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Selecting Public Goods Institutions: Who Likes to Punish and Reward?

Michalis Drouvelis and Julian C. Jamison

Abstract:

The authors extend the standard public goods game in a variety of ways, in particular by allowing for endogenous preference over institutions and by studying the relationship between individual types, their preferences, and later behavior within the various institutional environments. They collect individual data on a variety of demographic factors, in addition to measuring levels of risk aversion and ambiguity aversion (over both gains and losses). The authors then elicit preferences in an incentive-compatible manner over voluntary contribution mechanisms with and without reward and punishment options. Finally, they randomly assign subjects to one of the four institutions and observe repeated play. They find that payoffs are significantly greater when punishment is allowed but that only a small minority of participants prefers such an environment. There is at most a weak link between individual characteristics and elicited preferences over environments. On the other hand, institutional preferences, as well as individual characteristics, are more strongly predictive of behavior in the public goods game. For instance, loss averse individuals preemptively reward more often when that option is available. This result suggests that when studying social interactions, especially if people can choose whether to participate in a sanctions-and-rewards mechanism, it is important to consider individual attitudes toward risk and uncertainty.

Keywords: public goods; voluntary contribution; risk, loss, and ambiguity aversion; preference elicitation; reward and punishment

JEL Classifications: C92; H41; D81

Michalis Drouvelis is a lecturer in the department of economics at the University of Birmingham. His e-mail address is m.drouvelis@bham.ac.uk. Julian C. Jamison is a senior economist at the Federal Reserve Bank of Boston. His e-mail address is julian.jamison@bos.frb.org.

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I. Introduction

Institutions are an integral part of our social life and organize important aspects of economic activity. It is well-established that different institutions lead to different economic outcomes (North 1990). How institutions are shaped also has serious implications for the evolution of human culture and societies (Tabellini, 2008). Due to economic, political, social, and geographical reasons, different societies select different rules to govern their institutions and the development of institutional rules over time impacts a nation's economic performance and prosperity. For example, Acemoglu, Johnson, and Robinson (2001, 2002) show that the adoption of different colonization strategies and policies have led to differences in the institutions implemented in the respective colonized countries, which consequently have affected their long-run economic welfare. In related work, by using a large sample of countries Easterly and Levine (2003) and La Porta et al. (1998) demonstrate that institutions can explain differences in the levels of a country's economic development and financial performance, respectively. Thus, our understanding of how institutional structures are selected and established, as well as what factors are predictive of this process, are of great interest for economists and social scientists.

In this paper, we use experimental methods to shed more light on these questions and to gain a better understanding of how the underlying institutions enforce a society's norms. We focus on institutions that are concerned with providing public goods in settings where free-riding incentives are present. The general motivation for studying these institutions stems from the fact that a number of real-life situations (for example, tax compliance, donations to charities, tipping in restaurants, and participation in collective actions) are characterized by an incentive structure where people's individual and collective goals are at odds. This tension is starkly isolated in the public good environments we examine. In addition, experimental behavior in these institutions has inspired the recent development of novel theoretical models of social preferences (see Camerer 2003) which account for a number of the observed anomalies. Therefore, identifying which forces determine the content of acceptable standards of behavior captured by these institutions will shed further light on the proximate sources of human cooperation. It will also improve our inadequate understanding of how social norms are formed and enforced, insofar as those norms arise from self-selection into groups that prefer certain modes and rules of interaction. Our aim is to design an experiment which will provide a complete analysis of the

processes underlying the way that people make decisions in public good institutions by separating the conflict between personal and collective gains.

A more specific motivation for our study comes from a burgeoning experimental literature that investigates individuals' voting preferences over public good institutions and over the specific rules that govern these institutions. A main message from these studies (see the related literature section for a more extensive review) suggests mixed evidence on which institutions people favor, but in general it is observed that democratically selected institutions (by using a certain voting rule) perform better than institutions that have been exogenously imposed, both in terms of average contribution levels and efficiencies measured by net earnings. Yet the existing literature does not address two important issues in settings involving public goods. First, which institutions do individuals actually prefer? Second, which individual characteristics have predictive power over their preferred institutional choice and of behaviors in the relevant institutions?

Recent experimental studies typically implement a voting mechanism in order for individuals to express their institutional preferences. However, at least two difficulties arise when individuals cast their votes. First, voting may not necessarily provide an accurate measure of which institutions individuals actually prefer. When individuals vote for a certain institution, subsequent strategic considerations among individuals are likely to be taken into account, which in turn may confound voting behavior. For example, subjects may consider the behavior of other voters and vote strategically, a result that may lead to behavior that contradicts their authentic preferences over a given institution. Second, voting has the drawback of not allowing individuals to express the intensity of their preferences, making it impossible to draw conclusions about the strength of their approval or disapproval.

Our paper presents a novel experiment which introduces an incentive-compatible mechanism to elicit preferences over a menu of four institutions, each with different enforcement mechanisms to punish and/or reward behavior that does not comply with a certain norm: a standard voluntary contributions mechanism (VCM), a VCM with opportunities to sanction, a VCM with opportunities to reward, and a VCM with opportunities to sanction and reward. To elicit individual preferences, we ask subjects to indicate which institution they prefer by indicating how much each institution is worth to them. The stated monetary amount is subtracted

from their total earnings if they are assigned to an institution they prefer, and it is added to their total earnings if they are assigned to an institution they do not prefer. By observing how individuals select institutions from the available set of options, we are able to draw conclusions about which enforcement mechanism is actually preferred. By observing how much individuals are prepared to pay or how much they would need to be paid to participate in a given institution, we elicit the intensity of their preferences.

To the best of our knowledge, our paper is the first experimental study which elicits preferences regarding public good institutions and the intensity of these preferences in an incentive-compatible manner.[1] Our study also contributes to the understanding of social norms by simultaneously analyzing the three enforcement mechanisms that have played a central role in the social preferences literature. As a control case, we include an institution where neither sanctions nor rewards are present. The comparison of behavior among the three institutions using different enforcement mechanisms enables us to disentangle which particular institutional aspect (sanctions and/or rewards) of an institution, if any, is important for sustaining norms of high cooperation and maximizing individuals' overall welfare. We believe that the use of laboratory experiments is ideal for addressing these questions, as collecting data on our variables of interest is often infeasible in naturally occurring environments. Additionally, incentivizing preferences and assessing efficiency issues is typically difficult in the field due to a number of factors that operate simultaneously, confounding the analysis of causal relationships.

Furthermore, the level of tight control provided by experimental methods allows us to elicit a number of variables that we hypothesize may influence subjects' choice of institutions and subsequent play. Our central focus is on preference measures, such as risk, loss, and ambiguity aversion, an interest that stems from the fact that a high degree of uncertainty and ambiguity about the effect of a rule change might lead to a change in an individual's earnings. For example, institutions with punishment options have the potential to be detrimental (or at least add variability) to subjects' welfare and thus may be preferred by risk-seeking subjects. In

[1] Technically we need to be a bit careful about the exact usage of incentive-compatibility in this paper. The ordinal rankings are clearly incentive-compatible, and the cardinal rankings (intensities) have the right relative ratios within an individual, but may be compressed in absolute levels due to risk aversion. Cardinal preferences are always hard to compare across individuals, and that is even more true here due to potential differences in risk attitudes. In practice, as reported below, we do not see any empirical relationship between risk aversion and the absolute value of expressed intensities (not surprisingly given the stakes), so this absence is unlikely to cause any issues when interpreting the results.

contrast, institutions with reward mechanisms may be preferred by individuals who are averse to ambiguity. Also, loss averse and risk averse individuals may be attracted to institutions where sanctions and rewards are not available.

Our decision to focus on attitudes toward uncertainty is driven not just by the conceptual arguments above, but also by previous studies that found such a link in other institutional settings. Laboratory studies such as Bartling et al. (2009) and Dohmen and Falk (2011) have found that subjects who are less risk-averse are more likely to sort into competitive environments or variable-pay schemes. Similarly, Weinhold and Zak (2005) find that risk attitudes are central to wage-related occupational choice in China. Cramer et al. (2002) exhibit a negative relationship between risk-aversion and entrepreneurship and argue for causality, which is never absolutely clear but certainly follows if risk attitudes are stable, as in standard theory. Finally and perhaps most relevantly, there is a relatively long history in the contract theory literature studying the link between risk tolerance and contract choice, going back at least to Cheung (1969). A striking recent example is Ackerberg and Botticini (2002), who examine agricultural institutions in Renaissance Italy and show that risk-sharing is a major determinant of contract choice.

Although the papers described above are suggestive, the relationship between risk tolerance and social preferences, including voluntary contributions, has received relatively scant direct attention. There have been a few experimental studies (for example, Eckel and Wilson 2004; Humphrey and Renner 2011; Kocher et al. 2011), that have yielded equivocal evidence. Importantly, all these studies overlook the possibility that preferences other than standard risk preferences, such as loss and ambiguity aversion, may predict social preferences. These studies also do not credibly elicit preferences over specific social mechanisms for procuring public goods. In our paper, we elicit choices in order to construct four preference measures (risk aversion, loss aversion, ambiguity aversion, and ambiguity aversion over losses) in an incentive-compatible manner, and we provide the first comprehensive analysis of how these preference measures can predict subjects' reciprocal behavior in the form of punishing or rewarding their peers.

Our main findings can be summarized as follows. First, our four preference measures are significantly correlated with each other. Second, subjects' individual characteristics help explain

their preferences over risk, loss, and ambiguity. Third, which institutions individuals prefer are, surprisingly, not influenced by preference measures, although other individual traits do have some explanatory power. Fourth, institutions with punishment options are best able to maintain cooperative norms. Fifth, relative to institutions without sanctioning mechanisms, institutions that permit sanctions incur enforcement costs that lower overall welfare in the short run but increase overall efficiency in the long run. Sixth, positive and negative reciprocity are significantly correlated with our preference measures. Seventh, subjects' individual characteristics account for the way sanctions and rewards are used.

The remainder of the paper is structured as follows. Section 2 reviews the related literature. Section 3 outlines our experimental design and section 4 presents the results from our data analysis. Section 5 concludes by discussing the implications of our results and how these might be extended by further work.

II. Related Literature

Our paper contributes to three different strands of literature: a) classical public goods experiments; b) endogenous selection of environments; and c) the interaction of preference measures and social preferences. We discuss the related literature for each of these three lines of research in turn. Readers familiar with the extensive literature on public goods games can skim most of this section, but we hope that it will provide a useful survey for others, in addition to placing our contribution in context with the existing literature.

1. Classical public goods games: Over the last 40 years of experimental economic research, there has been extensive exploration of how people behave in decision situations where a tension exists between personal and collective gains. By now it is well-understood that actual behavior does not conform to standard economic theory's sharp prediction that people will free ride. The stylized facts emerging from these experiments suggest that, on average, individuals initially contribute between 40 percent and 60 percent of their endowment, but contributions gradually decline as the game progresses. The erosion of cooperation with repeated interactions is robust to variations in experimental design—for instance, whether group composition is constant or randomly changes over time (see, for example, Keser and van Winden 2000; Andreoni and Croson 1998), or whether the group size changes (see for example, Isaac and Walker 1998a).

These findings have been widely documented in numerous experiments, which are comprehensively surveyed by Ledyard (1995) and Gächter and Herrmann (2005). Intrigued by the fragility of cooperation, many economists have sought to identify mechanisms in order to remedy the free-rider problem. Thus far, a number of different processes that are able to sustain the norm of high contributions have been proposed. Principally, these include the introduction of sanction and reward possibilities (for example, Fehr and Gächter 2000, 2002; Noussair and Tucker 2005; Sefton, Shupp, and Walker 2007; Sutter, Haigner, and Kocher 2010); third-party punishment (for example, Fehr and Fischbacher 2004; Carpenter and Matthews 2012); expressions of disapproval (for example, Gächter and Fehr 1999; Masclet et al. 2003; Rege and Telle 2004); the threat of expelling group members (for example, Cinyabuguma, Page, and Putterman 2005); the establishment of leaders (for example, Güth et al. 2007; Levati, Sutter, and van der Heijden 2007); assortative matching (for example, Gächter and Thöni 2005); and communication among players (for example, Isaac and Walker 1988b; Bochet, Page, and Putterman 2006).

In our paper, we focus on public good environments where individuals have the opportunity to punish and/or reward their peer group members. Since Fehr and Gächter's seminal 2000 paper introduced the punishment mechanism, a growing literature has been generated to examine the effect that punishment has on cooperation (see Chaudhuri 2011 and Gächter and Herrmann 2009 for surveys).[2] This work suggests that punishment prevents the decline of contribution levels observed when sanctioning mechanisms are absent,[3] and that punishment promotes efficiency (as measured by individuals' net earnings) in the long run but not in the short run (see Gächter, Renner, and Sefton 2008). Another important finding of this literature is that individuals are willing to spend their own resources in order to lower the income of those peer group members who violate reciprocity norms. As a natural extension of findings on negative reciprocity, economists have also explored the effect of a reward mechanism in promoting cooperative behavior. Recent laboratory studies have shown that when the cost-to-impact ratio of rewards is

[2] In disciplines other than economics, the implications of punishment have also received considerable attention (see, e.g., Yamagishi 1986; Ostrom, Walker, and Gardner 1992; de Quervain et al. 2004).

