MUNI ECON

WORKING PAPER

n. 2023-09
ISSN 2571-130X
DOI: 10.5817/WP_MUNI_ECON_2023-09

Absolute vs. relative poverty and wealth: Cooperation in the presence of between-group inequality

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Creation date: 2023-12
Revision date:

Keywords: between-group, resource inequality, cooperation, public goods, online experiment,,beliefs
JEL classification: C72, C91, C92, D63, H41

Citation:
Levi, E., Ramalingam, A. (2023). *Absolute vs. relative poverty and wealth: Cooperation in the presence of between-group inequality*. MUNI ECON Working Paper n. 2023-09. Brno: Masaryk University. https://doi.org/10.5817/WP_MUNI_ECON_2023-09

Absolute vs. relative poverty and wealth: Cooperation in the presence of between-group inequality

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November 2023

Abstract

While inequality in resource endowments has been shown to affect cooperation levels in groups, much of this evidence comes from studies of within-group inequality. In an online public goods experiment, we instead examine the effects of payoff-irrelevant inequality in resources *between* groups on cooperation within equal groups. When all groups are poor or rich, their contribution behaviour is very similar. Relative inequality, when poor and rich groups coexist, leads to lower contributions in rich groups. Our results suggest that this is related to a combination of within- and between-group inequality aversion and to stereotypes about the rich contributing less than the poor.

Keywords: between-group; resource inequality; cooperation; public goods; online experiment; beliefs

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1. Introduction

Individuals' interactions and engagement with others is a crucial factor in creating vibrant and thriving communities. Such community involvement often takes the form of voluntary cooperation among individuals in local organisations, sports clubs, etc. (Alesina and La Ferrara, 2000). Inequality in incomes and wealth has been shown to lower cooperation with other members of their group, thus reducing "the sum total of people's involvement in community life" (Wilkinson and Pickett, 2011, p. 54). Much of this (experimental) evidence comes from studies of inequality *within* groups (e.g. Chan et al., 1999; Cherry et al., 2005; Buckley and Croson, 2006; Hargreaves Heap et al., 2016). However, income/wealth inequality *between* groups is ubiquitous and visible in society, e.g. regional income differences within cities, states and countries, or teams with heterogeneous resources within organisations. *Is the level of cooperation within (equal) groups affected by inequality* ***between*** *groups, i.e. by mere exposure to inequality?*

A reason to expect an effect of between-group inequality is the previous evidence on within-group inequalities and exposure to such inequality. In particular, inequality within groups affects cooperation in experiments especially when it is *visible* and *salient* (Anderson et al., 2008; Nishi et al., 2015). This suggests that the effects of inequalities may arise even when there is no inequality within the group. In a similar vein, papers from different disciplines have found that exposure to inequality affects many outcomes, such as preferences for redistribution, risk taking or health (Wilkinson and Pickett, 2006; Sands, 2017; Schmidt et al., 2019; Sands and de Kadt, 2020).

Another reason is theoretical and rooted in social preferences: with between-group inequality, individuals could, in principle, compare themselves not only to own group members with the same initial endowment, but also to individuals in other groups with different endowment levels

(Festinger, 1954). Then, inequality aversion (Fehr and Schmidt, 1999, hereafter FS) could push individuals to try to minimise both within- and between-group inequality. As we will formally show later, to minimise inequality, in an environment characterised by between-group inequality, the poor (rich) should contribute more (less) than under equality. This is the hypothesis we will test.

The question also has policy relevance. Inequality between different geographical areas can be as important as inequality within the area. For instance, consider differences in income or wealth between different neighbourhoods of a city, or between different regions of a country. Current policy explorations are based on small-scale experiments aimed at reducing within-group inequality (e.g. Stockton in California, or two thousand individuals in Finland). If between-group inequality affects behaviour, such local redistribution policies alone may not lead to better results in terms of cooperation and building stronger communities, and a rethink of policy may be called for.

Several studies have explored the effects of within-group inequality in endowments on contributions.[1] Buckley and Croson (2006) and Sadrieh and Verbon (2006) find no clear effects of inequality while several others find that such inequality is detrimental for cooperation (e.g., Cherry et al., 2005; Reuben and Riedl, 2013). Hargreaves Heap et al. (2016) confirm the negative effect of within-group inequality and show that it is the inequality rather than the amount of available resources that has the detrimental effect. This is because inequality lowers relative contributions by the rich.

