Social identity and preferences over redistribution

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ABSTRACT

We design an experiment to study the effects of social identity on preferences over redistribution. The experiment highlights the trade-off between social identity concerns and maximization of monetary payoffs. Subjects belonging to two distinct natural groups are randomly assigned gross incomes and vote over alternative redistributive tax regimes, where the regime is chosen by majority rule. We find that a significant subset of the subjects systematically deviate from monetary payoff maximization towards the tax rate that benefits their group when the monetary cost of doing so is not too high. These deviations cannot be explained by efficiency concerns, inequality aversion, reciprocity, social learning or conformity. Finally, we show that behavior in the lab helps explain the relationship between reported income and stated preferences over redistribution observed in survey data.

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1. Introduction

What determines preferences over economic policies in democracies? Economic self-interest appears to be a rather weak predictor of voting behavior: poor people do not necessarily vote for extensive redistribution of income, and rich people sometimes support welfare programs from which they do not expect to benefit. While many factors have been suggested to explain voting behavior, researchers have long noted that social context seems to have a crucial effect (Lazarsfeld et al., 1948; Miller et al., 1991; Beck et al., 2002). This view is supported by observed differences in voting patterns and reported policy preferences across social groups such as class, race and religious affiliation, controlling for measures of economic self-interest (Evans, 2000; Luttmer, 2001; Glaeser and Ward, 2006). One important factor underlying these relationships may be social identity. However, the precise relationship between social identity and political choices has yet to be properly understood. The main difficulty is due to endogeneity of both economic and social variables. For example, people with certain characteristics may be more likely to earn higher incomes, associate with certain groups and vote in certain ways. This hampers attempts at uncovering the mechanisms behind group-based voting and distinguishing them from other motives such as economic self-interest, altruism or inequality aversion.

This paper employs an experimental approach to study the effect of social identification on voting over redistribution. We define social identification in terms of preferences. We say that an individual identifies with a group if she cares not only about her own self-interest, but also about the status of that group.[1] This feature is a prominent implication of Social Identity Theory (Tajfel and Turner, 1979, 1986) and is motivated in the social psychology literature by observed behavior in Minimal Group experiments.[2] Caring about one's group is also consistent with behavior in strategic bargaining, prisoner's dilemma and public goods experiments.[3]

Our experiment is designed to identify whether a subject's preferences over redistribution are affected by the payoffs of her

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[1] Hence, this paper abstracts from the effect of prototypical or prescribed behavior associated with a given identity, a second important feature of social identity stressed by Akerlof and Kranton (2000).

[2] See Tajfel et al. (1971), Brewer (1979) and Bourhis and Gagnon (2001). In these experiments, individuals are assigned to one of two groups. Each individual then chooses an allocation of payoffs between two other randomly chosen subjects. The only information provided about these subjects is their group affiliation. Despite the very weak treatment, individuals systematically favor their ingroup member.

[3] For public goods experiments see, e.g., Brewer and Kramer (1986), Orbell et al. (1988), Eckel and Grossman (2005) and Ruffle and Sosis (2006). For other strategic games see Bernhard et al. (2006), Charness et al. (2007), Chen and Li (2008), Fowler and Kam (2007), and Goette et al. (2006).

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ingroup members. In the main treatment, subjects are divided into two weak natural groups based on their field of studies. They are randomly assigned gross incomes, and are informed of their own income, the overall mean income and the mean income of each group. Subjects then vote anonymously over a redistributive scheme consisting of a linear tax and a lump sum transfer. Taxes do not introduce distortions; that is, overall payoffs are unaffected by the chosen tax scheme. The tax is chosen by majority rule and applied to the entire population in the two groups combined. This procedure is repeated 40 times, without feedback between rounds, and without any interaction between subjects.

The income distributions are designed to allow us to classify deviations from self-interest into two distinct categories: inequality aversion and group identification. Specifically, inequality averse subjects exhibit a bias towards high redistribution regardless of their ingroup's income. In contrast, social identifiers exhibit a bias towards the tax rate that benefits their ingroup.

Our main finding is that group identification significantly affects preferences over redistribution. Over a third of the subjects systematically deviate from monetary payoff maximization towards the tax rate that benefits the average member of their group. That is, they tend to vote for high levels of redistribution when their group is relatively poor − even if they themselves are relatively rich. Further, and in contrast to the behavior expected under inequality aversion, these subjects also vote for low levels of redistribution when their group is relatively rich − even if they themselves are relatively poor. This pattern of behavior is especially striking since all voting decisions are not observed by any of the other subjects, and groups' prototypical behavior is unknown as well.

Although social identifiers are willing to forego monetary payoffs to support their group, their decision is affected by their economic self interest. That is, subjects respond systematically to the costs associated with supporting their ingroup. We find that, among the identifiers, the probability of supporting the ingroup tax rate decreases by 8 percentage points with a unit increase in the monetary cost to the subject divided by the average benefits to ingroup members. Remarkably, the probability of supporting one's group is higher when the social identifiers belong to a rich group than to a poor group.

Beyond studies of voting over redistribution and studies of social identity, the present paper also relates to the growing literature on social preferences. This literature attempts to develop models that accurately and parsimoniously capture individuals' preferences over other individuals' payoffs. These models include, most prominently, inequality aversion (Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000), competitive preferences (Boskin and Sheshinski, 1978; Bolton, 1991), various forms of altruism and Rawlsian preferences (Charness and Rabin, 2002), warm glow (Andreoni, 1989), and reciprocity (Rabin, 1993; Fehr and Gächter, 2000).[4] This paper attempts to expand our understanding of social preferences by disentangling the effect of group membership from the motives listed above in a political economy framework.

The paper is organized as follows. The next section presents the theoretical framework implemented in the experiment. Section 3 describes our experimental design. The main results appear in Section 4. Section 5 relates the behavior observed in the lab to survey evidence on the relation between income and preferences over redistribution. Section 6 concludes. Appendix A contains the proof to the theoretical claim. The instructions of the experiment are available on the online appendix.

2. Theoretical framework

The experiment is designed to isolate and examine one specific component of a general model of social identity in a political economy context. The general model studies both the endogenous determination of groups people end up identifying with, and the behavior of each individual given the groups he or she identifies with (Shayo, 2009). The present study focuses on this last component. Therefore, it does not examine equilibrium behavior. In our experiment, subjects are exogenously assigned to groups, leaving the endogenous determination of group identification out of the analysis.