[3] It is also worth mentioning that punishment's cooperation-enhancing effect can be eradicated in the presence of antisocial punishment (see Herrmann, Thöni, and Gächter 2008; Gächter and Herrmann 2009, 2011); second-round punishment opportunities (see Cinyabuguma, Page, and Putterman 2006; Denant-Boemont, Masclet, and Noussair 2007; Nikiforakis, 2008); and its cost and effectiveness (see Anderson and Putterman 2006; Carpenter 2007, Egas and Riedl 2008; Nikiforakis and Normann 2008).

1:1, the reward mechanism is unable to sustain cooperation either in repeated interactions (Sefton, Shupp, and Walker 2007) or in a one-shot environment (Walker and Halloran 2004). However, when the benefit of receiving a reward exceeds the cost of assigning it, there is evidence that rewards can also be effective in sustaining cooperation (e.g., Vyrastekova and van Soest 2008; Drouvelis 2010).

A common feature of the studies cited above is that the public good environments have been determined exogenously. In other words, the experimenter randomly assigns the participants to one institutional environment, so subjects do not select the environment they prefer to play in. A recent line of research has departed from this standard design to examine subjects' behavior when they are allowed to choose the environment in which they would like to interact. Our experiment contributes to this recent research, and we discuss the relevant literature in the next subsection.

2. Endogenous selection of environments. While our discussion will center on the literature addressing endogenous selection of public good structures, it is worth mentioning that endogenous selections of environments have been experimentally explored in other contexts. These include prisoner's dilemma games (Bohnet and Kübler 2005), dictator games (Lazear, Malmendier, and Weber 2012), auctions (Palfrey and Pevnitskaya 2008; Jamison and Karlan 2009), incentive pay schemes (Eriksson and Villeval 2008; Dohmen and Falk 2011), and competitive environments (Niederle and Vesterlund 2007; Bartling et al. 2009). With respect to public good environments, the experimental literature has focused on the selection of environments that offer rewards and punishments.[4] For example, in a study by Botelho et al. (2005) subjects were asked to vote for their preferred environment after they acquired experience by playing for 10 periods in each of the available environments (a standard public good game and a public good game with sanctioning opportunities). After the voting took place, the majority of votes determined which environment all subjects played in for a final period.[5] This study found that subjects did not favor the sanctioning environment and also found that sanctions did not have a sustained positive effect on contributions and profits.

[4] A notable exception is Potters, Sefton, and Vesterlund (2005) who conducted an experiment in which subjects voted on whether they preferred a simultaneous versus a sequential public good game with imperfect information. Their subjects preferred the sequential ordering to the simultaneous one.

[5] To make the voting decision salient, subjects' earnings in the final period were 10 times more those of each of the first 20 periods.

Another experiment by Gürerk, Irlenbusch, and Rockenbach (2006) had subjects vote at the beginning of every period whether they would like to play in an environment without or with sanctions (both positive and negative). In each period, a participant then interacted with all the other participants who had chosen the same institution. Their results provide evidence that given a "voting-with-one's-feet" approach the sanctioning environment becomes the predominant choice over time. In a later paper, Gürerk, Irlenbusch, and Rockenbach (2009) provide further evidence that when subjects are confronted with a choice between an environment with or without punishment, the environment with punishment gradually becomes the dominant choice. In both of their studies, the environment where sanctioning opportunities were available led to higher contribution and efficiency levels.

Sutter, Haigner, and Kocher (2010) examined how endogenous selection affected three public goods environments (a standard public good game, a public good game with punishment, and a public good game with rewards) by letting subjects vote whether or not to accept each of the available environments. Voting was optional and costly to those who decided to participate. If one environment received unanimous support, it was played by all subjects in all periods; if multiple institutions were unanimously supported the tie was randomly broken. If unanimity was not achieved on the first vote, subjects continued voting until one environment was unanimously chosen. Their findings suggest that institutional preferences depend on the cost-to-impact ratio of the punishment and reward environment. When the ratio was to 1:3, 85 percent of the groups agreed on the public good game with reward, whereas with a ratio of 1:1, 63 percent agreed on the standard public good game. In their endogenous treatments, Sutter, Haigner, and Kocher find that the reward environments (both under a 1:1 and a 1:3 ratio) and the punishment environment (under a 1:1 ratio) generate higher contribution levels than the standard public good game.[6]

A number of recent experimental studies have further indicated that democratically selected institutions have positive effects on behavior. Ertan, Page, and Putterman (2009) find that institutional environments where subjects vote on whom they are allowed to punish (meaning, below-average, average, and/or above average contributors) yield higher contributions and greater efficiencies than institutions in which punishment is unrestricted. In the democratic institutions, most groups vote to allow punishment of norm violators who undercontribute but do

[6] Note that the punishment environment with a ratio of 1:3 was never agreed to be played.

not sanction high contributors (those whose contribution exceeds the norm). In another study, Putterman, Tyran, and Kamei (2010) provide evidence that giving subjects the opportunity to vote on the penalty structure (meaning, whom to penalize and the strength of sanctions) in an environment that allows punishment will lead to efficiency-enhancing outcomes relative to an environment where subjects are not given this opportunity. Kamei (2011) also finds that when a sanctioning policy is implemented democratically, subjects who favor the policy contribute more to their group than subjects who favor the policy contribute when the policy is implemented exogenously. In another series of experiments, Dal Bó, Foster, and Putterman (2010) also show that letting subjects democratically choose which policy they prefer positively affects cooperative behavior.

A clear message from this literature is that voting is the prevalent procedure used to implement individuals' preferences over environments. Although voting is a valid method for endogenously assigning individuals to specific environments, its disadvantage is that voting is not necessarily an incentive-compatible process. Our experimental investigation contributes to the "endogenous selection" literature in at least two respects. First, as described briefly in the introduction and in detail below, we introduce a fully incentive-compatible mechanism to elicit preferences over different public good environments. Second, our design consists of all four possible environments (a standard public good game, a public good game with punishment, a public good game with rewards, and a public good game with punishment and rewards), thus allowing us to compare their relative appeal as well as to disentangle the different individual and collective incentives that might be at work in these environments. Further, since we randomize assignments, we can separate the effect of selection from the effect of the institutional rules per se.

3. The interaction of preference measures and social preferences. This topic has received little attention in the literature. A few experimental studies have recently addressed how preference measures interact with social preferences, but evidence from the available studies is mixed and focuses mainly on trust games. In a trust game in rural Paraguay, Schechter (2007) shows that risk aversion plays an important role in determining behavior, whereas Eckel and Wilson (2004) find no significant relationship between risk measures and the decision to trust. In another experiment, Kocher et al. (2011) provide evidence that there is no correlation between risk preferences and behavior in a public good game and in a trust game.

These experiments mainly address the issue of whether and how behavior in games measuring social preferences is affected by preference measures. While this is a relevant research question to identify the factors influencing prosocial behavior, another important question largely ignored in this literature is what motivates the demand for different public good environments. This is a significant omission, as better understanding the self-selection process can help us improve the design of public institutions that promote social welfare and cooperation. By designing a novel experiment which elicits preferences over a menu of public good institutions in an incentive-compatible manner, our paper systematically investigates whether and how individual preferences affect the choice of institutions and subsequent behavior.

III. Experimental Design

Our experiment was conducted in two parts. In the first part we elicited subjects' levels of risk and ambiguity aversion (over both gains and losses). In the second part we elicited preferences over four public good environments and then randomly assigned subjects to one of these environments to play a repeated voluntary contribution game. At the beginning of the experiment, subjects were informed that the experiment would consist of two parts (in order to reduce the likelihood of incorrect expectations about the nature of the experiment). However, they were not told what would happen in the second part of the experiment (see Appendix A for the timeline of tasks that occurred in a session).

In order to elicit their preferences, participants were shown a table with seven rows and asked to choose between a safe option and a lottery option in each row. The safe option was exactly the same in each row, but the amount in the lottery option increased from row to row. More precisely, in the first row subjects could choose to receive £6 with certainty, or they could choose to play the lottery and have a 50 percent chance of receiving £0 and a 50 percent chance of receiving £11. Moving down the table, the amount it was possible to win in the lottery increased to £12, £13, £14, £16, £18, and £20. After a subject had made a decision for each row, it was randomly determined which row became relevant for payoff. Subjects were informed of their lottery payment at the end of the experiment. This procedure guaranteed that each decision was incentive-compatible. The number of times a subject chose the safe option indicates his or her

attitudes towards risk; that is, the more times a subject selected the sure payoff of £6, the more risk averse this subject is.

As our public good environments involve payoffs that are ambiguous and may even involve losses, we consider it important to elicit individual attitudes towards loss aversion, ambiguity aversion, and ambiguity aversion with losses.[7] To elicit such preferences we implemented a procedure similar to the last one used to elicit risk preferences. For instance, to elicit individual attitudes towards losses, we used the exact same table described above but with payoffs shifted downwards by £3. Thus the lottery payoffs now involved losses, as these consisted of a 50 percent chance of losing £3 and a 50 percent chance of receiving a positive amount. As a measure of loss aversion, we used the frequency with which a subject chose the safe option. For the cases of ambiguity aversion with and without losses, we simply replaced the probability of each outcome, made explicit in the lottery option, with a question mark to indicate that the probability was unknown. The four tables were shown to subjects in a random order to control for order effects. In particular, if the risk and loss questions (with 50–50 lotteries) always preceded the ambiguity questions, we might expect subjects to have a 50–50 prior distribution over outcomes when considering the ambiguous lotteries. The randomized presentation of these questions minimized this effect.

After the elicitation of preference measures, subjects received new instructions describing each public good environment (see Appendix B). In total, we examined four different environments, each corresponding to a separate treatment, with the individual participants experiencing only one treatment (a between-subjects design). We refer to our four treatments as: a) voluntary contributions mechanism (VCM); b) VCM with punishment; c) VCM with reward; and d) VCM with punishment and reward. In each session, a group of 12 subjects were randomly assigned across the above treatments to play a 25 period repeated game in groups of four. The group composition remained the same throughout the session (that is, a partner matching protocol). Earnings were given in money units for the public good games and we used an exchange rate of £0.01 per money unit.

[7] For control purposes, we wanted to use a symmetric procedure to elicit individuals' preferences towards risk, loss and ambiguity which prevented us from using an elicitation method similar to that of Holt and Laury (2002).

We will begin by describing our baseline treatment, VCM, and comment on the structure of the remaining treatments in turn.[8]

a) VCM treatment

Our baseline treatment is a stylized model that captures the conflict between private and social interests and is called the voluntary contributions mechanism (VCM) with linear payoffs. Under this treatment, subjects are randomly assigned to a four-person group and endowed with 20 tokens each. We used tokens rather than actual monetary units (as in the tasks above) in order to conform with the standard approach used in this literature. Each subject has to decide how much of this endowment to keep for themselves and how much to contribute to a public good (described to subjects as the "project"). For each token kept a subject earned one money unit for themselves, while for each token contributed to the project, each of the four subjects in the group earned a return of 0.4 money units, resulting in a total of 1.6 money units for the whole group. Thus, the earnings π_i^1 of a group member i for a given period are as follows:

$$\pi_i^1 = 20 - g_i + 0.4 \cdot \sum_{j=1}^{n} g_j \qquad (1)$$

where g_i denotes group member *i*'s contribution to the public good. After all group members made their contribution decisions, they were informed of the total amount of all contributions made to the public good and of their own income.

This simple baseline treatment allows us to measure the extent of self-interested behavior: since a subject's contribution cost one money unit, while the private return is only 0.4 money units, a selfish group member always has an economic incentive to contribute nothing to the public good and rely on the contribution of other group members. Yet social efficiency requires that all group members contribute their entire endowment to the public good (in this case each group member receives an income equal to 32 money units, which is greater than his/her initial endowment).

[8] In the actual instructions we used neutral framing in the description of the public good games. In particular, we referred to VCM as "Institution A," VCM with punishment as "Institution B," VCM with reward as "Institution C," and VCM with punishment and reward as "Institution D."

b) VCM with punishment treatment

The VCM with punishment treatment is identical to the VCM treatment except for the addition of a second stage. After subjects made their contribution decisions during the first stage, the other three group members' contribution profiles are revealed at the beginning of the second stage. No individual subject could identify the particular contribution of any other group member, since the order of contributions shown in each screenshot randomly changed from period to period, and therefore, subject-specific reputations could not develop across periods. Each subject could then assign between zero and five negative points to each of the other group members. Assigning negative points was costly both to the punisher and the punished group member, as each negative point costs the punisher one money unit and the punished group member three money units. Thus, for a group member *i* for a given period, the total earnings from both stages, π_i , are as follows:

$$\pi_i = \pi_i^1 - \sum_{j \neq i} p_{ij} - 3 \cdot \sum_{j \neq i} p_{ji}, \qquad (2)$$

where π_i^1 denotes the group member *i*'s payoff from the first stage (as defined in equation 1) and p_{ij} the number of negative points group member *i* assigns to group member *j*.