[1] Studies have documented the negative effects on cooperation of other sources of inequality or heterogeneity within groups, such as in additional lump-sum payments (Anderson et al., 2008), productivity (Kölle, 2015) and returns from the public good (Gangadharan et al., 2017).

The above studies use between-subject designs. Groups are independent and are not provided any information on other groups in the experiment, or any information on conditions in other treatments. In equal groups, participants are not aware of other endowment levels they *could* have received. They are thus not aware that they may have been the poor/rich group in the experiment. In unequal groups, they know that they may be poor/rich. However, they also interact with participants with a different endowment within their group. This makes it impossible to disentangle the influence of the information – exposure to inequality – from that of other motives such as reciprocity and conditional cooperation (Sugden, 1984; Fischbacher et al., 2001).

As far as we are aware, Brañas-Garza et al. (2021) is the only paper that tests the effects of differences across groups on contributions in a public good game. However, the information exposure they explore is on marginal per capita returns (MPCRs) rather than on the endowments.[2] To the best of our knowledge, our experiment is the first to explicitly account, and test, for the effects of such between-group inequality in *endowments* in a cooperative setting.[3] We believe that differences in available resources are more evident to individuals and groups than are differences in the productivity of investments (i.e. MPCRs), particularly when such differences are present in other groups. We provide such information in our experiment when there is no possibility of direct interactions between the poor and rich. Further, we elicit beliefs on the contributions of others. In this way, we can provide evidence consistent with the hypothesis that information on inequality

[2] They find that, when exposed to the differences across groups, participants facing higher MPCRs increase their contributions while those facing low MPCRs decrease them.

[3] Hargreaves Heap et al. (2015) study a public goods setting with between-group inequality across homogenous groups. However, in their setting, pairs of groups are not independent in that groups' public goods contributions also enter a Tullock contest for a monetary prize. The additional prize thus forces interaction across groups, and changes the equilibrium of the game – group public goods contributions are positive in equilibrium. There is a related, but distinct, literature on global and local public goods (e.g. Blackwell and McKee, 2003). In such a setting, independent groups generate their own 'local' public goods, but members of both groups can also contribute to a 'global' public good that benefits both groups. Here, groups are also linked directly in that payoffs in one group are affected by decisions in the other. This is not the case in our setting.

affects contributions because of inequality aversion, and explore alternative hypotheses. Finally, we recruit a larger, and online, sample of participants.

In the absence of readily available field data on individual incomes and public good contributions, we use an online experiment to explore cooperation in the presence of between-group inequality. In our experiment, groups of three players interact in a repeated linear public goods game. Groups can be one of two types: members of poor (rich) groups receive a low (high) resource endowment. Importantly, in all treatments, all members of a group receive the same endowment, i.e. there is no inequality within groups. Further, groups are independent of one another, i.e. there are no spillovers of even information on actions or payoffs across groups.

Treatments manipulate the level of endowments and the presence of inequality within a session (as opposed to within a group). The baseline treatments capture absolute poverty/wealth, and establish benchmark cooperation levels in poor and rich groups when members are not aware of the existence of the other endowment level. Additional treatments implement between-group inequality in an explicit manner – both poor and rich groups are present in the same session, and all participants are aware of this.[4] These treatments thus capture relative poverty (wealth) in poor (rich) groups. In all treatments, we also first elicit individuals' beliefs about average cooperation levels in all groups within their treatment.

In this setting, we explore if information on endowments in other groups *alone* affects contributions to public goods within groups. If so, whose contributions are affected – those of the

[4] We assign groups to endowment levels randomly. There is a strand of the literature that explores whether inequality is randomly assigned or earned based on performance in another task affects cooperation levels. See Cherry et al. (2005), Kroll et al. (2007), Oxoby and Spraggon (2013). These studies also focus on within-group inequality. While it would be interesting to explore this additional source of difference in our between-group setting, we leave it for future work. Here, we focus on the pure effects of inequality alone.

rich, or those of the poor? We hypothesise that inequality aversion increases (decreases) the contributions of the poor (rich) with between-group inequality. An alternative hypothesis comes from theories of stereotypes about the rich. Elicited beliefs help us discriminate between these possible explanations.