We define identification with a group to mean caring about the status of that group. In our setting, an important determinant of group status is monetary payoff. Thus, the status of a social group can be thought of in terms similar to standard definitions of individual status (Boskin and Sheshinski, 1978; Clark and Oswald, 1998). To be more precise, let $\mathcal{N}$ be a set of individuals, $\mathcal{A}_i$ a set of available *actions* for each individual $i \in \mathcal{N}$, and $\pi_i : \times_{i \in \mathcal{N}} \mathcal{A}_i \rightarrow \mathbb{R}$ the individual's *monetary payoff*. In the present study we take the set of social groups as given. The status of a group $j \subseteq \mathcal{N}$ is represented by a function

$$S_j(a) = S_j(\overline{\pi}_j(a), \overline{\pi}_{-j}(a)), \tag{2.1}$$

where $\overline{\pi}_j$ is the mean monetary payoff of individuals that belong to group j (the ingroup) and $-j$ is the reference-group of group j, which in our two-group setting is simply the other group (the outgroup). We assume that the status of group j is strictly increasing in $\overline{\pi}_j$ and is decreasing in $\overline{\pi}_{-j}$.[5]

Given Eq. (2.1) identification with a group implies caring about the monetary payoffs of the other ingroup members. Although the above definition of identification allows for a more general utility function, in what follows we assume that the utility function of an individual i that identifies with group j is additively separable in monetary payoffs and group status; namely,

$$U_i(a) = u(\pi_i(a)) + v(S_j(a)), \tag{2.2}$$

where u and v are both strictly increasing functions and u is weakly concave.

2.1. Implications for voting over redistribution

We now embed the social identity framework outlined above into a standard political setting of income redistribution. Consider a population of individuals where each individual i has an exogenous pre-tax income of y_i. The population is partitioned into two social groups, P and R. Assume that the mean income in group P, denoted y_P, is lower than y_R, the mean income in group R. Individual i's monetary payoff is just her after-tax income, which is composed of income net of taxes and a transfer payment financed by the tax revenues. That is, monetary payoffs are given by

$$\pi_i(\tau) = (1-\tau)y_i + \tau y, \tag{2.3}$$

where $\tau \in [0, 1]$ is the tax rate and y is the mean income.[6] We refer to individuals with income above the mean income as "rich" and to those with income below the mean income as "poor."

The tax rate is chosen directly by the individuals. Individuals vote over two proposed tax rates, τ^h and τ^l, with $\tau^h > \tau^l$. The winner is decided by majority rule (ties are broken by an equal probability rule).

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[4] Recently, Fudenberg and Pathak (2009) have also shown that social preferences may explain punishment in public goods experiments better than an instrumental explanation.

[5] We allow the status function to be constant in $\overline{\pi}_{-j}$. In this case group j's status depends on the ingroup's mean absolute, rather than relative, payoff.

[6] The profile of actions affect monetary payoffs only through the chosen tax rate. Hence we write π_i directly as a function of τ.
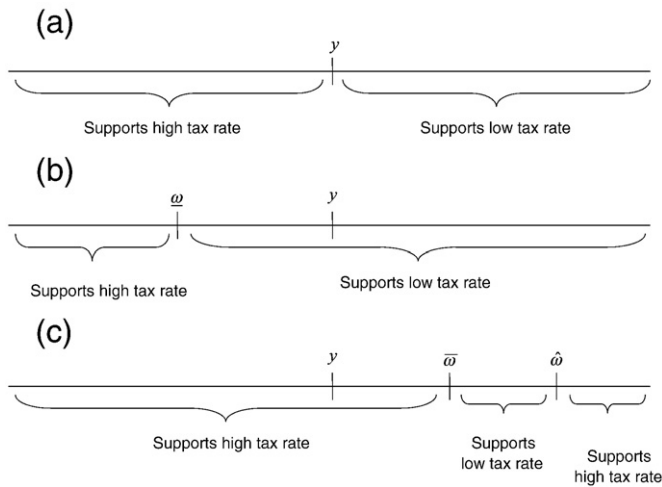
Fig. 1. Implications of identification for voting behavior. a. A monetary payoff maximizer. b. An individual that identifies with a rich group. c. An individual that identifies with a poor group.

Thus an action for individual i is a vote from $\mathcal{A}_i$, where $\mathcal{A}_i = \{\tau^h, \tau^l\}$ for all i. The implications of social identification, depicted in Fig. 1, are as follows.

Claim. *Assume that individuals do not play weakly dominated strategies. Then:*

1. *An individual who maximizes her own monetary payoffs votes for the high tax rate if her income is below the mean income ($y_i < y$) ; and votes for the low tax rate if her income is above the mean income ($y_i > y$).*
2. *An individual who identifies with the rich group votes for the high tax rate if her income is below a threshold level $\underline{\omega} < y$, and for the low tax rate if her income is above $\underline{\omega}$.*
3. *An individual who identifies with the poor group votes for the high tax rate if her income is below a threshold level $\overline{\omega} > y$. If the utility function is sufficiently concave in the individual's monetary payoffs, there exists a threshold level $\hat{\omega}$ (where $\hat{\omega} > \overline{\omega}$) such that individuals with incomes between $\overline{\omega}$ and $\hat{\omega}$ vote for the low tax rate, whereas individuals with incomes above $\hat{\omega}$ support the high tax rate. If u is not concave enough, all the individuals with income above $\overline{\omega}$ support the low tax rate.*

Proof. See Appendix A.

The basic intuition behind this claim is simple. Assuming that individuals do not play weakly dominated strategies, sheer economic interests should lead rich individuals to support a low tax rate and poor individuals to support a high tax rate (panel (a) in Fig. 1). This is, indeed, the standard approach of positive models of income redistribution.[7]

Strategies become more subtle once we allow for group identification. According to the second part of the claim, an individual identifying with the relatively rich group is expected to vote for the low tax rate even if her income is below the mean, as long as the difference between her income and the mean income is not too high (panel (b) in Fig. 1). Similarly, the third part states that individuals identifying with the poor group may vote for the high tax rate even if

their income is above the mean income. Furthermore, if the marginal utility of income decreases fast enough, then an individual identifying with the poor group votes for the high tax rate even if her income is very high (Fig. 1, panel (c)). That is, her marginal utility from an increase of the poor group's status is higher than her marginal utility from an increase in her own monetary payoffs.

Note that preferences for a more equal distribution of net income or a Rawlsian concern for the poor may also generate support for a high tax rate among relatively rich individuals. However, such preferences cannot account for poor individuals' support for a low tax rate when redistribution does not generate deadweight losses.

3. Experimental design

The experiment is designed to examine whether, and to what extent, subjects are influenced by their group membership when choosing a redistribution scheme. In particular, to what extent are individuals willing to vote against their own economic interest in order to enhance their ingroup's standing, even when they do not have any information about the typical (or prescribed) behavior in their group, and when their action is never observed by other individuals.[8]

The experiment was conducted at a computer lab at The Hebrew University of Jerusalem. The 180 subjects in this experiment were recruited from the pool of undergraduate students that belong to either the Faculty of Social Sciences or the Faculty of Humanities and had no previous experience in experiments related to redistribution.