At the end of the second stage, each subject was informed about the cost incurred for assigning negative points, the total number of negative points assigned to them, and their earnings from each period. No information about the number of adjustment points received by each group member was made available to them, meaning that they did not learn anything about possible social norms regarding punishment.

c) VCM with reward treatment

The VCM with reward treatment has a similar two-stage structure to the VCM with punishment treatment. The first stage is identical to the VCM treatment, while in the second stage, subjects learn the whole vector of individual contributions made in their group during the first stage. Then each subject is given the opportunity to assign positive points to other group members—assigning positive points is costly to the donor but beneficial for the recipient. Each positive point costs the donor one money unit and awards the recipient one money unit. Thus, for a group member *i*, the total earnings from both stages, π_i, for a given period are as follows:

$$\pi_i = \pi_i^1 - \sum_{j \neq i} p_{ij} + 1 \cdot \sum_{j \neq i} p_{ji}, \qquad (3)$$

where π_i^1 denotes the group member *i*'s payoff from the first stage and p_{ij} the number of positive points group member *i* assigns to group member *j*. The number of positive points that each group member could assign was between zero and five. As in the previous treatments, subjects received information about their own rewards and earnings but group information was not provided.

d) VCM with punishment and reward treatment

The VCM with punishment and reward treatment is a combination of the VCM with punishment and the VCM with reward. After subjects made their contribution decisions in the first stage and their group's contribution profile was revealed, each subject was given the opportunity to assign either up to five negative or up to five positive points to each of the other group members. The cost-to-impact ratio for the assignment of points also remained the same; that is, each negative point reduces the punisher's earnings by one money unit and the punished group member's earnings by three money units, whereas each positive point reduces the donor's earnings by one money unit and increases the recipient's earnings by one money unit, as follows:

$$\pi_i = \pi_i^1 - \sum_{j \neq i} p_{ij} - 3 \cdot \sum_{j \neq i} p_{ji} + 1 \cdot \sum_{j \neq i} p_{ji}, \qquad (4)$$

where π_i^1 denotes the group member *i*'s payoff from the first stage and p_{ij} the number of points (either negative or positive) that group member *i* assigns to group member *j*. As in the previous treatments, subjects learned their own earnings but did not learn about the performance of other group members.

Note that conditional on each subject i being motivated to maximize payoffs given by equations (2), (3), and (4), the unique subgame perfect equilibrium for the VCM with punishment and reward requires that subjects free ride completely in the first stage and refrain completely from assigning points in the second stage.

As soon as subjects read the instructions for each treatment, they received a number of computerized control questions to ensure that they understood the decision situation and the payoff calculations. All participants had to answer these questions correctly; otherwise, the

experiment would not proceed. Next, subjects were asked to indicate on a percentage scale how much they expected to earn relative to the maximum potential earnings, considering only earnings from the 25 rounds of the public good game (see figure C.1 in Appendix C for a screenshot of this step). We are interested in this assessment as a means to find out whether— and if so how— overconfidence affects the selection into public good games. Subjects received a bonus based on the accuracy of their estimation. In particular, if their estimation was within 10 percentage points in either direction of their actual earnings (calculated as a percentage of the maximum earnings), they received £1; if their estimation was within 15 percentage points in either direction of their actual earnings, they received £0.50, and if their estimation was within 25 percentage points in either direction, they received £0.20. Subjects were informed about their true rank in the distribution at the very end of the experiment.

After the subjects answered the overconfidence question, their institutional preferences were elicited. During this phase, the subjects were asked to indicate in which public good institution they preferred to participate by quantifying how much each institution was worth to them (in pounds and pence). The incentive system was as follows: subjects were asked to indicate a monetary amount for their preferred institution. They were told that if they were assigned to one of the institutions that they indicated they were willing to pay for, then the monetary amount they indicated would be subtracted from their final payment. If they were assigned to an institution for which they had indicated that they would need to be paid to participate in, then the monetary amount they stated would be added to their final payment. Note that the maximum amount they could state was any number (with two decimals places) from –£5 to £5 (inclusive) and that the sum of all four amounts was required to sum to 0. To control for order effects, each institution appeared onscreen in a random order across participants. Figure C.2 in Appendix C provides a screenshot of the interface we used for eliciting subjects' preferences for each institution.

Our incentive mechanism allowed subjects to truthfully express the ordinal ranking of their preferred institution as well as the strength of their preference (by stating a pound value for the amount that their preferred structure was worth to them). As long as subjects have diminishing marginal utility for money (that is, they would prefer to be given money in a low-income state of the world even if an equivalent [probability-weighted] amount were taken away in a high-income state), this mechanism induces them to state that they prefer exactly those environments in which they expect to earn more. On a related note, this elicitation procedure does add additional *ex ante*

uncertainty to their payoffs, so one might worry that the magnitude of the expressed preferences was a function both of actual underlying intensity and of risk aversion. However, when we regressed the average absolute value of the expressed preferences against the normalized risk, loss, and ambiguity attitudes, we found no relationship—suggesting that this was not a concern in practice.

After subjects entered their relative preferences, they were informed which of the four environments they had been assigned to and then played the game for 25 rounds. In order to collect the same amount of independent observations for each treatment, subjects were randomly allocated to one of the four treatments before the experiment began. After the 25 rounds of play concluded, subjects were informed of their payoff from the lottery task, the overconfidence question (along with their actual rank in the distribution), and their earnings from the public good game. At this point we also collected data on the subjects' demographic characteristics (such as gender, age, nationality, marital status, father's education, political and religious affiliations) and on a self-control task that is correlated with cognitive outcomes (see Frederick 2005).

Procedures

We conducted sixteen sessions, four sessions for each of the four treatments. A total of 192 subjects participated in the experiment and in each of the four treatments there were 48 subjects. All the subjects were recruited at the University of York, using the ORSEE software (Greiner 2004). The vast majority of participants were undergraduate students from various academic fields. The experiment was conducted in the Centre for Experimental Economics (EXEC) lab and all treatments were computerized and programmed with the Multistage software from Caltech. The instructions for the elicitation of risk preferences and the description of the public good environments are provided in Appendix B. Some of the instructions were presented on the computer screen. At the end of a session, subjects were paid in private according to their total earnings from all relevant tasks. Average earnings per treatment were as follows: £13.54 for the VCM, £13.80 for the VCM with punishment, £14.19 for the VCM with reward, and £14.62 for the VCM with punishment and reward (at the time of the experiment £1 was equivalent to $1.61). Sessions lasted, on average, 70 minutes, with no session taking more than 90 minutes.

IV. Results

In the following three subsections, we present the main results from our experiment. In the first subsection, we examine the responses that indicated the subjects' individual attitudes towards risk, loss, and ambiguity and how these preferences are interrelated and related to the subjects' personal characteristics and demographics. In the second subsection, we investigate how preference measures affect the subjects' choice of institutions. In the last subsection, we focus on behavior in the public good games, both in contribution levels and in the assignment of points for punishment and rewards.

1. Preference measures, cognitive reflection test (CRT) questions, and demographics

In the first part of our experiment, we elicited subjects' risk, loss, and ambiguity preferences. Recall that for a given preference measure, subjects had to make seven separate choices between a fixed amount safe option and a lottery, in which the payment amount increased from row to row moving down the table. We use the number of times a subject chose the safe option as a measure of his/her attitudes corresponding to the specific preference measure. For example, when eliciting risk preferences, never choosing the risky option indicates extreme risk aversion, whereas choosing seven risky options indicates extreme risk-seeking behavior. Table 1 presents summary statistics on how often the subjects chose the sure payoff for each preference measure. We observe that, on average, our subjects are ambiguity averse both with respect to both gains and losses. Performing a Wilcoxon matched-pairs signed rank test, we find that the difference between the mean values of risk aversion and ambiguity (without loss) aversion is highly statistically significant (p-value = 0.000). This is also the case when we compare the mean value of loss aversion and that of ambiguity (with losses) aversion (p-value = 0.000). Comparing the mean values of risk aversion and loss aversion, we find significant differences at the 5-percent level (p-value = 0.038), a result that implies our subjects were more risk averse than loss averse.

Table 1:Means and Standard Deviations of Preference Measures

Preference measure	**Mean**	**Standard deviation**
Risk aversion	3.51	1.65
Loss aversion	2.99	1.97
Ambiguity aversion (without losses)	4.28	1.71
Ambiguity aversion (with losses)	3.63	2.22

As is often observed with elicitation of preference measures, some of our subjects switch more than once between the safe option and the lottery option, a choice which is considered to be inconsistent behavior. We will refer to these subjects as "switchers." In our sample, there are 40 subjects who switched more than once in at least one preference measure. After excluding these 40 subjects, we find similar mean numbers of safe choices for each preference measure (see Table D.1 in the Appendix D for summary statistics). The differences in mean values, documented earlier, are robust to this exclusion, with the exception that the mean value of risk aversion and that of loss aversion is now significantly different at the 10-percent level (p-value = 0.052).

We next examine whether preference measures are correlated with each other. As Table 2 suggests (p-values are reported in square brackets), we find significant correlations between all pairs, except for the dyad of loss aversion and ambiguity aversion (without losses). In particular, the positive signs of the reported coefficients indicate that the more risk averse a subject, the more averse they are to loss and ambiguity.[9] In addition, loss averse subjects are more ambiguity averse only when losses are involved, whereas the more ambiguity averse a subject is towards gains, the more ambiguity averse he/she is to losses. These conclusions are robust when the 40 switchers are excluded (see Table D.2 in the Appendix D). Interestingly, previous studies that have used different instruments from ours do not find significant correlations between

[9] The latter result matches survey data reported in Butler, Guiso, and Japelli (2011).

preferences, suggesting that their findings are "inconsistent with the notion that individuals have a fixed, domain-general utility function that is applicable to all risky situations" (Eckel and Wilson 2004, p. 457). We view our evidence on correlations as a means of validating our preference measures, which are fairly standard but have not yet been replicated across a fully diverse set of environments. Of course, it is difficult to know for certain which, if any, of the preference measures are most closely capturing the underlying constructs.

Table 2:Pair-wise Correlation Coefficients of Preference Measures

	Risk aversion	**Loss aversion**	**Ambiguity aversion (without losses)**	**Ambiguity aversion (with losses)**
Risk aversion	1			
Loss aversion	0.25*** [.00]	1		
Ambiguity aversion (without losses)	0.40*** [.00]	0.09 [.21]	1	
Ambiguity aversion (with losses)	0.16** [.02]	0.61*** [.00]	0.25*** [.00]	1

We investigate whether the subjects' specific individual characteristics determine their particular/specific preferences towards risk, loss, and ambiguity. Table 3 presents our regression analysis of the four different institutional models; here the dependent variables correspond to each of our four preference measures. Model 1 includes how risk averse a subject is as a dependent variable, and it can assume an integer value from one (risk-loving subjects) to seven (highly risk averse subjects). Models 2, 3, and 4 include a dependent variable indicating how averse a subject is to loss and ambiguity (with and without losses), respectively. The construction of the dependent variables for these models follows similar reasoning. Note that in each of these four models, the dependent variable has been standardized to have a mean of zero and a standard deviation of one. As explanatory variables for these preferences we have included subjects' overconfidence levels (as reported in the elicitation phase of the experiment's second part), the number of correct cognitive reflection test (CRT) questions answered, gender, age, major,

father's education, perceptions about fairness, whether the subject has participated in an economic experiment before, the number of participants they know by name in their session, and their religious and political affiliations. Our regression results are shown in Table 3.

The main message to take from Table 3 is that the subjects' individual characteristics do play a role in determining their preferences regarding risk, loss, and ambiguity. In particular, age is a statistically significant determinant for all four measures and is related to lower aversion to risk, loss, and ambiguity. Given the narrow range of ages in a student population, this may be a proxy for social status within the university, rather than a function of age itself (or for example, a correlate of age such as income). A subject's father's education is also negatively and (weakly) significantly correlated with loss aversion. Political affiliations also affect preferences over ambiguity. Relative to those subjects who declare no political party affiliation, we observe that those who are affiliated with the Conservative party are more ambiguity averse, whereas those who are affiliated with a party other than the four major ones in the United Kingdom (that is, Conservative, Labour, Liberal Democrats, and Green) are found to be less ambiguity averse. In addition, subjects who report a religious affiliation (other than Protestant or Catholic, for which there is no effect) are less risk averse, compared to those with no religious affiliation. In sum, our findings from Table 3 document systematic correlations between our four preferences measures and individual characteristics.

We conclude this section by exploring how the level of individual cognition and executive function (as measured by the number of correct CRT questions) is related to subjects' preferences over risk, loss, and ambiguity. To address this question, we employ an ordered probit analysis where the dependent variable indicates the number of correct CRT questions that a subject provided. Table 4 presents our three regression models. In Model 1, we include whether a subject was a switcher and the four standardized preference measures as explanatory variables. Model 2 checks for the robustness of these results by adding age, gender, nationality, and overconfidence. Model 3 includes a number for other controls such as father's education, economics or business major, perceptions of fairness, whether a subject has ever participated in an economics experiment, number of other participants a subjects knows, political party, and religion affiliation.

