) provide a comparative statics analysis of punishment in PGGs. For this, they examine four different levels of punishment effectiveness in a standard PGG without punishment opportunities. They show that the degree of punishment effectiveness (defined as the factor by which one punishment point reduces the punished player's income) plays a significant role in determining the experimental outcome. A minimum degree of 3 of the punishment effectiveness is required in order to significantly raise contributions over time. Similarly, a punishment effectiveness of 2 is required so that the benefits of higher contribution rates off set the costs of punishment. Bochet et al. (2006) show a willingness to impose costly punishments on other subjects' earnings and that it is mainly targeted at low contributors. As in earlier similar experiments, they conclude that punishment increases contributions but because of its cost its net effect on efficiency is rather low. Punishment opportunities also entails hidden costs that can lead to excessive costly punishment. According to Dickinson and Masclet (2015), free-riders generate negative emotions that encourage excessive punishments. The authors examine the impact of the evacuation of these emotions on the lower level of excessive punishment, while preserving the cooperative incentives created by sanction mechanism. They note

that the evacuation of emotions reduces the punishment, increases contribution levels and in some cases has a positive net effect on final payments. Andreoni et al. (2003) examine both punishments and rewards (individually and jointly) and their effects on cooperation. They identify substantial demands for both options. As expected, an increase in the offer by proposers, on average, decreases the punishment and increases the reward. Curiously, while the average demand for punishment appears to be independent of the reward option, the demand for rewards is significantly larger when the responder doesn't have the option of punishing. In addition, on average, the proposed offer is the largest with both options (rewards plus punishments), and smallest when neither option is available.

Punishment opportunities can also be delegated to third-parties. Almenberg et al. (2011) study a costly punishment by a third-party. Generally, experiments care about a third-party observer who can pay to decrease the payoff of a player who has behaved selfishly (or generously) towards another. In their experiment, third parties have the choice to either punish or reward the player. Results demonstrate a consistent and intuitive pattern: selfish behavior is punished while generous behavior is rewarded. Indeed, costly rewards are at least as common as costly punishments. The preference for rewarding over punishing might be partly explained by a fear of retaliation. In the same vein, Ambrus and Greiner (2012) investigate the effects of a costly punishment option on cooperation and social welfare, in repeated public-good contribution games. They demonstrate that in a perfect monitoring environment, increasing the severity of the punishment increases both contributions and the average net payoffs of subjects. But in a more realistic imperfect monitoring environment, we find a U-shaped relationship between the severity of punishment and average net payoffs. In sum, in a perfect monitoring public-good contribution environment, increasing the severity of a costly punishment option undeniably increases average net payoffs; in an imperfect monitoring environment, the relationship is non-monotonic.

As already mentioned, the experimental literature on PGG also drew particular attention to the impact of communication on individual and collective contributions. In fact, Chaudhuri et al. (2006) use communication in a laboratory experiment where they compare the effect of three different forms of advices (private, public and common knowledge). Across the treatments, players can give an advice to one player, all players, or all players making the experimenter reading the advice. The study demonstrates first, that the contributions are higher in presence of a common knowledge advice. Secondly, that punishing the non-contributive behaviors is not the only way to increase contributions. Indeed, the application of a common knowledge advice can be as efficient as in a socially connected group. Finally, the effect of a mix of communication and punishment on behaviors in a PGG setting has also been investigated. For instance, Bochet et al. (2006) compare

face to face communication, a structured online communication announcing a level of contribution and a non-structured online communication. The possibility of punishment is added at the last step of the game. Results show that face to face communication is the most efficient in increasing the level of contributions. Although the structured online communication do not impact the level of contributions compared to a situation with no communication, interestingly, when punishment is allowed in addition, contributions increase. In our experiment, we aim at comparing the effects of punishment and communication on individual contributions in the context of a PGG applied to the environmental issue of waste recycling. Therefore, the kind of punishment considered consists of a tax (positive or negative) incentive implemented by a third-party depending on the average level of contributions in a given group. On the other hand, the type of communication on which we focus relates to a free advice or recommendation given by a third-party in order to increase the average level of contributions inside a group. This experimental strategy is justified by the existing literature investing the effect of incentive taxation and advice on individual pro-environmental behavior like waste recycling. Considerable literature exists concerning household recycling behavior but it mainly consist of theoretical (Brekke et al., 2003; 2010) or empirical (Viscusi et al., 2011; Cecere et al., 2014) work or of field experiments (Schultz, 1999). To our knowledge, no existing lab experiment investigates these questions.

The related environmental literature has discussed how to encourage or influence households to sort waste or to reduce waste production via the use of monetary incentives, i.e., incentive pricing. For instance, Wertz (1976) examines the effect of incentive pricing on the production of waste. For this purpose, he compares the average production of waste in San Francisco in 1970 to the one of other similar US cities that had not adopted the incentive pricing system. Results show that the generated quantity of waste decreases as the waste tax increases, while waste production increases with income.

In a more systematic study, Jenkins (1993) considers nine American cities, among which five had experienced an incentive pricing system. In this model, households' utility depends positively on the consumption of goods, and negatively on the recycled quantity of waste. Jenkins concludes that incentive pricing is more efficient that a flat tax in order to reduce the quantity of waste. Fullerton and Kinnaman (1996) are interested in the effect of introducing unit pricing, on the quantity of waste produced, the number and weight of waste containers, and the amount of waste recycled. The results show an increase in both volume weight of recyclable materials. However, Van den Bergh (2008) interest in non-monetary instruments to induce desired behaviour. We discuss the results of these related studies in the discussion section.

In this article, we use a PGG lab-experiment to compare the impact of two types of incentives implemented by a third-party: a free advice or a costly punishment (through a

tax) on pro-social motivation in a context of waste recycling. The behavioral repercussions (level of contributions in the PGG) to the common good (a shared dustbin) will show the most efficient incentive to use in order to increase the individuals' cooperation. In order to control for pro-sociality, we take into consideration the different types of individuals profiles (discriminating individualistic, pro-social, competitive and altruistic) using a Social Value Orientation (SVO) measure (Murphy et al., 2011). Moreover, we include an effort task in order to increment initial given endowments, and investigate wealth effects on contributions. The paper is organized as follows. Section 2 describes the experimental design of the experiment. Section 3 presents the results and section 4 concludes with a discussion.