Each subject was seated at a cubicle in front of a computer screen and was given written instructions. An administrator read the instructions aloud before the experiment started to make sure the rules of the experiment were public information. Subjects were also asked several hypothetical questions at the end of the instructions to verify their comprehension of the procedure (the instructions and questions are available in an online appendix). A session lasted about an hour. Payoffs were denominated in "Francs," which were converted to New Israeli Shekels (NIS) at the rate of 40 Francs per one NIS at the end of the session. Average earnings were equal to NIS 67 (slightly over $15 USD at the time) and were distributed privately and in cash.[9]

Eighteen subjects participated in each session. We ran seven sessions using a *group treatment* and three sessions as a *control treatment*. We first describe the group treatment. For each session we recruited nine subjects whose major field of study was from the Faculty of Social Sciences and nine subjects whose major was from the Faculty of Humanities.[10] Subjects were accordingly divided into two equal groups and were informed about the existence of groups, the size of the groups, and their group affiliation. Naturally, subjects maintained their group affiliation throughout the entire session.[11]

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[7] In the simplest version of this model individuals' income is exogenously determined (Hamada, 1973). Later analyses emphasize that individuals' income is a function of their ability and the chosen redistribution scheme (Romer, 1975; Roberts, 1977; Meltzer and Richard, 1981). The main message remains unchanged as individuals with higher ability prefer lower tax rates.

[8] See Akerlof and Kranton (2000) and Shayo (2009) for reviews on conformity to group norms; and Andreoni and Bernheim (2009) on social image motivation.

[9] The hourly minimum wage in Israel at the time was slightly below NIS 20. Thus, subjects on average earned more than 3 times the minimum wage.

[10] Students at The Hebrew University can choose to have a double major. For the group treatment we did not recruit any student who had one field of studies from the social sciences and the second field of studies from the humanities.

[11] Subjects were not informed of the exact affiliation of other subjects. In fact, every effort was made to minimize the extent to which participants in a given session knew each other. We did not allow participants to sign up together for a specific session and, from the pool of over three thousands students who had signed up to participate in experiments, we allowed no more than two participants from the same year and major. Throughout the experiment we ensured anonymity and effectively isolated each subject in a cubicle to minimize any undesired interpersonal influence. The allocation of subjects to cubicles was independent of subjects' field of study. Communication between subjects was not allowed throughout the session. Subjects' anonymity was guaranteed so that neither the other subjects nor the researchers knew the ingroup of any particular subject or her action in a given round.

Each session consists of 40 rounds. At the beginning of each round a chance move determines each group's gross income distribution and then each subject's income for the current round. The possible distributions – denoted x_1, x_2, z_1, z_2 – are presented in Table 1. In half the rounds one group draws x_1 and the other group draws x_2, and in the other half they draw z_1 and z_2. The design is such that each group draws each of the four distributions ten times. The exact timing of the assignment is randomly determined. After a distribution is assigned to a group, the nine gross incomes are randomly assigned to the nine group members. Subjects are not informed of the exact distributions of gross income or of the way they are chosen. They only know that after their group's total gross income has been chosen, their individual gross income is randomly chosen, and varies between 10 and 150 Francs. At the beginning of each round each subject is informed of her own gross income, the mean gross income of each group and the overall mean gross income.

After receiving this information subjects choose between two redistribution schemes. These schemes consist of a proportional tax rate on the income of every subject, with the resulting revenue distributed equally between all subjects. The two proposed tax rates are 20% and 40%. The implemented tax is decided by majority rule, with ties broken by an equal probability rule.

After the elections all subjects are notified of the end of the round and of the beginning of a new round. We do not provide the subjects with any feedback whatsoever regarding the outcome of the current or of previous rounds. Subjects learn of the elections' outcomes and their resulting payoffs for each of the rounds only at the end of the experiment. Subjects were informed of this feature of the experimental design at the beginning of the session.

After completing all the rounds and before learning the results of each round, each subject completes a questionnaire that includes basic demographics as well as questions on attitudes to redistribution taken from the General Social Survey (GSS) and the World Values Survey (WVS). The questionnaire also includes several questions to gauge the subject's identification with her ingroup. The questionnaire appears in Table 3. After each subject completes the questionnaire she is informed of her gross income, the chosen tax rate and her net income for every single round.

The control treatment follows exactly the same recruiting and protocol except for the following differences. Subjects are randomly assigned to two groups of nine subjects each, but are not informed of the existence of groups. Thus, they do not know they were assigned to a group and only receive information on the overall average gross income at the beginning of each round. We omit from their questionnaire questions related to social identity.

Table 1
Gross income distributions.

	x_1	x_2	z_1	z_2
1	10	**20**	10	**20**
2	20	**30**	20	**30**
3	30	**40**	20	**40**
4	40	**50**	20	**50**
5	50	80	20	110
6	**80**	90	**80**	110
7	**90**	100	**90**	110
8	**100**	110	**100**	110
9	**110**	150	**110**	150
Group Mean	58.9	74.4	52.2	81.1
Overall Mean		66.7		66.7

Note: Treatments with a conflict between own and group monetary payoff appear in boldface. In the control treatment, subjects are only informed of their own gross income, the support of the overall distribution, and the overall mean gross income. In the group treatment, subjects are additionally informed of the groups' gross mean incomes.

3.1. Discussion

The chosen design allows us to closely examine the effect of group membership on voting patterns. The main treatment divides the subjects into (very weak) natural groups instead of creating artificial ones to ensure that groups have some meaning outside of the laboratory. This does not imply that social identity effects are not to be expected under artificial groups. However, using artificial groups may arguably create a situation where all socially meaningful bases for decision making have been removed. This may render inferences regarding the effects of group membership in real elections rather tenuous. By using natural groups we seek to avoid such a situation.[12]

Beyond comparing behavior in the group treatment to that in the absence of groups, we compare each subject's behavior when facing different environments. In every round of the group treatment, eight subjects face a conflict between monetary payoffs maximization and maximizing ingroup status: There are four poor subjects whose ingroup is rich, and four rich subjects whose ingroup is poor. We exploit these situations of conflict (shown in boldface in Table 1) to examine the existence of social identity effects.

The construction of the first two distributions (x_1 and x_2) is guided by three major considerations. First, we want to examine the behavior of a subject with a given income level in situations when the relative mean income of her ingroup changes. This allows us to keep her own monetary incentives constant while changing only the incentives regarding group status.[13] Therefore, except for the highest and lowest income levels, all possible income levels appear in both distributions. Second, we want to distinguish deviations from monetary payoff maximization induced by social-identity from deviations induced by preferences for income equality (Loewenstein et al., 1989; Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000). Although a preference for equality may drive a rich subject in a poor group to vote for a high tax rate, this type of preference cannot account for poor subjects in a rich group supporting a low tax rate. Finally, we want to observe the subjects' decisions under a sufficiently rich support of incomes to examine the trade-off between monetary payoff maximization and social-identity concerns. That is, even if subjects with incomes below the mean do vote for a low tax rate when they identify with the rich group, we want to quantify the amount of money that an individual is willing to forego in order to promote her ingroup's status.

The income distributions z_1 and z_2 maintain the main attributes of the distributions x_1 and x_2, varying only the difference between the mean incomes of the two groups. As it turned out, there was no meaningful difference in behavior under the x and z distributions. Hence the next section reports results combining both distributions.

