# CeDEx

**CENTRE FOR DECISION RESEARCH & EXPERIMENTAL ECONOMICS**

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

## A Self-Funding Reward Mechanism for Tax Compliance

Enrique Fatas, Daniele Nosenzo, Martin Sefton and Daniel John Zizzo

August 2015

CENTRE FOR DECISION RESEARCH & EXPERIMENTAL ECONOMICS

The Centre for Decision Research and Experimental Economics was founded in 2000, and is based in the School of Economics at the University of Nottingham.

The focus for the Centre is research into individual and strategic decision-making using a combination of theoretical and experimental methods. On the theory side, members of the Centre investigate individual choice under uncertainty, cooperative and non-cooperative game theory, as well as theories of psychology, bounded rationality and evolutionary game theory. Members of the Centre have applied experimental methods in the fields of public economics, individual choice under risk and uncertainty, strategic interaction, and the performance of auctions, markets and other economic institutions. Much of the Centre's research involves collaborative projects with researchers from other departments in the UK and overseas.

Please visit http://www.nottingham.ac.uk/cedex for more information about the Centre or contact

Suzanne Robey
Centre for Decision Research and Experimental Economics
School of Economics
University of Nottingham
University Park
Nottingham
NG7 2RD
Tel: +44 (0)115 95 14763
Fax: +44 (0) 115 95 14159
suzanne.robey@nottingham.ac.uk

The full list of CeDEx Discussion Papers is available at

http://www.nottingham.ac.uk/cedex/publications/discussion-papers/index.aspx

# A Self-Funding Reward Mechanism for Tax Compliance

24/08/2015

Enrique Fatas[*], Daniele Nosenzo[**], Martin Sefton[**] and Daniel John Zizzo[***]

Abstract

We compare in a laboratory experiment two audit-based tax compliance mechanisms that collect fines from those found non-compliant. The mechanisms differ in the way fines are redistributed to individuals who were either not audited or audited and found to be compliant. The first, as is the case in most extant tax systems, does not discriminate between the un-audited and those found compliant. The second targets the redistribution in favor of those found compliant. We find that targeting increases compliance when paying taxes generates a social return. We do not find any increase in compliance in a control treatment where individuals audited and found compliant receive symbolic rewards. It is not the mere assigning of rewards, but the material incentives inherent in the rewards that improve compliance. We conclude that existing tax mechanisms have room for improvement by rewarding financially those audited and found compliant.

*Keywords*: tax evasion, rewards, audits.

*JEL Classification Codes*: C91, J26.

[*] School of Economics, University of East Anglia
[**] School of Economics, University of Nottingham
[***] BENC and Newcastle University Business School, Newcastle University

# 1. Introduction

A standard mechanism for encouraging tax compliance, and the mechanism used most widely by tax authorities, is an audit-based deterrence mechanism. Individuals are randomly audited and those found non-compliant are punished. In this paper we report an experiment investigating whether the standard mechanism can be improved by incorporating positive rewards for those found compliant. Our experiment differs from previous studies on the use of rewards for promoting tax compliance in that we study a fully self-funded mechanism. Moreover, our experiment is designed to disentangle different behavioral explanations for compliance.

The rationale for rewards goes back to traditional elements in tax compliance: auditing and sanctioning. The use of audits allows authorities to place individuals in one of three categories, i) individuals who have been found to be non-compliant; iii) individuals who have been found to have complied, and iii) individuals who have not been audited. Current practice penalizes individuals in the first category, but does not distinguish between the second and third. In fact, individuals in the second category may be penalized if audits are costly and inconvenient for them. In this paper we explicitly consider the potentially positive effects of discriminating between the latter two categories, by introducing a mechanism that rewards individuals who are audited and found to be compliant. Note that our mechanism rewards honest taxpayers by using the information collected from the standard auditing process, so no additional information (and auditing cost) is needed.

Theoretically optimal audit schemes often prescribe rewards to those audited and found compliant (Border and Sobel, 1987; Mookherjee and Png, 1989), but these are rarely used in practice. One possible reason for the absence of rewarding systems is that a reward-based scheme that increases compliance will require additional rewards to be paid, and funding these rewards may be costly; this may be politically unpopular and constitutes a barrier to using such schemes.[1] Only recently, different tax agencies have implemented lotteries that may be interpreted as probabilistic rewards. Naritomi (2013) reports on the program carried out by the Sao Paolo state government. Consumers receive monetary rewards (lottery tickets) if they asked merchants for receipts. The paper reports a significant increase in the tax revenue in retail sectors (around 23%) over four years. Wan (2010) and Fabri (2013) analyze similar schemes in China. Note that these lottery systems are designed to motivate consumers

---

[1] Another possibility is that rewards may crowd out intrinsic motivation to pay taxes, with an unclear net effect.

to get a receipt from the merchant, who is then induced to increase his tax compliance. Notably, rewards (i.e. lottery prizes) are not targeted at the taxpayer and are exogenously introduced into the system, so lotteries could fail to be self-funded if the positive impact on compliance is not enough to cover the cost of the rewards.

Previous laboratory experiments on tax compliance have mainly focused on mechanisms involving fines [2] (Andreoni et al., 1998; Alm, 2012, contain surveys). We are aware of only a few laboratory studies of tax compliance mechanisms incorporating rewards: Alm et al. (1992a), Bazart and Pickhardt (2011), Kastlunger et al. (2011) and Fochmann and Kroll (2014). These designs essentially offer an additional, exogenous, incentive to comply and, perhaps unsurprisingly, find that compliance rates increase. Again, the benefits from increased compliance should be set against the cost of using rewards.

The mechanism we study is a fully self-funded reward mechanism in the sense that rewards are directly funded from penalties. Specifically, in our mechanism the fines from non-compliant individuals are transferred to compliant individuals as far as this is possible. In the extreme case in which all audited individuals are non-compliant the fines are still added to the tax revenue, and distributed to non-audited taxpayers. In the other extreme, if all audited individuals are found compliant, no fines are collected, and no rewards are distributed, so no additional funds are required.[3] To study the effectiveness of this mechanism we implement it in a *Targeted* treatment (so named since the resources collected from fines are targeted towards honest taxpayers) and compare this with an *Untargeted* treatment where we use a standard deterrence-based mechanism in which fines are incurred by those caught evading taxes and fine revenue is redistributed equally among non-audited individuals and individuals who are audited and found to be compliant.

Our laboratory reward mechanism may be successful for a variety of reasons, quite apart from the intended incentive effects. One reason is that rewards may trigger an experimenter demand effect. Our participants could interpret the existence of rewards as an indication of desired behavior and comply because they simply want to conform with the desired behavior (see Zizzo, 2010, and Karakostas and Zizzo, 2014, for analysis of demand effects in the

---

[2] We specifically mean fines that are redistributed to taxpayers without discriminating between non-audited taxpayers and taxpayers found compliant. Some of the studies incorporate a public good element, which may be partially funded by fines.

[3] Note that our mechanism always has consequences on the distribution of income, so some honest taxpayers benefit from rewards (if audited and found compliant) while some others, honest or dishonest, do not (if they are not audited). At the social level, there is never a need to feed additional resources into the system to fund the rewards mechanism.

laboratory). Relatedly, participants could believe that the reward induces such a response from others and increase compliance because of social preferences that dictate complying when others are willing to do so. To control for these factors we also conduct a *Symbolic* treatment using a mechanism in which those audited and found compliant receive a negligible fixed reward.

We also systematically manipulate the amount dishonest taxpayers have to pay if caught (fines may be small, medium or high) and the social benefits participants may get from the compliant behavior of others (zero or positive). By exploring each combination of parameters we are able to identify whether compliance survives the elimination of social benefits, and control for other-regarding preferences, and whether compliance is driven primarily by deterrence (high fines). Moreover, we systematically control for the effect of rewards on beliefs by eliciting subjects' compliance expectation in an incentive compatible way.

Our results suggest that rewards significantly and substantially increase compliance only when taxes generate some social benefits. In particular, compliance is higher in our Targeted treatment and cannot solely be explained by errors, social preferences or overoptimistic beliefs. Notably, we do not find differences between our Untargeted and Symbolic conditions. The remainder of the paper is organized as follows. In the next section we describe our experimental design and procedures. We present our results in section 3, discuss them in section 4 and conclude in section 5.

## 2. Experimental design and procedures

### 2.1 Experimental design

Our experimental design involved three between-subjects treatments, which we label *Untargeted*, *Targeted* and *Symbolic*, each involving groups of 9 subjects. All treatments were based on linear public good contribution games with tax audits. In every game subjects simultaneously chose whether to keep an endowment of £10 or whether to pay taxes that would generate a return of $y$ for each group member ("comply" in what follows). In each group, three out of nine subjects were then randomly selected and audited. Audited subjects that were found non-compliant had to pay a fine $f$, whereas no fine was paid if an audited subject was found compliant. In all treatments, there were six games, each involving different combinations of public good return $y$ (£0 or £2) and fines $f$ (£0, £3 and £6). Table 1 shows the values of $y$ and $f$ in each of the six games.

**Table 1: Experimental Games**

| Game | $y$ | $f$ |
|:---:|:---:|:---:|
| 1 | £0 | £0 |
| 2 | £0 | £3 |
| 3 | £0 | £6 |
| 4 | £2 | £0 |
| 5 | £2 | £3 |
| 6 | £2 | £6 |

Our three treatments varied in how the fines collected from non-compliant subjects were redistributed across group members. In Untargeted, the money collected from those audited and found to be non-compliant was evenly redistributed across all other subjects. In Targeted, the fines were used as targeted rewards for audited subjects found to be compliant. In particular, label $n_c$ and $n_n$ as the number of subjects found compliant and non-compliant, respectively. If a subject was audited and found compliant, he or she earned a reward equal to $(n_n \cdot f / n_c)$. If no audited subject was found compliant, the money collected from fines was evenly redistributed across all non-audited subjects. The Symbolic treatment combined elements of the Untargeted and Targeted treatments: as in Untargeted, the money collected from those audited and found non-compliant was evenly redistributed across all other subjects; as in Targeted, compliant subjects received a reward. However, unlike in Targeted where the reward is endogenous, the Symbolic treatments used a fixed reward of £0.05, the smallest money unit used in our experiment. The £0.05 reward has little monetary value, but may nevertheless carry more significant psychological or normative value for subjects.