Table 3: Preference Measures and Individual Characteristics: Regression Results

	Std. risk aversion (1)	**Std. loss aversion (2)**	**Std. ambiguity (w/o loss) aversion (3)**	**Std. ambiguity (w/ loss) aversion (4)**
Overconfidence	–0.27	–0.74	–0.34	–0.46
	[0.56]	[0.50]	[0.53]	[0.51]
Correct CRT questions	–0.01	–0.08	0.10	0.05
	[0.07]	[0.08]	[0.07]	[0.08]
Male	–0.10	0.02	0.15	0.06
	[0.18]	[0.18]	[0.18]	[0.19]
Age	–0.06**	–0.03*	–0.06***	–0.06***
	[0.02]	[0.02]	[0.02]	[0.02]
UK nationality	–0.26	–0.28	–0.48**	–0.48***
	[0.19]	[0.18]	[0.19]	[0.17]
Father's education	–0.059	0.12*	0.03	0.07
	[0.07]	[0.06]	[0.06]	[0.06]
Economics or business major	–0.14	–0.27	0.24	–0.02
	[0.17]	[0.18]	[0.17]	[0.17]
Agree with "most people would be fair"	0.19	–0.019	–0.07	0.08
	[0.16]	[0.17]	[0.16]	[0.16]
Agree with "okay to avoid fare"	–0.17	–0.25	–0.14	–0.20
	[0.16]	[0.17]	[0.16]	[0.16]
Has participated in an economic experiment	0.11	0.02	0.06	0.17
	[0.16]	[0.17]	[0.16]	[0.18]
# other participants know by name	0.02	–0.04	–0.12	–0.18
	[0.12]	[0.13]	[0.12]	[0.12]
Catholic (vs. no religion)	–0.23	–0.24	–0.41	–0.32
	[0.22]	[0.21]	[0.25]	[0.23]
Protestant (vs. no religion)	–0.28	0.12	–0.20	0.39
	[0.25]	[0.27]	[0.23]	[0.27]
Other religions (vs. no religion)	–0.37*	–0.10	–0.27	0.10
	[0.20]	[0.21]	[0.19]	[0.19]
Liberal democrat (vs. no affiliation)	–0.23	–0.08	0.30	0.16
	[0.22]	[0.23]	[0.22]	[0.23]
Labour (vs. no affiliation)	–0.44	0.22	0.04	0.02
	[0.29]	[0.25]	[0.31]	[0.25]
Conservative (vs. no affiliation)	–0.38	0.32	0.57**	0.37
	[0.24]	[0.25]	[0.26]	[0.28]
Green (vs. no affiliation)	0.01	0.52*	0.10	0.35
	[0.31]	[0.30]	[0.34]	[0.36]
Other political party (vs. no affiliation)	–0.47	0.05	–0.44*	–0.12
	[0.47]	[0.33]	[0.27]	[0.23]
Observations	192	192	192	192

Note: Ordered probit with robust standard errors reported in square brackets. * denotes significance at the 10-percent level, ** denotes significance at the 5-percent level, and *** at the 1-percent level.

Table 4: CRT Questions: Regression Results

	Dependent variable: # correct CRT questions		
	1	**2**	**3**
Switcher?	–0.56***	–0.51**	–0.44*
	[0.21]	[0.23]	[0.24]
Standardized Risk aversion	–0.02	0.00	–0.03
	[0.09]	[0.09]	[0.10]
Standardized Loss aversion	–0.21**	–0.16	–0.16
	[0.11]	[0.11]	[0.11]
Standardized Ambiguity (w/o loss) aversion	0.10	0.08	0.11
	[0.09]	[0.09]	[0.10]
Standardized Ambiguity (w/ loss) aversion	0.14	0.11	0.12
	[0.11]	[0.10]	[0.10]
Male		0.31*	0.37**
		[0.17]	[0.18]
Age		0.00	0.00
		[0.02]	[0.02]
UK nationality		–0.136	–0.07
		[0.17]	[0.20]
Overconfidence		1.100**	1.09**
		[0.50]	[0.53]
Controls for other demographics?	No	No	Yes
Observations	192	192	192

Note: Ordered probit with robust standard errors reported in square brackets. * denotes significance at the 10-percent level, ** denotes significance at the 5-percent level, and *** at the 1-percent level.

Our regression analysis suggests that loss averse subjects appear to correctly answer fewer CRT questions. However, this effect vanishes when we control for the other demographic characteristics we collected. Interestingly, these characteristics have a significant impact on our specific measure of subjects' cognitive abilities. In particular, we find that males tend to answer more CRT questions correctly and subjects who report high overconfidence levels also tend to answer more CRT questions correctly. A noteworthy aspect of our regression results has to do with the subjects who switched back in at least one of our preference elicitation tasks. In all three models, it turns out that "switchers" tend to answer fewer CRT questions correctly. The main findings from this section are summarized in Result 1.

RESULT 1: Preference measures are positively and significantly correlated with each other and are systematically affected by individual characteristics such as age, nationality, political and religious affiliations. An individual's cognitive executive function, as measured by the CRT, are related to his or her degree of loss aversion, gender, overconfidence, and whether the subject switched more than once in at least one preference elicitation task.

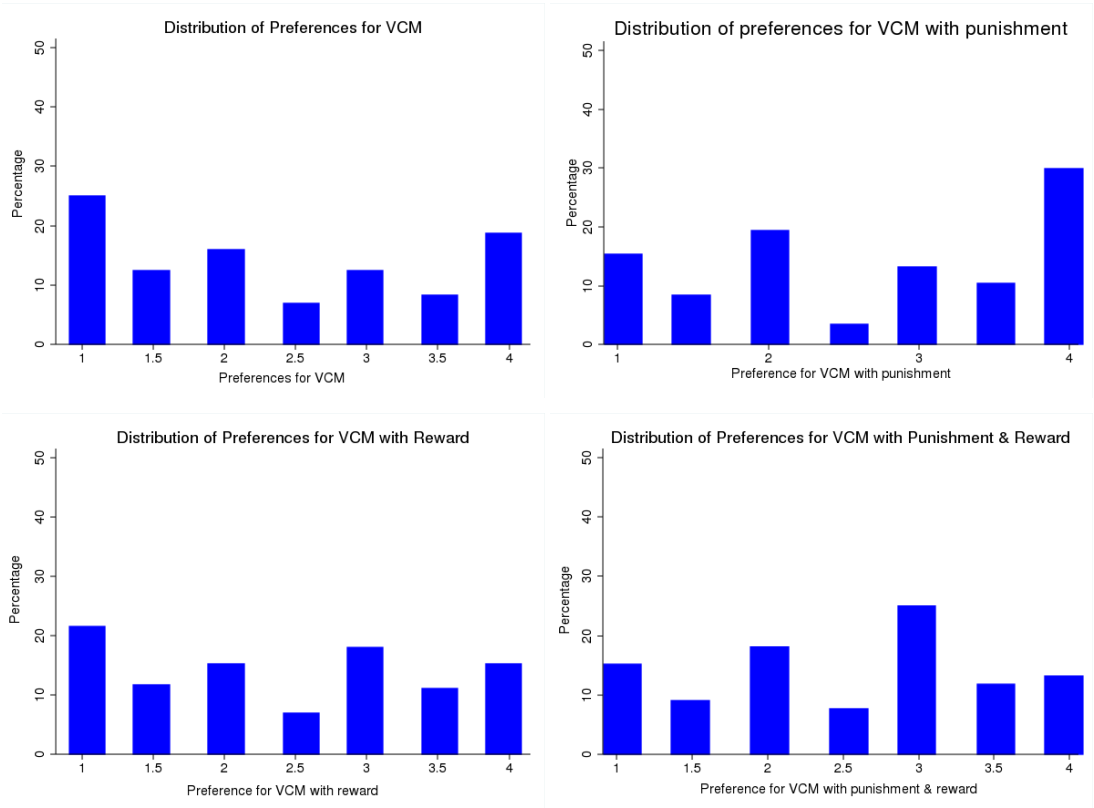
2. Choice of institutions

Figure 1 displays the subjects' distribution of preferences for each of the four institutions. The horizontal axis in each panel indicates the ranked preference for each institution using a four-point scale, where "1" denotes a subject's most favored institution and "4" denotes the least favored institution. In case of a tie between two or more institutions, we assigned the average value of the ranked positions that the two institutions occupied. This implies that the sum of the rankings of each institution for a given subject is always equal to 10.

Most subjects exhibit a preference to participate in institutions which do not include punishment opportunities. As Figure 1 suggests, the VCM treatment is assigned a ranking of 1, 1.5, or 2 by 53.65 percent of subjects, while the corresponding percentage of subjects who rank the VCM with reward treatment as 1, 1.5, or 2 is 51.04 percent. On the other hand, the VCM with punishment and reward, and the VCM with punishment treatments are ranked 1, 1.5, or 2 by 43.75 percent and 40.10 percent of subjects, respectively.[10]

[10] As a complementary measure of preferences, we explored how much each subject was willing to pay/get paid as a percentage of the maximum amount allowed (that is, £5). This analysis conveys a similar message to our earlier discussion. Specifically, 60.42 percent and 53.13 percent of subjects report that they want to pay a non-negative amount to participate in the VCM treatment and the VCM with reward treatment; while the corresponding

Figure 1: Distribution of Preferences Over Institutions



Note: 1= "Most preferred," 4= "Least preferred"
Source: Authors' calculations.

A relevant question to address is what influences the rank an individual assigns to each institution. Table 5 contains regression models, with two models corresponding to each institution. In models 1, 3, 5, and 7, we examine the extent to which a subject's risk, loss, and ambiguity preferences affect preferences over each institution separately; while in models 2, 4, 6, and 8, we check the robustness of these results to the inclusion of more explanatory variables including overconfidence levels, the number of correct CRT questions, gender, age, and nationality. Since we have an ordinal ranking for each institution we estimate ordered probit regression models. Our preference measures have been standardized to have a mean of zero and a standard deviation of one.

percentages for the VCM with punishment and reward and the VCM with punishment treatments are 52.6 percent and 43.75 percent, respectively.

Table 5: Preference Measures and Choice of Institutions

	Dependent variable: ranking of each institution (1, 1.5, ..., 4)							
	VCM rank		**VCM with punishment rank**		**VCM with rewards rank**		**VCM with punishment & rewards rank**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Std. Risk Aversion	–9.87	–11.88	10.18	10.86	–11.75	–12.97	11.44	13.99
	(19.05)	(19.32)	(17.69)	(17.51)	(16.51)	(16.37)	(16.41)	(16.82)
Std. Loss Aversion	5.19	–0.05	13.11	10.71	–9.01	–6.78	–9.30	–3.88
	(20.25)	(20.56)	(22.98)	(23.86)	(20.72)	(21.07)	(19.37)	(19.42)
Std. Ambiguity Aversion	18.48	20.04	–9.89	–6.98	–4.81	–5.11	–3.78	–7.94
	(18.29)	(19.89)	(19.38)	(20.58)	(19.77)	(20.95)	(17.44)	(18.23)
Std. Ambiguity (with loss) Aversion	–35.31	–30.65	0.293	2.52	8.91	8.24	26.11	19.89
	(22.36)	(22.24)	(22.96)	(23.63)	(21.23)	(21.47)	(21.93)	(22.35)
Overconfidence		–43.26		67.69		12.85		–37.28
		(93.90)		(100.69)		(93.02)		(82.33)
Correct CRT questions		1.55		–32.25**		20.11		10.60
		(15.27)		(15.06)		(13.85)		(12.90)
Male		–35.88		31.92		–40.27		44.22
		(36.20)		(40.46)		(33.59)		(33.44)
Age		–4.26		1.92		–0.71		3.05
		(4.52)		(5.09)		(4.45)		(4.45)
UK nationality		74.43**		–10.61		21.13		–84.94**
		(36.96)		(39.29)		(36.82)		(35.59)
Constant	21.63	118.40	–31.58*	–71.88	–8.59	–25.95	18.55	–20.57
	(16.10)	(121.75)	(16.29)	(131.35)	(15.15)	(125.60)	(14.92)	(118.16)
Observations	192	192	192	192	192	192	192	192

Note: OLS regressions with robust standard errors in square brackets. * denotes significance at the 10-percent level, ** denotes significance at the 5-percent level, and *** denotes significance at the 1-percent level.

Our regression analysis shows that individual preference measures are not good predictors of institutional choice, either in terms of magnitude or statistical significance. This result is robust to several alternate specifications: excluding the 40 subjects who switched back and forth in at least one preference elicitation task (see Table D.3 in the Appendix); using the ordinal rather than the cardinal strength of intensity over institutional environments; and including only one individual preference at a time in the regression (potentially preferable because of positive correlations between some of those measures). However, the institutional preference is not simply noise, as can be seen by noting that other individual variables such as cognitive self-control (as assessed by the CRT task) and UK nationality do in fact predict it. So although initially we predicted that risk, loss, and ambiguity attitudes would be important factors at this stage (based in part on previous work as described in the introduction), we cannot conclude that this is the case.