We find that the contributions of the poor are unaffected by between-group inequality. Moreover, their contribution behaviour is similar to that of the rich in the absence of inequality. Between-group inequality does affect members of rich groups; the contributions of the rich are lower in the presence of inequality. They are lower than those of rich groups who do not experience inequality, and lower than those of poor groups. Further analyses on contributions and beliefs show that inequality aversion and stereotypes about the rich are both plausible explanations for this effect.[5]

Our results suggest that previous findings on the effects of within-group endowment inequality on cooperation extend to between-group inequality; both forms of inequality are detrimental to cooperation, particularly by the rich. They also imply that even the potential for differences in outcomes in unrelated groups can nevertheless affect behaviour. Finally, they suggest that the current debate surrounding inequality reduction perhaps needs to widen its focus to include steps to reduce between-group inequality. A 'Big Push' approach that tackles resource inequality at state, national or even higher levels may be called for.

The rest of the paper is organised as follows. The next section presents the design of the study, and Section 3 presents our theoretical framework and hypotheses. Section 4 details our main findings, and Section 5 considers an alternative explanation for our findings. Section 6 concludes.

[5] Ultimately, inequality affects the accuracy of beliefs. In the absence of inequality, beliefs about others' cooperation levels are accurate. Under inequality, participants in the experiment underestimate the contributions of the poor and overestimate the contributions of rich individuals. See Appendix C.

2. Experimental design and procedures

2.1 Decision setting and treatments

Fixed groups of three members play a repeated linear public goods game (PGG) for 10 rounds. Members each receive an endowment of $e > 0$, which they simultaneously decide how to split between a private account and a group account (the public good). Returns from the private account are one. Each member earns half of the total allocations to the group account by all group members (i.e. MPCR = 0.5). The unique Nash equilibrium (social optimum) of the game is for all group members to allocate zero (100%) to the group account. Both remain the same under finite repetitions. Importantly, both are unaffected by conditions and decisions in other groups.

We have a 2×2 design that varied: (i) endowment levels, and (ii) presence/absence of inequality. Members of *Poor* (*Rich*) groups all received a per-round endowment of 20 (80) tokens. In the absence of inequality, all groups in a session were either *Poor* or *Rich*. Participants were explicitly told that everyone in the session had the same endowment. These treatments implement absolute poverty and wealth in groups that were unaware of the other endowment level.

Under between-group inequality, half the groups (randomly chosen) in a session were poor (*Inequality-Poor*) while the other half were rich (*Inequality-Rich*). This was explicitly announced, and was thus common information; participants were made aware of their relative poverty or wealth in the instructions and on the decision screen in every round (instructions and screenshots available in Appendix A). Importantly, there was *always* equality in initial endowments within a group in all treatments.

2.2 Belief elicitation

In light of the previous evidence on the role of beliefs and expectations of others' contributions

(e.g. Fischbacher and Gächter, 2010; Reuben and Riedl, 2013) and to provide support for our theoretical predictions, participants were asked to estimate the average individual contribution at the beginning of the experiment. In *Inequality*, beliefs about the contributions of poor and rich individuals were elicited separately before participants were assigned to groups and made aware of their endowment. Belief elicitation was incentivised (Gächter and Renner, 2010); a guess within one token of the actual average (over all 10 rounds) earned a participant 100 tokens.

The process of belief elicitation itself has been shown to affect behaviour in public goods games (Croson, 2000; Gächter and Renner, 2010). Moreover, "it is *only* the players who have strongly asymmetric payoff opportunities who show all these strong belief elicitation effects" (Ruström and Wilcox, 2009, p. 617; italics in original). Since our goal is to test the effects of asymmetric payoff opportunities on behaviour, we chose to elicit beliefs only once at the beginning, rather than repeatedly and during the decision-making phase of the experiment.