Assuming that subjects are risk neutral and care only about their own monetary payoffs, in all games and in all treatments, there is a unique Nash equilibrium where no subject complies.[4] However, there is ample evidence in the experimental literature that individuals often depart from such predictions. In the tax compliance experimental literature subjects pay taxes even though they maximize expected earnings by evading (e.g. Alm, et al., 1992b). Similarly, in the context of public goods games, many subjects contribute to the public good even when they have no material incentive to do so (see Ledyard, 1995 and Chaudhuri, 2011 for reviews of the literature). Voluntary payment of taxes or voluntary contributions to a public good could be due to a variety of reasons, for example errors, moral compliance norms, or social preferences. Based on this, it is reasonable to expect that, in some of our games, subjects may comply to some extent, even though the benchmark prediction is that they should not.

---

[4] See Appendix A for details.

Our parameters were chosen to discriminate among alternative explanations for compliance and include some interesting special cases. When $y = 0$ there are no social returns from contributing, and so this condition controls for motives based on social preferences. When in addition $f = 0$ the decision problem is essentially an individual decision problem in which a player's action has no effect on others and there are no incentives at all to comply. The degree to which subjects comply in this case can be seen as a control for any inbuilt bias for compliance due, for example, to confusion (Andreoni, 1995; Houser and Kurzban, 2002) or a pure social norm to comply (Karakostas and Zizzo, 2014). We also used parameterizations where taxes generate social benefits ($y = 2$) and varying positive fines ($f = 3, 6$).

We expect any positive compliance rate to be higher with $y = 2$ than with $y = 0$, as not only subjects with a concern for others' payoffs may prefer to comply, but also the opportunity cost of complying decreases if there is a public good return. Similarly, compliance should be higher the higher the fine $f$, as increases in $f$ raise the expected cost of non-compliance.

It is worth noting that the opportunity cost of compliance is almost the same in all treatments if $f = 0$ or if all other taxpayers are compliant (with a relatively minor difference in the *Symbolic* treatment, as honest taxpayers who are audited get the symbolic payment). However, if $f > 0$, for a given number of others who are non-compliant, the opportunity cost of complying becomes comparatively smaller in *Targeted* relative to *Untargeted* and *Symbolic*. Thus, with positive fines, and as long as the experimental manipulation of mechanisms does not alter subjects´ beliefs about the overall compliance level we would expect higher compliance in the Targeted treatment. Because of that, we systematically control for beliefs in the second part of the experiment, as the next section explains.

*2.2 Experimental procedures*

The experiment was programmed in zTree (Fischbacher, 2007) and run at the University of East Anglia. Subjects were invited from the CBESS subject pool using ORSEE Greiner (2004).[5] In total 162 students participated in nine sessions (18 subjects per session), earning £12.71 for ninety minutes on average. No subject took part in more than one session. All instructions were provided in a neutral frame.[6] Every session consisted of two parts. Before starting with Part 1, participants were randomly selected into groups of nine and remained in the same group for the rest of the session, i.e. for Part 1 and 2.

---

[5] The subject pool of the Centre for Behavioural and Experimental Social Science (CBESS) mainly contains university students.

[6] The experimental instructions can be found in Appendix B.

*Part 1*

At the beginning of Part 1, subjects received instructions that were also read aloud by the experimenter, and that did not include details of Part 2. Part 1 consisted of six tasks, each corresponding to one the six games shown in Table 1; the tasks were presented to subjects in randomized order with no feedback until the end of the experiment. Subjects learned that their final earnings in each task would be the sum of their *decision* earnings and their *selection* earnings for that task. Both types of earnings were explained in detail and the subjects understanding of how earnings were calculated was checked before making any decisions.

In each of the six tasks subjects saw a "decision earnings" payoff table similar to the one in Figure 1. Subjects were asked to either choose A (corresponding to non-compliance) or B (corresponding to compliance).

**Figure 1: Decision earnings of one out of six part 1 tasks**

| Decision earnings: | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Overall number of group members choosing B: | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Earnings of a group member who chooses A | 10.00 | 12.00 | 14.00 | 16.00 | 18.00 | 20.00 | 22.00 | 24.00 | 26.00 | - |
| Earnings of a group member who chooses B | - | 2.00 | 4.00 | 6.00 | 8.00 | 10.00 | 12.00 | 14.00 | 16.00 | 18.00 |

Notes: Example with *y* = 2. Note that for y=0, earnings of a group member who chooses A are always 10 and earnings of a group member who chooses B are always 0.

Subjects were informed that, for each task, the computer would choose three out of nine members of a group at random.[7] Subjects were also carefully informed about the consequences of being selected (audited) and found non-compliant. If a selected subject chose A in that task, he/she would be fined for doing so and received negative selection earnings. If the selected subject chose B, he/she would either get zero or positive selection earnings, depending on the treatment and the decisions made by the other audited participants. The calculation of the selection earnings for all subjects varied across treatments as described in section 2.1.

Before making any decisions subjects were also provided with and trained to use an "earnings calculator" that could be used to calculate the final earnings for all subjects, for arbitrary

---

[7] The realization of the random draw was disclosed to subjects only after they had made their choices in all six Part 1 tasks.

inputs. Subjects were required to fill short questionnaires controlling whether they understood the experimental set up of Part 1. All subjects had to answer all questions correctly before proceeding to the actual tasks of Part 1. After finishing all six tasks of Part 1 (choosing either A or B for six different payoff tables), subjects received additional instructions for Part 2.

*Part 2*

Part 2 had another six tasks. Each of the games presented in Part 1 was presented again in randomized order, but this time subjects were asked to provide an estimate of how many subjects in their group chose B in Part 1 for that given game. This belief elicitation was incentivized such that subjects whose stated beliefs exactly matched the actual number of B choices in their group received an additional £3 and those within the range of +/-1 received an additional £1.50.

The experiment concluded with a question to measure risk attitude (based on Charness and Villeval, 2009, and Charness and Gneezy, 2010);[8] with the Social Desirability Scale (Stöber, 2001) 16 items questionnaire,[9] that may be helpful to measure the individual sensitivity to comply out of a perceived social or experimental pressure to do so; and with standard demographic questions.

Payment followed. A random incentive lottery system was used by which only one of the tasks, randomly determined, was paid for real from each part. Subjects did not know which tasks were selected until the end of the experiment.

## 3. Results

The 162 subjects were equally distributed across treatments, resulting in 54 subjects per treatment. Table 2 shows that samples were well balanced across treatments with respect to age and gender, though with fewer economics major students in the Symbolic treatment;[10] this will be controlled for in the regression analysis in section 3.3.

---

[8] The question asked: "Suppose that in a lottery game the possibility to win £1,000 is 10%. How much would you pay at most to buy a lottery ticket?" and subjects responded by entering a whole amount in British Pounds. In the regressions of section 3 we will rescale subjects' responses by dividing each amount by 100.

[9] The scale can be found at http://www.erzwiss.uni-halle.de/gliederung/paed/ppsych/sesds17.pdf in its 16 items version.

[10] Wilcoxon $p < 0.001$. Throughout the paper, all p-values are for two-sided tests. All tests are at the level of individual subjects (using individual-level averages when needed to control for non-independence of observations by the same subjects). Note that subjects receive no information about other subjects' decisions until the end of the experiment.

<div align="center">

**Table 2: Sample characteristics**

</div>

| | *Untargeted* | *Targeted* | *Symbolic* |
|---|---|---|---|
| Age [years] | 23.06 (4.88) | 22.78 (4.73) | 22.74 (4.32) |
| Gender: Male [%] | 46.30 (49.94) | 44.44 (49.77) | 40.74 (49.21) |
| Economics [%] | 20.37 (40.34) | 20.37 (40.34) | 9.26 (29.03) |

Notes: means, standard deviations in parentheses

*3.1 Compliance Rates*

Figure 2 shows average compliance rates across treatments for different combinations of $f$ and $y$. In all treatments the observed compliance rates are significantly higher than the benchmark prediction of total non-compliance, but vary considerably across games. The broad patterns of compliance show that subjects respond to incentives in an intuitive way, which reflects our conjectures outlined in section 2.1. When $f = 0$ and $y = 0$, the compliance rate is about 8% across all treatments. As $f$ and $y$ increase, mean compliance rates broadly increase in all treatments, in line with our priors. Compliance rates tend to be higher when there is a public good return from compliance ($y = 2$) than when there is not ($y = 0$), and the effect is particularly marked in the Targeted treatment.[11] They also tend be higher with high ($f = 6$) than with low ($f = 3$) or zero ($f = 0$) fines.[12]

---

[11] Wilcoxon p = 0.001 for the Targeted treatment, with Wilcoxon p = 0.057 for Untargeted and 0.058 for Symbolic.

[12] In relation to $f = 6$ vs. $f = 0$, Wilcoxon p < 0.001, < 0.001 and = 0.002 for Targeted, Untargeted and Symbolic, respectively. In relation to $f = 6$ vs. $f = 3$, Wilcoxon p = 0.008, 0.008 and 0.057 for Targeted, Untargeted, and Symbolic, respectively. There is no statistically significant difference between $f = 0$ and $f = 3$ (p = 0.406, 0.185 and 0.199 for Targeted, Untargeted and Symbolic, respectively).