2 Experimental design

The experiment consisted of 18 sessions conducted at the LEEN laboratory located at Nice Côte d'Azur University, France. The 252 participants were mainly undergraduate students recruited using ORSEE (Greiner et al., 2004). No subject participated in more than one session. The experiment was conducted in French and computerized using the Ztree software package (Fischbacher, 2007). On average, participants earned 13.6 euros, including a 5 euro show-up fee. Participants interacted during 10 periods under a once for all random group matching protocol, for an average duration of one hour. The experiment is based on a repeated public-good game with n players, $n \geq 2$ ($n = 4$ for T_0, $n = 5$ for T_1 and T_2) and is composed of three treatments, labeled Baseline (T0), Advice (T1) and Sanction (T2). Each session conducted under any of the treatments consisted of a series of 10 periods. In total, we obtained 720 observations for T0 and 900 observations for the two other treatments (T1 and T2).

All treatments were composed of three stages: two preliminary common stages and one specific stage. **The first stage** consisted of a personal preferences measure based on "The ring Measure of social values" (Murphy et al., 2011; Crosetto et al., 2012). This test, called Social Value Orientation (SVO) test gives a magnitude measure of people's concern for others, through a study of the motivation underlying interdependent decision behaviour, assuming that people have different motivation level in their way of evaluating the allocations between themselves and others. It consists of 15 successive distributive decisions for the players between themselves and an unknown other among a continuum of joint payoffs (see Figure 6 in the appendix). A profile (altruistic, pro-social, competitor or individualist) was computed at the end of the task but not communicated to the players. The latter were however told that one decision out of 15 will be randomly selected in order to determine their payoff at the end of the first step and that the ECUs earned at this

stage will add to the ones obtained in the consecutive steps of the experiment.

In the second stage, the computer randomly assigned groups of 4 players. Each participant was given an initial endowment of 5 ECUs. A real effort task was implemented in order to increment their initial endowment up to a maximum of 10 ECUs depending on their performance. The rationale for this test was to have initial endowments made of a mix of earned and windfall money in order to artificially trigger higher engagement of the participants with the experiment. It consisted of a single screen displaying a number of "sliders" programmed in z-Tree (Fischbacher, 2007) (see Figure 7 in the appendix). The screen was identical across runs and subjects. We chose this effort task because of its simplicity of understanding, also for the very few randomness and guessing, what permits us to see the real effort done by the players. The code implementing the slider task is based on the one developed by Gill and Prowse (2012). It is presented as a screen of 18 sliders going from 0 to 100 positioned at 0, where the players can move the sliders at any integer location between 0 and 100 inclusive, having the possibility to adjust and readjust them an unlimited number of periods during the allotted 60 seconds to adjust at the value 50 exactly. The score points in the task are interpreted as the level effort they exert, converting each 4 sliders correctly positioned to 1 ECU added to the initial endowment.

The core of the experiment constituted the third step, which varied across treatments.

In the **Baseline treatment (T_0)** and in compliance with usual PGG experiments, each player i decides, simultaneously and without communication, how much to contribute to the public good out of her total endowment d_i. This amount constitutes the private individual contribution and is denoted by ci with $0 \leq c_i \leq d_i$. Given an initial endowment of 5 ECUs and a maximum increment of 5 ECUs, $d_i \in (5, 10)$, $c_i \in (0, d_i)$. The total payoff of player i is therefore defined as the sum of her initial endowment net of the amount of the private individual contribution $(d_i - c_i)$ plus a share of the total of the contributions of the members of the group she belongs to, including hers. The exact function form of the utility function for agent i (see equation (1) below) is adapted from Andreoni (1993):

$$u_i = (d_i - c_i + (1 - \frac{1}{n} e^{-\beta \sum c_i}))^{\alpha} (\sum c_i + e^{-\beta \sum c_i})^{1-\alpha} \tag{1}$$

In (1), n denotes the number of members in the group. β is the tax parameter. It is set at 0.5 in the Baseline treatment (T0) and can be raised to 0.01 in the Sanction treatment (T2) in case the sanction is activated. Note that smaller β means a higher tax burden. The left term of the utility function corresponds to the utility of the private consumption of agent i: it is equal to the difference between her total endowment net of her contribution to the public good plus her quote-part of the tax burden imposed by the municipality in order to manage households waste collecting. Note that 1 is added in order to secure strict positivity of the left term. The right term represents the public externality of the contributions of the whole group the agent i belongs to. Furthermore,

the parameters α and β are set such as to meet several Nash equilibria outcomes.

The game is based on the above payoff function, although subjects were not given this formula in the instructions. For the sake of tractability, the values of payoffs for each possible level of individual total endowment k (from k=5 to k=10) depending on performance to and were provided to the participants in the form of two-way tables with the private contribution level (from 0 to k) as the column variable and the sum of the contributions of the three other active members of the group (from 0 to a maximum of 30) as the row variable (see Figure 1 where $k = 5$). For example, a subject with 5 ECUs endowment has to decide on the amount of his contribution from 0 to 5 ECUs, according to her personal preferences and according to amount she anticipates the other members of her group to contribute. In this precise case, the maximum payoff of the period is given by a null contribution $c_i = 0$ and a maximum contribution of the other members of the group as $\sum c_i = 30$.

The Advice treatment (T1) is identical to the Baseline one except that a preliminary stage with an advice from a third-party is introduced. This additional player, called *Advisor*, is randomly selected inside each group. Furthermore, he is asked to wait during the real effort task until the participants of her group finish the task. Then he is given the information about the average endowment of the contributors of the group and suggests, thanks to an advise or a recommendation, a desirable level of individual contribution, which the contributors are free to follow or not. The advisor who does not contribute to the public good gets a payoff corresponding to the average of her group's earnings.