2.3 Online procedures

Our aim is to study the effects of subtle manipulations in information on behaviour. Hence, it is crucial to control for the effects of observability of decisions and other social cues (e.g. Boone et al., 2008; Ekström, 2012) and experimenter demand effects (e.g. Zizzo, 2010). The online environment presents a near ideal setting to test our conjecture. By recruiting participants from different physical locations whose online interactions are necessarily completely blind, it maximises anonymity among participants and between participants and experimenters, thus minimising these effects.

Participants were recruited using the online platform Prolific, which provides access to adult participants from several countries in the world. Data collection was spread over four sessions to

prevent server overload and crashes.[6] From Prolific, participants were directed to a website that hosted the experiment programmed in oTree (Chen et al., 2016). After reading instructions at their own pace and answering control questions, beliefs were elicited and then participants were randomly assigned to groups that stayed fixed for the 10 periods of the public goods game.

To maintain engagement with the experiment, participants had up to 30 seconds to submit a decision in each round. If a participant timed out in a round, a random contribution was entered for them. If they missed another (not necessarily consecutive) round, they were ejected from the experiment without pay. In this event, the group continued with the remaining members who were informed that a member had dropped out of the group. Participants answered a socio-demographic survey at the end of the experiment.

At the end of every round, participants were informed only of the total allocation to the public good in their own group, and their own earnings. Participants were paid their earnings from all 10 rounds and the belief elicitation tasks. Token earnings were converted to cash at the rate of 400 tokens to US$1. The entire experiment took an average of 12 minutes, and average individual earnings were US$3.05, including a US$1.50 participation fee for successful completion (US$15.25 as an hourly rate).

2.4 Sample size considerations

Given that the online setting may be fundamentally different from the laboratory, we look to the following previous online studies of public goods games in economics to guide us on our choice of sample sizes for the treatments in our experiment.

[6] The first and last sessions implemented *Inequality* while the second and third sessions implemented *Poor* and *Rich*.

Arechar et al. (2018) conducted an online public goods experiment on MTurk where groups of four members play the game in two Phases of 10 rounds each (without and with peer punishment). They report results based on a total of 62 groups (248 participants) where all group members completed the entire experiment. They experienced a high dropout rate of 18% of all participants, which, given their distribution across several groups, implied that 53% of their groups completed the experiment. Thus, the number of participants recruited to the experiment was considerably higher than the 248 used in the data analysis.

Chan and Wolk (2020) also used Prolific to conduct an online public goods experiment. They have two treatments where they collected data on 36 groups of three members on average per treatment (73 groups in total). However, given the dropout rates in their experiment, their usable sample size was 64 groups – 34 in one treatment and 30 in the other.

Arechar et al. (2018) is a within-subject study since groups play under both conditions. Chan and Wolk (2020), on the other hand, is a between-subject study where each group experiences only one condition. Since our experiment has a between-subject design, we closely followed the latter paper and aimed to collect an average of 30 usable groups of three members in each of our four treatments.

We collected data on 40 groups in *Poor*, 37 groups in *Rich*, 38 groups in *Inequality-Poor* and 35 groups in *Inequality-Rich*.[7] In our data analysis, we excluded groups where even one member missed even one round during the course of the experiment, thus using only those observations where all group members entered deliberate contribution choices in every round. As a result, we

[7] These are groups where all three members finished all 10 rounds, even if a group member may have missed one round out of 10. In addition, there were only 4 groups across all 4 treatments where one group member was ejected for missing two rounds. In all 4 groups, the remaining two members completed the experiment.

lost a total of 13 groups across all treatments.[8] Despite this strict inclusion criterion, we succeeded in collecting data on at least 30 usable groups in each treatment. This is higher than the sample size in a typical lab experiment. Even Arechar et al. (2018) collected data on 18 groups from the lab, while their online sample is substantially larger. Table 1 summarises our treatments and presents the number of usable participants (independent groups) in each.[9] Since there was no interaction outside one's own group, each group is an independent observation. Summary statistics associated with the characteristics of this sample are available in Appendix E.

Table 1. Summary of treatments

	End = 20	End = 80
No Inequality	*Poor*	*Rich*
	117 (39)	102 (34)
Between-group Inequality	*Inequality-Poor*	*Inequality-Rich*
	102 (34)	90 (30)

Figures in parentheses are the number of independent groups in each treatment.