**Figure 2: Percentage of compliant choices across treatments**
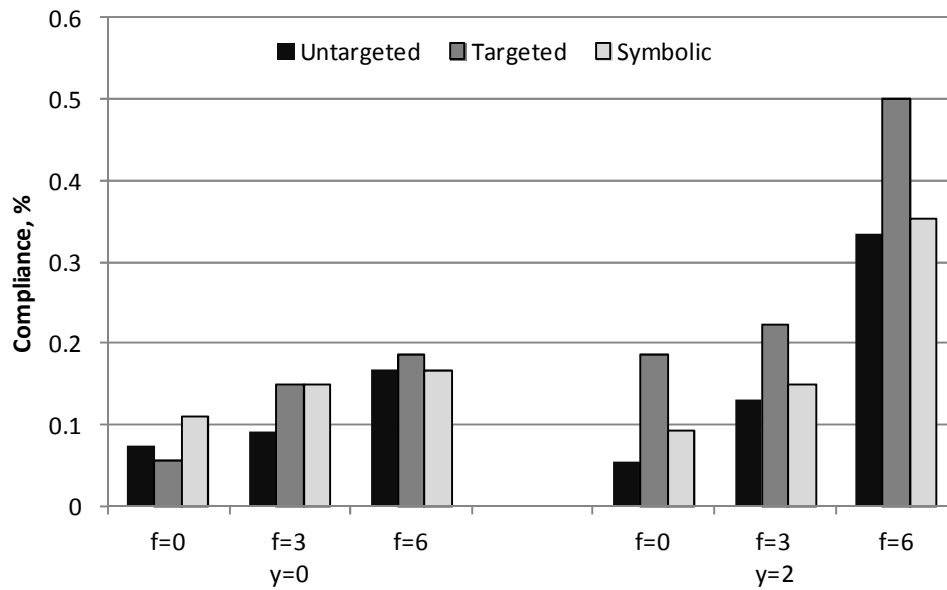


What makes rewards effective? By inspection, Figure 2 shows that treatment differences are driven by decisions made under $y = 2$. None of the across-treatment differences are significant under $y = 0$,[13] but compliance under *Targeted* is clearly higher than that under *Untargeted* or *Symbolic* under $y = 2$.[14] This is preliminary evidence for the conclusion that targeted rewards are effective in raising tax compliance and that their effectiveness does not stem from its symbolic value. We will find further support for this conclusion in the regression analysis of section 3.3.

Beyond Figure 2, and given that all our participants made decisions in each of the six-parameter combinations of *f* and *y*, it is possible to see whether the intensity of compliance (number of compliant decisions at the individual level) changes across the different treatments.

---

[13] Mann-Whitney p = 0.349, 0.565 and 0.745 for Targeted vs. Untargeted, Targeted vs. Symbolic, and Symbolic vs. Untargeted, respectively.

[14] Mann-Whitney p = 0.014, 0.049 and 0.565 for Targeted vs. Untargeted, Targeted vs. Symbolic, and Symbolic vs. Untargeted, respectively.

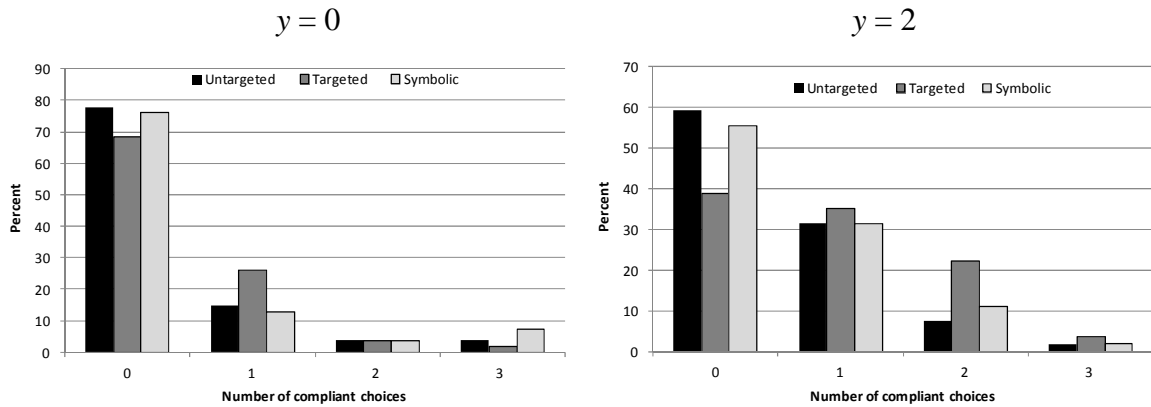**Figure 3: Total number of compliant choices per subject, across treatments**

$y = 0$                                               $y = 2$



Figure 3 shows the total number of compliant choices per subject, across treatments, pooling their decisions in two scenarios: *y=0* and *y=2*. We define *free riders* as the subjects who make zero compliant choices in the experiment. Under $y = 0$, the percentage of *free riders* was very similar across treatments: 68% in Targeted, 76% in Symbolic and 78% in Untargeted.[15] Under $y = 2$, instead, while the percentage was still basically the same in Untargeted (59%) and Symbolic (56%), it dropped to just 39% in Targeted.[16] Therefore, and in line with the results presented in Figure 2, the percentage of free riders went down only when the targeted rewards mechanism operates.

*3.2 Beliefs*

Figure 4 shows subjects' beliefs of compliance in each of the six games of our three treatments. The height of each bar is the average across all subjects of the (incentivized) guess about how many other members of the group are compliant. The observed patterns in the beliefs of compliance mirror the observed patterns in actual compliance rates, although most pairwise treatment comparisons are not statistically significant.[17] Spearman correlations between choice to comply and belief about the number of other subjects complying are always positive and significant for all six $(y, f)$ combinations, and range between 0.165 (p = 0.036) and 0.375 (p < 0.001).[18] Subjects expect others to comply less when $y = 0$ than when $y$

---

[15] $\chi^2$ test p = 0.278, 0.390 and 0.820 for Targeted vs. Untargeted, Targeted vs. Symbolic, and Symbolic vs. Untargeted, respectively.

[16] $\chi^2$ test p = 0.034, 0.083 and 0.697 for Targeted vs. Untargeted, Targeted vs. Symbolic, and Symbolic vs. Untargeted, respectively.

[17] The two significant comparisons are for Targeted vs. Untargeted $(y = 2, f = 0)$ (p = 0.053) and for Targeted vs. Symbolic $(y = 2, f = 0)$ (p = 0.051).

[18] The correlations are computed pooling across treatments for statistical power reasons. The largest correlation is for $(y = 2, f = 6)$ and the smallest for $(y = 2, f = 0)$. That said, subjects over-estimate the compliance rates of others; see Appendix C for more details. Appendix C also presents and discusses the finding that compliant

10

$= 2.$[19] Beliefs of compliance also increase in the level of the fine $f$, significantly so for all treatments in comparing $f = 6$ with $f = 0$.[20]

**Figure 4: Belief about number of other subjects complying**
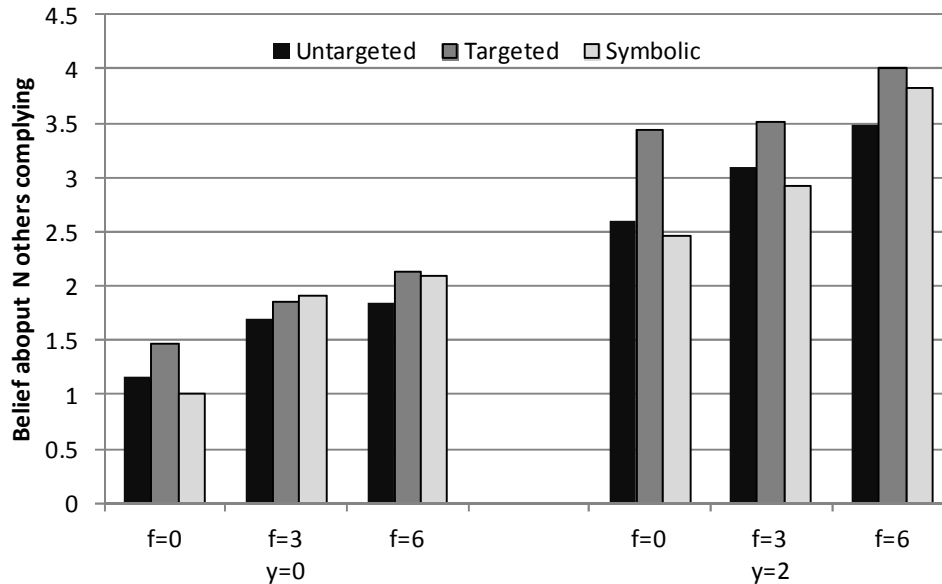


*3.3 Regression analysis*

Table 3 contains Logit regressions with standard errors clustered at the subject level to control for non-independence of observations. We estimate separate models for $y = 0$ and $y = 2$. The dependent variable is a binary variable indicating whether a subject complies or not. The independent variables include dummy variables for the Targeted and Symbolic treatments (we thus use the Untargeted treatment as the benchmark category). Additional independent variables included control variables for whether subjects have an Economics major background (=1 if so), are male (=1 if so), their age, and their risk and social desirability scale scores as measured by the relevant questions (*Risk* and *SDS*, respectively). Models 2-3 and 5-6 also include a variable capturing the level of the fine $f$, and models 3 and 6 include the *Belief of compliance* (that is, the number of subjects believed complying).

---

subjects expect higher compliance rates from others than non-compliant subjects do, particularly in the Targeted and Symbolic treatments.

[19] Wilcoxon $p < 0.001$ in all treatments. Appendix C shows the belief distributions in the three treatments against different $(y, f)$ combinations.

[20] In relation to $f = 6$ vs. $f = 0$, Wilcoxon $p = 0.059$, $0.010$ and $< 0.001$ for Targeted, Untargeted and Symbolic, respectively. In relation to $f = 6$ vs. $f = 3$, Wilcoxon $p = 0.270$, $0.466$ and $0.123$ for Targeted, Untargeted, and Symbolic, respectively. In relation to $f = 3$ vs. $f = 0$, Wilcoxon $p = 0.303$, $0.066$ and $0.009$ for Targeted, Untargeted, and Symbolic, respectively.