To further explore this possible relationship, one approach is to look for heterogeneity within the sample. In particular, note that stating a preference intensity of 500 pence for a particular institution implies an unrealistically large per-period gain in profits and may be an indicator that a given subject did not fully understand the situation.[11] If we restrict attention only to those subjects who expressed preference intensities in either direction of 200 pence at most (there are 135 such subjects from our total of 192), we find instead that being more risk averse and being more ambiguity averse both significantly predict a preference for the default VCM institution, meaning the simplest environment with no punishment or reward mechanisms, as would be expected. This result is robust to the specific cutoffs on intensity (within a reasonable range), but since this expectation was not our specific hypothesis in advance we hesitate to give it undue weight. Nevertheless, this result suggests that at least for some individuals, their attitude toward uncertainty is indeed an important determinant for their preference towards social structure.

RESULT 2: Overall, preference measures do not seem to matter for institutional choice. However, further work is warranted to explore the boundaries and extent of this relationship.

[11] We thank Urs Fischbacher for suggesting this line of reasoning.

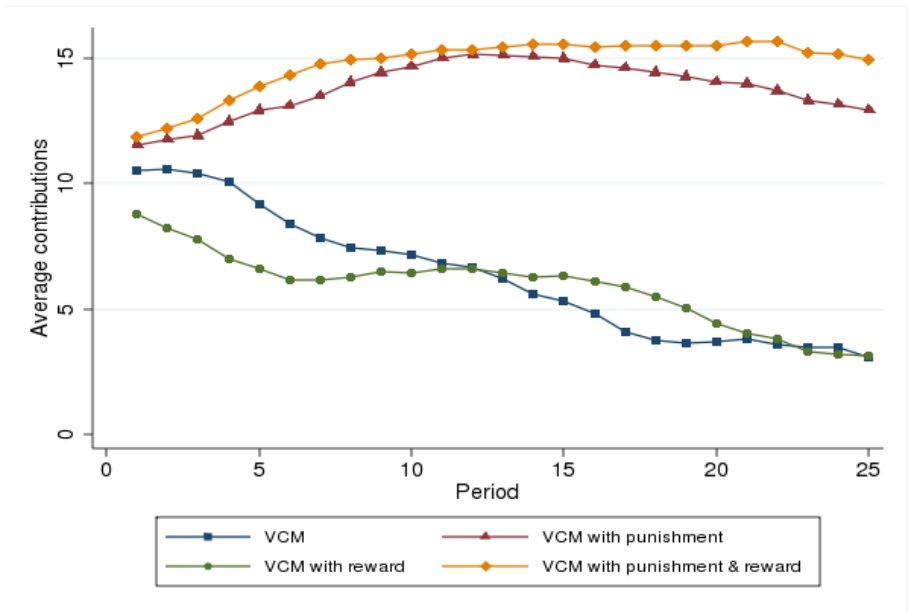
3. Behavior in institutions

3.1 Contribution behavior and net earnings

In this subsection, we discuss the results in the first stage of the VCM treatments. First we present our findings with respect to subjects' contribution behavior and then we analyze the efficiency of each of these institutions as measured by the subjects' average net earnings.

Figure 2 shows the average contributions made to the public good project across all 25 rounds, smoothed by a five-period moving average. We observe very similar patterns of average contributions between the standard VCM treatment and the VCM with reward treatment. In particular, subjects initially contribute approximately 50 percent of their total endowment, with group allocations declining to roughly 10 percent of the initial endowment after 25 rounds of play. However, as is apparent in Figure 2, the time trends and average contributions diverge when we examine the treatments which allow opportunities for punishment; that is, the VCM with punishment and the VCM with punishment and reward. Initial average contributions start from approximately the same point relative to the VCM and the VCM with reward treatments, but as the game progresses the contributions dramatically increase and move closely together. A visual inspection of Figure 2 suggests pronounced differences between the punishment and the no-punishment treatments, which are documented by our statistical analysis reported in Table 6.

Figure 2: Average contributions in each period by treatment



Source: Authors' calculations.

Table 6 presents the p-values of the non-parametric ranksum Wilcoxon test for each possible comparison between a pair of treatments. In parentheses, we also report the average contributions for each treatment across all 25 periods. In particular, we observe that the average contributions are largest in the VCM with punishment and reward treatment (14.73 tokens) and the VCM with punishment (13.74 tokens) and lowest in the VCM (6.25 tokens) and the VCM with reward treatments (5.86 tokens). Our statistical analysis records significant differences at the 1 percent level between the treatments with and without punishment.

Table 6. Average Contributions and p-Values of Pairwise Comparisons

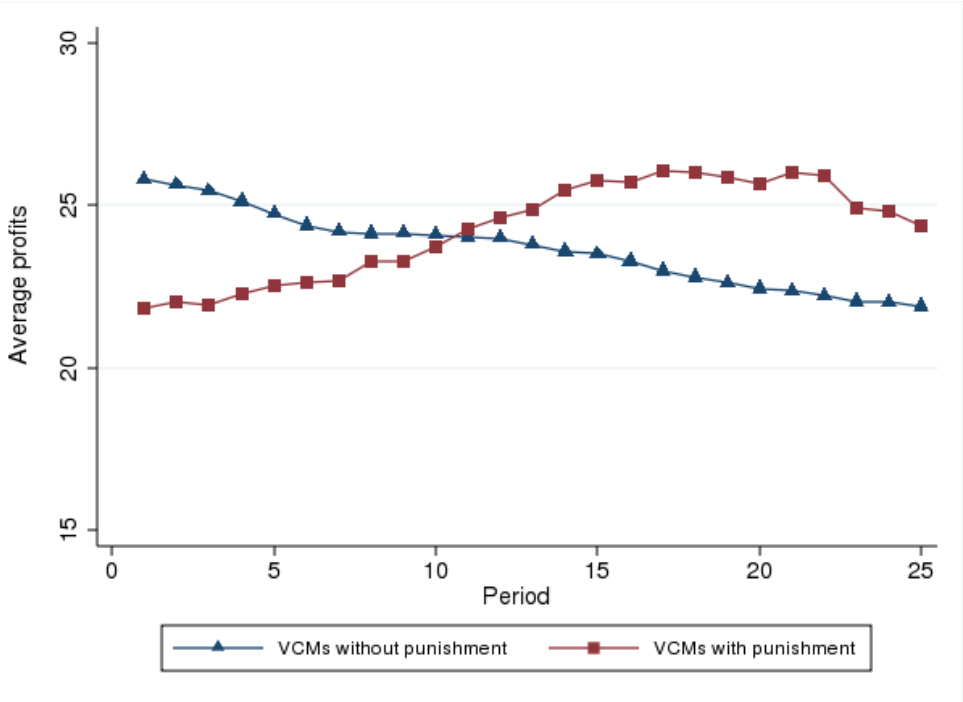
	VCM (6.25)	VCM with punishment (13.74)	VCM with reward (5.86)	VCM with punishment & reward (14.73)
VCM (6.25)	--			
VCM with punishment (13.74)	0.00	--		
VCM with reward (5.86)	0.66	0.00	--	
VCM with punishment & reward (14.73)	0.00	0.73	0.00	--

Notes: Numbers in cells correspond to p-values for each pairwise comparison (using a ranksum Wilcoxon test). Numbers in parentheses correspond to average contributions in each treatment across all 25 periods.

We further examine the efficacy of the treatments with and without punishment by looking at how average net earnings evolved over time. Figure 3 shows the average profits in each period in the punishment and the non-punishment treatments, smoothed by a five-period moving average. Most notably, we see that efficiencies follow a different dynamic across the treatments. At the beginning of the game the VCMs with punishment yield lower average net earnings, but as the game progresses the average net earnings increase, resulting in higher average profits. The opposite pattern is observed in the treatments without punishment. The net profits are not significantly different between treatments with and without punishment when we average across all 25 periods (ranksum Wilcoxon test, p-value = 0.503; 24.19 tokens in the punishment treatments and 23.64 tokens in the no-punishment treatments).

However, profits are lower (p-value = 0.001) in the first 5 periods of the punishment treatments (21.93 tokens) as compared to the ones with no punishment (25.45 tokens). Importantly, this trend is reversed across the final 10 periods, where average net profits are significantly higher (p-value = 0.016) for the punishment treatments (25.46 tokens) relative to the treatments with no punishment (22.41 tokens). Our findings provide further support for previous experimental evidence suggesting that the availability of a punishment mechanism decreases average net earnings in the short run, but causes an increase in efficiency in the long run.

Figure 3: Average Earnings in the Treatments with and without Punishment



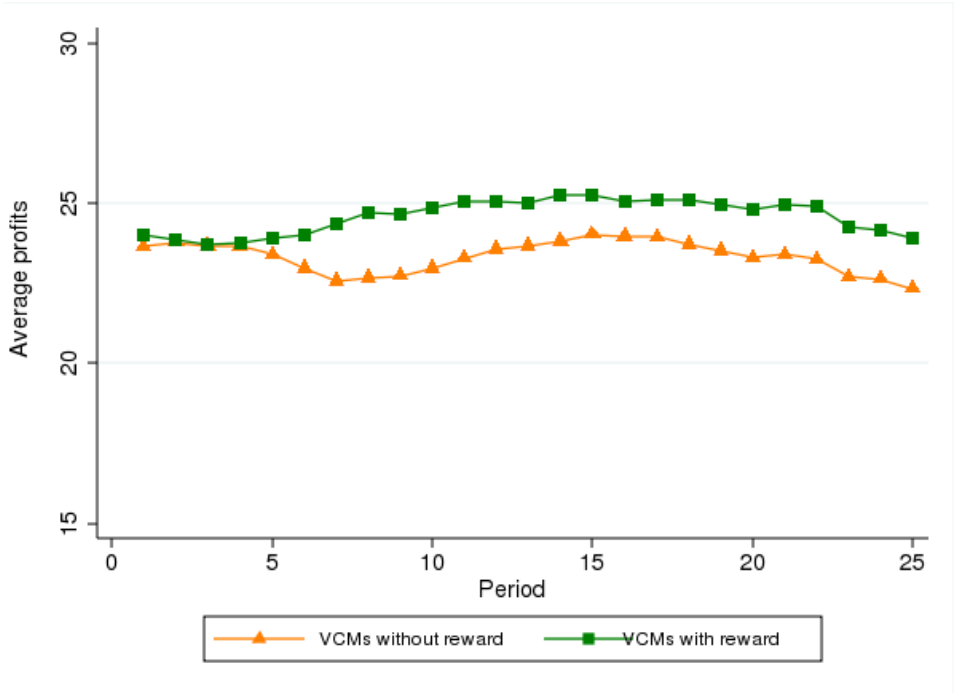
Source: Authors' calculations.

To further test that it is the punishment opportunities that cause an increase in the efficiency of the public good institutions, we also analyze how average net earnings evolved over time for the treatments with and without reward opportunities. As is apparent in Figure 4, which shows the average profits by period in the reward and the no-reward treatments (smoothed by a five-period moving average), the average net earnings per subject follow a similar dynamic across institutional conditions. Averaging across all 25 periods, net profits are 24.55 tokens in the VCMs with reward opportunities and 23.27 tokens in the VCMs without reward opportunities. This difference is not statistically significant (ranksum Wilcoxon test, p-value = 0.452). Nor is any significant difference observed when we look at

average net earnings in either the first 5 periods or the last 10 periods. The main findings from this section are recorded in Result 3.

RESULT 3: The VCM treatments with punishment sustain higher average contribution levels relative to the no-punishment VCM treatments. The presence of punishment opportunities causes an increase in efficiency, as measured by average net earnings, in the long run.

Figure 4: Average Earnings in Treatments with and without Rewards



Source: Authors' calculations.