3. Theoretical framework and hypotheses

A model of inequity aversion successfully explains positive contributions to public goods in homogeneous and independent group (FS). An inequity-averse individual derives utility from his/her own payoffs (π_i) but also disutility from differences in payoffs relative to other group members. We introduce a simple extension of the FS model of inequality aversion to allow for

[8] Even such timeouts were rare, and occurred in only 13 out of 4500 decisions (c.f. Chan and Wolk (2020), who experienced 129 timeouts in 2628 decisions). Including these groups in the analysis does not qualitatively change our findings. We believe that our strict time limit and repeated warnings that not adhering to the time limits would result in zero earnings were responsible for the very high completion rate in our experiment.

[9] Given the small number of dropouts and that the number of groups omitted from our analysis is similar across the four treatments, we do not believe there were any systematic treatment differences in dropouts.

payoff comparisons both within and across groups. For simplicity, we consider the case of just two groups. We postulate that an agent's utility is given by

$$u_i(\pi_1, \dots, \pi_n) = \pi_i - \frac{\alpha_i^{own}}{n-1} \sum_{j=1 j \neq i}^{n} max\{\pi_j^{own} - \pi_i, 0\} - \frac{\beta_i^{own}}{n-1} \sum_{j=1 j \neq i}^{n} max\{\pi_i - \pi_j^{own}, 0\}$$

$$- \frac{\alpha_i^{other}}{n-1} \sum_{j=1 j \neq i}^{n} max\{\pi_j^{other} - \pi_i, 0\} - \frac{\beta_i^{other}}{n-1} \sum_{j=1 j \neq i}^{n} max\{\pi_i - \pi_j^{other}, 0\}$$

where α_i (β_i) is his/her disutility from disadvantageous (advantageous) inequality and the *own* and *other* superscripts denote individual *i*'s own group and the other group respectively. We assume that $\alpha_i^{own} > \beta_i^{own}; \alpha_i^{other} > \beta_i^{other}$ and $\beta_i^{own} \in [0,1]; \beta_i^{other} \in [0,1]$.

In the original FS model, $\alpha_i^{other} = \beta_i^{other} = 0$, i.e. player *i* only cares about comparisons with his own group members. Under these conditions, FS show that any symmetric contribution profile (including zero and full contributions) can be sustained as an equilibrium. We posit instead that $\alpha_i^{other} > \beta_i^{other} > 0$, i.e. player *i* cares about comparisons with members of the other group as well. Further, we assume that player *i* cares more about own-group comparisons than about other-group comparisons, i.e. $\alpha_i^{own} > \alpha_i^{other}$ and $\beta_i^{own} > \beta_i^{other}$. We derive this assumption from social comparison theory, where individuals are posited to compare themselves to their own group first and then to other groups (Festinger, 1954).

In the rest of the paper, we focus on contributions as a percentage of endowment to allow for comparisons between endowment levels. Henceforth, contributions are synonymous with percentage contributions.

Given the above assumption, the FS result for just own group comparisons would hold here too. Thus, we would expect symmetric contribution profiles within each type (poor or rich) of group.

This prediction would directly apply when there is no inequality. Further, there is no reason to expect any differences between rich and poor groups when there is no possibility of between-group comparisons.

Prediction 0: *In the absence of inequality, there is no difference between the contributions of the poor and the rich.*

Once we allow for between-group payoff comparisons in the presence of inequality, we can generate predictions of *relative* contribution levels in poor and rich groups. To minimise inequality between poor and rich individuals, we would expect that all the rich would minimise contributions to their public good, i.e. contribute zero. This would lead to the lowest earnings for their group as a whole. To minimise inequality between poor and rich individuals, we would expect that all the poor would maximise contributions to their public good, i.e. contribute their entire endowments. This would lead to the highest earnings for their group as a whole, thus minimising the payoff gap between poor and rich groups. We thus have behavioural predictions that are symmetrical but opposite for the rich and the poor.

Prediction 1: *The rich under between-group inequality contribute less than do the poor under between-group inequality, and less than the rich under equality*.

Prediction 2: *The poor contribute more under between-group inequality than do the poor under equality*.