11

**Table 3: Regression analysis on the choice to comply**

**(a) $y = 0$**

| Dep var: 1 if comply | (1) | (2) | (3) |
|---|---|---|---|
| Targeted | -0.001 | -0.001 | -0.002 |
| | (0.046) | (0.045) | (0.043) |
| Symbolic | -0.008 | -0.008 | -0.001 |
| | (0.053) | (0.052) | (0.049) |
| $f$ | -- | 0.014*** | 0.011** |
| | -- | (0.005) | (0.005) |
| Belief of compliance | -- | -- | 0.022*** |
| | -- | -- | (0.006) |
| Economics | -0.033 | -0.032 | -0.034 |
| | (0.041) | (0.040) | (0.034) |
| Male | -0.047 | -0.045 | -0.033 |
| | (0.037) | (0.036) | (0.032) |
| Age | 0.003 | 0.003 | 0.001 |
| | (0.003) | (0.003) | (0.002) |
| Risk | -0.016 | -0.016 | -0.012 |
| | (0.018) | (0.018) | (0.017) |
| SDS | 0.017** | 0.016** | 0.011 |
| | (0.008) | (0.008) | (0.007) |
| $\chi^2$ test Targeted = Symbolic, p-value | 0.882 | 0.883 | 0.956 |
| $N$ | 486 | 486 | 486 |

**(b) $y = 2$**

| Dep var: 1 if compliant choice | (4) | (5) | (6) |
|---|---|---|---|
| Targeted | 0.114** | 0.116** | 0.103* |
| | (0.056) | (0.058) | (0.055) |
| Symbolic | -0.010 | -0.010 | 0.003 |
| | (0.056) | (0.055) | (0.053) |
| $f$ | -- | 0.047*** | 0.042*** |
| | -- | (0.007) | (0.007) |
| Belief of compliance | -- | -- | 0.037*** |
| | -- | -- | (0.008) |
| Economics | -0.082* | -0.080* | -0.076* |
| | (0.045) | (0.043) | (0.040) |
| Male | 0.009 | 0.009 | 0.010 |
| | (0.043) | (0.043) | (0.040) |
| Age | 0.000 | 0.000 | -0.000 |
| | (0.007) | (0.007) | (0.006) |
| Risk | -0.032** | -0.032** | -0.026* |
| | (0.016) | (0.015) | (0.014) |
| SDS | 0.012 | 0.012 | 0.007 |
| | (0.008) | (0.008) | (0.008) |
| $\chi^2$ test Targeted = Symbolic, p-value | 0.019 | 0.019 | 0.043 |
| $N$ | 486 | 486 | 486 |

*Notes*: Marginal effects, standard errors in parentheses; ***, ** and * stand for $p < 0.01$, $0.05$ and $0.10$, respectively.

In line with our discussion in section 3.1, the regressions in panel (a) of Table 3 show that treatments do not have an effect with $y = 0$. In the absence of a public good dimension, the way rewards are administered does not have any strong impact on willingness to comply. However, once we add the public good dimension - see panel (b) of Table 3 -, we observe differences in compliance rates depending on the mechanism used to administer rewards. When rewards are targeted to complying individuals, tax compliance increases with respect to both an untargeted mechanism and a mechanism that use targeted but purely symbolic rewards. The effect is slightly smaller, but still significant, when the belief of compliance is taken into account, and so does not operate (simply) through changes in the perception of what others are doing.

Among the control variables included in the regressions of Table 3, the fine $f$ has a positive and significant impact on compliance, as already suggested by Figure 2. The impact of the fine is stronger for $y = 2$ than for $y = 0$, as shown by the marginal effects reported in Table 3. Also in line with our previous discussion, the likelihood of complying is positively related to one's belief, both under $y = 0$ and $y = 2$, with the effect again being slightly larger in the latter case. When there is a public good dimension, we find evidence that economists contribute less, which replicates an established finding (e.g., Marwell and Ames, 1981; Carter and Irons, 1991). We also find the intuitively appealing result that more risk loving subjects are less likely to comply, significantly so when y = 2. Finally, we find that, in the absence of a public good dimension, compliance rates are positively related to subjects' social desirability concerns: subjects who gave more socially-desirable responses in the questionnaire are also more likely to comply in the experiment. Interestingly, this effect vanishes once we add the public good dimension.

### 3.4 Earnings

Unsurprisingly in the light of the success of our reward mechanism in eliciting greater compliance when there is a public good dimension, we find that that in the Targeted treatment on average subjects had greater earnings than in Untargeted or Symbolic. Table 5 shows the realized payoffs in each of our six games across treatments. When $y = 0$ we do not find any significant difference in earnings between treatments.[21] When $y = 2$, earnings in Targeted are higher than earnings in Untargeted and Symbolic, whereas we find no difference between the

---

[21] Mann-Whitney p = 0.370, 0.590 and 0.824 for Targeted vs. Untargeted, Targeted vs. Symbolic, and Symbolic vs. Untargeted, respectively

Untargeted and Symbolic treatments.[22] As the only difference between Untargeted and Targeted treatments comes from the way fines are distributed (in a targeted or untargeted way), any significant difference between earnings in both treatments necessarily comes from higher compliance.

**Table 5: Realized earnings**

|  |  | Untargeted | Targeted | Symbolic |
|---|---|---|---|---|
| $y = 0$ | $f = 0$ | 9.26 (2.64) | 9.44 (2.31) | 8.89 (3.17) |
|  | $f = 3$ | 9.07 (3.22) | 8.51 (3.47) | 8.52 (3.67) |
|  | $f = 6$ | 8.33 (4.56) | 8.15 (4.03) | 8.33 (4.63) |
| $y = 2$ | $f = 0$ | 10.44 (2.25) | 11.48 (3.79) | 10.74 (2.83) |
|  | $f = 3$ | 11.04 (3.45) | 11.78 (3.69) | 11.19 (3.62) |
|  | $f = 6$ | 12.67 (4.82) | 14.00 (4.58) | 12.82 (4.81) |

*Notes*: means, standard deviations in parentheses.

## 4. Discussion

Our experiment compares two audit-based deterrence mechanisms that collect fines from those found non-compliant. The mechanisms differ in the way fines are redistributed to individuals who were either not audited or audited and found to be compliant. The first, as is the case in most extant tax systems, does not discriminate between the un-audited and those found compliant. The second targets the redistribution in favor of those found compliant.

We find that targeting increases compliance when paying taxes generates a social return. One possible explanation might be that the mere fact of rewarding compliance may signal its desirability and increase the rate of compliance. To control for this possibility we also conducted a treatment where those found compliant were given "symbolic" rewards, i.e. rewards of negligible material value. Here we found no increase in compliance relative to our untargeted treatment. Thus we conclude that it is not the mere assigning of rewards, but the material incentives inherent in the rewards that improve compliance.

We also find that compliance increases with the size of the fine, and with the size of the social return associated with compliance. These findings are in line with previous findings in the literature and demonstrate that compliance rates shift predictably with changes in the material costs and benefits of evasion/compliance.

However, material incentives are not the whole story. In all of the treatments and conditions we ran, an individual maximizes expected earnings by evading. Thus the positive compliance

---

[22] Mann-Whitney p = 0.043, 0.064 and 0.880 for Targeted vs. Untargeted, Targeted vs. Symbolic, and Symbolic vs. Untargeted, respectively

rates demonstrate that other factors are at play. One important finding demonstrating this is the strong association between the likelihood that a subject complies and that subject's beliefs about others' compliance: when subjects expect others to comply they are more likely to do so themselves. Explaining this in terms of material incentives is all the more difficult since, from a purely selfish perspective, the incentive to evade is increased when others comply. However, the finding sits well with previous findings from survey data that find a positive relation between intrinsic motivation to pay taxes and beliefs about the tax compliance of others (e.g. Frey and Torgler, 2007). The observed positive relation could reflect an effect of beliefs on actions whereby people are more willing to comply when they believe others do so, akin to "conditional cooperation" in public good experiments where people are more willing to contribute when others do so (e.g., Keser and van Winden, 2000; Fischbacher and Gächter, 2010). Of course, there are other possibilities and further research is needed to identify channels and directions of causation.

## 5. Conclusions

The use of reward mechanisms to promote compliance is theoretically established but rarely applied. That rewards are rarely used in practice obviously limits the opportunity to gauge the effectiveness of reward-based audit mechanisms using field data. However, laboratory experiments do offer an opportunity to test-bed such mechanisms. Our experiment serves such a purpose. We find that targeting increases compliance when paying taxes generates a social return. Compliance is then supported by the belief that more other people also comply. Symbolic rewards are not sufficient; it is the material incentives inherent in the rewards that improve compliance.

The clear policy message of our paper is that existing tax mechanisms have room for improvement by rewarding those audited and found compliant. This would not be a financial burden on the tax authorities as it would be paid by the fines on those audited and found non-compliant, and it could not just be replaced by employing symbolic rewards. One possible objection to the mechanism is that people would *want* to be audited; it is of course unavoidable that any tax collection technology is inefficient and distortions already exist in the current tax system, which is rife with tax avoidance; in practice, only those who pay their taxes would want to be audited under the proposed mechanism, and so this distortion would only work on the assumption that taxes are being paid. Another possible objection to our reward mechanism is that it lacks fairness since it goes against the presumption of innocence by rewarding those that are audited and found complying, but not those who are not audited

even if complying. Research on the fairness perceptions of this policy would be an obvious next step. Yet, those who are not audited are currently advantaged relative to those who are audited because of avoiding the real hassle and costs (psychological and otherwise) that often come with being audited, and so the reward could be seen as a fair and currently lacking compensation for this.