A final comment relates to the information supplied to subjects. Recall that subjects do not receive any feedback until the end of the experiment. Hence, the subjects decide simultaneously on a set of forty votes. This suppresses repeated games effects (Costa-Gomes and Crawford, 2006), and is crucial for identifying behavior consistent with caring about ingroup status. For example, information on the outcomes of previous rounds may induce subjects to vote according to their narrow pecuniary interests if others did that in the past, due to conformity to the group. Finally, the design does not allow for collusive behavior or reciprocity effects. Therefore, the design provides 40 observations on each subject that allow us to focus on how a given individual responds to exogenous variations in her own and her ingroup's income.[14]

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[12] Our analysis does not assume that the two groups are similar. Hence there is little gain from randomly assigning subjects to groups.

[13] Note that by keeping the overall mean income constant we abstract from efficiency considerations. See Charness and Rabin (2002) for a study showing the effects of these considerations.

[14] It should be noted that we find little evidence for the existence of order effects. Specifically, initial conditions (subject's income, and/or subject's ingroup income, in the first round) are not significantly associated with the subjects' subsequent behavior.
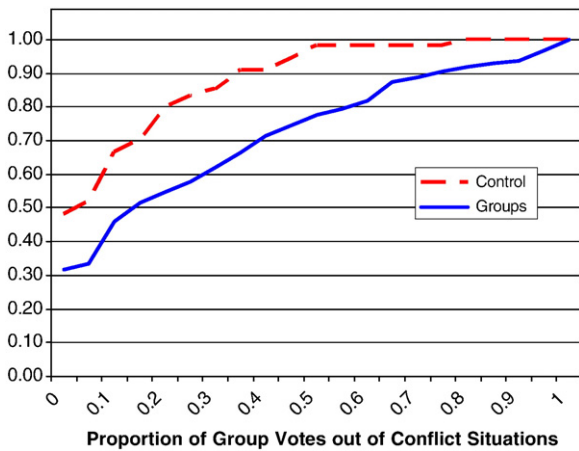
Fig. 2. Cumulative distribution of group votes out of conflict situations. Notes: There are 126 subjects in the group treatment and 54 subjects in the control treatment. The number of situations of conflict per subject varies from 10 to 26; its median is 18.

Fig. 3. Propensity to vote for the high tax rate (all subjects in group treatment). Notes: For each subject we compute the proportion of votes for a high tax rate separately for each income and the subject's ingroup's relative income. The figures depict the mean across subjects at each income level. Capped ranges indicate 95% confidence intervals. Data are from the group treatment only.

4. Results

This section presents the main experimental results. We first provide a glimpse of the subjects' behavior when facing a trade-off between social-identity concerns and their own monetary payoff. We then exploit the rich set of choices made by each subject to classify subjects into three categories: monetary payoff maximizers (MPM), social identifiers (SI), and inequality averse (IA). At the end of this section we closely examine the behavior of SIs vis-à-vis MPMs, and quantify the impact of monetary costs on the likelihood of supporting one's ingroup.

Recall that a subject faces a situation of conflict whenever the relative income of the subject is opposed to the relative income of her ingroup. For each subject we compute the proportion of votes in support of her ingroup out of her total votes in situations of conflict. Of course, subjects in the control treatment are unaware of the existence of groups (and thus of the existence of a conflict). Nevertheless, we compute for these subjects the proportion of votes in support of their ingroup as a benchmark to which we can compare the behavior of subjects in the group treatment.

Fig. 2 depicts the cumulative distribution of this proportion separately for the group and the control treatments. The figure highlights several important patterns in the data. Consider first the behavior in the control treatment. Almost 50% of subjects in this treatment never deviate from monetary payoff maximization in these situations. As for the remainder of the subjects, the vast majority of them deviate from monetary payoff maximization less than 20% of the time, and practically all subjects in this treatment deviate less than 50% of the time.

Consider now the behavior in the group treatment. Again, a sizable amount of subjects never vote in support of their ingroup at the expense of their own monetary payoffs. This is not for lack of opportunities since, on average, each of these subjects faced slightly over 18 situations of conflict. The proportion of such subjects is, however, substantially lower than in the control treatment.[15]

Another interesting pattern that emerges from the figure is the heterogeneity of the subjects' behavior in the group treatment. Once we focus on subjects that supported their group at least 15% of the
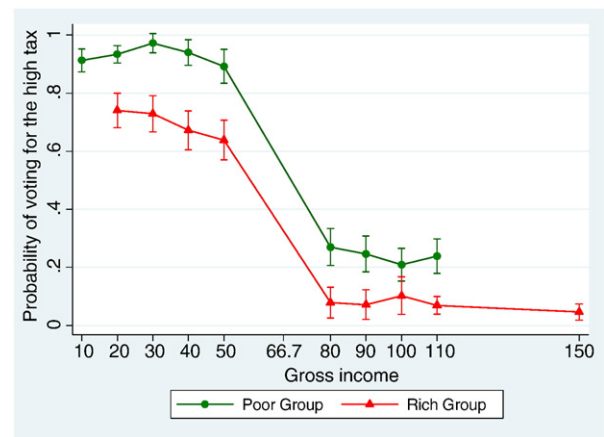
time (61 subjects), the distribution is close to uniform, with subjects spanning the entire range. This is reflected in the close to linear shape of the cumulative distribution function for the group treatment. Thirty one subjects supported their ingroup at least 50% of the time, and eleven subjects supported their ingroup at least 80% of the time.

Fig. 3 takes a closer look at the group treatment, differentiating the subjects according to the relative income of their ingroup. The figure shows the mean proportion of votes for the high tax rate (with the associated 95% confidence intervals) by the subjects' gross income.[16]

Fig. 3 suggests that group identification significantly affects subjects' voting behavior. Consider first the behavior of poor subjects (gross income less than 67 Francs). Taken together, poor subjects have a significantly lower propensity to support a high tax rate when their group is rich, compared to when it is poor. The difference is not only statistically significant for every income level but also of a sizeable magnitude, ranging from 19 to 27 percentage points.[17] That is, poor subjects show a striking willingness to sacrifice their own monetary payoffs to increase their ingroup's average payoffs. This behavior is inconsistent with inequality aversion.

The behavior of subjects when their income is above the mean also indicates a possible concern for ingroup payoffs. That is, rich subjects in a rich group vote overwhelmingly for the low tax. When they belong to a poor group, however, the likelihood that rich subjects vote for the high tax increases significantly.[18]

Looking at mean behavior is important, but it can mask substantial differences in individual responses to the economic environment. As

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[15] A Kolmogorov-Smirnov test confirms that the distributions are different across groups, with the control treatment containing smaller percentages of group votes than the group treatment (*p*-value = 0.006).

[16] To construct this figure we compute, for each subject and each income level, the proportion of votes for a high tax across all the different rounds. We then compute the mean (and confidence interval) across subjects at that income level. This eliminates any effects due to possible correlations across repeated observations within a given subject. To avoid unnecessary clutter, Fig. 3 does not display subjects in the control treatment. Behavior in this treatment does not differ by group income.

