Equality, Equity or Incentives. An Experiment[#]

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Abstract: This paper studies the tensions between egalitiarian sentiments, equity concerns, self-interest, and the need for incentives in a society. We propose an experimental game in which subjects can assign their endowment to private or (more efficient) group production activities, with the proceeds from group activity divided either equally, in proportion to contribution, or by combination of the two. The division rule is determined by vote or exogenously imposed, and unequal endowments are either determined in a way that creates feelings of entitlement or not. Subjects respond to incentives in a continuous fashion and vote mainly self-interestedly. Low endowment subjects push harder for and high endowment subjects are more tolerant of relatively equal division when endowments are randomly assigned than when they are earned, and assignments to group production are influenced by strategic considerations.

JEL Codes: C91, C92, D31, D63, H41, L29, P51

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Equality, Equity, or Incentives. An Experiment

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Societies and organizations experience conflicts between desires to attend to the needs of their weaker members the necessity of providing incentives for generating output, and concerns that rewards for effort and contribution of resources be fairly assigned, with each of the actors weighing these concerns also bringing his own self-interest into the mix. At the macro level, this trade-off is navigated by (among other things) determining levels of provision of social benefits and the extent and progressivity of taxation (Okun, 1975; Piketty, 1995; Benabou, 2000). At the micro level, it plays itself out in the negotiation of responsibilities and sharing of consumption in households (Lundberg and Pollak, 1996), and in determination of how differentiated rewards are in organizations (Lazear, 1989; Holmstrom and Milgrom, 1994; Irlenbusch and Ruchala, 2008).

In a business enterprise, rewards tend to be differentiated partly because each contributor to the team effort has the power to exit if not paid the value of his or her marginal contribution. Yet there are also numerous constraints on differentiation of reward. Firm-specific human capital drives a wedge between an employee's marginal value to her employer and the outside value of her current skill set, generating a quasi-rent the distribution of which is subject to negotiation (Williamson *et al*., 1975). To reduce the danger of invidious comparisons, companies pay workers with similar job descriptions and seniority similar amounts when indications of differences in productivity are not easily verifiable (Baker *et al*., 1988). In some environments, there may be social or cultural constraints on the maximum gaps between employees at different levels, which may help to explain why the pay differential between top managers and non-managerial employees varies considerably among countries (Abowd and Bognanno, 1995). Many companies implement profit-sharing arrangements partly to encourage helping behaviors among their employees (Kruse, 1992; Bhargava, 1994; Che and Yoo, 2001).

We study the trade-off between equality, equity and incentives in a stylized experimental environment that reflects both elements of the problem relevant to the firm level and ones relevant to entire societies. We propose a new experimental paradigm that captures this trade-off in a general but straightforward and easy-to-understand way and provide a set of results from our experimental implementation. In our experiment, a subject is paired with two others and makes a series of fifteen decisions on whether to contribute an endowment of tokens to a group project or to retain it as private income. Contributions to the group project are scaled up, mimicking a team production opportunity with a productivity advantage over the private one, as in the standard linear voluntary contributions mechanism (VCM) or public goods game (see Ledyard, 1995, for an early overview, and Zelmer, 2003, for a meta-study).[1] What makes the problem interesting is that the three team members have unequal endowments[2] and that the money generated by the team can be (i) divided up equally, (ii) in proportion to amounts contributed, or (iii) by any combination of the equal and the proportional distribution. With equal distribution, we have a division scheme that provides no incentive for a maximizer of private earnings to contribute but that would render earnings fully equal with at least some gain to all, were all to cooperate, which is the familiar VCM. With division of team output by contributions, in contrast, there is a straightforward incentive for each to contribute their entire endowment, but earnings are highly unequal. We make the scaling factor large enough so that over a considerable range of intermediate division settings incentives to contribute remain strong, yet earnings are somewhat equalized, potentially pleasing some and displeasing other group members.

In the experiment we study contribution responses to varying division parameters in four distinct treatments constituting a 2x2 factorial experimental design. In two treatments, we allow subjects to determine the setting of the division parameter by majority vote, while in two others the parameter is set exogenously, tracking the settings of the voting groups so that we can examine the response of contributions to changes in

[1] Although the team's productive advantage can be motivated by reference to scale economies, the productivity differential is left invariant to the exact input to the team so as to simplify the decision problem facing the subjects.

[2] There are several examples of public goods games in the literature that implement unequal endowments: e.g. Chan et al. (1996, 1999), van Dijk et al. (2002), Cherry et al. (2005), Buckley and Croson (2006), Sadrieh and Verbon (2006), or Reuben and Riedel (2009). None of them studies the trade-off between incentives and equality.

incentives free of strategic motivation to influence voting. The other dimension of variation that we study concerns the origin of the inequality of endowments. We devised two treatments, one in which unequal endowments are assigned randomly, and one in which the endowments are earned by performance on a task (a quiz) that increases the feeling of entitlement over the endowment (see, for instance, Hoffman and Spitzer, 1985, Gächter and Riedel, 2005, Durante and Putterman, 2009). This allows us to investigate whether voting and responses to incentives are influenced by differing senses of the fairness of the inequalities within the group.

For treatments in which the division parameter is determined by voting, our set-up is predicted to foster a struggle in which low and high endowment subjects attempt to influence the votes of decisive middle endowment subjects. The latter should be indifferent over a wide range of parameter values unless they have preferences over equality or fairness, or if high or low subjects succeed in signaling that their willingness to contribute depends on the parameter in a manner pertinent to middle subjects' self-interest. Observations with the parameter exogenous permit testing of whether seemingly strategic behaviors in the voting treatments are in fact strategically motivated. If earned endowments confer entitlement, middle subjects will display less concern with equality in the quiz treatment. High and low endowment subjects' contribution decisions may also be influenced by their preferences for equality, which may likewise be lessened by entitlement concern when present.

We are not aware of any existing similar setup in the literature, or a paper that is able to address our research questions in a unifying framework. Our experiment provides a number of interesting results. First, subjects respond to the strength of incentives in a roughly continuous fashion, rather than jumping from zero contributions when their marginal return for contributing is below unity to full contributions when it exceeds that threshold, as standard theory would predict. This is true of subjects in each endowment class, and thus appears to stem from bounded rationality rather than from concerns about equality or inequality. Second, high and low endowment subjects' votes are largely predictable from self-interest, with the former mostly favoring payment proportionate to contributions and the latter favoring more equal payment. Third, low and middle endowment subjects' votes are sophisticated, taking into account the impacts of the distribution parameter on contributions as observed in their groups—that is, they respond to others' responses to incentives in a manner that is selfishly rational on the margin. Fourth, subjects' contributions are influenced by strategic considerations: low endowment subjects contribute more when the marginal return is less than one when the division is determined by vote (presumably to signal willingness to cooperate despite low incentive) than when the same division parameters arise exogenously. High endowment subjects influence groups' choices of the division parameter by withholding contributions when it is relatively low even though contributing the full endowment maximizes their immediate payoff, but the argument that they do so out for strategic reasons is undercut by the fact that the effect is stronger, not weaker, when the parameter is exogenous.

Despite the predominance of self-interest there are signs of fairness preferences. First, subjects display greater preference for equality when inequalities are arbitrary than when they are earned by task performance, since low and high endowment subjects are observed to vote for more equality following an otherwise identical history if endowments were not earned. Second, personal characteristics influence votes over the distribution parameter, with female subjects and those obtaining more cooperative scores in a Ring Test (see Offerman et al., 1996) selecting significantly more equal parameters. The same subjects also contribute more unconditionally and are less responsive to incentive changes.

The remainder of the paper is organized as follows: The following section provides a short overview of the related literature. Section 2 describes our experimental design and our theoretical predictions in greater detail. In Section 3, our results are represented in several analytical steps, and section 4 concludes the paper.

1. Literature

[To be added.]

2. Experimental Design and Predictions

2.1 Basic setup

We conducted two sessions of each of four treatments (see Table 1). In each treatment, 36 subjects are randomly assigned to fixed groups of 3 who remain anonymous to one another, in two sessions of 18 subjects each. In each group, one subject has an endowment of 5 tokens, a second an endowment of 10 tokens, and a third an endowment of 15 tokens, with a given subject receiving the same endowment in each of 15 periods of play, a finitely repeated design. In each period, subjects must decide how many tokens to put in the group project, with the remainder being placed in a private account. In a given period, subject *i* earns

$$y_i = (E_i - C_i) + (1-\alpha)R\frac{C}{3} + \alpha\frac{C_i}{C}RC = (E_i - C_i) + (1-\alpha)R\frac{C}{3} + \alpha RC_i \quad (1)$$

where E_i is *i*'s endowment (5, 10 or 15), C_i is his or her contribution to the group project (an integer), $C = \sum_{j=1}^{3} C_j$ is the sum of the three contributions, $j = l, m, h$ represents the low, middle, and high endowment subjects respectively, $1 < R < 3$ is the scaling factor, and α ($(1-\alpha)$) is the share of group output distributed on the basis of contributions (equally). In the experiment, $\alpha \in \{0, 0.1, 0.2, ..., 1\}$, and we set $R = 2$, so equation (1) becomes

$$y_i = (E_i - C_i) + (1-\alpha)\frac{2}{3}C + \alpha 2C_i \quad (1')$$

This choice of parameters means that the marginal return from contributing to the group project, $\partial y_i / \partial C_i$, is less than 1 when $\alpha < 0.25$ and greater than 1 when $\alpha > 0.25$. If all subjects are strictly self-interested, perfectly rational, and have common knowledge of this, then contributions should be zero and earnings 5, 10 and 15, respectively, when α = 0, 0.1 or 0.2. Under the same assumptions, contributions should be equal to endowments when $\alpha \geq 0.3$, with earnings out of the fixed total of 60 varying from a relatively equal 17, 20, and 23 when $\alpha = 0.3$ to their most unequal values of 10, 20 and 30 when $\alpha = 1$. This wide scope for equalization without in theory undermining incentives creates a broad space for expression of distributive preferences, distributional conflict, and "posturing" so as to influence voting outcomes. Also, whereas endowments such that the median endowment was below the average would generate a right-skewed earnings distribution more like that commonly observed at the macro political level, the symmetrically distributed endowments in our design make it easier to identify the effects of redistributive preferences and countervailing incentive concerns, since this symmetry causes each group's median voter to have no personal stake in how income is divided, apart from such concerns.

Insert Table 1 around here

In the Quiz-Vote (henceforth also **QV**) and Quiz-Exogenous (**QE**) treatments, subjects first complete a twenty-minute general knowledge quiz before being assigned to the low, middle or high endowment level based on their performance. In **QE**, they then proceed to make fifteen contribution decisions, each time with an α-value that is exogenous to them being announced at the beginning of the period, and with the decisions and earnings of all subjects being announced at the end of the period. The Random-Exogenous (**RE**) treatment is like the **QE** treatment except that there is no quiz and the endowment levels are assigned randomly. In the **QV** and Random-Vote (**RV**) treatments, subjects specify the value of α that they favor at the beginning of each period and are then shown the value selected by the group—the median value among the three submitted—before proceeding to make their contribution decisions. The **RV** treatment differs from **QV** but resembles **RE** in that there is no quiz and endowments are assigned randomly. To facilitate testing of whether exogeneity of α influences contribution decisions, we match each **RV-**treatment group to an **RE** group and assign the latter the precise sequence of α's selected by voting in the former, although **RE** subjects are not informed that this is what determines α.[3] Each **QE-**treatment group is likewise assigned the sequence of α's determined by the median voter in a counterpart **QV** group. Subjects knew in advance that there would be exactly 15 periods of play, each subject knew that

[3] They were simply told that the relevant α-value for a specific period would be announced at its beginning and that it would always come from the set $\{0, 0.1, 0.2, ..., 1\}$. Details are provided in the experimental instructions in Appendix C.

his or her endowment and group composition would not change, and in the **QV** and **QE** treatments subjects knew that their performance on the quiz would determine their endowment.