# References

Alm, J. 2012. Measuring, explaining, and controlling tax evasion: lessons from theory, experiments, and field studies. *International Tax and Public Finance* 19(1), 54–77.

Alm, J., B.R. Jackson, and M. McKee. 1992a. Deterrence and Beyond: Toward a Kinder, Gentler IRS. In *Why People pay Taxes*, ed by. Joel Slemrod, 311–29. Ann Arbor: University of Michigan Press.

Alm, J., G.H. Mcclelland, and W.D. Schulze. 1992b. Why Do People Pay Taxes. *Journal of Public Economics* 48(1), 21–38.

Andreoni, J. 1995. Cooperation in public-goods experiments - kindness or confusion? *American Economic Review* 85(4), 891–904.

Andreoni, J., B. Erard, and J. Feinstein. 1998. Tax compliance. *Journal of Economic Literature* 36(2), 818–860.

Bazart, C., and M. Pickhardt. 2011. Fighting Income Tax Evasion with Positive Rewards. *Public Finance Review* 39(1), 124 –149.

Border, K.C., and J. Sobel. 1987. Samurai Accountant: A Theory of Auditing and Plunder. *The Review of Economic Studies* 54(4), 525–540.

Carter, J.R., and M.D. Irons. 1991. Are Economists Different, and If So, Why? *Journal of Economic Perspectives* 5(2), 171–177.

Charness, G., and U. Gneezy. 2010. Portfolio choice and risk attitudes: an expriment. *Economic Inquiry* 48(1), 133–146.

Charness, G., and M.-C. Villeval. 2009. Cooperation and Competition in Intergenerational Experiments in the Field and the Laboratory. *The American Economic Review* 99(3), 956–978.

Chaudhuri, A. 2011. Sustaining cooperation in laboratory public goods experiments: a selective survey of the literature. *Experimental Economics* 14(1), 47–83.

Fabri, M. 2013. Shaping Tax Norms Through Lotteries. Mimeo, University of Bologna, available at SSRN: http://ssrn.com/abstract=2202189

Fischbacher, U. 2007. z-Tree: Zurich toolbox for ready-made economic experiments. *Experimental Economics* 10(2), 171–178.

Fischbacher, U., and S. Gächter. 2010. Social preferences, beliefs, and the dynamics of free riding in public good experiments. *American Economic Review* 100(1), 541–556.

Fochmann, M., and E. Kroll. 2014. The Effects of Rewards on Tax Compliance Decisions. SSRN working paper, http://ssrn.com/abstract=2437778.

Frey, B.S., and B. Torgler. 2007. Tax morale and conditional cooperation. *Journal of Comparative Economics* 35(1), 136–159.

Greiner, B. 2004. An online recruitment system for economic experiments. In *Forschung und wissenschaftliches Rechnen. GWDG Bericht 63*, ed by. K. Kremer and V. Macho, 79–93. Göttingen: Ges. für Wiss. Datenverarbeitung.

Houser, D., and R. Kurzban. 2002. Revisiting Kindness and Confusion in Public Goods Experiments. *American Economic Review* 92(4), 1062–1069.

Karakostas, A., and D.J. Zizzo. 2014. Obedience. SSRN working paper, http://ssrn.com/abstract=2388555.

Kastlunger, B., S. Muehlbacher, E. Kirchler, and L. Mittone. 2011. What Goes Around Comes Around? Experimental Evidence of the Effect of Rewards on Tax Compliance. *Public Finance Review* 39(1), 150 –167.

Keser, C., and F. van Winden. 2000. Conditional cooperation and voluntary contributions to public goods. *Scandinavian Journal of Economics* 102(1), 23–39.

Ledyard, J.O. 1995. Public goods: A survey of experimental research. In *The Handbook of Experimental Economics*, ed by. Alvin E. Roth and John H. Kagel, 111–181. Princeton: Princeton University Press.

Marwell, G., and R.E. Ames. 1981. Economists free ride, does anyone else? Experiments on the provision of public goods, IV. *Journal of Public Economics* 15(3), 295–310.

Mookherjee, D., and I. Png. 1989. Optimal Auditing, Insurance, and Redistribution. *The Quarterly Journal of Economics* 104(2), 399–415.

Naritomi, J. 2013. Consumers as Tax Auditors. Mimeo, Harvard University.

Stöber, J. 2001. The Social Desirability Scale-17 (SDS-17): Convergent Validity, Discriminant Validity, and Relationship with Age. *European Journal of Psychological Assessment* 17(3), 222–232.

Wan, J. 2010. The Incentive to Declare Taxes and Tax Revenue: The Lottery Receipt Experiment in China. *Review of Development Economics*, 14 (3), 611-624. ☐

Zizzo, D.J. 2010. Experimenter demand effects in economic experiments. *Experimental Economics* 13(1), 75–98.

**Appendix A.**

By evading rather than complying a player's decision earnings are increased by $10 - y$. In the event the player is audited (i.e. with probability 1/3) selection earnings are decreased by $f + E$, where $E$ are the expected selection earnings when compliant and audited. Thus, assuming risk neutrality, the net benefit from evading rather than complying, is $10 - y - (1/3)(f + E)$.

For our *Symbolic* treatment $E = 0.05$. The net benefit is decreasing in $y$ and $f$ and so is least when $y = 2$ and $f = 6$. Thus, the net benefit from evading is at least

$$10 - 2 - (1/3)(6 + 0.05) \approx 5.98$$

and so it is optimal to evade in any of our parameterizations in *Symbolic*.

In the other treatments $E$ is a function of $n$, the number of other subjects who are non-compliant. For our *Targeted* treatment

$$E = (f/2)(n/8)(1 - (n-1)/7) + (f/2)(1 - (n/8))(n/7) + 2f(n/8)(n-1)/7$$

$$= (6 + n)nf/56.$$

$E$ is increasing in $n$ and $f$, and so for our parameters takes the maximum value when $n = 8$ and $f = 6$. Thus, the net benefit from evading rather than complying, is

$$10 - y - (1/3)(f + (6 + n)nf/56) \geq 2.$$

Thus for any beliefs about the number of others complying, $n$, and for any of our $(y, f)$ parameterizations the optimal choice is to evade and so a player has a dominant strategy to evade in *Targeted*.

For our *Untargeted* treatment

$$E = (f/8)(n/8)(1 - (n-1)/7) + (f/8)(1 - (n/8))(n/7) + (2f/7)(n/8)(n-1)/7$$

$$= (48 + n)nf/1568.$$

Again, this is increasing in $n$ and $f$ and so for our parameters the net benefit from evading rather than complying, is

$$10 - y - (1/3)(f + (48 + n)nf/1568) \geq 38/7.$$

Again, a player has a dominant strategy to evade.

19

**Appendix B.**

# INSTRUCTIONS

Welcome to this experiment on decision making. The instructions are simple and if you follow them carefully you will privately get an amount of money in cash at the end of the experiment. Talking is forbidden during the experiment. You cannot use your mobile phones while in the laboratory. If you have any questions, raise your hand and your question will be answered in private.

This experiment consists of two parts. In each part you will complete 6 tasks. In all tasks you are in a group with eight other people. The composition of each group is randomly determined at the beginning of the experiment and will not change. You will never know the identity of the other group members and they will not know yours. Your earnings for each task depend on the choices made in your group.

At the end of the experiment one task from each part will be selected at random for your group and your payment from today's experiment will be based on your earnings in those tasks. You will be paid in private and in cash. Each task has an equal chance of being selected, so please consider each task carefully.

We will continue with the instructions for Part One. After you have completed Part One we will give additional instructions for Part Two.


**Instuctions for Part One**

You have to make a decision for each of six tasks. For each task you make your decision at the same time that the other members of your group are making their decisions. You will not be informed of the decisions made by otther memebrs of your group. At the end of the experiment one of these tasks will be randomly selected, and you will be informed of your earnings from this task.

**Your earnings from a task**

For each task in Part One you make two types of earnings, *decision* earnings and *selection* earnings. Note that the *selection* earnings might be negative. Your *final* earnings will be the sum of your *decision* earnings and your *selection* earnings:

$$\textit{Final} \text{ earnings} = \textit{decision} \text{ earnings} + \textit{selection} \text{ earnings}$$


**How your *decision* earnings are determined**

In each task you choose between two alternatives: A and B.

If you choose A, you will get £10 and the other group members will get nothing from your decision.

If you choose B, you and all the other group members will get £Y each from your decision.

At the same time, the other eight members of your group will also be choosing between A and B, and your earnings will depend on their decisions in the same way. If one of the other group members chooses A, that person gets £10 and you get nothing from this particular decision. If that group member chooses B, you and all the other group members will receive £Y each form this particular decision.

So, your *decision* earnings will always depend on the choices of all the group members. Let us show you a simple example using a particular value of Y.

**Example**

Suppose Y = £2. Following the logic described above, *decision* earnings will be a function of the decisions of all the group members and your screen would show you the following table (where all amounts are in British pounds):

| Decision earnings: | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Overall number of group members choosing B: | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Earnings of a group member who chooses A | 10.00 | 12.00 | 14.00 | 16.00 | 18.00 | 20.00 | 22.00 | 24.00 | 26.00 | - |
| Earnings of a group member who chooses B | - | 2.00 | 4.00 | 6.00 | 8.00 | 10.00 | 12.00 | 14.00 | 16.00 | 18.00 |

For example, if no one chooses B, you and everyone else earn £10 and, if you choose B while no one else does (so 1 person overall chooses B), you earn £2 while everyone else earns £12.

As another example, if everyone chooses B, you and everyone else earn £18 and, if you choose A while everyone else chooses B (so 8 people overall choose B), you earn £26 while everyone else earns £16.

Note that Y may change from task to task. In each task you will be informed of Y on your computer screen before making any decision. Your screen will also show the relevant table with all possible *decision* earnings for that value of Y. All amounts shown on the screen will be in British pounds.