[17] Equality of means across group-incomes is rejected at the 1% level for all income levels from 20 to 110, except for 100 Francs where it is rejected at 2%. Mann-Whitney tests reject equality of behavior at 1% level for all income levels.

[18] Note that rich individuals supporting a high tax rate when their ingroup is relatively poor may also be consistent with group specific inequality aversion. However, group specific inequality aversion cannot account for poor individuals supporting a low tax rate when their group is rich.

we have seen in Fig. 2, subjects display considerable heterogeneity in whether or not they support their group. Some of this heterogeneity may be a consequence of subjects' different preferences. Some of it, however, may be due to the different monetary costs of voting for one's ingroup. We explore these two possibilities in turn.

4.1. Classifying subjects into preference-types

As suggested by the behavior in the control treatment, the deviations from monetary payoff maximization depicted in Fig. 2 may not necessarily reflect a preference for higher ingroup payoffs. These deviations may well stem from other factors such as plain errors or inequality aversion. We now propose an algorithm to classify each subject into one of three categories: monetary payoff maximizer, inequality averse or social identifier.

Consider the following econometric model, applied *separately* to each subject:

$$E[(vote\ low)_{it} | y_{it}, y_{jt}] = \beta_1 (rich)_{it} + \beta_2 (rich\ group)_{it} \qquad (4.1)$$
$$+ \beta_3 (rich * rich\ group)_{it}$$

where $(vote\ low)_{it}$ equals one if subject i voted for the low tax rate in round t and zero otherwise; $(rich)_{it}$ equals one if i's income in round t was above the mean income $(y_{it} > y_t)$ and zero otherwise; and $(rich\ group)_{it}$ equals one if the mean income of i's group in round t was above the mean income $(y_{jt} > y_t)$.

Consider now the behavior of a subject that always chooses to maximize her monetary payoff. Assuming that subjects do not play weakly dominated strategies, an MPM votes for a low tax in round t if and only if $y_{it} > y_t$, independently of her ingroup's relative income. Thus, for an MPM, $E[(vote\ low)_{it} | y_{it}, y_{jt}] = rich_{it}$. It follows that a subject can be classified as a monetary payoff maximizer whenever the conditions $\beta_1 = 1$ and $\beta_2 = \beta_3 = 0$ are jointly satisfied.

Consider next a subject that has a preference for income equality. An inequality averse subject never supports the low tax rate when $y_i < y$, but may vote for the high tax rate when $y_i > y$. That is, for an IA, $E[(vote\ low)_{it} | y_{it}, y_{jt}] = \beta_1 rich_{it}$, where $1 - \beta_1 > 0$ represents the probability that the subject votes for a high tax rate when $y_{it} > y_t$. This gives us the parameter restrictions $\beta_1 < 1$ and $\beta_2 = \beta_3 = 0$. Note that, similar to an MPM, the decisions of an IA are independent of her group's relative income.

Finally, a subject that identifies with group j always votes for the low tax rate whenever $y_i > y$ and $y_j > y$ (thus $\beta_1 + \beta_2 + \beta_3 = 1$). Similarly, this subject never votes for the low tax rate when $y_i < y$ and $y_j < y$. As established in the Claim above, an SI sometimes supports a low tax even when $y_i < y$ provided that $y_j > y$. The necessary conditions for a subject to be an SI in terms of model (4.1) are thus, $\beta_1 < 1$, $\beta_2 > 0$ and $\beta_1 + \beta_2 + \beta_3 = 1$, where $1 - \beta_1 > 0$ is the probability of voting for the high tax when the subject is rich and her group is poor; and β_2 is the probability of voting for the low tax when the subject is poor and her group is rich.

This suggests that we can classify a subject as an MPM, an IA or an SI by estimating model (4.1) separately for each individual and then applying the following procedure:

1. We start with the null hypothesis that the subject is an MPM; that is, a subject is classified as an MPM whenever the joint hypothesis H_0: $\beta_1 = 1$ and $\beta_2 = \beta_3 = 0$ cannot be rejected at the 95% confidence level.
2. If H_0 is rejected, we test the joint hypothesis H_1: $\beta_1 < 1$ and $\beta_2 = \beta_3 = 0$. If this hypothesis is not rejected at the 95% confidence level we classify the subject as an IA.
3. If H_0 and H_1 are rejected, we test hypothesis H_2: $\beta_1 < 1$, $\beta_2 > 0$ and $\beta_3 = 1 - \beta_1 - \beta_2$. If this hypothesis is not rejected at the 95% confidence level we conclude that the subject is an SI.
4. If H_0, H_1 and H_2 are rejected we conclude that the subject cannot be classified in any of these three categories.

We apply this procedure using OLS with robust standard errors.[19] The resulting classification of the subjects between the three categories is as follows (percentage of total appears in parenthesis).[20]

Classification of subjects

	Group treatment	Control treatment
Monetary Payoff Maximizer (MPM)	70(55.6%)	43(79.6%)
Inequality Averse (IA)	8(6.3%)	6(11.1%)
Social Identifier (SI)	42(33.3%)	1(1.9%)
None	6(4.8%)	4(7.4%)
Total	126	54

The resulting classification of subjects into three preference-types is striking for several reasons. In the control treatment, where subjects are asked to choose a tax policy knowing nothing about the characteristics of its beneficiaries, the overwhelming majority behave as MPMs. This is consistent with previous experimental results on voting over redistribution (Rutström and Williams, 2000; Esarey et al., 2007). Although several subjects do show a consistent concern for the welfare of the relatively poor, their proportion is rather low compared to related studies (Tyran and Sausgruber, 2006). Finally, one subject is classified as an SI even though she is unaware of the existence of groups.

The picture is dramatically different in the group treatment. We observe a significant decrease in the proportion of MPMs. Remarkably, this proportion is very similar to that found in Andreoni and Miller (2002), who classified 47.2% of the subjects as selfish in a dictator game experiment. Subjects that are not MPM are often classified as efficiency maximizers or inequality averse (Charness and Rabin, 2002; Tyran and Sausgruber, 2006). In contrast to previous studies, our design allows subjects to deviate from both selfishness and inequality aversion, without introducing efficiency considerations. As a result the classification reveals a very low percentage of IAs and a significantly larger proportion of subjects that support their ingroup, even when this causes greater inequality.

As expected, subjects' behavior varies significantly according to preference-type. Fig. 4 reproduces the analysis of Fig. 3 but differentiates the subjects according to their type.[21]

The figure corroborates that the procedure used to classify subjects into different types, while somewhat arbitrary, delivers a sensible classification. For MPMs it makes virtually no difference whether their group is rich or poor: they almost always vote for the high tax rate when their income is below the mean, and for the low tax rate otherwise.[22] For SIs, on the contrary, the ingroup's income has a large effect. Whereas poor SIs in a poor group support the high tax rate over 90% of the time on average, poor SIs in a rich group support the high tax less than 30% of the time.[23] Similarly, rich SIs in a rich group vote overwhelmingly for the low tax, whereas rich SIs in a poor group are

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[19] We repeated the estimation of Eq. (4.1) using Feasible Generalized Least Squares (FGLS) to adjust for heteroskedasticity of the standard errors. The estimation based on FGLS produced the exact same classification of the subjects as the one based on robust standard errors. The results of these estimations and the subsequent classification of the subjects can be obtained from the authors upon request.