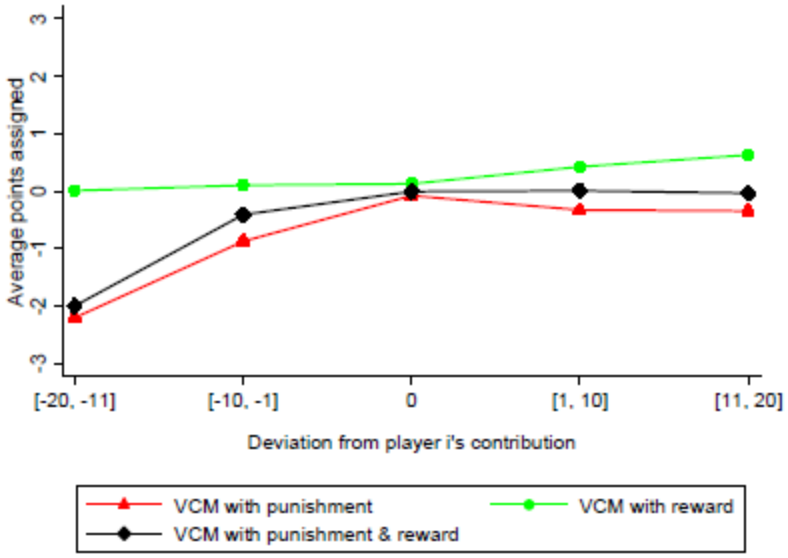
3.2 Assigning points for sanctions and rewards

This section analyzes behavior in the second stage of the VCM treatments by discussing how sanctions and rewards are actually used. Figure 5 depicts how subjects mete out punishments and rewards based on how much the peer's contribution deviates from the punisher's/donor's contribution. The vertical axis indicates the average points assigned to a group member by player *i*. The horizontal axis indicates the deviation in discrete intervals of the recipient's contribution from the contribution of the punisher/donor (player i). For

example, a subject in the VCM treatment with punishment assigned, on average, –2.21 points to those who contributed between 11 and 20 tokens less than him/her.[12]

Figure 5 provides evidence that in both treatments where punishment opportunities exist, negative deviations from the punisher are strongly sanctioned. In particular, the greater the negative deviation is from the punisher's contribution, the harsher the punishment. Not surprisingly, in the VCM treatment with reward, we observe that negative deviations are not rewarded. Positive deviations (using the donor's contribution as a base) are rewarded, with the reward being increasing in the size of the deviation. However, for the VCM treatment with punishment and reward, the average points assigned for positive deviations are half as much as the average points assigned in the reward only treatment.

Figure 5: Average Points Assigned as a Function of Deviation
from the Sanctioning/Rewarding Player's Contribution



Source: Authors' calculations.

To analyze the characteristics of those subjects who assign sanctions and/or rewards, we employ a multivariate Tobit regression analysis. The dependent variable is the costs an individual incurs by assigning sanctions and/or rewards in a given period, while the explanatory variables include the standardized preference measures, the absolute negative and positive deviations from player *i*'s contribution (as negative/positive deviations elicit

[12] The actual points assigned by the punisher/donor in each deviation interval are shown in Table D.4 in Appendix D.

different punishment/reward responses), and other characteristics such as gender, age, nationality, whether the subject is an economics/business major, overconfidence, and the number of correct CRT questions. Our regression results are presented in Table 9.

In line with previous results in the literature, we find that absolute negative deviations are significantly and negatively correlated with the points assigned for punishments and/or rewards in all three treatments. This result suggests that the more a subject negatively deviates from the punisher's/donor's contribution, the more negative points are assigned to him/her. In addition, positive deviations are only significantly positively correlated with points assigned in the VCM treatment with reward, implying that the more a subject positively deviates from the donor's contribution the more rewards the donor assigns to him/her.

Furthermore, we document statistically significant relationships between preference measures and punishment/reward behavior. Specifically, standardized risk aversion is positively correlated with the assignment of points in the VCM treatment with punishment, while loss aversion is significantly and positively correlated with assigned rewards. For the VCM treatment with punishment and reward, we find that both risk aversion and loss aversion are significant determinants for assigning points. The more risk averse a subjects is, the less points he/she assigns; whereas, the more loss averse a subjects is, the more expenditure he/she makes (by assigning more points).

Finally, our regression results indicate that there is a statistically significant correlation between UK nationality and point assignment in all three treatments. For the VCM treatment with reward, we also observe that gender and age are positively and significantly correlated with assigned rewards, and that those with an economics or business major reward significantly fewer points than other subjects.

RESULT 4: Preference measures significantly affect the points assigned in all three treatments. Negative and positive deviations also determine punishment and reward responses, in the expected direction. Other individual characteristics, such nationality, gender, age, and economics/business major play a role in how individuals actually use sanctions and rewards.

Table 9: Preference Measures and Assignment of Points: Regression Results

	Dependent Variable: Points assigned by player i					
	VCM with punishment		**VCM with reward**		**VCM with punishment and reward**	
	1	**2**	**3**	**4**	**5**	**6**
Standardized risk aversion	1.15***	0.85**	–0.32	0.02	–0.03	–0.11***
	[0.28]	[0.34]	[0.39]	[0.26]	[0.05]	[0.04]
Standardized loss aversion	0.17	–0.20	0.79**	0.29	0.13***	0.14**
	[0.52]	[0.42]	[0.35]	[0.37]	[0.04]	[0.06]
Standardized ambiguity (without loss) aversion	0.05	0.23	0.05	–0.21	0.00	0.05
	[0.31]	[0.34]	[0.29]	[0.21]	[0.04]	[0.04]
Standardized ambiguity (with loss) aversion	–0.32	0.15	–0.05	–0.28	–0.02	–0.04
	[0.40]	[0.50]	[0.32]	[0.29]	[0.03]	[0.06]
Absolute negative deviation	–0.39***	–0.40***	–0.16**	–0.19***	–0.13***	–0.14***
	[0.07]	[0.06]	[0.07]	[0.06]	[0.02]	[0.02]
Positive deviation	–0.06	–0.01	0.22***	0.22***	–0.01	0.00
	[0.04]	[0.03]	[0.04]	[0.03]	[0.01]	[0.01]
Male		–0.92		1.16**		0.05
		[0.96]		[0.52]		[0.10]
Age		–0.07		0.15***		–0.02
		[0.06]		[0.04]		[0.01]
UK Nationality		1.40***		–1.24**		0.17**
		[0.52]		[0.54]		[0.07]
Economics or business major		–0.59		–0.90**		–0.04
		[0.94]		[0.44]		[0.10]
Overconfidence		0.55		–1.29		0.14
		[1.45]		[1.69]		[0.18]
Correct CRT Questions		–0.04		–0.26		–0.01
		[0.29]		[0.23]		[0.03]
Constant	4.05***	5.78***	–3.42***	–6.36***	0.01	0.26
	[0.76]	[2.17]	[0.84]	[2.00]	[0.04]	[0.41]
Observations	3,600	3,600	3,600	3,600	3,600	3,600

Note: Tobit regressions with standard errors (clustered by matching group) in square brackets. * denotes significance at the 10-percent level, ** denotes significance at the 5-percent level, and *** at the 1-percent level.

As a final step, we check to see whether individuals' underlying preferences over institutions involving reward or punishment are linked to their ultimate use of reward and/or punishment. The results of this analysis are reported in Table 10. In addition to the effect of deviations from one's own contribution level, as reported above, the most striking finding is that those subjects who said they preferred a reward environment actually give out significantly more reward points. Recall that this result is not a selection effect, since everyone was equally likely to have ended up in the reward setting, and indeed the subjects are aware that they are matched with people with all different possible preferences. Nevertheless, these subjects seem to have an underlying belief in the efficacy of rewards to induce positive behavior (or simply for its own sake). No similar link is found in the case of punishment.

Table 10: Institutional Preferences and the Assignment of Points for Punishment and Reward

	Dependent Variable: Points assigned by player i					
	VCM with punishment		**VCM with reward**		**VCM with punishment and reward**	
	1	**2**	**3**	**4**	**5**	**6**
Absolute negative deviation		–0.40***		–0.15**		–0.13***
		[0.07]		[0.07]		[0.02]
Positive deviation		–0.08		0.22***		–0.01
		[0.05]		[0.04]		[0.01]
Ranking of VCM with punishment	0.14	–0.01				
	[0.29]	[0.27]				
Ranking of VCM with reward			–0.41**	–0.43**		
			[0.18]	[0.19]		
Ranking of VCM with punishment and reward					0.007	0.01
					[0.036]	[0.05]
Constant	3.16***	4.08***	–2.36***	–2.46**	–0.184*	–0.02
	[1.19]	[1.06]	[0.83]	[0.97]	[0.099]	[0.10]
Observations	3,600	3,600	3,600	3,600	3,600	3,600

Note: Tobit regressions with standard errors (clustered by independent matching groups) in square brackets. * denotes significance at the 10-percent level, ** denotes significance at the 5-percent level, and *** at the 1-percent level.

V. Concluding remarks

This paper provides experimental evidence that a subject's individual characteristics are significantly related to his/her economic preferences, which in turn affect behavior in public goods settings (although surprisingly not the initial institutional preferences). The set of four institutions we are concerned with in this study are: the standard VCM, the VCM with punishment, the VCM with reward, and the VCM with punishment and reward. The literature on public good games suggests the existence of different payoff implications among these institutions, depending on the rules governing the game. It is therefore a logical inference to associate preferences over institutions with risk and ambiguity preferences, and to examine the empirical validity of this relationship. Our novel experimental design also provides us with a rich dataset which allows us to analyze whether and how preference measures are correlated with each other, as well as whether these measures gauge the impact of social preferences such as negative or positive reciprocity. These issues have been relatively less explored in the literature and our experiment provides a complete set of answers to these questions in the context of a public good game.

Our paper also demonstrates the significance of individual traits to preference measures. Although this relationship has recently seen growing interest (see Borghans et al. 2009; Dohmen et al. 2011; Fréchette, Schotter, and Trevino 2011; Butler, Guiso, and Jappelli 2011), these studies limit their attention to particular aspects of individuals' preferences (typically risk and ambiguity aversion). We extend this literature by examining four preference measures: risk aversion, loss aversion, ambiguity aversion, and ambiguity (with loss) aversion. We show that all four measures are related to a number of individual characteristics including age, nationality, political and religious affiliations. Interestingly, our analysis also suggests that our preference measures are strongly correlated with each other, implying that individuals have a general utility function that is applicable to situations involving risk and ambiguity. In addition, we find that executive function and cognitive fluidity, as measured by the number of correct answers to CRT questions, is also associated with preference measures.

Furthermore, we provide evidence that some individual characteristics are related to preferences over institutions. The explanation of these preferences is important as they can have serious implications for a society's evolution, as well as on its economic performance and welfare over time. It is therefore important to analyze from an empirical perspective how institutions are determined. Our findings suggest that most people prefer to participate in institutions where no sanctioning is present. We also show that the demand for these

environments is affected by cognitive sophistication but importantly does not seem to be affected by attitudes toward risk, loss, or ambiguity.[13] Of course, participants had not experienced any of the environments when making their choices, which was a deliberate design decision in order to exclude any confounds such as status quo bias, strategic considerations, or choosing whichever institution happened to have given the highest payoff based on limited exposure to these environments. A natural avenue for further work is to see what happens when subjects have amassed some degree of experience with the various institutional environments. It is also worth pointing out that some previous literature (see Allen and Lueck 1995 for a review) similarly concludes that there is a weaker relationship between risk attitudes and contract choice than has been hypothesized by many researchers.

We document significant relationships between reciprocity (whether driven by strategic concerns or moral disgust) and preference measures. Risk aversion is positively (negatively) correlated with points assigned in the VCM with punishment (VCM with punishment and reward), whereas loss aversion is positively related with point assignment in the VCM with punishment and reward. Our paper confirms and validates previous findings that although in the short run institutions with sanctions yield lower welfare, in the long run institutions are more efficient with a punishment mechanism: subjects' earnings, on average, are higher relative to the average earnings of those who participate in institutions without sanctioning options.

Our evidence also suggests some new avenues to enrich the economic theory on social interactions and the emergence of institutions. For example, recent social preference models can explain contribution decisions and punishment patterns in public good environments but lack the ability to incorporate factors such as preference measures and individual characteristics, which have been shown to have significant predictive behavior. Our research provides further evidence that risk and social preferences should be incorporated into economic analysis, as these are related notions that help us further understand certain aspects of economic behavior. However, additional work remains to be done in producing a rich body of empirical knowledge in explaining how individual traits interact with economic preferences.

[13] As reported above, we do see some interesting links when the sample is restricted to subjects who are not at the tails of the distribution. Since this was an *ex post* analysis, we cannot be as statistically confident in it. However, it is reassuringly suggestive for future study.