2.2 Theoretical predictions

2.2.1 Full rationality and self-interest

Rational payoff-maximizing subjects with common knowledge of type would select $C_i = 0$ in all periods in which $\alpha \leq 0.2$ and $C_i = E_i$ (= 5, 10 or 15) in all periods in which $\alpha \geq .3$. Thus, standard economic theory gives our first (non-behavioral) hypothesis:

Hn.1: $C_i = 0, E_i$ *as* $\alpha \leq 0.25, \alpha \geq 0.25.$

When considering how to vote in the **QV** and **RV** treatments, such subjects should likewise assume that $C = 0$ for all i when $\alpha \leq 0.2$ and $C = 30$ for all i for $\alpha \geq 0.3$. Given this and in the absence of strategic voting, low endowment subjects should vote for α = 0.3, which maximizes their earnings at 17, high endowment subjects should always vote for $\alpha = 1$, which maximizes their earnings at 30, and middle endowment subjects should be indifferent between the eight values of α between 0.3 to 1, since they earn 20, regardless. Assuming that the middle endowment subjects choose randomly among these values, α would thus vary randomly over the 0.3-to-1 range, and expected incomes would be mid-way between the most and least equal sets reported above, i.e. 13.5, 20 and 26.5. Assuming that the middle endowment subject's voted α – call it α_m – is no higher than his own, a high endowment subject has no reason to favor one value over another in the interval $\alpha_m \leq \alpha \leq 1$, but with no way to anticipate what α_m will be in a given period, we expect high endowment voters to always choose the weakly dominant equilibrium of voting for $\alpha = 1$.[4] Since the vote of the low endowment subject will never be pivotal in equilibrium, however, that subject can also vote for α = 0, 0.1 and 0.2, if she believes that the two other group members are rational. Hypothesis Hn.2 summarizes these considerations.

[4] The trembling hand perfection argument (Selten, 1975) can also be used to motivate an $\alpha_h = 1$ prediction.

Hn.2: *High endowment subjects always vote for* α = *1.0, middle endowment subjects distribute their votes randomly for* α*-values in the interval from 0.3 to 1.0, and low endowment subjects choose any* $\alpha \in [0;0.3]$. *Thus, the median vote is always cast by the subject with the middle endowment.*

2.2.2 Heterogeneous (social) preferences

We consider two social preferences that may cause subjects' behaviors to deviate from what would maximize their own pay-offs. These are (a) inequality aversion, and (b) concern with equity, or respect for "earned" inequalities. The presence and weight placed on each preference may vary among individuals and when present may affect both contribution and voting choices.

With regard to (a), suppose that each subject's utility can be described by the model of Fehr and Schmidt (1999) in which an individual may be willing to sacrifice some income to reduce inequalities that are to her own disadvantage, perhaps willing to do the same to reduce inequalities that are to her advantage, and the strength of the second concern never outweighs that of the first. For our high endowment subjects, only advantageous inequality is of potential concern, for low ones only disadvantageous inequality, and for middle ones, both advantageous and disadvantageous inequalities are potential concerns.

Consider the effect of inequality aversion on voting assuming initially that contributions themselves are pay-off maximizing, hence $C_i = 0$ in all periods in which $\alpha \leq 0.2$ and $C_i = E_i$ (= 5, 10 or 15) in all periods in which $\alpha \geq .3$. Then inequality aversion would not alter the vote of a low endowment subject, who in the absence of social preferences already votes for $\alpha \leq 0.3$, but both middle and high endowment subjects might vote for lower values of α than otherwise if they are inequality averse. Indeed, since no income sacrifice is in theory required of her, a middle endowment subject with any degree of inequality aversion would vote for $\alpha = 0.3$, eliminating both advantageous and disadvantageous inequality in a single stroke. A high endowment subject, in contrast, incurs a loss of own income to reduce only advantageous inequalities, so assuming similar distributions of inequality aversion in both groups, we should expect more downward bias in votes for α due to inequality aversion on the parts of middle than of high endowment subjects.

Factor (b), the desire of some subjects that "earned" inequalities not be unfairly eliminated, can be present in the same individuals who are inequality averse, or by itself. If present alone, this equity concern will have no influence on the votes of high endowment subjects (who select $\alpha = 1$ in any case), may cause middle-endowment subjects to bias their votes upwards within the $0.3 \leq \alpha \leq 1$ range, and may lead some low-endowment subjects to vote contrary to their own interest for $0.3 < \alpha$, in the **QV** treatment. For subjects having both equality and equity preferences, the prediction is one of favoring higher values of α in the **QV** than in the **RV** treatment.

Assuming substantial numbers of subjects who are averse to inequalities, averse to equalizing earned inequalities, or both, we make the following behavioral predictions:

Hb.1. *Middle endowment subjects will on average vote for higher* α.*in the* ***RV*** *than in the* ***QV*** *treatment.*

Hb.2. *Some high endowment subjects will vote for* $\alpha < 1$*, and more high endowment subjects will do so, voting for lower values of* α, *in the* ***RV*** *than in the* ***QV*** *treatment.*

2.2.3 Bounded rationality and strategic considerations

The picture becomes more complicated if individuals need not be assumed to contribute either 0 or their full endowment depending only on whether $\alpha \geq 0.25$ or $\alpha \leq 0.25$. In addition to bounded rationality factors, discussed shortly, there are strategic, i.e. reputational, and preference-based reasons why individuals may choose contributions other than those that are statically payoff-maximizing for them. In the voting treatments subjects may use their choices of C_i to signal willingness or unwillingness to contribute at given α in order to influence others' subsequent votes. And if subjects' utilities are interdependent, positive or negative concern for others can influence contributions even in the non-voting treatments, since one's contribution affects one's group-mates earnings whenever $\alpha < 1$.

With respect to strategy, high endowment subjects who seek to maximize their payoffs would want, if possible, to influence the middle endowment subjects to vote for higher values of α. A behaviorally realistic scenario would be that the high endowment subjects might (except in the last period) reduce C_h when α is in the low end of the 0.3-to-1 range, even though they incur a cost in short-run earnings, in order to signal their displeasure with the low α-value. If there were truly common knowledge of full rationality and of utilities depending on payoffs only, such moves would be pointless, because the subjects could not credibly threaten to hold $C_h < 15$ in the last period, whereupon setting $C_h < 15$ in the next-to-last period will also have no effect, and so forth. Realistically, however, subjects may not be sure of others' types, and there may exist subjects with, for example, a "taste for distributive justice" sufficiently strong to willingly incur a payoff loss as a cost for signaling their preference, so $C_h < 15$ seems a likely possibility when α is low, at least in early periods of the **RV** and especially (assuming some inequality *and* inequity aversion) the **QV** treatment. That C_h will be lower in treatments with voting than in those without for given values of α that exceed 0.25 but are not too far above 0.3 is our second behavioral prediction for the experiment.[5]

Hb.3. *Most high endowment subjects will contribute less in the voting than in the non-voting treatments when* $0.3 \leq \alpha < 1$, *with contributions that are lower the lower is* α *and the earlier is the period*.

A further behavioral prediction concerns another strategic consideration that might affect contribution decisions. Contrary to the standard theory's prediction that $C_i = 0$ in all periods in which $\alpha = 0$, 0.1 or 0.2, subjects who favor greater equality either for self-interest or for inequity-aversion reasons may contribute to the group project despite such low values of α, in an effort to make equality more palatable and to moderate the equality-efficiency trade-off. Low endowment subjects, especially, are predicted to

[5] Low endowment subjects could conversely withhold contributions to try to sway the middle endowment subject's vote when α is high, but since they have only 5 to withhold versus the 15 controlled by their high endowment counterparts, any such moves on their parts are probably more sensibly interpreted as symbolic or expressive protests rather than as strategic moves calculated to sway voting.

contribute more of their endowments than others when $\alpha = 0$, 0.1 or 0.2 and α is determined by vote, since this could reduce the costliness of low α as perceived by other group members thereby leading them to vote for such values in future periods. Inequality-averse middle and high endowment subjects may also contribute more when $\alpha = 0$, 0.1 or 0.2, especially in the **RV** treatment, where inequalities are unearned and contributions may influence subsequent votes. For the same reason, inequality-averse high endowment subjects will engage in no or at least in less strategic withholding of contributions when $0.3 \leq \alpha < 1$.

> **Hb.4**. *Low endowment subjects and inequality-averse middle and high endowment subjects will contribute positive amounts when $\alpha \leq 0.2$ and α is determined by vote, so as to encourage further votes for lower values of α, and the extent of this behavior will be greatest in the **RV** treatment. Inequality-averse high endowment subjects will also engage in less strategic withholding of contributions than others with high endowment when $0.3 \leq \alpha < 1$.*

The voluminous literature on VCM-experiments leads to the expectation that contributions will not be zero when $\alpha < 0.25$, and therefore the marginal return from contributing, known in the literature as the MPCR (marginal per capita return), is less than unity. While some of this contributing behavior may be attributable to inequity aversion, conditional cooperation, or other preferences mentioned above, some is also probably due to confusion, boundedly rational responsiveness to incentives, and conformism. In our experiment the MPCR rises from 2/3 at $\alpha = 0$ to 0.8 at $\alpha = 0.1$, and to $0.9\overline{3}$ at $\alpha = 0.2$. Controlled experiments have shown (e.g., Isaac and Walker, 1988) that subjects contribute more when the MPCR is higher, so we may expect some responsiveness to changing incentives within the set of α's that are below 0.25. Furthermore, contributions are unlikely to suddenly switch to full endowment at $\alpha = 0.3$, partly for reasons of bounded rationality and perhaps partly due to the fact that some of the benefits of one's contribution goes to other group members, when $\alpha < 1$.[6]

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[6] There are many possible reasons why subjects might withhold contributions when this is the case. One might be a perception that others are free-riding on one's contribution, which the decision-maker might

Hb.5. *Contributions will tend to be positive when* α *≤ 0.2 even without fairness or cooperative preferences, and contributions will tend to respond continuously to changes in marginal incentives, rather than jumping from 0 when α ≤ 0.2 to full endowments when α ≥ 0.3.*

The tendency of contributions to respond to changes in *α* continuously rather than with a discrete jump means that the predictions of Hb.2 and Hb.4 must be studied against a more subtle background, but this does not render them predictively useless or impossible to test. Relatively continuous responsiveness of contributions to *α*, if present, is also expected to be taken into account by subjects in their voting on *α* and in adjusting their contribution behaviors to influence others' votes. It is worthwhile to explicitly augment hypotheses Hb.1 and Hb.2 to account for continuous responsiveness to α and especially to positive contributions at α < 0.3 as follows:

Hb.6. *Inequality averse high and especially middle endowment subjects will sometimes vote for α < 0.3, this happening more often in the* ***RV*** *than in the* ***QV*** *treatment. Moderately inequality averse middle subjects will also sometimes vote for α = 0.4 , 0.5, etc. rather than α = 0.3 because continuous responsiveness of contributions to incentives means that their own earnings are affected by the choice of α within the 0.3 to 1.0 range, contrary to Hn.1.*

2.3 Laboratory protocol

The computerized experiment was programmed using z-Tree (Fischbacher, 2007). A total of 144 participants (36 for each of the treatments), who were invited by using the software ORSEE (Greiner, 2004), took part in the eight sessions of the experiment (two per treatment), all of them being undergraduate students with different study backgrounds.

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view as unfair. Grosse *et al.* (2009) find that contributions to a group project are lower when the MPCR is 1.8 than when it is 3.

Sessions proceeded in the following way: Upon entering the laboratory, participants were randomly assigned to cubicles and provided with written instructions (see Appendix C) for the first part of the experiment, i.e. the Ring-test.[7] The instructions were read out aloud by the experimenter. Subjects knew that there will be a second part of the experiment and that it will be unrelated to the first part. Upon completion of the first part, the instructions for the second part were handed out and read aloud. Participants were, then, asked to answer a set of twelve control questions to make sure that the rules of the game had been fully understood. Any incorrect entries were corrected and all remaining questions were clarified before the second part commenced. In the treatments with the quiz, sessions started with the trivia questions that, then, determined the endowment of a subject throughout the second part of the experiment. Treatments without the quiz started with the random assignment of endowments.