[20] The sequence of the tests above is the most conservative in terms of the number of subjects classified as SIs. If we start out with H_2 as the null hypothesis, we obtain that 47 subjects (rather than 42) in the group treatment are classified as SIs. The difference is caused by 5 subjects for whom we cannot reject either H_0 or H_2 at the 95% confidence level.

[21] Behavior of MPMs in the control treatment is basically the same as that of MPMs in the group treatment.

[22] The average proportion of votes for the high tax among poor MPMs is above 97% when in the poor group and slightly below 95% when in the rich group. Mann-Whitney tests cannot reject equal behavior of MPMs in the rich group and in the poor group for any income at a significance level of 10 percent.

[23] The proportion of poor SIs in a rich group voting for a low tax rate is highly statistically different from the proportion observed for poor SIs in a poor group for any income level. The confidence intervals do not overlap and equality of behavior is also rejected by Mann-Whitney tests with p-value <0.001 for any income level.
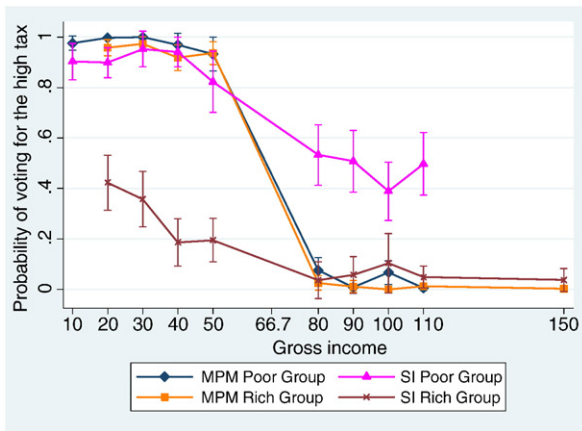
Fig. 4. Propensity to vote for the high tax rate by preference type. Notes: For each subject we compute the proportion of votes for a high tax rate separately for each income and the subject's ingroup's relative income. The figures depict the mean across subjects at each income level. Capped ranges indicate 95% confidence intervals. Data are from the group treatment only.

equally likely to vote for the low tax as for the high tax.[24] Notably, MPMs are not the only ones to show little concern for equality of payoffs. Rich SIs behave similarly when their group is rich.

4.2. Do social identifiers respond to monetary costs?

In a situation of conflict the cost of supporting the tax that benefits the ingroup increases with the difference between the subject's income and the mean income. Although SIs sacrifice money for their group, Fig. 4 suggests that these subjects do take into account the associated cost. That is, an increase in the cost of supporting the ingroup seems to cause a decrease in the proportion of subjects that choose to do so.

To analyze the trade-off between own monetary payoffs and group status among SIs we need to quantify the cost of voting for one's group. The subject's cost of supporting the tax that benefits her ingroup is zero if she is not in a situation of conflict. Consider now a situation of conflict. When the tax that benefits the subject's ingroup is adopted, her monetary loss is $0.2|y_i - y|$; that is, the difference between the two tax rates times the difference between the subject's income and the mean income. When the subject is pivotal, by voting for the tax that benefits her ingroup she increases the probability that this tax is adopted by 50%. Thus, if p is the probability that the individual is pivotal, then the expected cost of siding with one's ingroup is:

$$cost = \begin{cases} p*0.5*0.2|y_i - y|, & \text{if in conflict} \\ 0, & \text{otherwise}. \end{cases} \quad (4.2)$$

At the same time, the expected benefit to the average member of group j from the subject's siding with that group is:

$$benefit = p*0.5*0.2|y_j - y| \quad (4.3)$$

regardless of whether or not i is in a situation of conflict.

The analysis below examines how the ratio of expected cost to expected benefit affects the behavior of SIs. A convenient feature of this cost/benefit measure is that the term measuring the probability of being pivotal cancels out. The cost/benefit measure ranges from 0 to 6.03 for subjects in the rich group and from 0 to 5.54 in the poor group.

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[24] The behavior of rich SIs in a poor group is highly statistically different from the behavior of rich SIs in a rich group for any given income level (Mann-Whitney, *p*-value <0.001).

Table 2
Support for ingroup among social identifiers (random effects probit estimates).

Variable	(1)	(2)	(3)
(Cost/Benefit) of Voting for Ingroup	− 0.301***	− 0.751***	− 0.592***
	[0.021]	[0.062]	[0.091]
(Cost/Benefit)^2		0.090***	0.055***
		[0.012]	[0.016]
Poor Ingroup			− 0.400***
			[0.132]
(Poor Ingroup)*(Cost/Benefit)			− 0.399***
			[0.129]
(Poor Ingroup)*(Cost/Benefit)^2			0.083***
			[0.024]
Constant	1.348***	1.558***	1.833***
	[0.111]	[0.116]	[0.149]
Log Likelihood	− 759.3	− 728.5	− 696.2

Notes: The dependent variable is the probability of voting in support of the ingroup. The sample consists only of subjects classified as Social Identifiers and has 1680 observations. Standard errors in parentheses. *** indicates statistically significant at 1% level.

Table 2 presents the results of the estimation of a random effects probit model for SIs.[25] The dependent variable is whether or not subject i voted for the tax that benefits the average member of her ingroup. The main explanatory variable is the cost/benefit ratio of supporting that tax.

The first column shows that overall, the effect of costs on the probability that SIs vote for their ingroup is negative, large and highly statistically significant. The implied probability of supporting the ingroup tax rate for the average subject decreases by 8 percentage points for an increase of one unit in the cost to benefit ratio of doing so. Column 2 adds to the model the square of the cost to benefit ratio to assess possible nonlinearities. The results suggest that indeed the subjects' propensity to support their ingroup is better represented by a decreasing convex function.

Column 3 examines whether the subjects' behavior differs systematically when their ingroup is poor or rich. To that effect we introduce a dummy variable equal to one when the ingroup is poor, fully interacted with the cost variables. Interestingly, the subjects' behavior is qualitatively different in a rich or a poor ingroup. This difference is illustrated in Fig. 5.

The figure presents the predicted probabilities (for SIs) of supporting the ingroup's tax rate as functions of the cost/benefit ratio, for rich and poor ingroups separately, based on the estimates in Column (3). Accordingly, the probability that SIs support their ingroup is significantly higher when that group is rich than when it is poor at any given cost/benefit ratio, even though supporting a rich group increases income inequality. We conjecture that this behavior could be a consequence of subjects attaching a higher status to rich groups, which tends to increase identification (Shayo, 2009). Finally, we observe that the probability of supporting the ingroup decreases almost linearly for rich groups but is a convex function of cost for poor groups.