While any symmetric contribution profile is an equilibrium in the FS model, arriving at a particular contribution level requires coordination. Arguably, such coordination is easier for the rich in this case. Zero contribution is relatively easier to coordinate on since it is focal – previous work has found that a large proportion of individuals free ride completely (Fischbacher et al., 2001). Once

here, it is also easier to maintain since selfishness and reciprocity provide strong incentives to keep contributions at zero – unilaterally increasing contributions above zero is costly for individuals. However, coordinating on full contributions is likely to be more difficult. Indeed, very few individuals contribute 100% of their endowment in public goods experiments (Fischbacher et al., 2001). Further, selfishness and reciprocity provide strong incentives to unilaterally lower contributions. Hence, poor groups are likely to be less successful than are rich groups.

In addition, contributions may be sensitive to beliefs. Given the relations $\alpha_i^{own} > \alpha_i^{other}$ and $\beta_i^{own} > \beta_i^{other}$, individuals' first priority is still to match the contributions of own-group members. This is true for both poor and rich individuals; in both cases, they should focus on their beliefs about contributions of their own type (rich or poor) than of the other type. To minimise within-group inequality, individuals must match their beliefs about contributions of their group members, i.e. their own type. This is in line with previous findings about the relation between contributions and beliefs (e.g. Fischbacher and Gächter, 2010) in situations where there is only one group. Our expectation is that this relation between beliefs and contributions extends to the presence of between-group inequality.

Prediction 3: *Both with and without between-group inequality, individuals' contributions are increasing in their beliefs about contributions of other individuals of their own type.*

Within-group comparisons weaken the between-group Prediction 1. With increasing beliefs of the rich, contributions of the rich are expected to increase, thus moving the group away from zero contribution. This increase is likely to be driven by those rich who have optimistic expectations of their group members. The deviation from Prediction 2 is driven by those poor who have pessimistic beliefs about their group members – they drag the group down from full contribution, or towards zero. Thus, within-group comparisons weaken the between-group prediction for the poor as well.

Given our assumptions about the utility function, between-group inequality in payoffs also negatively impacts utility (the last two terms). Thus, in the presence of between-group inequality, contributions are also likely to be influenced by beliefs about contributions in the other group (of the other type). Expected payoff inequality between the poor and the rich is increasing (decreasing) in the expected contributions of the rich (poor), all else equal.

The greater the expectations of the poor about the contributions of the rich, the greater the expected disadvantageous inequality against the poor, and the greater the negative impact on utility. To minimise between-group payoff inequality, the poor would thus need to increase their contributions with their beliefs about the contributions of the rich. On the other hand, the greater the expectations of the rich about the contributions of the poor, the lower the expected advantageous inequality in their favour, and the lower the negative impact on their utility. Thus, the contributions of the rich would increase in their beliefs about the contributions of the poor.

Prediction 4: *Under inequality, individual contributions of the poor and the rich are increasing in their beliefs about the contributions of members of the other group.*

4. Results

4.1 Contribution behaviour

Figure 1 presents average percent (of endowment) contributions in all treatments over time. Table 2 presents averages over all rounds and groups within treatments. Figure 1 shows the usual pattern of declining contributions over time in all treatments (see Fehr and Gächter, 2000; Chaudhuri, 2011). Both the Figure and the Table show that there is little difference in the contributions of the poor between treatments, or between the rich and poor in the absence of inequality. On the other