At the end of each period, subjects were informed about all individual contributions within their groups linked to IDs and their own period incomes in tokens as well as the individual period income in tokens of the other two group members.

After 15 periods, the experiment ended, subjects were paid out privately and in cash. Sessions lasted in total for a bit less than two hours, including payment. At the end of each session, the accumulated period profits in experimental currency units (ECU) were converted into euro at the pre-announced rate. Average earnings were € 33.47 per subject, which breaks down into € 5.59 for part 1 (the ring test) and € 27.88 for part 2 (the main experiment).

[7] In this fully incentivized test, subjects have to make binary choices in 24 different allocation tasks (see Appendix D). In each task, a subject has to choose among two allocations that allocate money to herself and a recipient. Adding up the 24 decisions yields a total sum of money allocated to oneself (x-amount) and to the recipient (y-amount). From the ratio (x/y) one can calculate a subject's social orientation, indicated by a vector θ, which can then be classified into any of eight categories: individualism, altruism, cooperation, competition, martyrdom, masochism, sadomasochism, and aggression. See Offerman et al. (1996) or Brosig (2002) for further details on the Ring-test.

3. Results

We first provide a descriptive overview of our results regarding voting on α (in section 3.1.1) and contributions (section 3.1.2) and then proceed with more detailed regression analysis and non-parametric tests (section 3.2).

3.1 Descriptive overview of results

3.1.1 Voting

Table 2 provides an overview of some key outcomes by treatment. Beginning with the votes that subjects cast for the distribution parameter α, we see that as predicted the preferred α tended to be lower for low than for high endowment subjects, with the average value voted for by middle endowment subjects lying in between. This tendency to vote differently depending on endowment is associated with statistically significant differences, as shown by Kruskal-Wallis-tests and pairwise Mann-Whitney-U-tests (all with $p < 0.001$). The averages in Table 2 and the corresponding Figure 1 show, in line with our prediction in Hn.2, that low endowment subjects clearly did not always vote for α of 0.3, voting often for α of 0, and voting on average for α a little greater than 0.3 with earned endowments, and for α less than 0.2 with random endowments. High endowment subjects sometimes voted for $\alpha < 1$, a result potentially more consistent with Hb.3 than with Hn.2. The higher average α voted for by low and high endowment subjects when endowments were determined by quiz than when they are random are consistent with presence of inequality aversion for random endowments and with a sense of legitimacy of earned inequalities in **QV**, as anticipated in Hb.3. Middle subjects' votes, while roughly consistent with voting randomly over the $0.3 \leq \alpha \leq 1$ range especially in the **QV** treatment, are for higher rather than lower α's when endowments are random, contrary to Hb.1. The middle subject turned out to be the median voter (sometimes tied with another group member) in 2/3 of all votes in **QV** and in 76.1% of votes in **RV**.[8]

[8] Ties were most often with high endowment subjects: in 144 out of 360 decisions, the high and middle subjects concurred on the same α (usually 1); in 30 decisions, the high and low endowment subjects concurred; in 21 cases, the middle and low concurred; and in 16 cases, all three concurred.

Insert Table 2 and Figure 1 around here

Figure 1 shows that in both voting treatments, the modal choice of low endowment subjects is to set $\alpha = 0$, but less than half (40.6%) of their votes are for 0 when endowments are determined by quiz performance, versus about two-third (66.1%) when endowment assignment is random. In **QV**, 0.1 and 1.0 each attract more than 10% of the low subjects' votes, with almost 46% of votes being for values of 0.3 and above. In **RV**, $\alpha = ½$ is the only option other than 0 to get more than 10% of low subjects' votes, and only a little under 28% of votes are for values of 0.3 and above. Low endowment subjects on average act as if they view inequality that disfavors them as being more acceptable when it is the result of performance. We will see shortly that an added reason why low endowment subjects may have voted for $\alpha < 0.3$ is that contributions did not drop precipitously as α dipped below that threshold—i.e., contribution behavior was consistent with Hb.5 rather than Hn.1.

High endowment subjects' votes come closer to our most parsimonious theoretical prediction, with 86.7% of votes in **QV** and 77.8% in **RV** being for $\alpha = 1$. High endowment subjects vote for $\alpha \geq 0.3$ 97.2% and 95.6% of the time, respectively, with no value other than 1 garnering more than 10% of their votes. Of course, these figures leave 10.5 and 17.8% of high subjects' votes, respectively, to be for values in the 0.3 to 0.9 range, supporting Hb.2.

For middle endowment subjects, $\alpha = 1$ is also the modal choice, accounting for 43.3% of votes in **QV** and for 58.9% of votes in **RV**. In **QV**, $\alpha = 0$ and $\alpha = ½$ each get over 10% of middle subjects' votes, while those values attract between 5 and 10% of middle subjects' votes in **RV**. 80.6% and 88.3% of middle subjects' votes are for $\alpha \geq 0.3$ in **QV** and **RV**, respectively—which means that middle subjects violated Hn.2 but supported Hb.6 by voting for $\alpha < 0.3$ about 16% of the time.

3.1.2 Contributions

In Table 2 and in much of our discussion we do not report absolute contribution C_i but proportions of endowment contributed, C_i/E_i, which aids comparability across endowment levels. On average, subjects contributed to their group project the large majority of their tokens, ranging from 82.8% of their endowments in the **QE** treatment to 88.4% in the **RE** treatment. These contribution averages are not far from what would be expected had behaviors adhered to Hn.1, with subjects contributing their full endowments or zero depending on whether α > or < 0.25. Given that we have $\alpha < 0.25$ in 12.5% of periods and $\alpha > 0.25$ in 87.5% of periods, C_i/E_i would have been 87.5% on average had all subjects behaved as predicted by Hn.1. We will see shortly, however, that actual contributions vary more-or-less continuously as α varies, providing stronger support for Hb.5 than for Hn.1.

Looking at average contribution by endowment and treatment, the only difference that stands out in Table 2 is that high endowment subjects contributed about 10% less of their endowments in the **QE** treatment than in the others, a result that might be explained by unhappiness with redistribution when endowment was earned, but that is perplexingly not mirrored in the **QV** treatment.

The last three rows of Table 2 report average C_i/E_i separated not by endowment but rather by the range in which the group's median incentive parameter α lies. We report average C_i/E_i during periods in which $\alpha < 0.25$ (VCM incentives), average C_i/E_i when $0.3 \leq \alpha \leq 0.6$ (in theory high enough to induce full contributions but possibly inducing lower contributions either due to a continuous response to incentives associated with bounded rationality, or to high contributors' resistance to "unfair" sharing, or both), and lastly average C_i/E_i during periods in which $0.7 \leq \alpha \leq 1$ (a range of strongest incentives from a behavioral perspective to contribute the entire endowment). For each treatment, the average proportion contributed is substantially above 0 when $\alpha < 0.25$, and it rises as the range of α does, demonstrating that contributions respond more smoothly to incentive changes, as predicted by Hb.5. In the VCM range ($\alpha < 0.25$), the displayed numbers resemble the commonly reported average contribution of about 50% of endowment in the first period of laboratory VCM experiments, but looking across the columns, average contributions are far lower in the **QV** and **QE** treatments than in the **RV** and **RE** treatments, consistent with greater willingness to contribute despite low incentives when inequality is viewed as arbitrary. The difference between contributions in the former and latter treatments is highly significant (Mann-Whitney-U-test, $p < 0.001$). A similar although less pronounced pattern appears when comparing **QV** to **RV** and **QE** to **RE**, with the difference in the first pair being insignificant but that in the latter pair being significant at the 5% level. This shows that it is mainly the difference between **QE** and **RE** that drives the overall differences between treatments with and without the quiz.

Insert Figure 2 around here

A further sense of how contributions responded to incentives is provided by Figure 2, which graphs average C_i/E_i as a function of α for each endowment level combining the data of all four treatments. One curiosity is that not only does the share contributed fail to jump from 0 to 100% when α crosses the theoretical threshold at 0.25, but C_i/E_i actually drops by over 10% for all three endowments, at that threshold. We believe that this drop may be an artifact of the relatively small numbers of observations at the respective levels of α (of about 2% of periods in total for both $\alpha = 0.2$ and $\alpha = 0.3$), and merely point out the anomaly to emphasize that standard theory (Hn.1) performs poorly in predicting a discrete divide. An alternative interpretation would be associated with the crowding out of intrinsic incentives to contribute in the VCM. A low contribution with $\alpha = 0.3$ could signal dissatisfaction with removing the opportunity of voluntary contributions, but given the small number of observations, it is clearly not possible to draw any strong conclusions from these data. The main insight from Figure 2 is that contributions tend to rise over the full range of α (and MPCR) values, from $\alpha = 0$ (MPCR = 2/3) to $\alpha = 1$ (MPCR = 2).[9]

Insert Figure 3 around here

[9] This is born out also by estimating regression equations in which total contribution (C) is the dependent variable and median α and its square are the only explanatory variables. Median α obtains a large, positive, and highly significant coefficient in such a regression when all treatments are pooled as well as in regressions for each of the four individual treatments, with the coefficient on the square term sometimes being significant (both signs are observed) but never undermining the conclusion that the best-fitting curve is monotonically increasing for α between 0 and 1. The regression is not shown to save space, but is of course available on request.

A different question about responses to incentives can be addressed with the help of Figure 3, which plots the average percentage of endowment contributed by range of α and period. In VCM experiments, contributions routinely fall with repetition, a result that has spurred a large literature on learning, subject heterogeneity, and group dynamics in collective action settings.[10] Consequently, we might expect our subjects' contributions to be lower when $\alpha < 0.25$ in later periods. On the other hand, when $\alpha > 0.25$, subjects' contributions might rise over time as they learn that they earn more by contributing more. Figure 3 and related analyses are not supportive of the first expectation but are mildly supportive of the second. A likely reason why contributions fail to decline for $\alpha < 0.25$ in later periods in our experiment is that almost no group experiences a long series of periods during which α is in that range. On the contrary, the observations in the lower curve of Figure 3 come from a large number of groups each of which occasionally finds itself with $\alpha < 0.25$ for a period or two only.[11]

3.2 Regression analysis

For a more nuanced view of how contributions are affected by the distribution parameter in different treatments and for subjects having different endowments, it is helpful to simultaneously control for several variables using multivariate regressions, although the usual caveats regarding independence of observations need to be kept firmly in mind.

We will first consider the determinants of the contribution choice (in section 3.2.1) and then the determinants of the voting decision (section 3.2.2). Addressing the two choices separately allows taking into account a host of possible behavioral determinants of choices discussed in the prediction section. We are aware of the potential endogeneity bias in the regressions. In Appendix B we use 2SLS to account for the simultaneity in the dependent variables. The results show that all our effects remain robust. One

[10] For an excellent overview, see the survey in Gächter and Herrmann (2009); for a paper focusing on subject heterogeneity, see Fischbacher and Gächter (2009).

[11] Observations in the $\alpha < 0.25$ range also can have MPCR ranging from 0.67 to 0.93. Hence, contributions may rise or fall, independent of the time trend, but depending which specific values of α predominate (consider the curves in the $\alpha \leq 0.2$-range in Figure 2).

disadvantage of the simultaneous estimations is however that we can only use the median α, because the other two α values do not play any direct role in determining contributions. Obviously, the test of some of our hypotheses requires a more nuanced assessment and, more specifically, the interpretation of the vector of α's in a group. Since the regressions in Appendix B show that the endogeneity bias is very small, we therefore decided to address contribution decisions and the choice of α in separate regressions in order to be able to tackle our more subtle strategic predictions.