In the sanction treatment (T2), the third-party can sanction through an increase (a decrease of the value of the parameter β) of the tax rate the group if she considers the contributions too low. The use of the modification of the tax rate, i.e., the possibility to punish or not, is close to the idea of Gürerk et al. (2006) who argues that punishment might be more efficient if given by an institution. Note that the third-party is also sanctioned when she decides to raise the tax rate. The positive correlation between contributors' and third-party's well being seems realistic, judging by the reduction of the State well being due to low levels of contributions from the population in a pro-environmental project.

Table 1: Payoffs matrix for 5 ECUs of Endowment in the baseline treatment (T0)

My Contribution

The sum of the contributions of the other members of my group	0	1	2	3	4	5
0	2,4	2,79	3,04	3,08	2,85	2,23
1	3,07	3,41	3,57	3,5	3,17	2,44
2	3,74	3,99	4,05	3,89	3,47	2,64
3	4,38	4,53	4,5	4,25	3,74	2,83
4	4,97	5,03	4,91	4,59	4	3
5	5,51	5,49	5,3	4,9	4,24	3,16
6	6,02	5,92	5,66	5,2	4,47	3,32
7	6,49	6,33	6	5,48	4,69	3,46
8	6,93	6,71	6,33	5,74	4,9	3,61
9	7,35	7,07	6,63	6	5,1	3,74
10	7,75	7,42	6,93	6,24	5,29	3,87
11	8,12	7,75	7,21	6,48	5,48	4
12	8,49	8,06	7,48	6,71	5,66	4,12
13	8,83	8,37	7,75	6,93	5,83	4,24
14	9,17	8,66	8	7,14	6	4,36
15	9,49	8,94	8,25	7,35	6,16	4,47
16	9,8	9,22	8,49	7,55	6,32	4,58
17	10,1	9,49	8,72	7,75	6,48	4,69
18	10,39	9,75	8,94	7,94	6,63	4,8
19	10,68	10	9,17	8,12	6,78	4,9
20	10,95	10,25	9,38	8,31	6,93	5
21	11,22	10,49	9,59	8,49	7,07	5,1
22	11,49	10,72	9,8	8,66	7,21	5,2
23	11,75	10,95	10	8,83	7,35	5,29
24	12	11,18	10,2	9	7,48	5,39
25	12,25	11,4	10,39	9,17	7,62	5,48
26	12,49	11,62	10,58	9,33	7,75	5,57
27	12,73	11,83	10,77	9,49	7,87	5,66
28	12,96	12,04	10,95	9,64	8	5,74
29	13,19	12,25	11,14	9,8	8,12	5,83
30	13,42	12,45	11,31	9,95	8,25	5,92

3 Experimental results

In the first part of this section, we report the descriptive statistics of our data. We also provide non-parametric statistics based on STATA. The second part will then present results based on regression analysis.

3.1 Descriptive statistics

3.1.1 *Main variables*

Table 2 summarizes descriptive statistics on contributions across the three experimental treatments. Considering the mean of the relative contributions (i.e., the absolute level of contributions over the 10 periods divided by the level of initial endowments), we observe that the average behavior of the players display similar features as reported in the literature. According to Ledyard et al. (1997) and Ostrom (2000), the typical efficiency level of contributions in traditional public good games is between 40 and 60%.

Table 2: Statistics on relative contributions (by treatment)

Treatment	Observation	Mean	Standard deviation	Min	Max
T0 'Baseline'	720	0.39	0.27	0	1
T1 'Advice'	900	0.33	0.31	0	1
T2 'Sanction'	900	0.34	0.31	0	1

Table 3 synthesizes the general statistical characteristics of main individual variables of our analysis.

Table 3

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**
Endowment	6.49	0.98	5	9
Absolute Contribution	2.35	2	0	8
Relative Contribution	0.35	0.3	0	1
Average absolute contribution	3	1.1	0.25	6.67
Average endowment	7.19	0.81	6	9
Payoff	7.12	1.69	2.64	12.73
Pro-social	0.44	0.5	0	1
Individualistic	0.52	0.5	0	1
Competitor	0.04	0.19	0	1
Advice	1.53	2.63	0	10
Sanction	0.19	0.4	0	1

From this table, we can find that the average amounts of endowments and absolute contributions are relatively low. The sample is mainly composed of individualistic players (52%), followed by pro-socials (44%) and a very low proportion of competitors (4%). We

also notice that the average amount of the advice is of 1.53, which is far below he average amount of endowment (6.5). As far as the sanction by third-party players is concerned, we find that it is activated in only 19% of the periods on average.

3.1.2 *Evolution of contributions over periods*

Figure 1 shows the average amount contributed to the public good in the three treatments, by period. We observe that average contribution in sanction treatment (T2) exceeds that of the other two treatments. In fact, the average contributions in T2 decrease from 3.6 ECU to 2.5 ECU. In the advice treatment (T1), average contributions are lower starting from 3.4 ECU, and decrease in the last periods. The lowest average contributions are observed in the baseline treatment (T0). Moreover they follow a declining trend, as reported in the literature on PGGs. Figure 1 shows endgame effects, starting from period 8 onwards.

Kruskal-Wallis equality of populations rank tests with the means as observations confirm that average contributions over the 10 periods differ significantly across any of the treatment comparisons. We therefore reject the null hypothesis that the contribution is equal for the three treatments ($X^2(3) = 41.492$, $p = 0.0001$). In fact, the possibility of being sanctioned by the third-party (T2) exerts a stronger effect than the advice provision on the contribution of the players. In sum, both the advice and the potential for being sanctioned enhance the amount of contributions to the public good, with a stronger effect for the threat of sanction.