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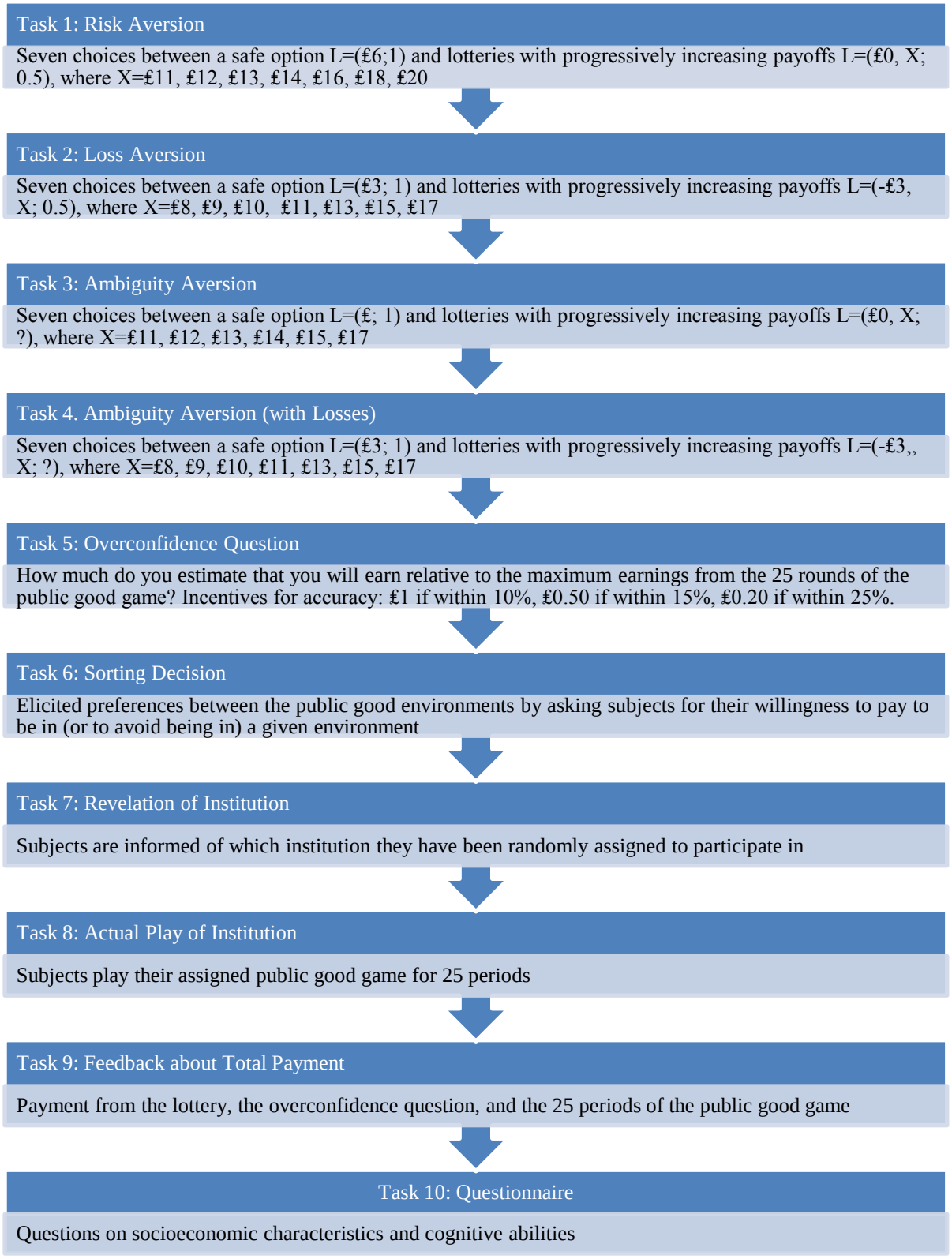
Appendix A: Timeline of Tasks



***Notes*:** (a) The order of Tasks 1-4 was randomized across participants. At the end of the experiment one of the four tasks was chosen to be paid off. (b) In Task 6, the order in which the institutions appeared on subjects' screen was randomized.

Appendix B: Experimental Instructions

Note: These are the written instructions used in all experimental sessions. The order of tasks for the preference elicitation in Section A was random for each subject. The order of institutions was the same for all subjects (as appears in the instructions of Section B). However, the order in which the institutions appeared on subjects' screen (see Appendix C for a screenshot) was randomized.

Instructions – Section A

During this experiment, you will take part in two Sections. You will now undertake Section A. You will learn about Section B at the beginning of that section, where you will receive new instructions.

At the beginning of this experiment, everyone will receive a lump-sum payment, which ensures that you will have positive overall earnings.

Section A involves decision making between two options. In the first option, there will always be a fixed amount of money, whereas, in the second option, there will be some randomness involved in determining your payoff.

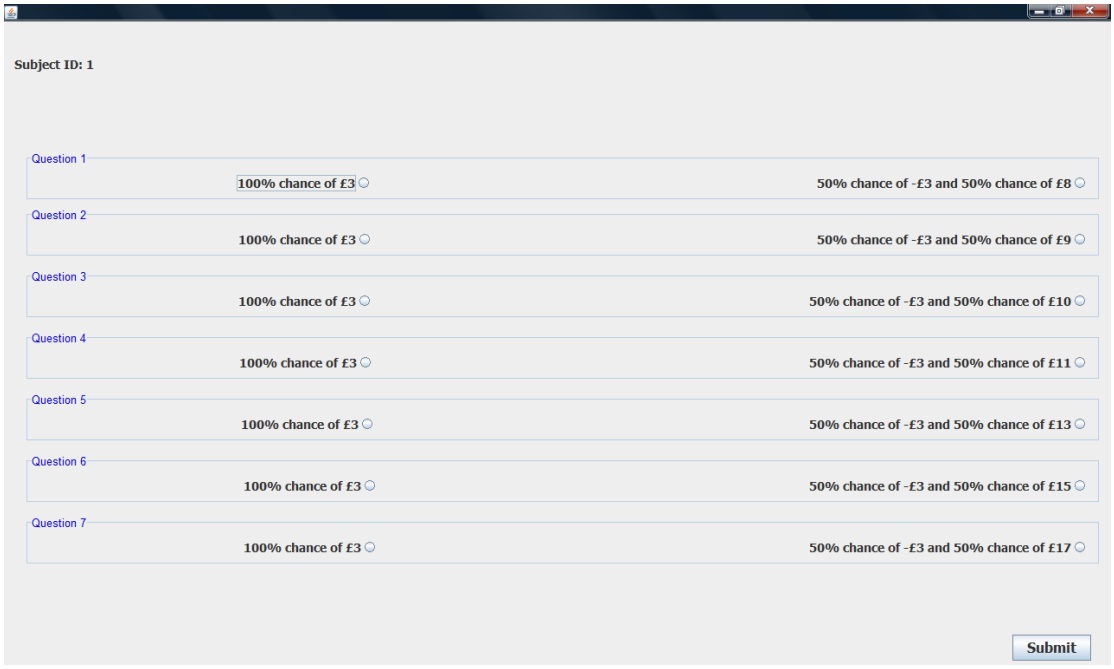
At the end of Section A, one of your decisions will be randomly chosen and you will receive the payment according to the resulting outcome from this decision.

Your total earnings from this experiment will consist of your income in Section A and your income in Section B.

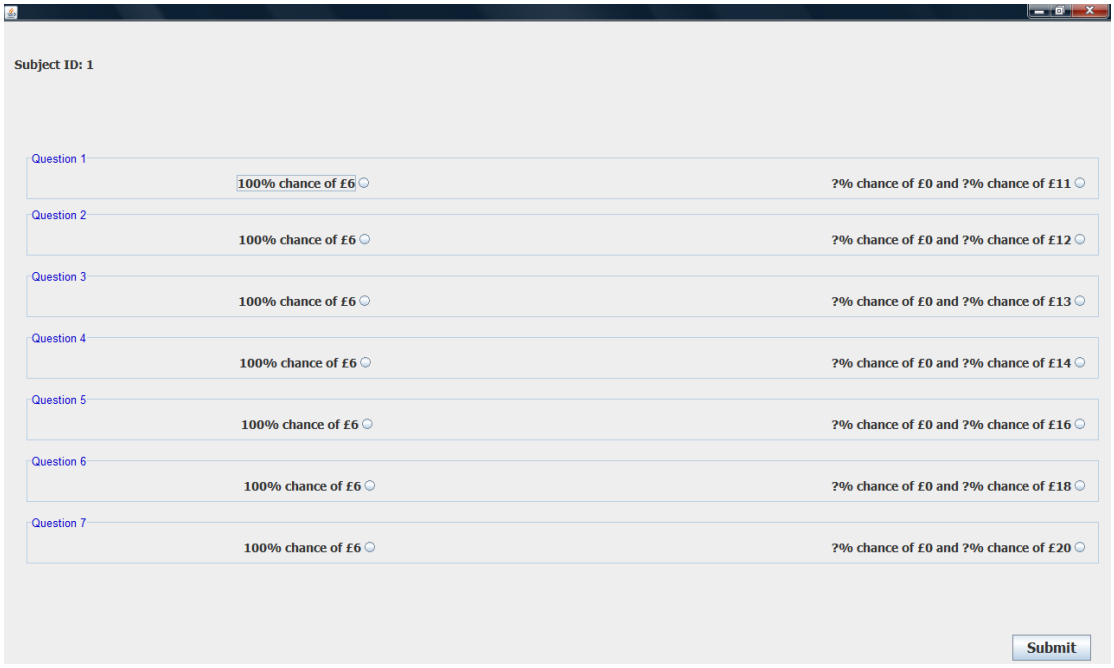
Risk:


Subject ID: 1
Question 1
100% chance of £6
50% chance of £0 and 50% chance of £11
Question 2
100% chance of £6
50% chance of £0 and 50% chance of £12
Question 3
100% chance of £6
50% chance of £0 and 50% chance of £13
Question 4
100% chance of £6
50% chance of £0 and 50% chance of £14
Question 5
100% chance of £6
50% chance of £0 and 50% chance of £16
Question 6
100% chance of £6
50% chance of £0 and 50% chance of £18
Question 7
100% chance of £6
50% chance of £0 and 50% chance of £20
Submit

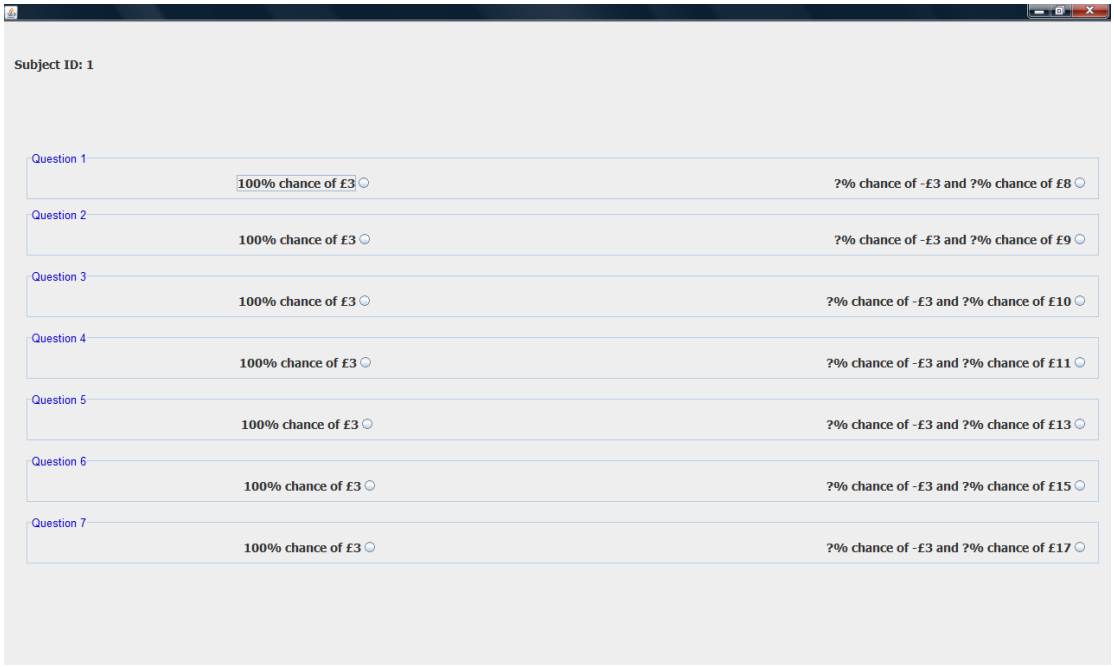
Loss:


Subject ID: 1
Question 1
100% chance of £3
50% chance of -£3 and 50% chance of £8
Question 2
100% chance of £3
50% chance of -£3 and 50% chance of £9
Question 3
100% chance of £3
50% chance of -£3 and 50% chance of £10
Question 4
100% chance of £3
50% chance of -£3 and 50% chance of £11
Question 5
100% chance of £3
50% chance of -£3 and 50% chance of £13
Question 6
100% chance of £3
50% chance of -£3 and 50% chance of £15
Question 7
100% chance of £3
50% chance of -£3 and 50% chance of £17
Submit

Ambiguity:



Ambiguity (with losses):



Instructions – Section B

You are now about to take part in Section B of this session. For this Section, you will now have to choose which of the following institutions described below you want to participate in. If you read the instructions carefully, you can, depending on the decisions that you and other participants make, earn a considerable amount of money. It is therefore very important that you read these instructions with care.

These instructions are solely for your private use. **It is prohibited to communicate with the other participants during the session.** If you have any questions, please raise your hand, but avoid distracting others in the room. We would like to stress to you that your answers are entirely anonymous.

In this Section, unless otherwise stated, we will not speak in terms of Pounds, but of Money Units. Your entire earnings will, thus, be calculated in Money Units. At the end of the session the total amount of Money Units you have earned will be converted to Pounds at the following rate:

1 Money Unit = 0.01 Pounds

At the end of the session your entire earnings will be paid to you **in cash**. These earnings will be added to what you have earned from Section A.

At the beginning of Section B, in each period the participants are divided into groups of four. You will therefore be in a group with 3 other participants. **The composition of the groups will remain the same throughout this Section.** Each institution consists of twenty-five periods. Below we describe each of the four institutions in detail.

After the twenty-five periods, you will need to answer a short sequence of survey questions.

INSTITUTION A

At the beginning of each period each participant receives 20 tokens. We call this his or her endowment. Your task is to decide how to use your endowment. You have to decide how many of the 20 tokens you want to contribute to a project and how many of them to keep for yourself.