3.2.1 Regression analysis of contribution decisions

Table 3 shows four regression models attempting to explain the proportion of endowment that subjects contribute as a function of the current value of α, its square, dummy variables denoting low and middle endowment subjects (with the high endowment subjects being the reference group), a dummy variable for quiz-based endowments (*Quiz*), a dummy for voted (as opposed to exogenous) α (*Vote*), a period trend term, lagged C_i/E_i, and interactions of the low and middle endowment dummies with α, *Quiz*, and *Vote*. Columns (1) and (2) differ with respect to inclusion or not of group fixed effects. The estimates for both specifications show C_i/E_i to be significantly increasing in α, consistent with expectation and with Figure 2. Coefficients on α^2 are negative, suggesting concavity, but not consistently significant. C_i/E_i does not appear to vary significantly for the two distinguished endowments or their interaction with α. The coefficients on the *Quiz*-dummy are negative and significant, indicating that contributions are significantly smaller when endowments are determined by performance, an effect that seems not to differ by endowment (see the interaction terms). Determination of α by vote also negatively affects C_i/E_i, although this effect seems lessened or even reversed for middle endowment subjects. Not surprisingly, there is significant persistence of individual contribution, *ceteris paribus*. There is no indication of a time trend.

Insert Table 3 around here

The regressions in columns (3) and (4) add interaction terms between the treatment dummy variables (*Quiz* and *Vote*) and a dummy for observations in which $\alpha < 0.8$.[12] The first of the new interaction terms returns highly significant negative coefficients, indicating that the negative impact of the quiz on proportion contributed was about twice as large when α was low. This suggests that a major reason why endowments being quiz-based caused lower contributions is that more subjects found lower, redistributive values of α unacceptable when differences in endowment were "earned."[13] But since the coefficient on *Quiz* remains significant even when this interaction term is included, protest or resentment of redistribution cannot be the only explanation. The interaction between *Vote* and low α is insignificant, providing no support for the idea that subjects contribute less when there is voting in order to prompt votes for higher values of α. Other coefficients are not qualitatively changed except that the coefficient on α^2 becomes more uniformly negative and significant, consistent with the mild concavity suggested by Figure 2.[14]

Do low endowment subjects signal that they don't require incentives?

Hb.4 suggests that in order to encourage others to vote for low values of α, low endowment subjects will contribute in spite of weak or absent incentives. We test this hypothesis by investigating whether, for given low values of α, low endowment subjects contribute more in a treatment with endogenously chosen α than in a corresponding treatment in which α's value is set exogenously. Our design allows us to match up each observation for a low endowment subject in treatment **RV** with a corresponding observation for the unique treatment **RE**-subject having exactly the same history of values of α up to the same period, and to likewise match each **QV** observation with a unique corresponding observation from the **QE** treatment. We then perform a Wilcoxon-signed-ranks-test of the difference in C_i/E_i (equivalently C_i, since we look only at subjects with $E_i = 5$). Because there are relatively few observations for which $\alpha = 0$, 0.1 or 0.2, we

[12] Interactions between the treatment dummies and the endowment dummies are omitted in column (4).

[13] Hb.2 deals with the effect of this judgment on voting, while Hb.3 is consistent with the effect seen for contributions but deals explicitly with high endowment subjects only.

[14] Regressions with subject fixed effects yield very similar results.

expand the set of "low α"-observations to include all in which $\alpha \leq ½$.[15] Observations for the final period are excluded, since strategic incentives would be absent when choosing C_i at that point.

When the paired observations of both pairs of treatments are pooled, the test finds no significant difference between the contributions in the treatment with voting and those in the treatment with exogenous α. However, when we test only the paired **RV** and **RE** observations for subjects with the low endowment, we find that **RV** subjects contributed significantly more than **RE** subjects at given low values of α (for periods 1–14, $p < 0.05$).[16] For these two treatments then, the data support Hb.4.

That low endowment subjects did not contribute more in the **QV** than in the **QE** treatment might be explained by their having reservations about "pushing for" lower values of α when endowments are viewed as earned and inequality is accordingly considered more "fair." This was the basis for Hb.4's prediction that "the extent of this behavior [i.e., strategic contributing] will be greatest in the **RV** treatment".

We can also look for strategic behaviors by low endowment subjects by comparing their behaviors with those of high endowment counterparts. The data show that low endowment subjects contributed a larger proportion of their endowments than did high endowment subjects when $\alpha \leq 0.5$ in the **RV** treatment ($p < 0.01$; Mann-Whitney-U-test). On the contrary, there were no significant differences between high- and low endowment subject contributions in treatment **QV**, or in **RV** and **QV** combined. Once again, this finding can be interpreted as being due to the fact that low endowment subjects feel more entitled to push for equality when endowments are not earned.

Do high endowment subjects signal demands for higher α *by withholding contributions in voting treatments?*

High endowment subjects may have contributed less when α was low (0.3 or just above) than when it was high (1.0 or close to 1.0), partly due to the same behavioral responsiveness to marginal incentives exhibited by other subjects. We can check whether

[15] There are a total of 60 cases of $\alpha \leq 0.2$ in the four treatments versus 176 cases of $\alpha \leq ½$..

[16] When we restrict the sample to observations for periods 1–12 (or even 1–10) – periods in which strategic incentives would in principle have been stronger – the difference becomes even more significant.

high endowment subjects strategically contributed less at low values of α so as to induce others to vote for higher α by comparing their contribution levels when α was low but still high enough to make full contributions rational, say $0.3 \leq \alpha \leq 0.7$, in treatments with voting and in those without. Hb.3 implies that in this range and especially in early periods, high endowment subjects' contributions will be lower in **RV** than in **RE**. The difference will be even stronger for **QV** versus **QE** if subjects feel more entitled to higher earnings when their endowments were attributable to their performance. Contrary to this hypothesis, Wilcoxon matched pair tests find that high endowment subjects contributed *more* in the two voting than in the two non-voting treatments in given periods and at given values of α in the 0.3 to 0.7 range, significant at the 1%-level. Moreover, the difference is entirely attributable to the pair of treatments with quiz-based endowments: contributions by high endowment subjects are higher in **QV** than in **QE** ($p < 0.01$), whereas the contribution difference between **RV** and **RE** taken alone is not significant. It would appear that high endowment subjects consider low α unfair and thus withhold contributions out of dissatisfaction and not necessarily out of desire to influence future votes. The finding that contributions in the low α-range are higher in **QV** than in **QE** might even be attributable to the subjects considering low α-values to be less unfair when they have been chosen democratically than when they are exogenously imposed.

Effects of gender and cooperativeness

In our theoretical discussion, including that of Hb.3 and Hb.4, we hypothesized that behavior might differ depending on subjects' degrees of inequity aversion, an individual preference parameter. To explore this issue, we investigate the impact of two individual characteristics—gender, and *Cooperativeness (Coop)*, a measure constructed from the Ring-test decisions (see Appendix D for details). Table 4 presents a series of regressions explaining share of endowment contributed using the same explanatory variables as in the regressions of Table 3 but adding a *Female* dummy and/or the variable *Coop*, and in some specifications their interactions with the prevailing α. In the regression of column (1) we add *Female* only and find that it obtains a significant negative coefficient. When we add also an interaction between *Female* and α, in column (2), however, the sign on *Female* switches and there is a highly significant negative coefficient on the interaction term. The idea that females contribute less than males that is conveyed by regression (1) thus appears to be mainly attributable to the fact that female subjects contribute more when α is low but are significantly less responsive to increases in this incentive measure.[17]

Insert Table 4 around here

Column (3)'s specification adds only *Coop* and does not obtain a significant coefficient. When both *Coop* and its interaction with α are entered, in column (4), the result is qualitatively similar to that for *Female* in column (2) except that both variables obtain highly significant coefficients. Thus, the Ring-test measure of cooperativeness seems to correctly identify a propensity to contribute to a public good, and thus relative insensitivity to the strength of the individual incentive. Finally, when all four variables are included, in the specification of column (5), we see that the effects shown in columns (2) and (4) continue to hold but are strengthened in both magnitude and significance. Thus, *Female* and *Coop* appear to capture individual characteristics that are predictive of higher contributions and lower responsiveness to incentives but that are somewhat distinct, rather than perfectly overlapping. Note finally that all our previous results remain stable after adding the two variables.

3.2.2 Regression analysis of voting choices

When analyzing voting on α in the **QV** and **RV** treatments, we consider two factors influencing own earnings and one that might influence the vote by way of social or other-regarding concerns. Assume subject *i* votes so as to maximize

$$U_i = f(y_i, \mathbf{S}_i(\alpha | \mathrm{E}_i, Q)) \qquad (2)$$

where y_i is *i*'s earnings for the period, as given in (1'), and $\mathbf{S}_i$ reflects *i*'s social or other-regarding preference for equality (α) and is permitted to vary depending on *i*'s

[17] Note that the negative coefficient on the interaction term is still considerably smaller than the positive coefficient on α itself, so female subjects are somewhat responsive to incentives, just less so than males are. This plays very nicely into the results of Croson and Gneezy (2008) on gender differences.

endowment E_i and on whether it was earned ($Q = 1$) or randomly assigned ($Q = 0$). $\mathbf{S}_i$ is an individual-specific function which might be predictable on the basis of *i*'s gender and background characteristics or *i*'s behavior in other contexts. For simplicity, we rewrite (2) as an additive function of *i*'s income and *i*'s social preferences.

$$EU_i = E(y_i) + \mathbf{S}_i(\alpha | \mathrm{E_i}, Q) \qquad (2')$$

We focus first on the effects of *α* on *i*'s income. Mathematically, the effect of *α* on y_i decomposes into a direct effect which, holding contributions constant, simply redistributes the group revenue toward or away from *i*, and an incentive effect which, for a given way of sharing out group revenue, alters *i*'s income by altering group effort. In symbols,

$$EU_i = g\{(\frac{\partial y_i}{\partial \alpha}\bigg| C_i, C_{-i}), (\frac{\partial y_i}{\partial C_{-i}})E(\frac{\partial C_{-i}}{\partial \alpha})\} + \mathbf{S}_i(\alpha | \mathrm{E_i}, Q) \qquad (2'')$$

The first argument of *g* is the marginal effect of *α* on y_i taking the contributions of each subject as given, and the second is the marginal effect of *α* on y_i acting through its effect on the other group members' contributions.[18] $\partial y_i / \partial \alpha | C_i, C_{-i}$ and $\partial y_i / \partial C_{-i}$ are immediately calculable at observed *C*-values using (1')[19], while a subject can form estimates of $E(\partial C_{-i} / \partial \alpha)$ [20] by calculating impacts of changing *α* on group-mates' contributions up to the time of a given vote from the data for each individual and group. Assuming a first-order condition that can be linearized in the arguments of (2'), we adopt as the core of our estimating equation

$$^{v}\alpha_{it} = b_0[(\frac{4}{3})C_i - (\frac{2}{3})(C_j + C_k)] + b_1\{\frac{2}{3}(1-\alpha)[\frac{1}{(t-1)}]\sum_1^{(t-1)}[\frac{\Delta(C_j + C_k}{\Delta \alpha}]_t\} + \sum_{all\ i} b_i(D_i) + b_2(\mathbf{QV}) + \varepsilon_{it} \quad (3)$$

where $^{v}\alpha_{it}$ is the value of *α* for which subject *i* votes in period *t.* On the right hand side (RHS), the term-multiplying coefficient *b₀* is the expression for $\partial y_i / \partial \alpha | C_i, C_{-i}$. Looking at the second additive expression on the RHS, $[\Delta(C_j + C_k) / \Delta \alpha]_t$ is the

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[18] The impact of changing *α* on *i*'s income through a change in *i*'s own contribution is ignored by virtue of the usual envelope argument.

[19] $\partial y_i / \partial \alpha | C_i, C_{-i} = (4/3)C_i - (2/3)C_{-i}$ and $\partial y_i / \partial C_{-i} = 2/3(1-\alpha)$.

[20] Recall that according to standard theory, $\partial C_{-i}\partial\alpha = 0$ everywhere except at α = 0.25, where it is infinite. Expectations of non-zero $\partial C_{-i}\partial\alpha$ values are based entirely on observed behavior.

observed change in the other group members' contributions in response to a change in *α* between periods *t-1* and *t*, and all such past changes are summed, then divided by (*t* – *1*).[21] The full expression which coefficient b_1 multiplies includes $(2/3)(1-\alpha)$, which is $\partial y_i / \partial C_{-i}$ of equation (2"). To simplify discussion of our estimates, we refer to the purely distributive term multiplied by b_0 as the "distributive effect," to the term measuring *α*'s effect on *i*'s income through changes in others' contributions—which has coefficient b_1—as the "incentive effect." In our regressions, we allow for differences in the incentive effect at different endowment levels by including interactions with low and high endowment dummy variables, but omit these for the distributive effect the structure of which incorporates contribution terms and is thus in practice highly correlated with endowment.