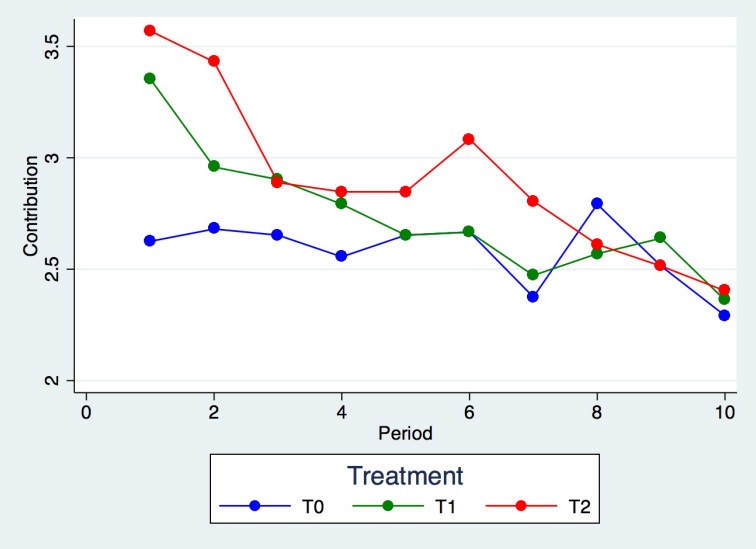

Figure 1: Mean of absolute contributions by periods

3.1.3 *Evolution of payoffs over periods*

Figure 2 shows average payoffs in the three treatments as well as their trend over periods. It appears that the possibility of punishment significantly impact average payoffs, and that higher payoffs are observed in the case of sanction treatment (Kruskal-Wallis test p-value = 0.0001). We already emphasized that average contributions are higher in treatment T2. Consequently, we observe that high contributions lead to higher payoffs. However, we see a decrease of payoffs in the advice treatment, reaching a lower level compared to Baseline treatment between the 5th and 9th period.

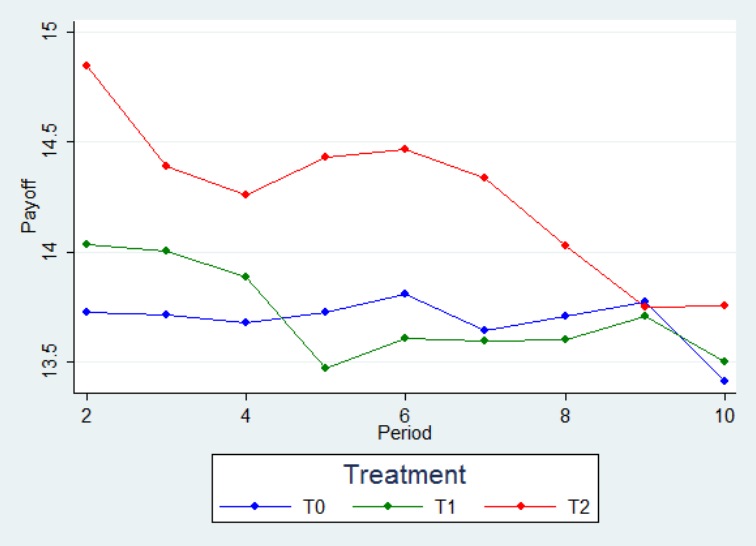

Figure 2: Payoff evolution by periods

3.1.4 *Wealth effects on contributions*

In contrast to usual PGGs in which all subjects are provided with the same initial endowment, in our experimental design, the origin (windfall as well as earned money) and therefore the total amount of initial endowments vary across subjects Kroll et al. (2007). This creates a potential for wealth effects. Figure 3 displays absolute contributions depending on the wealth (level of the endowment), using a dummy variable *High Wealth (Low Wealth)* for players with a greater (lower) endowment than the average endowment of their group. Individuals with relatively lower wealth (as compared to wealthier group members) contribute the same amount to the public good in the Baseline and less in the Sanction treatment, whereas in the Advice treatment they contribute more. By splitting the sample between *High Wealth* and *Low Wealth*, we investigate whether the altruism hypothesis Becker (1974) holds. This hypothesis states that wealthier individuals contribute more in absolute value than poorer ones. We test this hypothesis by comparing average

contributions[1] of the *High Wealth* vs. the *Low Wealth*. Our results corroborates Becker's hypothesis, thus contradicting findings from Buckley and Croson (2006), according to which well-off persons contribute the same as worse-off ones.

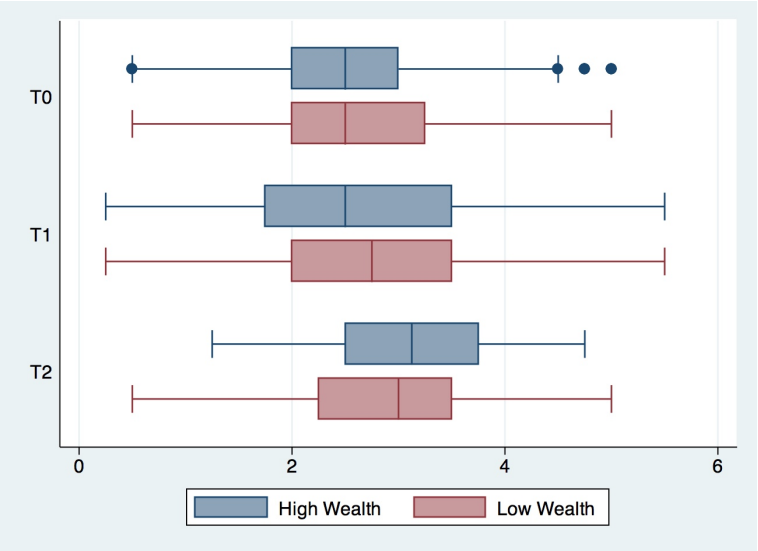

Figure 3: Wealth effect on absolute contributions

3.1.5 *Evolution of contributions depending on social preference profiles*

An interesting question to investigate is whether different Social Value Orientation (SVO) profiles impact on absolute and relative contributions. We hypothesize that pro-social individuals are likely to contribute a larger percentage of their income to the public good as compared to individuals with individualistic or competitive orientations. Figure 4 shows the averages of absolute and relative contributions for each of the social profiles. The figure clearly shows that the competitors contribute less than the pro-socials and the individualists, both in absolute and relative terms. Moreover, the data indicate that relative contributions levels do not significantly differ for individualistic and pro-social profiles. However, it appears that pro-socials tend to contribute more in absolute value.

By looking at the SVO profiles across treatments (see figure 5), we observe that contributions of pro-socials are higher than those of individualists and competitors in all treatments. In treatment T1, competitors contribute slightly more than individualists but less than pro-socials. In treatment T2 (where there is no competitor), we find again that pro-socials contribute only slightly more than individualists.