========================================================================

Now answer the following questions, whose only purpose is to check and ensure your understanding of the experiment. Please raise your hand if anything is unclear.

1. Using the table above with Y = £2, assume that you and 2 other group members (so 3 people overall) choose B.

What would be your *decision* earnings? _____

What would be the *decision* earnings of the other group members who chose A? _____

What would be the *decision* earnings of the other group members who chose B? _____

2. Again using the table above with Y = £2, assume now that 4 other group members choose B, but you and the other 4 choose A.

What would be your *decision* earnings? _____

What would be the *decision* earnings of the other group members who chose A? _____

What would be the *decision* earnings of the group members who chose B? _____

**How your *selection* earnings are determined**

After all participants make their decisions, three will be randomly selected in each group. If a selected group member chose A, he/she will make a payment of £P, and if they chose B they will not have to make a payment of £P.

There are 9 group members and every group member has an equal chance of being selected. Thus you have a 3 out of 9, or approximately 33%, chance of being selected.

*Selection* earnings depend exclusively on the decisions made by the selected group members. There are four possible cases.

Case 1: All selected group members chose B
No payment is made by the selected group members. *Selection* earnings are zero for all group members.

Case 2: Two selected group members chose B and one selected group member chose A
The selected group member who chose A will make a payment, and receive *selection* earnings –£P.
The payment will be redistributed to the other eight group members, and each of these will receive *selection* earnings £ (P / 8).

Case 3: One selected group member chose B and two selected group members chose A
The selected group members who chose A will each make a payment, and receive *selection* earnings –£P.
The payments will be redistributed to the other seven group members, and each of these will receive *selection* earnings £ (2P / 7).

Case 4: All selected group members chose A
Each selected group member will make a payment, and receive *selection* earnings –£P.
The payments will be redistributed to the other six group members, and each of these will receive *selection* earnings £ (3P / 6).

> **Example**
>
> Assume again that Y is £2. Suppose the payment is P = £2.
>
> - If all three selected group members chose B, the *selection* earnings are zero for all the participants in the group.
>
> - If two selected group members chose B and one selected group member chose A, the selected group member who chose A gets selection earnings of –£2. The other eight group members each get selection earnings £2 / 8 = £0.25.
>
> - If one selected group member chose B and two selected group members chose A, the selected group members who chose A each get selection earnings of –£2. The other seven group members each get selection earnings £4 / 7 = £0.57.

- If all three selected group members chose A, the selected group members each get selection earnings of –£2. The other six group members each get selection earnings £6 / 6 = £1.

Note that the payment P may change from task to task. In each task you will be informed of P on your computer screen before making any decision. The amounts shown on the screen will be in British pounds.

**Earnings Calculator**

You will get an earnings calculator on the screen to help you make decisions. The calculator is simple. You just need to enter a decision (A or B) for each group member and indicate three group members to be selected. When you click the button CALCULATE, the computer will show you the *final* earnings ( = *decision* earnings + *selection* earnings) of each group member. All amounts shown on the screen will be in British pounds.



Use the earnings calculator that will now appear on your screen to go through the following example questions, whose only purpose is to check and ensure your understanding of the experiment. Please raise your hand if anything is unclear.

========================================================================
1. Using the earnings calculator on the screen, please tick A for you and B for everyone else. Tick three other group members as being selected.

What would be your *final* earnings? _____

What would be the *final* earnings of the group members being selected? _____

2. Again, tick A for you and B for everyone else. Tick yourself and two others as being selected.

What would be your *final* earnings? _____

What would be the *final* earnings of the other group members being selected? _____

What would be the *final* earnings of the group members not being selected? _____

3. Using again the earnings calculator on the screen, now tick B for yourself and group member #2, and A for everyone else.

What would be your *final* earnings if you and group members #2 and #3 are selected? _____

What would be your *final* earnings if you and group members #3 and #4 are selected? ____

What would be your *final* earnings if you are not selected and group members #3, #4 and #5 are selected? _____

What would be your *final* earnings if you are not selected and group members #2, #3 and #4 are selected? _____

4. Now again tick B for yourself and group member #2, and A for everyone else.

23

What would be the *final* earnings of group member #3 if he/she and group members #4 and #5 are selected? _____

What would be the *final* earnings of group member #3 if he/she and group members #2 and #5 are selected? _____

======================================================================

======================================================================

Please now answer the following final questions, again with the only purpose to check your understanding of the experiment.

1. How likely is it that you will be selected in the one task out of 6 for which you will be paid?

 (a) Very unlikely (less than 10% chance)

(b) More unlikely than likely (between 10% and 39% chance)

(c) Around even chance (between 40% and 60% chance)

(d) More likely than unlikely (more than 61% and 90% chance)

(e) Very likely (more than 90% chance)

2. Are the following statements true or false?

"In each task the other participants will be able to see my decision before they make their own decisions." True _____ False _____

 "In each task participants will be able to see the decisions made by other participants in previous tasks". True _____ False _____

*Instructions for part one of the Targeted treatment*

# INSTRUCTIONS

Welcome to this experiment on decision making. The instructions are simple and if you follow them carefully you will privately get an amount of money in cash at the end of the experiment. Talking is forbidden during the experiment. You cannot use your mobile phones while in the laboratory. If you have any questions, raise your hand and your question will be answered in private.

This experiment consists of two parts. In each part you will complete 6 tasks. In all tasks you are in a group with eight other people. The composition of each group is randomly determined at the beginning of the experiment and will not change. You will never know the identity of the other group members and they will not know yours. Your earnings for each task depend on the choices made in your group.

At the end of the experiment one task from each part will be selected at random for your group and your payment from today's experiment will be based on your earnings in those tasks. You will be paid in private and in cash. Each task has an equal chance of being selected, so please consider each task carefully.

We will continue with the instructions for Part One. After you have completed Part One we will give additional instructions for Part Two.

24

**Instuctions for Part One**

You have to make a decision for each of six tasks. For each task you make your decision at the same time that the other members of your group are making their decisions. You will not be informed of the decisions made by otther memebrs of your group. At the end of the experiment one of these tasks will be randomly selected, and you will be informed of your earnings from this task.

**Your earnings from a task**

For each task in Part One you make two types of earnings, *decision* earnings and *selection* earnings. Note that the *selection* earnings might be negative. Your *final* earnings will be the sum of your *decision* earnings and your *selection* earnings:

$$Final \text{ earnings} = decision \text{ earnings} + selection \text{ earnings}$$

**How your *decision* earnings are determined**

In each task you choose between two alternatives: A and B.

If you choose A, you will get £10 and the other group members will get nothing from your decision.

If you choose B, you and all the other group members will get £Y each from your decision.

At the same time, the other eight members of your group will also be choosing between A and B, and your earnings will depend on their decisions in the same way. If one of the other group members chooses A, that person gets £10 and you get nothing from this particular decision. If that group member chooses B, you and all the other group members will receive £Y each form this particular decision.

So, your *decision* earnings will always depend on the choices of all the group members. Let us show you a simple example using a particular value of Y.

**Example**

Suppose Y = £2. Following the logic described above, *decision* earnings will be a function of the decisions of all the group members and your screen would show you the following table (where all amounts are in British pounds):

| Decision earnings: | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Overall number of group members choosing B: | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Earnings of a group member who chooses A | 10.00 | 12.00 | 14.00 | 16.00 | 18.00 | 20.00 | 22.00 | 24.00 | 26.00 | - |
| Earnings of a group member who chooses B | - | 2.00 | 4.00 | 6.00 | 8.00 | 10.00 | 12.00 | 14.00 | 16.00 | 18.00 |

For example, if no one chooses B, you and everyone else earn £10 and, if you choose B while no one else does (so 1 person overall chooses B), you earn £2 while everyone else earns £12.

As another example, if everyone chooses B, you and everyone else earn £18 and, if you choose A while everyone else chooses B (so 8 people overall choose B), you earn £26 while everyone else earns £16.

Note that Y may change from task to task. In each task you will be informed of Y on your computer screen before making any decision. Your screen will also show the relevant table with all possible *decision* earnings for that value of Y. All amounts shown on the screen will be in British pounds.

===================================================================

Now answer the following questions, whose only purpose is to check and ensure your understanding of the experiment. Please raise your hand if anything is unclear.

1. Using the table above with Y = £2, assume that you and 2 other group members (so 3 people overall) choose B.

What would be your *decision* earnings? _____

What would be the *decision* earnings of the other group members who chose A? _____

What would be the *decision* earnings of the other group members who chose B? _____

2. Again using the table above with Y = £2, assume now that 4 other group members choose B, but you and the other 4 choose A.

What would be your *decision* earnings? _____

What would be the *decision* earnings of the other group members who chose A? _____

What would be the *decision* earnings of the group members who chose B? _____

===================================================================

**How your *selection* earnings are determined**

After all participants make their decisions, three will be randomly selected in each group. If a selected group member chose A, he/she will make a payment of £P, and if they chose B they will not have to make a payment of £P.

There are 9 group members and every group member has an equal chance of being selected. Thus you have a 3 out of 9, or approximately 33%, chance of being selected.

*Selection* earnings depend exclusively on the decisions made by the selected group members. There are four possible cases.

Case 1: All selected group members chose B
No payment is made by the selected group members. *Selection* earnings are zero for all group members.

Case 2: Two selected group members chose B and one selected group member chose A
The selected group member who chose A will make a payment, and receive *selection* earnings –£P.

26

The payment will be redistributed to the other selected group members who chose B, and these group members will each receive *selection* earnings £ (P / 2). The *selection* earnings of the other group members will be zero.

Case 3: One selected group member chose B and two selected group members chose A
The selected group members who chose A will each make a payment, and receive *selection* earnings –£P.
The payments will be redistributed to the other selected group member who chose B, and this group member will receive *selection* earnings £ (2P). The *selection* earnings of the other group members will be zero.