Your income therefore consists of two parts:

(1) The tokens which you have kept for yourself ("Income from retained tokens") whereby 1 token = 1 Money Unit.

(2) The "Income from the project". This income is calculated as follows:

Your income from the project = 0.4 *times* the total contributions to the project.

For each token which you keep for yourself you earn an income of 1 Money Unit. For each token contributed to the project instead, then the total contributions to the project would rise by one token. Your income from the project would rise by 0.4*1=0.4 Money Units. However the income of the other group members would also rise by 0.4 Money Units each, so that the total income of the group from the project would rise by 1.6 Money Units. Your contribution to the project therefore also raises the income of the other group members. On the other hand you earn an income for each token contributed by the other members to the project. For each token contributed by any member you earn 0.4*1=0.4 Money Units.

The income of each group member from the project is calculated in the same way, i.e., each group member receives the same income from the project. Assume, for example, that the sum of the contributions of all group members is 40 tokens. In this case each member of the group receives an income from the project of: 0.4*40 = 16 Money Units.

Your period income is therefore calculated as follows:

Period income in Money Units =

(20 – your contribution to the project) + 0.4*(total contributions to the project)

INSTITUTION B

Institution B consists of two stages in each period. The first stage is identical to that of Institution A. That is, at the first stage you have to decide how many tokens out of 20 you want to contribute to a project (and hence you decide with it how many tokens you keep for yourself). Your income from the first stage will be calculated exactly in the same way as in Institution A. For each token you keep for yourself, you earn an income of 1 Money Unit. For any token you contribute to the project, you and all other group members will earn 0.4 Money Units. Therefore, each token that another group member contributes to the project will increase your income by 0.4 Money Units.

What is different in Institution B?

Now there is a **second stage.** At the start of the second stage, you see how much each group member contributed to the project in the first stage. **During this stage, you can alter the income of each other group member by assigning negative points. By assigning negative points, you can decrease the income of each other group member.** You can assign between 0 and 5 negative points to each group member.

Each negative point that you assign decreases this group member's income by 3 Money Units. For example, if you assign 2 negative points, this group member's income will be decreased by 6 Money Units. The only exception arises because negative points cannot do more than eliminate a group member's first stage income. Thus, a group member's income cannot be decreased by more than their first stage income, through negative points assigned by others.

If you assign negative points, you have costs in Money Units. The more negative points you assign, the higher your costs. **For each negative point that you assign, there is a cost to you of 1 Money Unit.** For example, if you assign 2 negative points, this costs you 2 Money Units. We refer to this as "Cost of negative points assigned by you". Just as you can decrease other members' income by assigning negative points to them, so they can also decrease your income by the same method. We refer to this as "Number of negative points assigned to you".

Your period income is therefore calculated as follows:

Period income in Money Units =

= Income from the first stage

– Cost of negative points assigned by you

– 3*(Number of negative points assigned to you)

if the impact of the negative points assigned to you is less than the income from the first stage;

OR

= 0 – Cost of negative points assigned by you

if the impact of the negative points assigned to you is greater than the income from the first stage.

INSTITUTION C

Institution C consists of two stages in each period. The first stage is identical to that of Institution A. That is, at the first stage you have to decide how many tokens out of 20 you want to contribute to a project (and hence you decide with it how many tokens you keep for yourself). Your income from the first stage will be calculated exactly in the same way as in Institution A. For each token you keep for yourself, you earn an income of 1 Money Unit. For any token you contribute to the project, you and all other group members will earn 0.4 Money Units. Therefore, each token that another group member contributes to the project will increase your income by 0.4 Money Units.

What is different in Institution C?

Now there is a **second stage.** At the start of the second stage, you see how much each group member contributed to the project in the first stage. **During this stage, you can alter the income of each other group member by assigning positive points. By assigning positive points, you can increase the income of each other group member.** You can assign between 0 and 5 positive points to each group member.

Each positive point that you assign increases this group member's income by 1 Money Unit. For example, if you assign 2 positive points, this group member's income will be increased by 2 Money Units.

If you assign positive points, you have costs in Money Units. The more positive points you assign, the higher your costs. **For each positive point that you assign, there is a cost to you of 1 Money Unit.** For example, if you assign 2 positive points, this costs you 2 Money Units. We refer to this as "Cost of positive points assigned by you". Just as you can increase other members' income by assigning positive points to them, so they can also increase your income by the same method. We refer to this as "Number of positive points assigned to you".

Your period income is therefore calculated as follows:

Period income in Money Units =

= Income from the first stage

– Cost of positive points assigned by you

+ 1*(Number of positive points assigned to you)

INSTITUTION D

Institution D consists of two stages in each period. The first stage is identical to that of Institution A. That is, at the first stage you have to decide how many tokens out of 20 you want to contribute to a project (and hence you decide with it how many tokens you keep for yourself). Your income from the first stage will be calculated exactly in the same way as in Institution A. For each token you keep for yourself, you earn an income of 1 Money Unit. For any token you contribute to the project, you and all other group members will earn 0.4 Money Units. Therefore, each token that another group member contributes to the project will increase your income by 0.4 Money Units.

What is different in Institution D?

Now there is a **second stage.** At the start of the second stage, you see how much each group member contributed to the project in the first stage. **During this stage, you can alter the income of each other group member by assigning negative or positive points. By assigning negative points, you can decrease the income of each other group member. By assigning positive points, you can increase the income of each other group member.** You can assign between 0 and 5 negative or positive points to each group member.

Each negative point that you assign decreases this group member's income by 3 Money Units. For example, if you assign 2 negative points, this group member's income will be decreased by 6 Money Units. The only exception arises because negative points cannot do more than eliminate a group member's first stage income. Thus, a group member's income cannot be decreased by more than their first stage income, through negative points assigned by others. **Each positive point that you assign increases this group member's income by 1 Money Unit.** For example, if you assign 2 positive points, this group member's income will be increased by 2 Money Units.

If you assign either negative or positive points, you have costs in Money Units. The more negative or positive points you assign, the higher your costs. **For each negative point that**

you assign, there is a cost to you of 1 Money Unit. For each positive point that you assign, there is a cost to you of 1 Money Unit. For example, if you assign 2 negative points, this costs you 2 Money Units. If you assign 2 positive points, this costs you 2 Money Units. We refer to this as "Cost of negative points assigned by you" and "Cost of positive points assigned by you", respectively.

Just as you can decrease or increase other members' income by assigning negative or positive points to them, so they can also decrease or increase your income by the same method. We refer to this as "Number of negative points assigned to you" and "Number of positive points assigned to you", respectively.

Your period income is therefore calculated as follows:

Period income in Money Units =

= Income from the first stage
– Cost of negative points assigned by you
– Cost of positive points assigned by you
– 3*(Number of negative points assigned to you)
+ 1*(Number of positive points assigned to you)

if the impact of the negative and positive points assigned to you is less than the income from the first stage;

OR

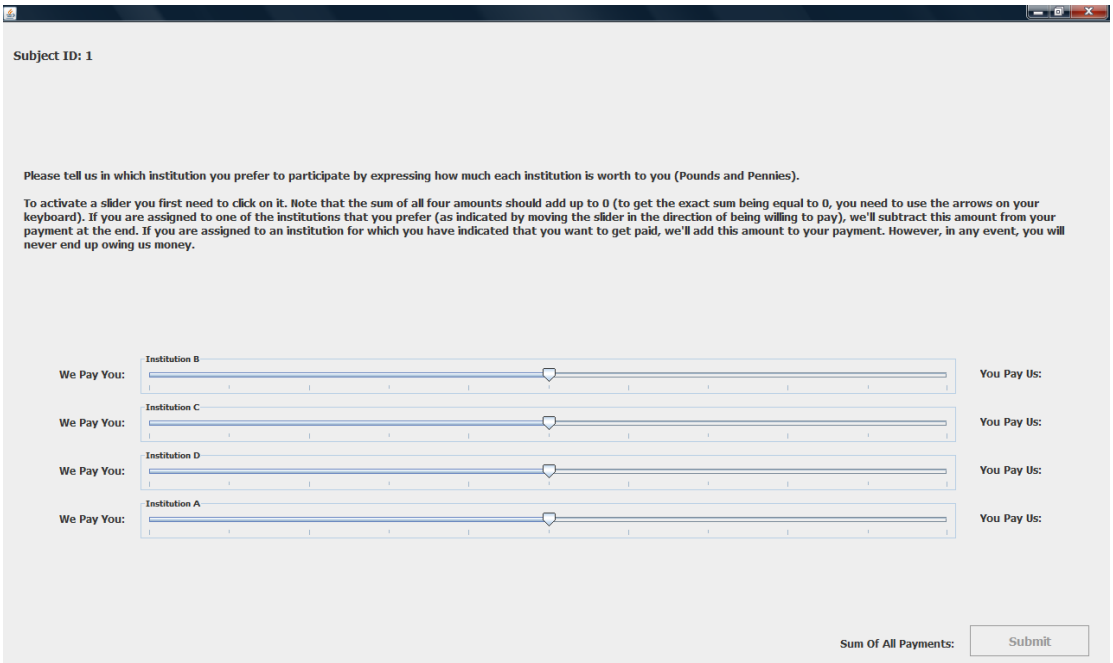
= 0 – Cost of negative points assigned by you
– Cost of positive points assigned by you

if the impact of the negative and positive points assigned to you is greater than the income from the first stage.

Appendix C: Screenshots for Eliciting Overconfidence and Institutional Preferences

Figure C.1. Elicitation of overconfidence

Figure C.2. Elicitation of institutional preferences



Appendix D: Additional Statistical and Regression Analysis

Table D.1. Means and Standard Deviations of Preference Measures
(Excluding the 40 "Switchers")

Preference measure	Mean	Standard deviation
Risk aversion	3.47	1.70
Loss aversion	2.98	2.04
Ambiguity aversion (without losses)	4.36	1.83
Ambiguity aversion (with losses)	3.62	2.36

Table D.2. Pair-wise Correlation Coefficients of Preference Measures
(Excluding the 40 "Switchers")

	Risk	Loss	Ambiguity without loss	Ambiguity with loss
Risk	1			
Loss	.33*** [.00]	1		
Ambiguity without loss	0.44*** [.00]	0.07 [.36]	1	
Ambiguity with loss	0.20** [.01]	0.64*** [.00]	0.24*** [.00]	1

Table D.3. Preference Measures and Choice of Institutions (Excluding the 40 "Switchers")

	Dependent variable: ranking of each institution (1, 1.5, ..., 4)							
	VCM rank		**VCM with punishment rank**		**VCM with reward rank**		**VCM with punishment and reward rank**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Std. Risk Aversion	–23.96 (22.52)	–26.19 (23.19)	5.67 (21.97)	5.45 (21.20)	4.66 (18.59)	4.13 (17.03)	13.64 (20.08)	16.61 (20.78)
Std. Loss Aversion	25.02 (25.85)	18.23 (26.34)	22.28 (29.59)	22.80 (31.03)	–22.97 (24.54)	–23.70 (24.70)	–24.33 (25.19)	–17.34 (25.57)
Std. Ambiguity Aversion	15.81 (20.10)	19.00 (22.24)	–6.93 (22.31)	0.96 (23.97)	–10.00 (21.63)	–16.39 (22.47)	1.12 (19.75)	–3.58 (21.34)
Std. Ambiguity (with loss) Aversion	-45.71* (25.10)	–39.43 (25.25)	–3.28 (27.52)	–0.32 (28.62)	15.46 (24.31)	12.90 (24.57)	33.53 (25.50)	26.84 (26.43)
Over-confidence		4.06 (104.37)		88.44 (117.66)		–42.57 (100.81)		–49.93 (93.22)
Correct CRT questions		–2.33 (19.94)		–35.97 (19.45)		34.28** (16.91)		4.01 (16.30)
Male		–25.76 (41.47)		15.48 (47.79)		–40.04 (39.45)		50.32 (37.60)
Age		–3.72 (5.29)		8.92* (5.20)		–8.59* (4.62)		3.39 (4.38)
UK		71.38 (43.52)		–3.304 (48.96)		12.91 (44.66)		–80.99* (42.37)
Constant	26.61 (18.70)	84.08 (133.53)	–27.21 (19.53)	–217.06 (143.53)	–10.01 (17.81)	154.57 (133.50)	10.62 (17.18)	–21.60 (123.11)
Obs.	152	152	152	152	152	152	152	152

Note: OLS regressions with robust standard errors in square brackets. * denotes significance at the 10-percent level, ** denotes significance at the 5-percent level, and *** denotes significance at the 1-percent level.

Table D.4. Assignment of Points for Different Levels of Deviation Across All Periods

Treatments	**[–20, –11]**	**[–10, –1]**	**0**	**[1, 10]**	**[11, 20]**
VCM with punishment	–2.21	–0.87	–0.08	–0.33	–0.35
VCM with reward	0.01	0.10	0.13	0.43	0.63
VCM with punishment and reward	–2.00	–0.41	–0.01	0.01	–0.04