[1]Baseline treatment (Kruskal-Wallis test p-value = 0.012). Advice treatment (Kruskal-Wallis test p-value = 0.001). Sanction treatment (Kruskal-Wallis test p-value = 0.0012)

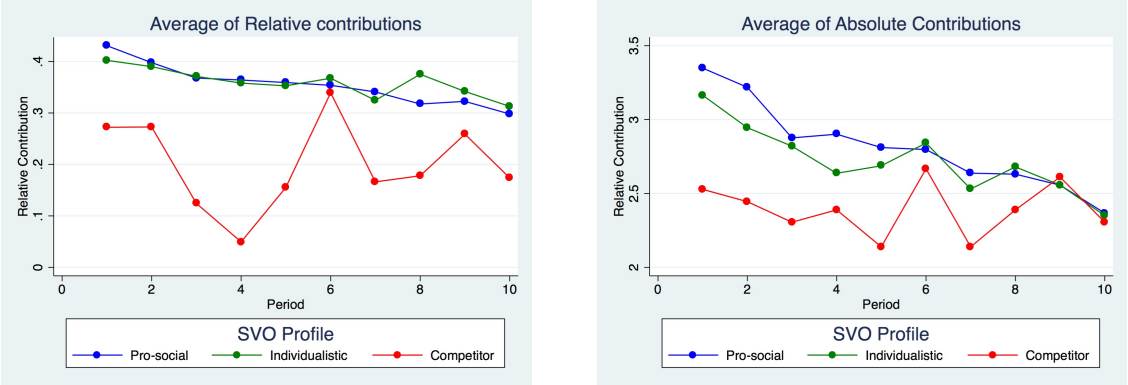

Figure 4: Absolute and relative contributions

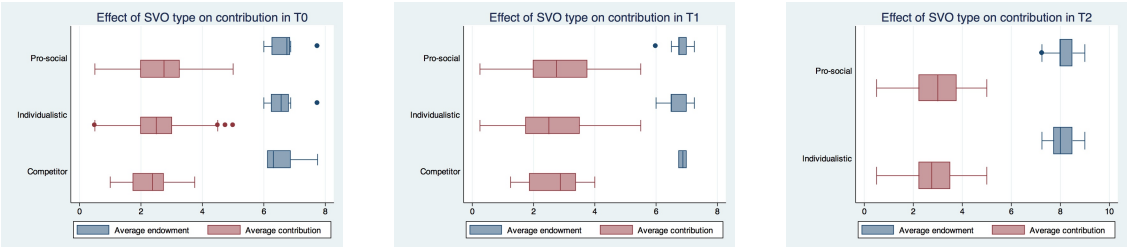

Figure 5: Social Value Orientation impact on contributions

3.2 Regression analysis

3.2.1 A Negative Binomial Model of contributions

In order to confirm our interpretation in terms of aggregate numbers in the previous section, we conduct an econometric analysis of individual decisions. Our experiment set up consists of panel data, which display decisions of participants over 10 periods. We aim at estimating the impact of two treatments (Advice and Sanction) on individual contributions. We use two estimations strategies: first, given the count nature of our dependent variable, we estimate a Negative Binomial Model (NBM)[2]; second we conduct an Ordinary Least Square (OLS) regression. In both models we control for individual characteristics and cluster the standard error around subjects[3]. Table 4 gives the description of the variables used in the econometric analysis.

[2] The Poisson distribution has a few restrictive properties, one of them being that the mean and the variance of the process are equal. In our case $mean = 2.35$ and $variance = 4.02$. The negative binomial is a generalization of the Poisson model that allows for overdispersion

[3] Given the qualitative nature of the variables of our estimation, the Hausman test cannot be used in order to choose between fixed and random effects for NBM. When the Hausman test is rejected, it does not allow using the RE (Baum, 2006). However, FE is not appropriate because it drops important qualitative variables that are fixed among periods and individuals.

Table 4: Variables of the econometrics models

Symbol	Definition
Dependant variables	
Contribution [1]	The amount of individual contribution to public good, from 0 to 10
Advice [2]	The amount of advice, from 0 to 10
Sanction [3]	1 if sanction, 0 otherwise
Independant variables	
Average contribution in $t-1$ [123]	The amount of group's contribution in the previous period
Average endowment in $_{t-1}$ [123]	The amount of group's endowment in the previous period
High Wealth	1 if the endowment is greater than the average group endowment, 0 otherwise
Pro-social [123]	1 for pro-social , 0 otherwise
Individualistic [123]	1 for individualistic , 0 otherwise
Competitor [123]	1 for competitor, 0 otherwise
Payoff in $_{t-1}$ [123]	The amount of individual's payoff in previous period
Advice [1]	The third-party amount of advice, from 0 to 10
Sanction [1]	1 if the third-party punishes, 0 otherwise
No sanction in T_2 [1]	1 if the third-party not punish in treatment 2 , 0 otherwise
No advice in T_1 [1]	1 if the third-party advice of zero in treatment 1 , 0 otherwise

[1]see table 5, [2]see table 6, [3]see table 6

3.2.2 *Contributors' behavior*

Table 5 reports results of our two estimations. In column 1 (NBM), we observe that the average level of contribution in $t-1$ significantly affects the amount of individual contribution: an increase of 1 of the group's level of contribution at period $t-1$ is associated with an increase of 25 % of the amount of individual contribution to public good. The payoff at period $t-1$ is also significant. However, the sign is negative, which means that an increase of 1 of individual's payoff at period $t-1$ decreases individual contributions by 22% . As already emphasized, one original feature of our paper lies in the introduction of a measure of individual social value orientations in order to investigate their impact on individual contributions to public good. Results show that the pro-social and individualistic orientations affect the amount of individual contribution: pro-socials and individualists respectively contribute 61.7% and 57% more than competitors. We also highlight that individuals with a higher endowment ($HighWealth = 1$) contribute more than less endowed ones: an increase of 1 in individual wealth is associated with a 51.4% increase of the amount of individual contribution. Concerning the advice, the models report a significant positive correlation: in other words, an increase of 1 of the third-party advice leads to a 2.4% rise of the individual contribution.