Case 4: All selected group members chose A
Each selected group member will make a payment, and receive *selection* earnings –£P.
The payments will be redistributed to the other six group members, and each of these will receive *selection* earnings £ (3P / 6).

### Example

Assume again that Y is £2. Suppose the payment is P = £2.

- If all three selected group members chose B, the *selection* earnings are zero for all the participants in the group.

- If two selected group members chose B and one selected group member chose A, the selected group member who chose A gets selection earnings of –£2. The other two selected group members each get selection earnings £2 / 2 = £1.

- If one selected group member chose B and two selected group members chose A, the selected group members who chose A each get selection earnings of –£2. The selected group member who chose B gets selection earnings £4.

- If all three selected group members chose A, the selected group members each get selection earnings of –£2. The other six group members each get selection earnings £6 / 6 = £1.

Note that the payment P may change from task to task. In each task you will be informed of P on your computer screen before making any decision. The amounts shown on the screen will be in British pounds.

**Earnings Calculator**

You will get an earnings calculator on the screen to help you make decisions. The calculator is simple. You just need to enter a decision (A or B) for each group member and indicate three group members to be selected. When you click the button CALCULATE, the computer will show you the *final* earnings ( = *decision* earnings + *selection* earnings) of each group member. All amounts shown on the screen will be in British pounds.

Use the earnings calculator that will now appear on your screen to go through the following example questions, whose only purpose is to check and ensure your understanding of the experiment. Please raise your hand if anything is unclear.

===================================================================
1. Using the earnings calculator on the screen, please tick A for you and B for everyone else. Tick three other group members as being selected.

What would be your *final* earnings? _____

What would be the *final* earnings of the group members being selected? _____

2. Again, tick A for you and B for everyone else. Tick yourself and two others as being selected.

What would be your *final* earnings? _____

What would be the *final* earnings of the other group members being selected? _____

What would be the *final* earnings of the group members not being selected? _____

3. Using again the earnings calculator on the screen, now tick B for yourself and group member #2, and A for everyone else.

What would be your *final* earnings if you and group members #2 and #3 are selected? _____

What would be your *final* earnings if you and group members #3 and #4 are selected? ____

What would be your *final* earnings if you are not selected and group members #3, #4 and #5 are selected? _____

What would be your *final* earnings if you are not selected and group members #2, #3 and #4 are selected? _____

4. Now again tick B for yourself and group member #2, and A for everyone else.

What would be the *final* earnings of group member #3 if he/she and group members #4 and #5 are selected? _____

What would be the *final* earnings of group member #3 if he/she and group members #2 and #5 are selected? _____

===================================================================

===================================================================
Please now answer the following final questions, again with the only purpose to check your understanding of the experiment.

1. How likely is it that you will be selected in the one task out of 6 for which you will be paid?
 (a) Very unlikely (less than 10% chance)
(b) More unlikely than likely (between 10% and 39% chance)
(c) Around even chance (between 40% and 60% chance)
(d) More likely than unlikely (more than 61% and 90% chance)
(e) Very likely (more than 90% chance)

2. Are the following statements true or false?

"In each task the other participants will be able to see my decision before they make their own decisions." True _____ False _____

"In each task participants will be able to see the decisions made by other participants in previous tasks". True _____ False _____

*Instructions for part one of the SYMBOLIC treatment*

# INSTRUCTIONS

Welcome to this experiment on decision making. The instructions are simple and if you follow them carefully you will privately get an amount of money in cash at the end of the experiment. Talking is forbidden during the experiment. You cannot use your mobile phones while in the laboratory. If you have any questions, raise your hand and your question will be answered in private.

This experiment consists of two parts. In each part you will complete 6 tasks. In all tasks you are in a group with eight other people. The composition of each group is randomly determined at the beginning of the experiment and will not change. You will never know the identity of the other group members and they will not know yours. Your earnings for each task depend on the choices made in your group.

At the end of the experiment one task from each part will be selected at random for your group and your payment from today's experiment will be based on your earnings in those tasks. You will be paid in private and in cash. Each task has an equal chance of being selected, so please consider each task carefully.

We will continue with the instructions for Part One. After you have completed Part One we will give additional instructions for Part Two.

**Instuctions for Part One**

You have to make a decision for each of six tasks. For each task you make your decision at the same time that the other members of your group are making their decisions. You will not be informed of the decisions made by other members of your group. At the end of the experiment one of these tasks will be randomly selected, and you will be informed of your earnings from this task.

**Your earnings from a task**

For each task in Part One you make two types of earnings, *decision* earnings and *selection* earnings. Note that the *selection* earnings might be negative. Your *final* earnings will be the sum of your *decision* earnings and your *selection* earnings:

$$Final \text{ earnings} = decision \text{ earnings} + selection \text{ earnings}$$

**How your *decision* earnings are determined**

In each task you choose between two alternatives: A and B.

If you choose A, you will get £10 and the other group members will get nothing from your decision.

If you choose B, you and all the other group members will get £Y each from your decision.

At the same time, the other eight members of your group will also be choosing between A and B, and your earnings will depend on their decisions in the same way. If one of the other group members chooses A, that person gets £10 and you get nothing from this particular decision. If that group member chooses B, you and all the other group members will receive £Y each form this particular decision.

So, your *decision* earnings will always depend on the choices of all the group members. Let us show you a simple example using a particular value of Y.

### Example

Suppose Y = £2. Following the logic described above, *decision* earnings will be a function of the decisions of all the group members and your screen would show you the following table (where all amounts are in British pounds):

| | | | | | | Decision earnings: | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Overall number of group members choosing B: | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Earnings of a group member who chooses A | 10.00 | 12.00 | 14.00 | 16.00 | 18.00 | 20.00 | 22.00 | 24.00 | 26.00 | - |
| Earnings of a group member who chooses B | - | 2.00 | 4.00 | 6.00 | 8.00 | 10.00 | 12.00 | 14.00 | 16.00 | 18.00 |

For example, if no one chooses B, you and everyone else earn £10 and, if you choose B while no one else does (so 1 person overall chooses B), you earn £2 while everyone else earns £12.

As another example, if everyone chooses B, you and everyone else earn £18 and, if you choose A while everyone else chooses B (so 8 people overall choose B), you earn £26 while everyone else earns £16.

Note that Y may change from task to task. In each task you will be informed of Y on your computer screen before making any decision. Your screen will also show the relevant table with all possible *decision* earnings for that value of Y. All amounts shown on the screen will be in British pounds.

======================================================================

Now answer the following questions, whose only purpose is to check and ensure your understanding of the experiment. Please raise your hand if anything is unclear.

1. Using the table above with Y = £2, assume that you and 2 other group members (so 3 people overall) choose B.

What would be your *decision* earnings? _____

What would be the *decision* earnings of the other group members who chose A? _____

What would be the *decision* earnings of the other group members who chose B? _____

2. Again using the table above with Y = £2, assume now that 4 other group members choose B, but you and the other 4 choose A.

What would be your *decision* earnings? _____

What would be the *decision* earnings of the other group members who chose A? _____

What would be the *decision* earnings of the group members who chose B? _____

======================================================================

**How your *selection* earnings are determined**

After all participants make their decisions, three will be randomly selected in each group. If a selected group member chose A, he/she will make a payment of £P, and if they chose B they will not have to make a payment of £P and instead will receive a payment of £0.05.

There are 9 group members and every group member has an equal chance of being selected. Thus you have a 3 out of 9, or approximately 33%, chance of being selected.

*Selection* earnings depend exclusively on the decisions made by the selected group members. There are four possible cases.

Case 1: All selected group members chose B

No payment is made by the selected group members. *Selection* earnings are zero for all non-selected group members. *Selection* earnings are £0.05 each for all selected group members.

Case 2: Two selected group members chose B and one selected group member chose A

The selected group member who chose A will make a payment, and receive *selection* earnings –£P.

The payment will be redistributed to the other eight group members. Each of the non-selected group members will receive *selection* earnings £ (P / 8). Each of the selected group members who chose B will receive *selection* earnings £ (P / 8) + £0.05.

Case 3: One selected group member chose B and two selected group members chose A

The selected group members who chose A will each make a payment, and receive *selection* earnings –£P.

The payments will be redistributed to the other seven group members. Each of the non-selected group members will receive *selection* earnings £ (2P / 7). The non-selected group member who chose B will receive *selection* earnings £ (2P / 7) + £0.05.

Case 4: All selected group members chose A

Each selected group member will make a payment, and receive *selection* earnings –£P.

The payments will be redistributed to the other six group members, and each of these will receive *selection* earnings £ (3P / 6).

**Example**

Assume again that Y is £2. Suppose the payment is P = £2.

- If all three selected group members chose B, the *selection* earnings are zero for all the non-selected participants in the group. The *selection* earnings are £0.05 each for all the selected participants in the group.

31

- If two selected group members chose B and one selected group member chose A, the selected group member who chose A gets selection earnings of –£2. The six non-selected group members each get selection earnings £2 / 8 = £0.25. The two selected group members who chose B each get selection earnings £2 / 8 + £0.05 = £0.30.

- If one selected group member chose B and two selected group members chose A, the selected group members who chose A each get selection earnings of –£2. The six non-selected group members each get selection earnings £4 / 7 = £0.57. The selected group member who chose B gets selection earnings £4 / 7 + £0.05 = £0.62.

- If all three selected group members chose A, the selected group members each get selection earnings of –£2. The other six group members each get selection earnings £6 / 6 = £1.

Note that the payment P may change from task to task. In each task you will be informed of P on your computer screen before making any decision. The amounts shown on the screen will be in British pounds.

### Earnings Calculator

You will get an earnings calculator on the screen to help you make decisions. The calculator is simple. You just need to enter a decision (A or B) for each group member and indicate three group members to be selected. When you click the button CALCULATE, the computer will show you the *final* earnings ( = *decision* earnings + *selection* earnings) of each group member. All amounts shown on the screen will be in British pounds.