5. Relating behavior in the lab to survey evidence

This section examines whether the classification of subjects into preference types can enhance our understanding of the low correlation between preferences over redistributive policies and income observed in numerous surveys (Blinder and Krueger, 2004; Fong, 2001). Specifically, is it the case that the observed low correlation is due to the lumping together of individuals who care primarily about their own economic interests (MPMs) with individuals who care about other issues, for example the wellbeing of their

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[25] A linear probability model with fixed effects yields very similar results.
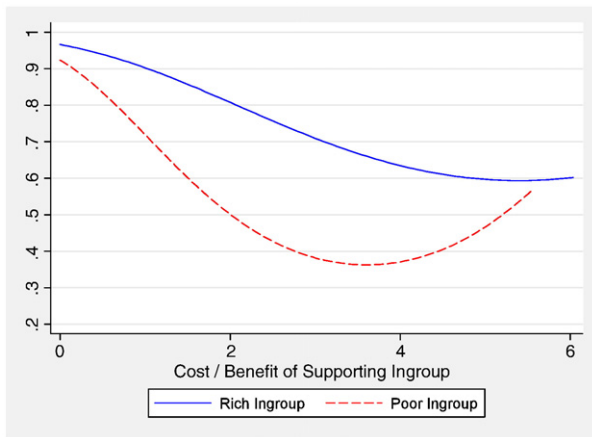
Fig. 5. Predicted probability of supporting the ingroup. Note: Predicted probabilities from the random effects probit model in Table 2, estimated for Social Identifiers.

groups? We address this issue using answers to the questionnaire administered at the end of each session.

Table 3 depicts mean responses to the questionnaire by subjects in both treatments and separately for SIs and MPMs in the group treatment. Consistent with other studies, we observe the well known "economist effect" whereby subjects studying economics and/or business administration are significantly more likely to exhibit selfish behavior (Marwell and Ames, 1981; Frank et al., 1993). We do not find a significant direct relationship between the subjects' revealed preferences and their reported income. On the other hand, social identifiers convey greater concern over income inequality and express a somewhat higher willingness to help the poor (though not statistically significant at conventional levels).

The answers to the questions measuring social identification show that, as expected, SIs report a heightened awareness of their group membership and feel more emotionally involved with their group than MPMs. Interestingly, social identification as revealed by costly actions is, if anything, most closely correlated with answers to item 2: "When someone criticizes [own faculty] it feels like a personal insult" followed by item 4: "I am proud to be a student in [own faculty]" (Spearman's $\rho = 0.08$ for both). It is not meaningfully associated with answers to item 5: "I am similar to other students of [own faculty]" ($\rho = -0.009$). This is consistent with Ellemers et al. (1999), who show that (costless) ingroup favoritism in allocation decisions is captured by questions on "commitment to the group" and not by mere self-categorization statements such as "I am similar to other members of my group". This might be important for empirical work, where identification is often measured by questions of the self-categorization type.[26]

Table 4 presents the correlation between self-reported income and self-reported preferences for redistribution for subjects in the group treatment. Income is measured on a 5 point scale from Rich, through Middle-Class to Poor as done in the World Values Survey (WVS). Since our subjects are university students, we concentrate on reported parental income when subjects were in high school, rather than on current income.[27] We use two questions that measure

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[26] Indeed, in recent work on charitable giving to Hurricane Katrina victims, Fong and Luttmer (2009) find an important difference between the effect of subjective racial identification (measured by the question "How close do you feel to your ethnic or racial group?") and that of merely belonging to a racial group. Fong and Luttmer (2009) show that the objective race of the respondent is not significantly related to giving to a particular racial group, but that subjective racial identification is associated with significantly higher giving to victims from one's racial group.

[27] Given that most students work (if at all) in temporary jobs, this appears to be a better measure of the subjects' economic conditions. Results are qualitatively similar when using current income, but the correlations tend to be weaker.

Table 3
Subjects' characteristics by preference type.

	Group treatment			Control treatment
	SI	MPM	All	
Percent Male	0.333	0.486	0.413	0.333
Percent in Humanities	0.571	0.429	0.5	0.5
Percent studying Economics and/or Business	0.19***	0.471***	0.341	0.222
Parent income when in high school (1 = poor, 5 = rich)	3.143 (0.751)	3.057 (0.883)	3.056 (0.813)	3.278 (0.811)
Income today (1 = poor, 5 = rich)	2.929 (0.947)	2.886 (0.826)	2.849 (0.859)	3.037 (0.726)
Inequality				
1 = "Incomes in Israel should be more equal"	3.881*	4.543*	4.206	3.981
10 = "We need larger income differences as incentives for individual effort"	(2.452)	(2.250)	(2.347)	(2.023)
Helping the poor				
1 = "The government should do everything possible to improve the standard of living of all the poor in Israel"	3.048 (2.326)	3.529 (2.131)	3.373 (2.160)	3.444 (2.034)
10 = "improving the standard of living of the poor is not the government's responsibility: people should take care of themselves"				
Social Identification (1 = strongly disagree, 7 = strongly agree)				
1. Being a student of [own faculty] is an important part of my identity	4.143 (1.761)	3.829 (1.818)	4.040 (1.791)	
2. When someone criticizes [own faculty] it feels like a personal insult	3.167* (1.807)	2.629* (1.704)	2.968 (1.771)	
3. When I talk about students of [own faculty] I usually say 'we' rather than 'they'	3.976 (2.170)	3.786 (1.887)	3.968 (1.984)	
4. I am proud to be a student in [own faculty]	5.095 (1.590)	4.814 (1.467)	4.968 (1.486)	
5. I am similar to other students of [own faculty]	3.976 (1.774)	3.943 (1.453)	4 (1.565)	
6. I would rather be a student of [other faculty]	2.262 (1.251)	2.3 (1.366)	2.325 (1.361)	
Number of Subjects	42	70	126	54

Notes: Mean responses to questionnaire administered at the end of the experiment. Standard deviations are in parentheses. Inequality item adapted from the World Value Survey (WVS); Helping the poor item adapted from the General Social Survey; Social identification items 1–3 adapted from Roccas (2003); item 4 adapted from WVS, and items 5–6 adapted from Ellemers et al. (1999). * indicates difference between SI and MPM populations is statistically significant at 10% level by Mann-Whitney test. *** indicates difference between SI and MPM populations is statistically significant at 1% level by Mann-Whitney test.

preferences for redistribution. The first, adapted from the WVS, asks whether inequality in Israel should be reduced or increased. The second, adapted from the General Social Survey (GSS), asks whether the government should improve the standard of living of the poor in Israel. We then compare the results obtained from our sample of university students to those obtained from representative samples of the Israeli and American populations, using the WVS and the GSS.

Consider first the attitudes towards inequality, starting with Column 3. Overall, the correlation between the subjects' income and their stated preferences over inequality in our entire sample is 0.16. That is, higher income is associated with more acceptance of inequality. This value is remarkably similar to the correlation of 0.12 observed in the 2001 Israeli WVS, which consists of a representative sample of 1,161 respondents. A similar correlation is also observed in the American WVS. Consider now the same correlation when differentiating subjects by their revealed preference types. Remarkably, among MPMs the correlation is quite high, consistent with the suggestions of standard models of political economy: richer people tend to oppose redistribution more strongly. However, for those

Table 4
Correlation between income and self-reported preferences over redistribution.