Economists generally advocates the use of monetary sanctions in order to enforce cooperation. The argument runs as follows: by reducing the expected payoffs of non-

cooperative people, punishment makes the cooperation strategy more profitable. However, experimental findings also emphasize motivation crowding out (Frey and Jegen, 2001) due to a non monotonic relation between incentives and motivation Gneezy and Rustichini (2000); Fehr and Falk (2002); Festré and Garrouste (2015). Our experimental results show that the effect of sanction is negative, although not significant. This result runs against the conventional economic literature which takes the monotonicity of the relation between incentives and efforts as granted and therefore mainly highlights the benefits of tax policies (Masclet et al., 2003). By contrast, we do not rule out crowding-out effects (Andreoni, 1993).

More convincingly, results indicates that the threat of being sanctioned exert a disciplinary effect: the effect of the 'No sanction' variable shows that the potential of being sanctioned while not being punished induce participants to contribute significantly more by 46.3% than individuals in the Baseline treatment. Just like the findings of Masclet et al. (2013), we thus assume that simply the threat of sanctions has a positive effect on contributions. In other terms, *The pen is mightier than the sword.*

Table 5: Estimated models of the contributions

	NBM	OLS Model
Average contribution in $t-1$	0.250***	0.665***
Average endowment in $t-1$	0.110	0.253
High Wealth	0.514***	1.078***
Pro-social	0.617**	0.958***
Individualistic	0.570*	0.853***
Competitor	0.000	0.000
Payoff in $t-1$	-0.218***	-0.514***
Advice	0.024*	0.082**
Sanction	-0.062	0.022
No sanction in T_2	0.463***	1.116***
No advice in T_1	-0.231	-0.329
Constante	-0.114	0.582
Constante	-1.572***	
R-squared		0.28
Number of observation	2268	2268

Legend: $^*p < .1$; $^{**}p < .05$; $^{***}p < .01$

3.2.3 *Third-party's behavior*

Table 6 reports the results of two estimated regressions: NBM and marginal effect Probit models to explain respectively the *Advice* (in T1) and the *Sanction* (in T2) from the third-party introduced inside each group of participants to the PGG.

Results show that the individuals' profile does not affect the behavior of the third-party. However, the level of the advice is significantly affected by average contributions and endowments of groups members at period $t-1$. This means that an increase of average contributions and endowments by 1 each translates in an increase of the level of advice of 7.4% and 72.8% respectively. As regards the 'sanction' (T2), only the payoff of groups members at period $t-1$ affects positively the sanction decision.

Table 6: Estimated models of Advice and Sanction

	Advice		**Sanction**	
	NBM	OLS	Probit (ME)	OLS
Average contribution in $t-1$	0.074**	0.330**	-0.027	-0.027
Average endowment in $t-1$	0.728***	3.119***	-0.05	-0.049
Pro-social	-0.036	-0.025	-0.023	-0.023
Individualistic	-0.062	-0.102		
Payoff in $t-1$	-0.002	-0.002	0.041**	0.040**
Constante	-3.642***	-17.653***		0.753
Constante	-1.776***			
R-squared		0.129		0.018
Number of observation	810	810	810	810

Legend: *$p < .1$; **$p < .05$; ***$p < .01$

4 Discussion and conclusion

This paper explores the relative efficiency of advice and sanction from a third-party called the advisor in promoting public good contributions in an artificially reconstructed environmental context. In order to investigate this question, we designed an experiment consisting of three treatments in which the adviser's payoff is correlated with the payoff of the members of the group she belongs to by means of random assignment. The Baseline treatment (T0) is a classical PGG. The advice treatment (T1) includes the advisor who provides, on the basis of observation of the average level of endowments and previous contribution of her group's member's, a recommendation of a desired level of individual contributions. In the sanction treatment (T2), the advisor can exert a collective sanction through an increased tax rate

The four major results of the experiment can be summarized as follows. First, in line with the experimental literature on public goods provision, we observe that individuals contribute more that predicted by the theoretic models based on pure self-interest paradigm. This discard from the predictions is observed in an heterogeneous population regarding to social preferences. In fact, this tendency was observed among the three social preference profile we reported. The experimental pool of subjects composed by a larger part of individualistic and prosocial individuals showed a decreasing level of contributions along the periods, the minority part of competitor players contributed significantly less than the rest of the players.

Second, concerning the relative impact of advice and sanction in promoting cooperation within groups, we find that advising individuals has a positive impact in increasing cooperation, but this impact fades away with time. In fact, after a certain period of time, the advice incentive has no added value compared to a non-incentivized situation.

As explained by Chaudhuri et al. (2006), when the majority of players practice conditional cooperation, an inherent social norm appears in the group, which leads to high levels of contribution, and this without using any threat of effective sanction. However, we observed that the pro-socials who have been advised (in the Advice treatment) contributed significantly less than the pro-socials in the Baseline treatment.

Regarding the impact of sanction, there is a large existing literature showing the mixed effects of sanction such as taxation on cooperation in public good. Our experimental results suggest, that the threat of sanction is more efficient than advice (and than a situation where there is neither advice nor sanction) in prompting significantly higher levels of contributions both in the short and in the long run. This finding echoes results of previous experiments in PGG such as the one of where that cooperation can be increased without applying the sanction like in as in Masclet et al. (2013) where the threat alone (i.e., without ever being carried out) pushes individuals to increase significantly their average

contribution.

The literature reports also that in presence of an institution (such as our third-party), the minority of free riders adjust to the behavior of the majority by increasing their contributions. From our data, we observe that it is not the case since punished individuals in the Sanction treatment continue to free-ride. They do not seem to be influenced either by the fact of being sanctioned or by the majority of contributing partners. Quite the contrary: the more they are punished, the less they contribute in the next periods. Our interpretation is that the fact of being sanctioned is considered as a price to pay for adopting a free rider behavior. This interpretation goes hand in hand with our conjecture that sanction in a form of a tax can crowd out the motivation of prosocial individuals to contribute to the public good.