Use the earnings calculator that will now appear on your screen to go through the following example questions, whose only purpose is to check and ensure your understanding of the experiment. Please raise your hand if anything is unclear.

=======================================================================
1. Using the earnings calculator on the screen, please tick A for you and B for everyone else. Tick three other group members as being selected.

What would be your *final* earnings? _____

What would be the *final* earnings of the group members being selected? _____

2. Again, tick A for you and B for everyone else. Tick yourself and two others as being selected.

What would be your *final* earnings? _____

What would be the *final* earnings of the other group members being selected? _____

What would be the *final* earnings of the group members not being selected? _____

3. Using again the earnings calculator on the screen, now tick B for yourself and group member #2, and A for everyone else.

What would be your *final* earnings if you and group members #2 and #3 are selected? _____

What would be your *final* earnings if you and group members #3 and #4 are selected? ____

What would be your *final* earnings if you are not selected and group members #3, #4 and #5 are selected? _____

What would be your *final* earnings if you are not selected and group members #2, #3 and #4 are selected? _____

4. Now again tick B for yourself and group member #2, and A for everyone else.
What would be the *final* earnings of group member #3 if he/she and group members #4 and #5 are selected? _____

What would be the *final* earnings of group member #3 if he/she and group members #2 and #5 are selected? _____

=================================================================

=================================================================
Please now answer the following final questions, again with the only purpose to check your understanding of the experiment.

1. How likely is it that you will be selected in the one task out of 6 for which you will be paid?

 (a) Very unlikely (less than 10% chance)

(b) More unlikely than likely (between 10% and 39% chance)

(c) Around even chance (between 40% and 60% chance)

(d) More likely than unlikely (more than 61% and 90% chance)

(e) Very likely (more than 90% chance)

2. Are the following statements true or false?

"In each task the other participants will be able to see my decision before they make their own decisions." True _____ False _____

 "In each task participants will be able to see the decisions made by other participants in previous tasks". True _____ False _____

## Instructions for Part Two

In this part of the experiment there are also 6 tasks, and you will be paid for one of them, randomly selected at the end of the experiment. Each task is based on the decisions made in your group in the Part One tasks. For each task you completed in Part One, you must make a prediction about how many of the other group members chose B.

## Description of Part Two tasks

On your computer screen you will be reminded of the particular values of Y and P used in one of the Part One tasks. You will also get the earnings calculator on the screen in case you nedd to use it again. You must indicate how many out of the other eight group members chose B in this Part One task. If your prediction is *exactly* correct, you will receive £3. If the difference between your prediction and the actual number is plus or minus one you will receive £1.50. If you are incorrect by two or more, you will receive £0.

### Example

Suppose Y = £2 and P = £2. Your screen would look as follows (where all amounts are in British pounds):



If you indicate that six of the other eight group members chose B, then if six did choose B you will receive £3. If five or seven chose B you will receive £1.50. If less than five or more than seven chose B you will receive £0.

**Appendix C: Additional quantitative analysis**

Figure C1 shows the distribution of beliefs against mean choices in all three treatments and for all $(y, f)$ combinations. There are clearly no robust differences across distributions, though beliefs track mean choices along the lines discussed in the main text.

**Figure C1: Distribution of beliefs (densities) and mean choices (vertical lines)**
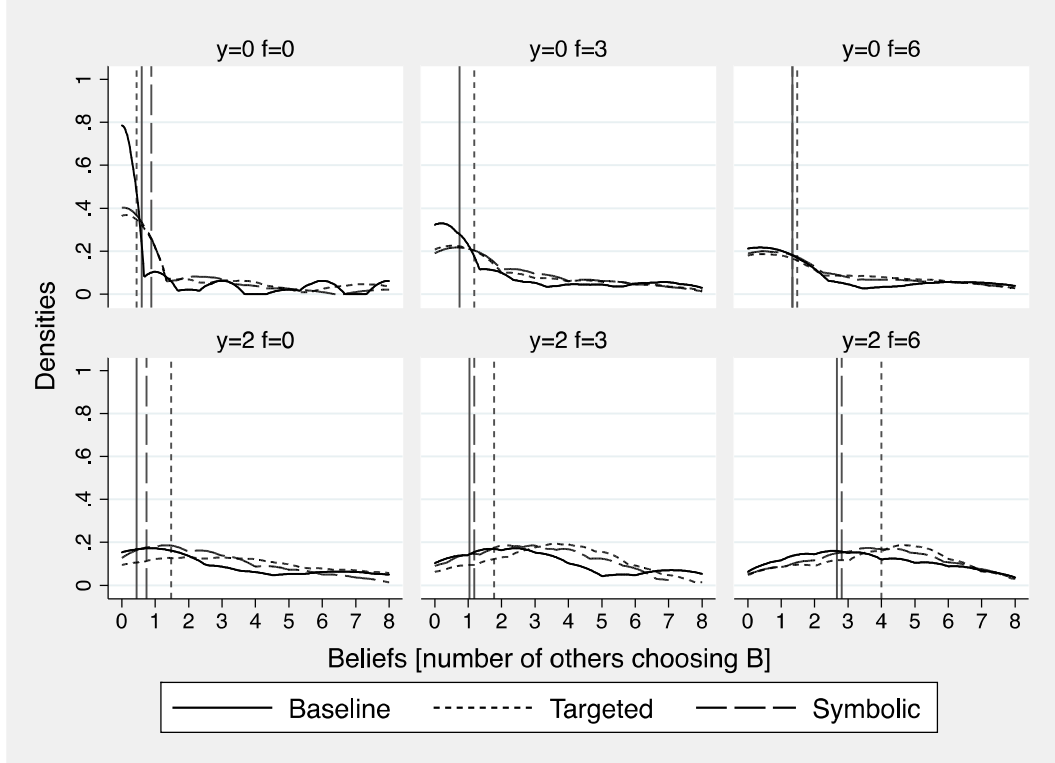


*Notes*: The density functions reflect the proportion of subjects believing that a given number of other subjects has chosen B for each $(y, f)$ combination and treatment. The grey lines are the mean number of B choices for each $(y, f)$ combination and treatment.

Table C1 analyzes the interaction between actions and beliefs in each treatment and condition. The table compares beliefs about the number of other participants complying (up to 8, as elicited in the experiment) with the average number of others complying. The table also presents separately the average beliefs of subjects who complied with those who did not. In all treatments and for all $(y, f)$ combinations, subjects over-estimate the compliance rates of others. Also, compliant subjects tend to expect higher compliance rates from others compared with non-compliant subjects, and this difference between the beliefs of compliant and non-compliant subjects is often significant. Of course, this correlation says nothing about the direction of causality. It could be that subjects have preferences to conform with others so that higher expectations about compliance lead to more compliance, or the pattern could reflect a

false consensus effect whereby people tend to overestimate the extent to which their own behavior is also exhibited by others (Ross et al., 1977)

**Table C1: Actions and beliefs**

| | | y=0 | | | y=2 | | |
| | | f=0 | f=3 | f=6 | f=0 | f=3 | f=6 |
|---|---|---|---|---|---|---|---|
| Untargeted | Action | 0.59 | 0.74 | 1.33 | 0.44 | 1.04 | 2.67 |
| | | (2.11) | (2.34) | (3.01) | (1.85) | (2.71) | (3.81) |
| | *Beliefs by action A/B* | *1.1/2.0* | *1.5/3.6* | *1.9/1.7* | *2.6/3.0* | *3.1/3.1* | *2.8/4.8* |
| | *P value* | *0.3462* | ***0.0637*** | *0.7176* | *0.9537* | *1.0000* | ***0.0041*** |
| | Belief | 1.17 | 1.70 | 1.85 | 2.59[a] | 3.09 | 3.48 |
| | | (2.33) | (2.43) | (2.66) | (2.81) | (2.48) | (2.28) |
| Targeted | Action | 0.44 | 1.19 | 1.48 | 1.48 | 1.78 | 4.00 |
| | | (1.85) | (2.87) | (3.14) | (3.14) | (3.36) | (4.04) |
| | *Beliefs by action A/B* | *1.4/2.3* | *1.5/3.6* | *1.8/3.6* | *3.2/4.4* | *3.2/4.5* | *3.5/4.5* |
| | *p value* | *0.3018* | ***0.0180*** | ***0.0387*** | *0.2127* | ***0.0606*** | *0.1068* |
| | Belief all | 1.46 | 1.85 | 2.13 | 3.44 | 3.52 | 4.00 |
| | | (2.39) | (2.31) | (2.49) | (2.62) | (1.96) | (2.15) |
| Symbolic | Action | 0.89 | 1.19 | 1.33 | 0.74 | 1.19 | 2.81 |
| | | (2.54) | (2.87) | (3.01) | (2.34) | (2.87) | (3.86) |
| | *Beliefs by action A/B* | *.5/4.7* | *1.6/3.6* | *1.7/4.1* | *2.3/4.0* | *2.8/4.5* | *3.5/4.5* |
| | *p value* | ***0.0002*** | ***0.0205*** | ***0.0102*** | ***0.0813*** | *0.4079* | ***0.0005*** |
| | Belief all | 1.00 | 1.91 | 2.09 | 2.46[b] | 2.93 | 3.81 |
| | | (1.93) | (2.22) | (2.47) | (2.19) | (1.81) | (2.07) |

Notes:

*Beliefs* refers to the average individual belief about the number of other participants in the group choosing B (from 0 to a maximum of 8), in each treatment and condition; standard deviations between brackets.

*Actions* refers to the actual number of participants choosing B in each treatment and condition, normalized to a maximum of 8, to make data comparable; standard deviations between brackets.

*p-values* refers to the outcome of Wilcoxon rank-sum tests between the beliefs of participants choosing A and those choosing B as an action, in each treatment and condition, bolded when significant at least at the 10% level.