With respect to the social preference portion of (2")— $\mathbf{S}_i(\alpha | \mathrm{E_i}, Q)$ —we control for individual social preferences in our estimating equation by including individual fixed effects, b_i, and in some specifications *Female* or *Female* and *Coop* dummy variables. We control for the possibility that subjects view redistribution as less fair when endowments are earned via quiz performance by including a dummy variable for our **QV** treatment, *Quiz*, also with endowment dummy interactions. We include free-standing dummy variables for two endowment levels, in case endowment has effects not captured by the other terms. A time trend is also included. Finally, ε_{it} is an error term. Our prediction is that $b_0 > 0$, $b_1 < 0$ and $b_2 > 0$.

Table 5 displays the results of the regression estimates. The result in column (1) supports our prediction with a significant positive sign on the distributive effect, and is supportive with regard to the incentive effect for one endowment category, the usually pivotal middle subjects. The quiz (or 'earned endowment') treatment effect is insignificant for high endowment subjects but significant and positive for those with low endowment, and significant and negative for those with middle endowment. Low endowment as such has a large and significant negative effect on the vote for *α*, while the coefficient on middle endowment is small and quite insignificant, indicating no

[21] To avoid dividing by 0 in a given $\Delta(C_j + C_k)/\Delta\alpha$ -term, we omit those adjacent periods in which *α* was unchanged for the group in question, and we reduce the denominator *t*–1 accordingly.

difference with high endowment subjects except via interactions with the incentive and treatment effects. There is a significant positive coefficient on *Period*, indicating an economically small upward trend.

Insert Table 5 around here

The results in columns (2) and (3), which add *Female* and *Coop* dummies, are qualitatively similar for the other variables while providing support for the idea that social preferences matter. In particular, female subjects and subjects classified as cooperative based on the Ring Test favor significantly more equal distribution, after controlling for other factors.

In sum, our regressions based on eq. (3) suggest that subjects' votes on the distribution parameter were significantly influenced by its direct effect on their own earnings (distributive effect), while its predicted effect via its influence on others' contributions (incentive effect) appears significant for middle endowment subjects only. Even after controlling for the distributive effect, low endowment subjects favor more redistribution, but their zeal in this regard is significantly reduced when endowments were earned by quiz performance, another indication of respect for earned inequalities. In contrast, middle endowment subjects are—contrary to Hb.1—more inclined to redistribute when endowments are due to quiz performance.[22] High endowment subjects appear to respond only to the distributive effect.

Redistributive conflict and the influence of the rich

As previously noted, from the standpoint of standard theory there is a static incentive to contribute one's full endowment provided that $\alpha \geq 0.25$, and thus low endowment subjects should be indifferent among α values in the set {0, 0.1, 0.2, 0.3}, high endowment subjects should vote for α of 1.0, and middle endowment subjects should be indifferent among values of α in the 0.3-to-1.0 range. With votes of the latter being decisive and being distributed randomly over that range, α should average around 0.65 but for the presence of egalitarian or equity preferences or the impact of strategic

[22] Conceivably, "sour grapes" are at work: some runner-up middle subjects might believe they came very close and were denied the prized high position by chance, and thus unfairly.

contribution behavior. Since in fact α averages 0.79 in the **QV** treatment and 0.77 in the **RV** treatment, it appears that strategic contribution behavior succeeds in swaying division away from equality. (Equity preference could drive average α above 0.65 in the **QV** but not the **RV** treatment.)

Indeed, the experiment as a whole might be viewed as a struggle over equality waged between "rich" subjects interested in the greater rewards they obtain with less equality and the "poor" ones with opposite interest. In the absence of other tools of persuasion, the battle is largely fought by attempting to change perceptions of the impact of the division parameter on contributions, a fundamentally strategic factor that calls for actions contrary to one's short-term self-interest in order to signal willingness to sacrifice for a "principle." The action is partially obscured by the fact that contributions do not jump from 0 in the $0 \leq \alpha \leq 0.2$-range to full endowment in the $0.3 \leq \alpha \leq 1.0$-range, partly for behavioral or bounded rationality reasons. Also, the comparison of high endowment subjects' contribution behaviors in voted versus exogenous α treatments favors an emotional rather than strategic interpretation of those behaviors. Nevertheless, we have seen evidence of a struggle in the form of low endowment subjects contributing large amounts at very low α's, high endowment subjects contributing small amounts when $\alpha \geq 0.3$ but substantially below 1, and voters responding to observations of $\partial C_{-i}/\partial\alpha$ in the manner predicted in equation (2").

We perform an additional exercise showing evidence that higher endowment subjects managed, whether intentionally or not, to "push α upwards" from the predicted 0.65 average by withholding contributions. For each group in the **QV** and **RV** treatments, we calculated $\partial C_h/\partial\alpha$ with C_h being the contribution of the high endowment subject, using observations for periods 1–7. This is a group-level observation of the steepness of the gradient between the high contributor's contribution and the group's chosen α. Then we calculated the group's average chosen α during periods 8–14 (leaving out period 15, in which strategic incentives in contribution choice are absent). We then calculated the correlation between the two variables. For the 22 valid observations of the two treatments combined, the correlation is 0.30, which is significant at the 9%-level in a one-tailed test. For the seven valid observations of the **QV** treatment alone, the correlation is 0.58, which is also significant at the same level of significance in a one-tailed test.[23] Although these significance levels are not high, they are consistent with the other indications of effective influence on division decisions of high-endowment subjects' contribution decisions.

4. Discussion and conclusion

We provide a new paradigm to study the struggle between equality, equity and the need for incentives. It can be applied to the general question regarding the trade-off between equality and incentives that every society has to answer through taxes and redistribution, but it can, for instance, also be applied to assess the optimal incentives for work teams. The current paper presents an experimental test of the set-up that can be extended in several ways.

Our main findings can be summarized as: First, subjects respond to the strength of incentives in a roughly continuous fashion, rather than jumping from zero contributions when their marginal return for contributing is below unity to full contributions when it exceeds that threshold, as standard theory would predict. This is true of subjects in all endowment classes, and thus appears to stem from bounded rationality or strategic considerations rather than from strong concerns about equality or inequality.

Second, high and low endowment subjects' votes are largely (although not entirely) predictable from self-interest, with the former mostly favoring payment proportionate to contributions and the latter favoring more equal payment. The level of revealed social preferences seems to be smaller than in comparable experiments, which might be a consequence of the fact that a vote on a distribution parameter seems more abstract than a direct decision over a contribution or transfer.

Third, despite the predominance of self-interest there are signs of fairness preferences. In particular, subjects display greater preference for equality when inequalities are arbitrary than when they are earned by task performance, since low and high endowment subjects are observed to vote for more equality following an otherwise identical history if endowments were not earned. Moreover, female subjects and those

[23] A number of group-level observations are lost because α did not vary during periods 1–7, causing $\partial C_h / \partial \alpha$ to be undefined.

scored as more cooperative, based on a Ring-test, contribute more unconditionally, are less responsive to incentives, and show a preference for greater equality in their voting on the division parameter.

Fourth, there is evidence that low endowment subjects' contributions are influenced by strategic considerations: low endowment subjects contribute more when the marginal return is less than one if the division is determined by vote (presumably to signal willingness to cooperate despite low incentive) than when the same division parameters arise exogenously. High endowment subjects influence groups' choices of the division parameter by withholding contributions when it is relatively low, even though contributing the full endowment maximizes their immediate payoff. However, the withholding of contributions by high endowment subjects may be more a response to perceived unfairness than a conscious attempt to influence votes, since there is actually less such behavior in groups with voting.

What lessons might be drawn for the design of actual institutions? Because self-managing firms are less common than hierarchical ones, the implications of our experiment for organizational design are most straightforward for the **QE** and **RE** treatments. Continuous rather than dichotomous response to the incentive parameter, in particular, suggests that organizations considering an element of reward-sharing, for instance to foster helping behaviors among workers,[24] can anticipate smaller responses of changes in marginal rewards than standard theory predicts. For those organizations that do engage in some self-management, an important implication of our results is that the desires of some team members to reduce inequalities as an end in itself means that maximization of joint utility and joint money pay-offs call for different choices along the spectrum of incentives versus equality.

Because people are fairly mobile among organizations, the macro-political economic implications of our experiment may be even more important than are the micro ones, despite the tiny size of our experimental "societies." That those with the most resources to contribute strive to convince others of their need for incentives seems a real feature of both our experiment and modern democratic polities. Our design makes the

[24] There is no direct role for such behaviors in our experimental set-up, so our remark applies to a richer environment where sharing of information and other forms of cooperation on the job may have an organizational pay-off.

presence of fairness preferences and incentive considerations more transparent by making the immediate interest of the likely median voters a neutral one, but an interesting extension would be to mimic the right-skewness of real world income distributions by starting with an asymmetric distribution of endowments—5, 8, 15, say, rather than the 5, 10, 15 of the current design—in which case we should expect to see somewhat more redistribution prevail. One suggestion that might be drawn from the deleterious effect of such redistribution on incentives is that a more equal initial distribution of skills and other assets, which can be fostered by education and tax policies, among others, provides a foundation for a more prosperous society.

Finally, in contrast to several other existing papers (e.g., Dal Bó *et al*., 2009; Sutter *et al*., 2006), there does not seem to be a strong difference in cooperation or relative contributions depending on whether the distribution parameter α is implemented exogenously or endogenously. (Our finding that high endowment subjects hold back contributions to a smaller degree when low values of α result from voting could be viewed as an exception.) One reason for the difference is probably that our design alternates votes and contribution decisions repeatedly, so that causation may run more from contribution decisions to voting than in the reverse direction. It would be interesting to try a variant of our design in which a single voted choice of distribution parameter follows a series of periods of interaction under exogenous parameter values without subject knowledge that a vote is to come. Having some groups then interact under their voted parameters while others are randomly assigned parameters, over-riding their votes as in Dal Bó *et al*., would generate clear evidence on the presence or not of an endogeneity premium. This is one of many variations on the device of nesting the voluntary contribution mechanism in a more variable incentive model and making incentive settings endogenous, which our paper introduces.