Third, turning to the impact of wealth heterogeneity on individual behavior, we analyze the absolute contributions as a function of the endowment of the players. Our setting permits us to test the altruism hypothesis which argues that wealthy individuals contribute more in absolute value compared to poorer ones (Becker, 1974). We observe that the population defined as *High Wealth* contributes more in absolute value, which confirms the altruism hypothesis. However, in relative terms, the contributions are not significantly different. An argument found in the literature is that wealthy individuals do not contribute necessarily more than less-endowed ones because of an anticipated reciprocity effect Cherry et al. (2005). This effect stands for the idea that people expect reciprocation of their contributions. They are therefore likely to contribute more when they believe that the other members of the group will act the same. Cherry et al. (2005) links this anticipation effect with the concept of conditional cooperation of Fischbacher et al. (2001) who explain that contribution of an individual is higher as her belief about the contribution of others is optimistic. In our experiment, the *High Wealth* players can infer information about the average endowment of the group members, and thus understand that their partners cannot afford high levels of contribution, or at least not as high as their owns.

Furthermore, we analyze the behavior of the third party by looking at the determinants of the amount of the advice he provides and the decision of giving a sanction. It appears that the amount of the advice is a function of the level of the wealth (endowment) and contributions of the players. To what concern the decision of sanctioning, the third-party based on the earned payoffs only.

Fourth, in addition to experimental data analysis interpretation, we consider the behavioral consequences which provid some useful information to policymakers regarding to environmental protection. Indeed, our behavioral results can help in anticipating impacts of state policiy on individuals reaction to incentives.

The experiment suggests some ways to limit welfare losses associated with waste sorting management conceived as a typical social dilemma. The modified PGG experiment we

performed shows that the threat of sanction from the advisor, which we treated here as a substitute for the State is more efficient in strengthening cooperation than mere advice. It appears also that, contrary to what some believe, if observed relatively to the wealth level, wealthy people do not systematically cooperate more (in relative way). We find same behavioral results from the following empirical data on waste sorting management.

From one hand, Van den Bergh (2008) underlines studies that show that people are not motivated solely by monetary compensation. Van den Bergh (2008) notes that non-monetary instruments can also be used to induce desired behaviour. Therefore, in focusing on social factors such as social norms, peer pressure, intrinsic or extrinsic motivation, we can change individual behaviour. That is why behavioural non-monetary incentives as *Advice* provision are used by public authorities to encourage individuals adopt socially desirable behaviours. In fact, we observe from our experimental results that the non-monetary incentive by the free advice, succeed in increasing group members cooperation, eventhow this effect is persistant in the time.

From an other hand on the tax incentive, the study by Fullerton and Kinnaman (1996) is interested in the effect of introducing unit pricing, on the quantity of waste produced, the number and weight of waste containers, and the amount of waste recycled. The results show, after the introduction of an incentive pricing, a reduction of 14% in the weight of waste collected and an increase of 37% in the volume and 16% increase in the weight of recyclable materials. As in our experimental setting, the tax incentive enhanced cooperation, and thus prosocial behaviors. However, the authors show that, after estimating illegal waste diversion, the decrease in collected waste weight reduced to 10%, which can be assimilated to the free riding behaviors observed in the experimental study. Even if the effect of the incentive pricing remains positive, the authors highlight also several arguments against incentive pricing. First, the administrative and implementation costs are too high; second, 28% to 43% of total waste is diverted away from legal waste flows (illegal dumping, depositing waste in the workplace or in neighbors' bins, and burning of waste). We can consider the first limitation of the cost of tax implemtation as an explanation of the low proportion of sanction application. In fact, the sanction only 19% of the total rounds in sanction treatment. Other studies examine the impact of variant incentive pricing systems (based on waste weight, waste volume, bags, and collection frequency) on the production of total, unsorted, compostable and recyclable waste (Nestor and Podolsky, 1998; Dijkgraaf and Gradus, 2004; Kinnaman and Fullerton, 2000; Ferrara and Missios, 2012). All of these studies show the positive impact of incentive tax (comparing various levels). In fact, this conclusion is in a line with the previous experimental findings.

Palicy makers can thus consider alternatives to monetary incentives as texes as advicing which can provide positive results on behaviors in a short term. However, much remains to be done in order to design such as non monetary tool able to maintain the imact in a

long term. For this reason, the present study suggest to keep sanction by tax application, or at list the threat of it. These results underscore the usefulness of experimental studies of behavioral reaction, and are important in waste sorting managment study.

5 Appendix

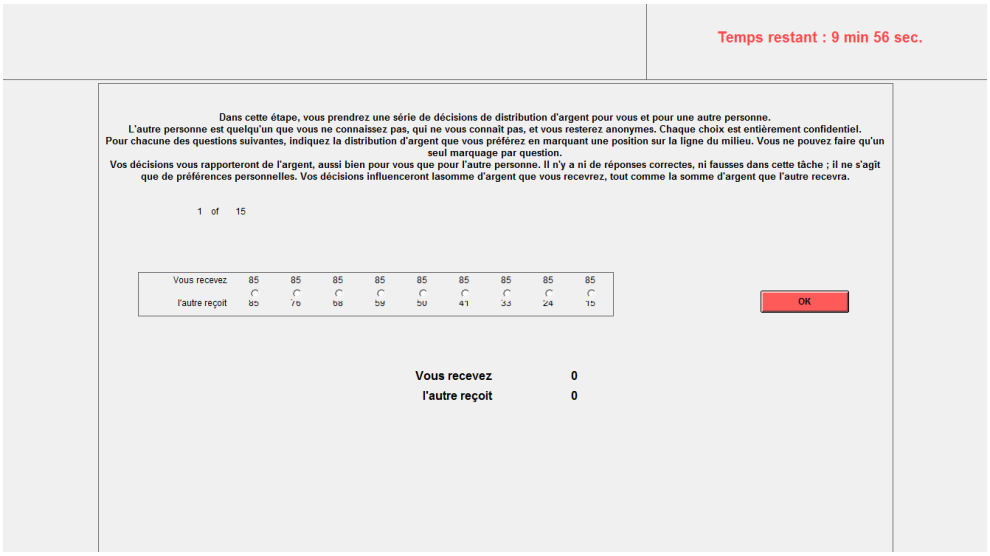

Figure 6: Social Value Orientation Test

English instruction: In this stage, you will take a couple of decisions about ECU distribution for you and for another person. For each following question, please indicate the ECU distribution you prefer by checking a position in the middle line. You may make only one decision by line. Your decisions will earn ECU for you and for the other person. There are neither wrong nor right answers in this task; it is just a matter of personal preferences.