	SI	MPM	All	WVS Israel — 2001	WVS/GSS USA — 1999/2000
	(1)	(2)	(3)	(4)	(5)
Inequality					
1 = "Incomes in Israel should be more equal"	− 0.070	0.283**	0.162*	0.120***	0.114***
10 = "We need larger income differences as incentives for individual effort"	[0.660]	[0.018]	[0.071]	[0.000]	[0.000]
Helping the poor:					
1 = "The government should do everything possible to improve the standard of living of all the poor in Israel"	− 0.102	0.146	0.047		0.132***
10 = "improving the standard of living of the poor is not the government's responsibility: people should take care of themselves"	[0.522]	[0.230]	[0.599]		[0.000]
Number of Observations	42	70	126	1161	WVS: 1174 GSS:1816

Notes: p-values in parentheses. Columns 1–3 report results for experimental subjects in the group treatment, using the parent income variable (1 = poor, 2 = lower middle class, 3 = middle class, 4 = upper middle class, 5 = rich). Column 4 reports results from the Israel World Values Survey using the same inequality question and respondent's social class (1 = lower class, 2 = lower middle class, 3 = middle class, 4 = upper middle class, 5 = upper class). Column 5 reports results for the inequality item from the USA 1999 World Value Survey, and for the helping the poor item from the GSS 2000, using a 4-valued social-class question (1 = lower class, 4 = upper class). * indicates statistically significant at 1% level; ** indicates statistically significant at 5% level; *** indicates statistically significant at 1% level.

subjects who exhibited social identification, the hypothesis that the correlation is zero cannot be rejected.[28,29]

Our results thus suggest that the well-documented low correlation between income and preferences over redistribution may partly be due to an aggregation effect. That is, it may be a consequence of there being a significant portion of the population that tends to vote according to group membership, rather than by own economic interests.

6. Conclusions

This paper developed an experimental design to study the effect of group membership on preferences over redistribution. The design explicitly ruled out other prominent explanations for deviations from simple selfish behavior, most notably collusion, efficiency concerns and reciprocity. Our study's results support the common view in the political science literature that social identification is an important force shaping voting behavior. A third of the subjects consistently deviated from both monetary payoff maximization and inequality aversion to support the average member of their ingroup. Given that the groups we used are extremely weak, it is not improbable that in real life situations individuals consistently forego personal gains for the wellbeing of their groups.

Importantly, social identifiers did not automatically support their ingroup in every situation. Rather, they tended to support their ingroup only when the cost of doing so was not too high. Finally, we found that among social identifiers, the correlation between their actual economic situation and their stated preferences for redistribution outside the laboratory is essentially zero. By contrast, the correlation among monetary payoff maximizers is positive and relatively high. This suggests that the low correlation between these two variables observed in many surveys may be partly due to the effects of social identity on some individuals' policy preferences.[30]

The design developed in this paper is rich in what it allows us to infer regarding subjects' policy preferences, yet it is easy to implement. We thus believe that it can be useful for examining a wide variety of issues: Do members of one ethnic group (gender) identify with their group more than members of another ethnic group (gender)? How sensitive are identification patterns to varying group attributes (e.g. group status)? What happens to the proportion of social identifiers in the electorate when voting is costly?

This paper was confined to the study of preferences over redistribution. Social identification has, however, wide ranging implications in other important spheres of social behavior. We hope that future studies will shed more light on the interaction between social identity and individual behavior in economic environments.

Appendix A. Proof of Claim 1

1. Assume first that individual i maximizes her monetary payoffs π_i. From Eq. (2.3) follows that $\pi_i(\tau^h) > \pi_i(\tau^l)$ if and only if $y_i < y$. Thus, for $y_i < y$ and any profile of actions of the other voters, individual i cannot increase $\pi_i(\tau^h)$ by voting τ^l, and is strictly better off voting τ^h when she is pivotal. A similar argument holds for $y_i > y$.
2. Assume that individual i identifies with group j and keep the mean income of group j, y_j, fixed. Let us define

$$\Delta u_i \equiv u(\pi_i(\tau^h)) - u(\pi_i(\tau^l)) \text{ and}$$
$$\Delta v_i \equiv v(S_j(\overline{\pi}j(\tau^h), \overline{\pi}{-j}(\tau^h)) - v(S_j(\overline{\pi}j(\tau^l), \overline{\pi}_{-j}(\tau^l)).$$

Individual i's weakly dominant strategy is to vote for τ^h whenever $\Delta u_i + \Delta v_i > 0$ and to vote for τ^l otherwise. Since u is increasing in π_i we have $\Delta u_i > 0$ if and only if $y_i < y$. Similarly, it follows from Eq. (2.1) that $S_j(\overline{\pi}_j(\tau^h), \overline{\pi}_{-j}(\tau^h)) > S_j(\overline{\pi}_j(\tau^l), \overline{\pi}_{-j}(\tau^l))$ if and only

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[28] See also Durante and Putterman (2009), who find a significant relationship between decisions in a redistribution experiment and self-reported political preferences.

[29] With respect to the helping-the-poor item we do not have representative data from Israel. The relationship using the American GSS is much stronger than that observed in our sample. In fact, in our sample views regarding helping the poor (as opposed to views regarding inequality) do not correlate very strongly with income even among MPMs.

[30] This is consistent with the empirical results of Shayo (2009). He showed that individuals with higher levels of national identification exhibit lower support for redistribution, controlling for their income. Given that national identification is higher among the poor, the overall correlation between income and support for redistribution is attenuated.

if $y_j < y$. Given that v is increasing in S_j we have that $\Delta v_i > 0$ if and only if $y_j < y$ as well.

Suppose individual i identifies with the rich group. This implies that $\Delta v_i < 0$. If $y_i > y$ then $\Delta u_i < 0$ and i's weakly dominant strategy is to vote for τ^l. If $y_i < y$ then $\Delta u_i > 0$. Since u is an increasing and weakly concave function of π_i it follows that there exists $\varepsilon > 0$ such that $\Delta u_i + \Delta v_i < 0$ for $y_i + \varepsilon = y$. This establishes that $\underline{\omega} < y$. Concavity of u implies that $\underline{\omega}$ is uniquely defined.

3. An argument similar to the one above proves the existence of $\overline{\omega} > y$. To establish the existence of $\hat{\omega}$ note that whereas $\pi_i(\tau^l) - \pi_i(\tau^h)$ strictly increases with y_i when $y_i > y$, for u concave enough there exists a threshold value of income such that the absolute value of Δu_i decreases with y_i. Since Δv_i (which is strictly positive) is independent of y_i it follows that exists $\hat{\omega} > \overline{\omega}$ such that $\Delta u_i + \Delta v_i > 0$. $\square$

Appendix B. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.jpubeco.2009.12.003.

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