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Figures

Figure 1: Number of votes for each value of α, by endowment level and treatment

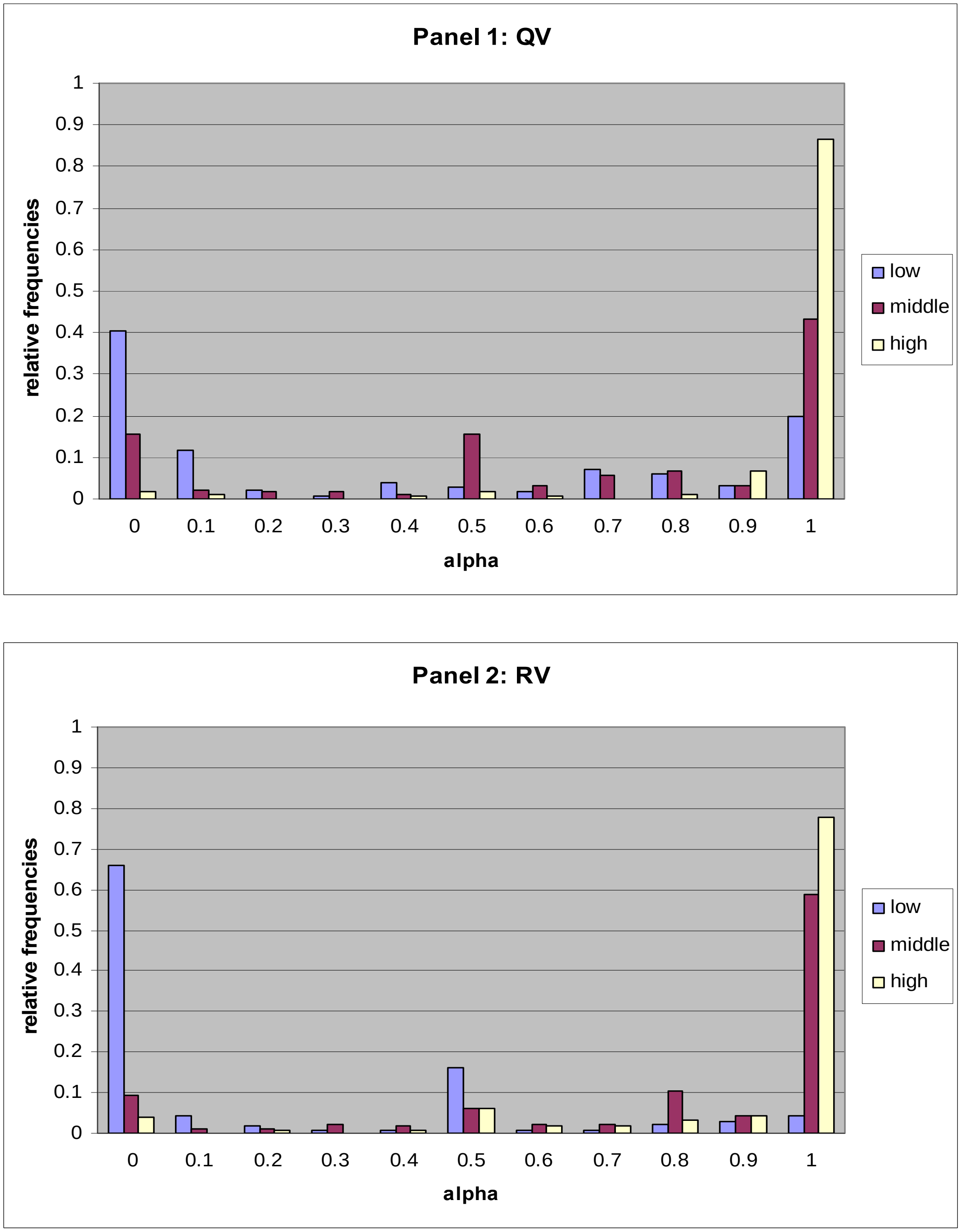


Figure 2

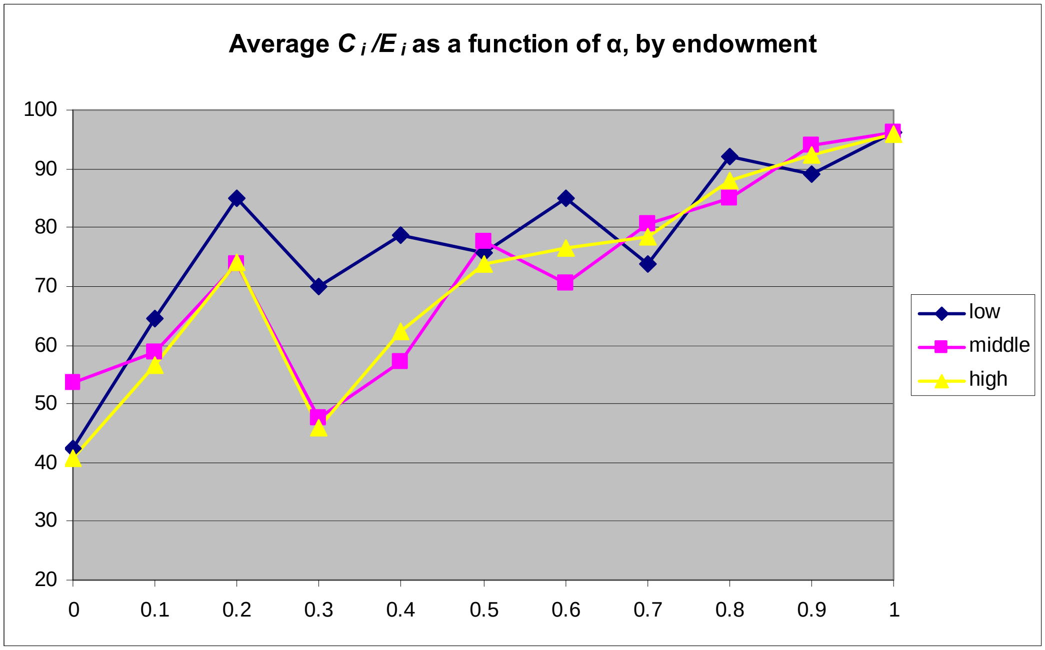
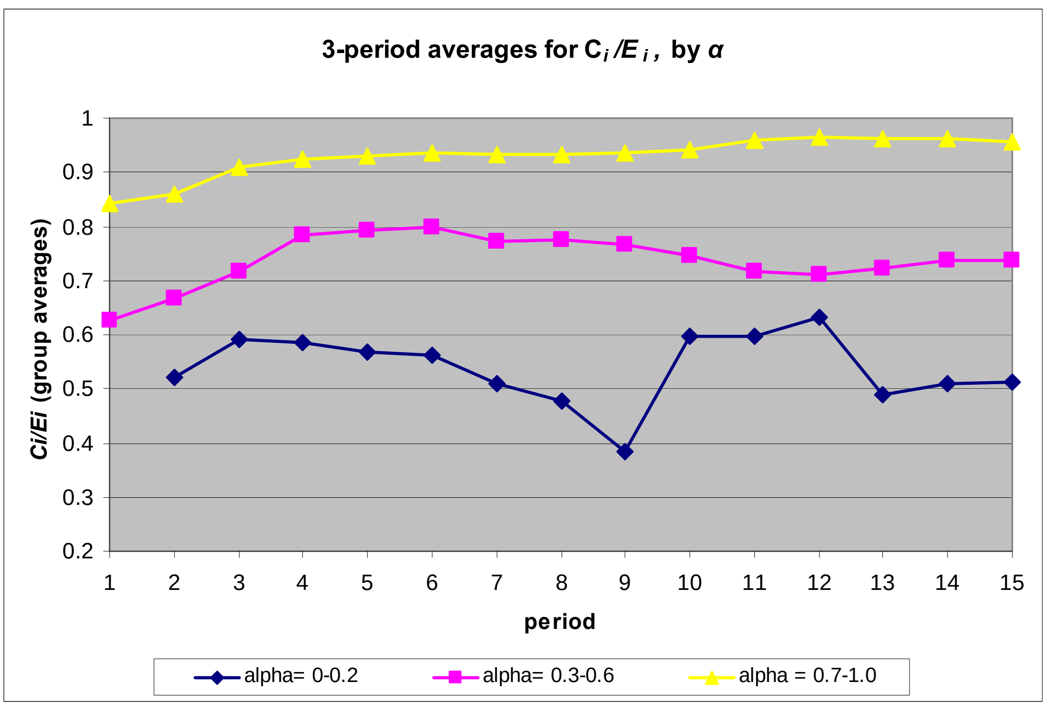


Figure 3



Tables

Table 1: Treatments, groups and subjects in the experiment

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">Endowment Determined by Quiz?</td></tr>
<tr><td>Yes</td><td>No</td></tr>
<tr><td rowspan="2">α Chosen by Vote?</td><td>Yes</td><td>QV
12 groups
36 subjects</td><td>RV
12 groups
36 subjects</td></tr>
<tr><td>No</td><td>QE
12 groups
36 subjects</td><td>RE
12 groups
36 subjects</td></tr>
</table>

Table 2. Summary statistics on votes and contributions (standard deviations in brackets)

Treatment / Variable	Voted α		Exogenous α	
	Quiz (**QV**)	Random endowment (**RV**)	Quiz (**QE**)	Random endowment (**RE**)
α (votes cast)	0.669 (0.410)	0.625 (0.430)	n/a	n/a
α (votes by low)	0.387 (0.418)	0.187 (0.307)	n/a	n/a
α (votes by middle)	0.668 (0.373)	0.789 (0.330)	n/a	n/a
α (votes by high)	0.951 (0.178)	0.900 (0.237)	n/a	n/a
Median α	0.792 (0.282)	0.768 (0.306)	0.792 (0.282)	0.768 (0.306)
C_i/E_i (all subjects)	0.863 (0.275)	0.870 (0.265)	0.828 (0.289)	0.884 (0.235)
C_i/E_i (low endowment)	0.858 (0.288)	0.883 (0.283)	0.854 (0.274)	0.879 (0.267)
C_i/E_i (middle endowment)	0.844 (0.270)	0.861 (0.265)	0.844 (0.273)	0.899 (0.209)
C_i/E_i (high endowment)	0.886 (0.267)	0.866 (0.248)	0.787 (0.315)	0.874 (0.227)
C_i/E_i, α <0.25	0.434 (0.398)	0.608 (0.436)	0.346 (0.283)	0.707 (0.364)
C_i/E_i, $0.3 \leq \alpha \leq 0.6$	0.751 (0.315)	0.795 (0.285)	0.633 (0.302)	0.758 (0.296)
C_i/E_i, $0.7 \leq \alpha \leq 1$	0.930 (0.193)	0.929 (0.192)	0.921 (0.205)	0.946 (0.150)

Table 3. Determinants of the proportion of endowment contributed I

Dependent variable: C_i/E_i	**(1)**	**(2)**
α	0.647 ***	0.620 ***
	(0.104)	(0.113)
α^2	-0.159 **	-0.125
	(0.076)	(0.088)
Low endowment	0.073	0.077
	(0.054)	(0.051)
Middle endowment	0.079	0.085
	(0.051)	(0.049)
α**Low*	-0.073	-0.075
	(0.057)	(0.053)
α**Middle*	-0.068	-0.072
	(0.054)	(0.052)
$(C_i/E_i)_{(t-1)}$	0.259 ***	0.199 ***
	(0.025)	(0.025)
Period	-0.0003	0.0001
	(0.001)	(0.001)
Quiz	-0.036 **	-0.102 *
	(0.015)	(0.056)
*Quiz*Low*	0.007	0.007
	(0.023)	(0.023)
*Quiz*Middle*	-0.001	-0.001
	(0.022)	(0.021)
Vote	-0.029 *	-0.149 ***
	(0.015)	(0.034)
*Vote*Low*	0.025	0.027
	(0.023)	(0.023)
*Vote*Middle*	0.045 **	0.048 **
	(0.022)	(0.021)
Constant	0.257 ***	0.281 ***
	(0.044)	(0.071)
Fixed effects	No	Group
No. of observations	2016	2016
R squared	0.345	0.392
Prob. > F	0.000	0.000

Coefficient robust standard errors are given in brackets. *, **, *** denote significance at the 10%, 5% and 1% level respectively.

	(3)	(4)
α	0.691 ***	0.691 ***
	(0.112)	(0.112)
α^2	-0.233 ***	-0.233 ***
	(0.090)	(0.091)
Low endowment	0.077	0.066
	(0.051)	(0.048)
Middle endowment	0.085 *	0.060
	(0.049)	(0.047)
α**Low*	-0.749	-0.074
	(0.531)	(0.053)
α**Middle*	-0.071	-0.071
	(0.051)	(0.051)
C_i/E_i *(t-1)*	0.201 ***	0.203 ***
	(0.025)	(0.025)
Period	0.0001	0.0001
	(0.001)	(0.001)
Quiz dummy	-0.122 ***	-0.121 ***
	(0.045)	(0.044)
*Quiz*Low*	0.007	-
	(0.022)	
*Quiz*Middle*	-0.001	-
	(0.021)	
Vote	0.016	-0.009
	(0.042)	(0.041)
*Vote*Low*	-0.027	-
	(0.023)	
*Vote*Middle*	-0.048 **	-
	(0.021)	
α < *0.8 * Quiz*	-0.122 ***	-0.122 ***
	(0.027)	(0.027)
α < *0.8 *Vote*	0.027	0.027
	(0.026)	(0.026)
Constant	0.411 ***	0.421 ***
	(0.053)	(0.053)
Fixed effects	Group	Group
No. of observations	2016	2016
R squared	0.401	0.400
Prob. > F	0.000	0.000

Coefficient robust standard errors are given in brackets. *, **, *** denote significance at the 10%, 5% and 1% level respectively.