Figure 7: Slider effort task (Gill and Prowse, 2012)

Instructions ***The following text corresponds to English translation of the instructions of baseline treatment (T0). All the parts related to Advice and Sanction Treatments are mentioned between brackets***

Welcome to the Laboratory of Experimental Economics of Nice (LEEN - Nice Lab). You will participate to an experiment where your decisions will be anonymous and will determine in part your final payment, so please read the following instructions carefully. In addition to the earnings collected in the experiment and depending on your decisions, a fixed amount of 50 ECU will be given to you to cover your travel expenses. A variable amount will be added depending on the decisions made during the experiment. The total amount of your payoffs will be paid to you at the end of the experiment after filling out a questionnaire. Concerning the payment, there is strict anonymity with respect to the other participants as well as with respect to us. The currency used in this experiment is the Experimental Currency Unit (ECU). However, at the end of the experience you will be paid in euros according to the exchange rate: 10 ECU = 1 EURO. We ask that you not talk with one another for the duration of the experiment. Please turn-off your cellphones. If you do not follow these rules, the experience will be interrupted and all the payments canceled. If you encounter a technical problem, please raise your hand silently and wait for the experimenter to come and see you. All the people present in this room have exactly the same instructions and will participate to the same experiment.

The experiment consists of 3 steps.

Step 1: We propose to you an exercise in which you must anonymously decide series of money distribution for you and for another person present in the room without knowing at any time who it is. You have to indicate the distribution of money you prefer by marking a position on the middle line. There is no right or wrong answer in this task; it is only personal preference matter. In the example, one person chose to distribute the money so that it receives 85 units, while the other person receives 33 units (see 6). You can do only one choice per question. You will have to answer 15 questions in total. Your decisions will bring you money and the other person. A period among the 15 will be drawn at random and will define your payoff for that first part of the experiment. The conversion of points earned in this part of the experiment will be at a rate of 10 units = 1 ECU and added to the ECUs accumulated during the subsequent stages and converted into euros at the end of the experiment.

End of the first stage of the experiment

Step 2: You will be grouped randomly and anonymously with another 3 participants. The results and information gathered during the experiment will respect your anonymity. Each of you has an initial allocation of 5 ECU. During this stage of the game, you will be invited to participate in a game that will allow you to increment this initial endowment. The amount of your total endowment will be between a minimum of 5 ECU and a maxi-

mum of 10 ECU depending on your performance during the next game.

[*In Advice treatment players are told :* You will be grouped randomly in group of 5 players. Each group will consist of 4 contributors and 1 observer. The results and information gathered during the experiment will respect your anonymity.
The observer : Your role is to observe the behavior of contributors in your group. You will be informed of the average endowment of contributors in your group. You will then advise them on an amount of contribution to a common good. Contributors will have the choice of whether or not follow your advice. *The contributor:* Each of you has an initial allocation of 5 ECU. During this stage of the game, you will be invited to participate in a game that will allow you to complete this endowment.]

[*In sanction treatment after the random groups constitution as in treatment 1, players are told: The observer:* You have to wait for the contributors in your group to complete the previous slider game. You will then have information about the average endowment of contributors in your group.]

How to increase your endowment? The game consists of using the computer mouse to place a maximum of sliders at the center of each slide (see figure 7) so as to show the number 50, and this in a limited time A total of 60 seconds. At the end of the allotted time, the number of well placed cursors will be converted into ECU, at the rate of: 4 well placed cursors = 1 ECU. In this example, the participant has managed to place well 4 sliders on the slides, which earns him 1 extra ECU. You will notice that the cursors placed on the digits 49 and 51 have not been validated. The task is to set the value 50 exacly! So the endowment of this participant for all the rest of the experiment will be equal to: 5 ECU + 1 ECU = 6 ECU, i.e., the amount in ECU allocated to the start of the experiment + the additional amount in ECU earned through play slides = the total amount in ECU to be used during the rest of the experience.
End of the second stage of the experiment

Step 3: Now that your endowment is incremented, you now have the opportunity to transfer a portion of it to contribute to a common good (for example, a device to better manage household waste). The proportion that you decide to allocate to the common good will potentially reduce the total cost of waste management in your group. The greater the collective contribution, the greater the cost reduction. The experiment will be repeated ten times in succession (10 periods) within the same group.

Calculation of earnings: To help you make decisions, please refer to the table for the amount of your endowment. The following tables present a simulation of your earnings based on the amount of your endowment, the amount of your contribution and the total

amount contributed by your group members. (see example in 1 for endowment = 5 in baseline treatment)

[*In advice treatment, the third party is given the information about his payoff as follow : The observer:* Your payoff is equal to the average earnings of contributors in your group.]

[*In sanction treatment:*

The Observer : Your role is to observe the behavior of contributors in your group. You will be able to sanction them collectively if you consider that the average contribution of the group to the common good is not sufficient. This penalty is costly to you as your payoff is related to the average contributors payoffs in your group. At the end of each round, you will be informed of the average contributions within your group. You will then be able to maintain the calculation of earnings as it is, or else exercise you can apply the penalty through a higher tax rate. The experience will be repeated ten times 10 rounds in a row in the same groups and with the same roles for each of you.

The contributors: To help you make decisions, please see the table for the amount of your endowment. The following tables present a simulation of your payoff according to: The amount of your endowment; The amount of your contribution; The amount of the total contribution of the members of your group. In summary: your total payoff will depend on: 1) the decision of the observer to apply or not the sanction, 2) the share of private gain linked to private consumption, and 3) on the part of the individual gain resulting from the collective behavior of your group. It may happen that the latter share outweighs that associated with private consumption.]

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