Table 4. Determinants of the proportion of endowment contributed II

Dependent variable: C_i/E_i

	(1)	(2)	(3)	(4)	(5)
α	0.620 ***	0.667 ***	0.631 ***	0.712 ***	0.785 ***
	(0.113)	(0.117)	(0.123)	(0.120)	(0.120)
α^2	-0.125	-0.121	-0.144	-0.160 *	-0.153 *
	(0.088)	(0.087)	(0.094)	(0.093)	(0.091)
Low endowment	0.074	0.059	0.046	0.055	0.031
	(0.051)	(0.051)	(0.056)	(0.056)	(0.054)
Middle endowment	0.088 *	0.075	0.008	0.009	-0.001
	(0.050)	(0.049)	(0.056)	(0.055)	(0.055)
α**Low*	-0.072	-0.057	-0.045	-0.055	-0.031
	(0.054)	(0.053)	(0.058)	(0.058)	(0.056)
α**Middle*	-0.074	-0.060	0.004	0.005	0.012
	(0.052)	(0.052)	(0.059)	(0.059)	(0.058)
C_i/E_i *(t-1)*	0.197 ***	0.200 ***	0.185 ***	0.184 ***	0.184 ***
	(0.025)	(0.025)	(0.028)	(0.028)	(0.028)
Period	0.000	0.000	-0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Quiz dummy	0.142 ***	0.141 ***	0.042	0.026	0.040
	(0.051)	(0.051)	(0.100)	(0.098)	(0.100)
*Quiz*Low*	0.011	0.015	-0.013	-0.016	-0.010
	(0.023)	(0.023)	(0.026)	(0.026)	(0.026)
*Quiz*Middle*	0.003	0.004	0.009	0.013	0.020
	(0.021)	(0.021)	(0.025)	(0.024)	(0.025)
Vote	-0.135 **	-0.153 ***	-0.025	-0.023	-0.059
	(0.054)	(0.057)	(0.085)	(0.084)	(0.086)
*Vote*Low*	-0.022	-0.015	-0.017	-0.012	-0.001
	(0.023)	(0.023)	(0.026)	(0.026)	(0.026)
*Vote*Middle*	-0.050 **	-0.049 **	-0.053 **	-0.058 **	-0.062 **
	(0.021)	(0.021)	(0.024)	(0.024)	(0.025)
Female	-0.023 **	0.073 *	-	-	0.135 ***
	(0.011)	(0.042)			(0.044)
α**Female*	-	-0.124 ***	-	-	-0.186 ***
		(0.047)			(0.050)
Coop	-	-	0.019	0.123 ***	0.146 ***
			(0.012)	(0.047)	(0.046)
α**Coop*	-	-	-	-0.134 ***	-0.168 ***
				(0.052)	(0.051)
Constant	0.441 ***	0.422 ***	0.315 ***	0.265 ***	0.207 ***
	(0.059)	(0.061)	(0.074)	(0.072)	(0.075)
N	2016	2016	1680	1680	1680
R squared	0.394	0.398	0.409	0.414	0.424
Prob.>F	0.000	0.000	0.000	0.000	0.000

OLS regressions with group fixed effects. Robust standard errors in brackets. *, **, *** denotes significance at the 10%, 5%, 1% level respectively.

Table 5. Determinants of the vote for *α*

Dependent variable: α

	(1)	**(2)**	**(3)**
Distributive effect $\partial y_i / \partial \alpha$	0.008 *** (0.003)	0.007 *** (0.003)	0.008 *** (0.003)
Incentive effect	0.007 (0.011)	0.003 (0.011)	0.0003 (0.001)
*Incentive*Low*	0.010 (0.013)	0.011 (0.013)	.0001 (0.001)
*Incentive*Middle*	-0.037 ** (0.016)	-0.029 * (0.016)	-0.0001 (0.001)
Quiz	-0.004 (0.036)	-0.017 (0.037)	-0.008 (0.044)
*Quiz*Low*	0.194 *** (0.056)	0.217 *** (0.056)	0.205 *** (0.060)
*Quiz*Middle*	-0.121 ** (0.055)	-0.112 ** (0.055)	-0.195 *** (0.059)
Low endowment	-0.588 *** (0.063)	-0.598 *** (0.062)	-0.621 *** (0.060)
Middle endowment	-0.042 (0.049)	-0.060 (0.050)	-0.012 (0.049)
Period	0.008 *** (0.003)	0.007 ** (0.003)	0.006 ** (0.003)
Female		-0.069 ** (0.028)	-0.564 ** (0.029)
Coop			-0.074 *** (0.029)
Constant	1.078 *** (0.052)	1.099 *** (0.052)	0.859 *** (0.049)
Fixed effects	Group	Group	Group
No. of observations	868	868	755
R squared	0.502	0.507	0.476
Prob. > F	0.000	0.000	0.000

Coefficient robust standard errors are given in brackets. *, **, *** denote significance at the 10%, 5% and 1% level respectively.

Appendix A: Additional results

Table A.1. Votes for α by endowment

		Endowment			Total
		5	10	15	
α	0.0	192	45	10	247
	0.1	29	6	2	37
	0.2	7	5	1	13
	0.3	2	7	0	9
	0.4	8	5	2	15
	0.5	34	39	14	87
	0.6	4	10	4	18
	0.7	14	14	3	31
	0.8	15	31	8	54
	0.9	11	14	20	45
	1.0	44	184	296	524
Mean		.287	.729	.925	.647
Total		360	360	360	1080

Appendix B: Instrumental variable estimations

We provide two sets of two-stage least square regressions for contributions below. The first stage of the two-stage procedure (see Table A.2) uses the individual α-values from those subjects only who had the median α in their group (model (1)). There is also a group-level estimate in which what is used for the incentive and distribution effects in the first-stage regression is the average value of the variables only for those group members who voted for what ended up being median α of that period (model (2)). The independent variables are defined as in equation (3). The instruments, *Group distributive effect* and *Group incentive effect* are defined as the average of *Distributive effect* and of *Incentive effect* for the (one, two or three) subjects who had the same vote for α in each group in a given period.

Table A.2. Determinants of the vote for α (2SLS)

Dependent variable: α

	(1) Median α	**(2) Mean α**
Distributive effect $\partial y_i / \partial \alpha$	0.013 *** (0.002)	-
Group distributive effect	-	0.026 *** (0.003)
Incentive effect	-0.016 ** (0.007)	-
Group incentive effect	-	-0.006 (0.008)
C_i/E_i *(t-1)*	0.000 (0.057)	-
C/E (t-1)	-	0.049 (0.093)
Quiz	0.077 *** (0.028)	0.085 *** (0.032)
Period	0.011 *** (0.004)	0.011 ** (0.004)
Constant	0.675 *** (0.061)	0.576 *** (0.092)
No. of observations	465	290
R squared	0.136	0.227
Prob. > F	0.000	0.000

Coefficient robust standard errors are given in brackets. *, **, *** denote significance at the 10%, 5% and 1% level respectively.

Our main instruments in the first stage are highly significant and have the right sign. The main parameter α is also highly significant in the second stage, and the Sargan test does not reject the null of valid instruments. Table A.3 displays the second-stage results.

Table A.3. Determinants for the proportion of endowment contributed (2SLS)

Dependent variable: C_i/E_i

	(1) **C_i/E_i**	**(2)** **Average group** **C_i/E_i**
A	0.389 *** (0.102)	0.474 *** (0.063)
C_i/E_i (t-1)	0.190 *** (0.040)	-
C/E (t-1)	-	0.241 *** (0.045
Quiz	-0.003 (0.021)	0.009 (0.018)
Period	-0.002 (0.003)	-0.002 (0.002)
Constant	0.437 *** (0.068)	0.327 *** (0.053)
No. of observations	465	290
Sargan statistic (overid. test)	0.277	1.251
Chi-sq(1) P-value	0.599	0.263
Instrumented: α		
Instruments: (Group) distributive effect, (group) incentive effect, *C_i/E_i (t-1)* [*C/E (t-1)*], Quiz, Period		

Coefficient robust standard errors are given in brackets. *, **, *** denote significance at the 10%, 5% and 1% level respectively.

Appendix C: Instructions for treatment QV[25]

Welcome to an experiment on decision-making. Thank you for participating! During the experiment you will be asked to make decisions and so will the other participants. Your decisions, as well as the decisions of the other participants, will determine your monetary payoff according to the rules that will be explained shortly.

As is standard in such experiments, communication of any kind with other participants is prohibited. If you violate this rule, you will be excluded from the experiment. If you have any questions during the experiment, please raise your hand and one of the experimenters will come to assist you.

The experiment is computerized and will last for approximately two hours. Decisions will be made on your screen. All your decisions and answers to questions **remain confidential and anonymous**. We will use the identification tag that you have received on entering the room only to identify you when we pay you your income after the experiment.

The experiment will consist of two parts. You will receive instructions on the relevant parts in turn. We will read the instructions aloud and, then, give time for you to ask questions. Please do not hesitate to ask if anything is unclear. Decisions in the two parts of the experiment are completely independent.

Your income in the experiment will be in "tokens." At the end of the experiment, tokens will be converted into euro at an exchange rate which is specified in the respective part.

Part I

In Part I, all persons in the room will be randomly matched into pairs of two. Nobody will find out neither during nor after the experiment with whom he or she was connected. You will have to make 24 choices between two options, called Option A and Option B. Every option allocates a positive or negative number of tokens to your account and a positive or negative amount of tokens to the other person's account. This other person answers exactly the same questions. Your total income from Part I depends on your decision and the decision of the other person in your pair.

Example:

	Option A	**Option B**
Your payoff	10.00	7.00
Other's payoff	-5.00	4.00

[25] The instructions for the other treatments are analogous.

If you choose option A, you will receive 10 tokens and the other person will be deducted 5 tokens. If the other person in your pair chooses option A too, then you will also receive a deduction of 5 tokens. In total you would have earned 5 tokens (10 tokens from your choice minus 5 tokens from the choice of the other person). In case you choose option B and the other person chooses option A, you will receive 2 tokens (7 tokens from your own choice minus 5 tokens from the choice of the other person in your pair). The other person would have earned 14 tokens (10 tokens + 4 tokens).

Your total income from Part I will be determined as follows: Looking at your decisions, the values for "Your payoff" will be summed up. Looking at the person you are connected with, the values for "Other's payoff" will be summed up. The sum of both sums determines your payoff and will be exchanged into euros according to the following exchange rate: **3 tokens = 1 euro**. This exchange rate is only valid for Part I.

You do not get any information on single decision of the person you are paired with, but you will be informed about the sum of payoffs.

Please raise your hand if you have any questions. We will come to your seat to answer them.

Part II[26]

The tokens you earn in Part II will be exchanged into euros at the end of the experiment according to the following exchange rate: **10 tokens = 1 euro.**

All participants will be divided in groups of three members. You will not learn the identity of the other participants in your group.

At the beginning of Part II
At the outset you will be asked to answer 20 trivia questions. For each question, we will provide four answers, but only one of them is correct. The endowment that you will receive in each of the subsequent periods in Part II depends on the number of questions you answer correctly. Specifically, the group member within your group with the most correct answers will receive the highest endowment; the group member within your group with the second-most correct answers will receive the second-highest endowment and so on. Equal numbers of correct answers will be resolved by a random draw of the computer. Thus, there is always a strict ranking of endowments within your three-person group.

The distribution of endowments within your group will be:

Rank (according to correct answers)	Endowment each period of Part II
1	15 tokens

[26] Handed out after completion of Part I.

2	10 tokens
3	5 tokens

The rank will also be your group member number.

The basic decision situation

You will learn later exactly how the experiment is conducted. We first introduce you to the basic decision situation. You will find control questions at the end of the description of the decision situation that help you to get a better understanding.

As you know you will be a member of a group consisting of 3 people. In each period each group member has to decide on the allocation of his or her endowment. You can either invest your endowment into your private account or you can contribute them fully or partially to a project. Each token you do not contribute to the project will automatically remain in your private account.

Your income from the private account each period

You will earn one token for each token you put into your private account. For example, if you put 15 tokens into your private account, your income in this period will amount to exactly 15 tokens out of your private account. If you put 2 tokens into your private account, your income from this account will be 2 tokens for that period. No one except you earns something from your private account.

Your income from the project each period

Your income from the project depends on three things: (1) your contribution to the project, (2) the combined contribution to the project by all group members, and (3) a proportion x, between 0 and 1, which determines the weight placed on (1) versus (2).

If $x = 1$, only your own contribution to the project affects your project income; in particular, your project income is then $2 \cdot c_i$, where c_i is your contribution.

If $x = 0$, only the combined contribution affects your project income; in particular, your project income is then $(2 \cdot C)/3$, where C is the total contribution to the project by all members of your group, yourself included.

If x is more than 0 but less than one, some weight is placed both on c_i (or more specifically, on $2 \cdot c_i$) and on C (that is, on $(2/3) \cdot C$).

Generalizing, what you earn is $(1-x) \cdot \frac{2 \cdot C}{3} + x \cdot 2 \cdot c_i$.

Your total income each period

Your total income is the sum of your income from your private account and that from the project:

Income from your private account (= endowment – contribution to the project)
+ Income from the project
= Sum of income each period

Or, mathematically:

$$Income = (e_i - \text{own contributions}) + (1-x)\cdot\frac{2}{3}\cdot(\text{all contributions in your group})$$
$$+\, x\cdot 2\cdot(\text{your contribution})$$

where e_i denotes your endowment.
Remember: *x* is the weight placed on your contribution, (1-*x*) is the weight placed on the total contributions within your group.

Control questions

Please answer the following control questions. They will help you to gain an understanding of the calculation of your income, which varies with your decision about how you distribute your tokens. Please answer all the questions and write down your calculations. After that please enter your answers on the screen.
For the first set of questions, assume that x = 1 and that you are the second-ranked member of your group, i.e., your endowment is 10 tokens.

1. Assume that none of the three group members (including you) contributes anything to the project.
   What will your total income in tokens be? Your income ____________
   What will group Member 1's total income in tokens be? ____________
   What will group Member 3's total income in tokens be? ____________

2. You contribute 10 tokens to the project. The other members of the group contribute 13, respectively 4 tokens to the project.
   What will your total income be? Your income ____________
   What will group Member 1's total income in tokens be? ____________
   What will group Member 3's total income in tokens be? ____________

3. The other two members contribute a total of 5 tokens to the project.
   a) What will your total income be, if you – in addition to the 10 tokens – contribute 0 tokens to the project? Your Income ____________
   b) What will your total income be, if you – in addition to the 10 tokens – contribute 5 tokens to the project? Your Income ____________
   c) What will your total income be, if you – in addition to the 10 tokens – contribute 10 tokens to the project? Your Income ____________

4. Assume that you contribute 5 tokens to the project.
   a) What is your total income if the other group members – in addition to your 5 tokens – contribute another 3 tokens to the project? Your Income ____________
   b) What is your total income if the other group members – in addition to your 5 tokens – contribute another 10 tokens to the project? Your Income ____________
   c) What is your income if the other group members – in addition to your 5 tokens – contribute another 20 tokens to the project? Your Income ____________

For the second set of questions, assume that x = 0 and that you are again the second-ranked member of your group, i.e., your endowment is 10 tokens.

5. Assume that none of the three group members (including you) contributes anything to the project.
   What will your total income in tokens be? Your income ____________
   What will group Member 1's total income in tokens be? ____________
   What will group Member 3's total income in tokens be? ____________

6. You contribute 10 tokens to the project. The other members of the group contribute 13, respectively 4 tokens to the project.
   What will your total income be? Your income ____________
   What will group Member 1's total income in tokens be? ____________
   What will group Member 3's total income in tokens be? ____________

7. The other two members contribute a total of 10 tokens to the project.
   a) What will your total income be, if you – in addition to the 10 tokens – contribute 2 tokens to the project? Your Income ____________
   b) What will your total income be, if you – in addition to the 10 tokens – contribute 5 tokens to the project? Your Income ____________
   c) What will your total income be, if you – in addition to the 10 tokens – contribute 8 tokens to the project? Your Income ____________

8. Assume that you contribute 5 tokens to the project.
   a) What is your total income if the other group members – in addition to your 5 tokens – contribute another 4 tokens to the project? Your Income ____________
   b) What is your total income if the other group members – in addition to your 5 to-kens – contribute another 10 tokens to the project? Your Income ____________
   c) What is your income if the other group members – in addition to your 5 to-kens – contribute another 19 tokens to the project? Your Income ____________

For the third set of questions, assume that x = 0.5 and that you are again the second-ranked member of your group, i.e., your endowment is 10 tokens.

9. Assume that none of the three group members (including you) contributes anything to the project.
   What will your total income in tokens be? Your income ____________
   What will group Member 1's total income in tokens be? ____________
   What will group Member 3's total income in tokens be? ____________

10. You contribute 10 tokens to the project. The other members of the group contribute 13, respectively 4 tokens to the project.
   What will your total income be? Your income ____________

What will group Member 1's total income in tokens be? ___________
What will group Member 3's total income in tokens be? ___________

11. The other two members contribute a total of 10 tokens to the project.
    a) What will your total income be, if you – in addition to the 10 tokens – contribute 2 tokens to the project? Your Income ___________
    b) What will your total income be, if you – in addition to the 10 tokens – contribute 5 tokens to the project? Your Income ___________
    c) What will your total income be, if you – in addition to the 10 tokens – contribute 8 tokens to the project? Your Income ___________

12. Assume that you contribute 5 tokens to the project.
    a) What is your total income if the other group members – in addition to your 5 tokens – contribute another 4 tokens to the project? Your Income ___________
    b) What is your total income if the other group members – in addition to your 5 tokens – contribute another 10 tokens to the project? Your Income ___________
    c) What is your income if the other group members – in addition to your 5 tokens – contribute another 19 tokens to the project? Your Income ___________

The Procedure

Each period in Part II consists of **two phases**, and there are a total of 15 such periods in Part II. After the trivia questions, you will learn your rank within your group (equal to your group member number) and your endowment. You will receive this endowment at the beginning of each period, and your rank will not change from period to period.

<u>Phase 1 – choice of x:</u>
Your group can choose the preferred x. You can choose from the following values of x: 0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9 and 1. Each group member will be asked to propose his or her preferred x. The median of these three proposals within your group will then be implemented and be valid for this period.
Suppose the three proposals within your group are: 0.1, 0.2 and 0.3. The median proposal to be implemented would be 0.2.
Suppose the three proposals within your group are: 0.9, 1 and 1. The median proposal to be implemented would be 1.
Suppose the three proposals within your group are: 0.5, 0.6 and 0.6. The median proposal to be implemented would be 0.6.
At the end of Phase 1 you will be informed about the relevant median proposal.

<u>Phase 2 – contribution decision:</u>
Each member of the group has to decide on how much of his or her endowment to contribute to the project. The rest of the individual endowment will be automatically invested into the private account.

Your income for this period will be determined in the following way:

Reminder

Your total income is the sum of your income from your private account and that from the project:

Income from your private account (= endowment – contribution to the project) + Income from the project = Sum of income each period

Or, mathematically:

$$Income = (e_i - c_i) + (1 - x) \cdot \frac{2 \cdot C}{3} + 2 \cdot x \cdot c_i$$

At the end of each period, you will be informed about all individual contributions within your group (you will be able to link them to the Member numbers) and your period income in tokens as well as the individual period income in tokens of the other two members.

Each of the 15 periods will be identical and will follow the protocol described above. You will be staying in the same group for the 15 periods, i.e., the two other group members will remain unchanged over Part II of the experiment.

The End

Your total income over the 15 periods will be converted to euro (at the exchange rate 10 tokens = 1 €) and privately be paid to you at the end of the experiment. It will be added to the amount that you earned from Part I of the experiment.

After Part II, we ask you to fill in a questionnaire. Please answer the questions frankly and seriously because they are very important for our research. Thereafter, the experiment ends. There will be no other parts or repetitions.

Please raise your hand if you have any questions. We will come to your place to answer them privately.

Appendix D: Ring-Test

The social orientation questionnaire consists of 24 choices (see Table C1) between two own-other payoff allocations (the "decomposed game") in constant, anonymous pairs. Each allocation assigns a given amount of experimental money to the subject herself, called own payoff x, and a certain amount of points to the matched player, called other payoff y. It was common knowledge that every subject received the same questionnaire. During the questionnaire players did not receive any feedback about the other player's choices in order to avoid strategic considerations. The payoff allocations were constructed such that $r^2 = 15^2 = x^2 + y^2$ holds. Hence, each allocation can be represented as a vector in a Cartesian plane which lies on a circle with radius r centred at the origin.

The payoff allocations are paired such that each choice consists of two adjacent vectors. If one assumes that a – yet unknown – motivational vector $\vec{M}$ exists, a subject will choose that allocation (vector) which is closer to $\vec{M}$. Based on a series of choices, therefore, it is possible to determine a subject's "social motivation" with respect to weighing own payoffs (x) versus others payoffs (y) by adding up x and y separately across all choices and calculating the angle θ_M of the resulting vector $\vec{M}$. By means of this angle subjects' motivation can be classified as belonging to one of the following eight categories: individualism, altruism, cooperation, competition, martyrdom, masochism, sadomasochism, and aggression.

In addition, the length of the motivational vector serves as a measure of consistency, i.e., whether the choices are taken such that the subject has always chosen that vector which is closest to the motivational vector. If a subject chooses consistently throughout the 24 choices, the length of the resulting vector would be 30. Random choice would result in a vector of zero length.

In order to incentivize the procedure, subjects' total payoffs from the series of choices were determined by the sum of choices made by the subject herself and by the choices of the paired player.

Table A.4. Ring-test – own-other payoff allocations

	Option A		Option B	
Question number	self (x)	other (y)	self (x)	other (y)
1	15	0	14.5	-3.9
2	13	7.5	14.5	3.9
3	7.5	-13	3.9	-14.5
4	-13	-7.5	-14.5	-3.9
5	-7.5	13	-3.9	14.5
6	-10.6	-10.6	-13	-7.5
7	3.9	14.5	7.5	13
8	-14.5	-3.9	-15	0
9	10.6	10.6	13	7.5
10	14.5	-3.9	13	-7.5
11	3.9	-14.5	0	-15
12	14.5	3.9	15	0
13	7.5	13	10.6	10.6
14	-14.5	3.9	-13	7.5
15	0	-15	-3.9	-14.5
16	-10.6	10.6	-7.5	13
17	-3.9	-14.5	-7.5	-13
18	13	-7.5	10.6	10.6
19	0	15	3.9	14.5
20	-15	0	-14.5	3.9
21	-7.5	-13	-10.6	-10.6
22	-13	7.5	-10.6	10.6
23	-3.9	14.5	0	15
24	10.6	-10.6	7.5	-13

The classification of the subjects was accomplished by means of the angle of the motivational vector $\vec{M}$ (based on the vectors defining the basic social motivation; see Figure C1) Subjects with an angle θ_M between 0° and 22.5° or 337.5° and 0° were classified as individualistic, subjects with an angle between 22.5° and 67.5° as cooperative. Further angles were: altruist (between 67.5° and 112.5°), martyrdom (between 112.5° and 157.5°), masochism (between 157.5° and 202.5°), sadomasochism (between 202.5° and 247.5°), aggression (between 247.5° and 292.5°), and competitive (between 292.5° and 337.5°), but they are very rarely observed in practice. To avoid examining subjects who made relatively inconsistent choices we included in the analysis only those subjects with a vector length of 15 (out of the maximal length of 30).

Figure A.1. Vectors defining the basic social motivation