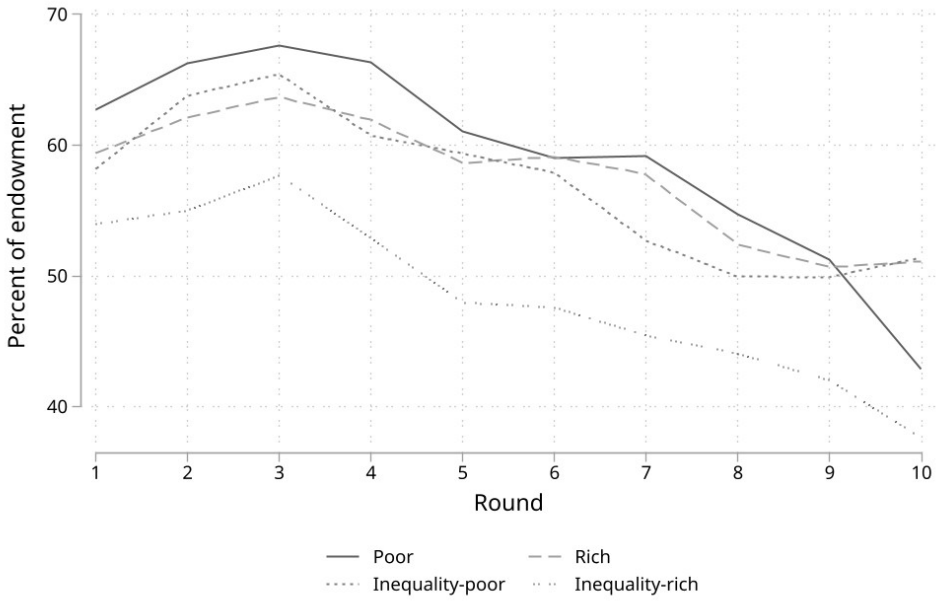
hand, average contributions of the rich are lower in the presence of inequality in all 10 rounds. Using aggregate (Wilcoxon ranksum) tests, we find that the difference between *Rich* and *Inequality-Rich* is significant (p = 0.043) while difference between *Inequality-Poor* and *Inequality-Rich* is weakly significant (p = 0.086).[10]

Table 2. Average (st dev.) percent contributions

	Obs.	*Poor*	Obs.	*Rich*	Ranksum p-value
No Inequality	39	59.11 (14.00)	34	57.68 (18.99)	0.7271
Inequality	34	56.94 (20.77)	30	48.42 (20.13)	0.0857
Ranksum p-value		0.6034		0.0427	

Figures in parentheses are standard deviations

Figure 1. Average percent contributions over time



[10] Each group constitutes an independent observation. Hence, the number of observations in each test is the number of groups in the treatments being compared.

To account for the richness of our data (i.e. dynamics such as time trends and, more importantly, beliefs about others' behaviour), Table 3 reports a panel random effects regression of individual percent contributions in a round on one-period lagged deviation of an individual's contribution from the average contribution of the other group members, treatment dummies (excluded = *Poor*), round dummies, demographic controls (age, gender, education, employment status, country of residence) and the number of previous experiments. In the second column, we additionally include the individual's belief about others' contributions, which in *Inequality*, is an average of beliefs about the poor and the rich.

Table 3. Treatment comparisons of contributions

	Percent contributions	
Lagged deviation	8.785***	7.312***
	(1.991)	(2.008)
Beliefs	-	0.417***
		(0.054)
Rich	-1.814	-2.13
	(3.962)	(3.416)
Inequality-Poor	-1.568	-0.009
	(3.882)	(3.519)
Inequality-Rich	-11.07***	-9.836***
	(4.275)	(3.638)
Observations	3,699	3,699
R^2	0.188	0.254

Std. errors clustered on group in parentheses. Controls (not reported) include round dummies, demographic controls (age, gender, education, employment status, country of residence) and the number of previous experiments. *Poor* is the baseline category for the treatments. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The regressions confirm the above results. The rich contribute lower amounts in the presence of inequality relative to those in *Poor*, as the coefficient associated with *Inequality-Rich* is strongly significant and negative in both specifications. On average, the rich under inequality contribute approximately 10% less than do the poor in the absence of inequality. Wald tests after the first regression show that contributions in *Inequality-Rich* are also lower than in *Inequality-Poor* ($p = 0.045$) and in *Rich* ($p = 0.053$). This does not change when controlling for average beliefs.[11, 12]

Result 0 (in support of prediction 0): *In the absence of inequality, there is no difference between the contributions of the poor and the rich.*

Result 1 (in support of prediction 1): *Between-group inequality lowers the contributions of the rich. In the presence of inequality, the rich contribute less than do the poor.*

Result 2 (against prediction 2): *Between-group inequality does not change the contributions of the poor.*

We find support for Predictions 0 and 1, but not for Prediction 2. Observed behaviour is thus consistent with the effects of inequality aversion for the rich, but not for the poor. We next test our model of inequality aversion by exploring the role played by beliefs in influencing contribution decisions.

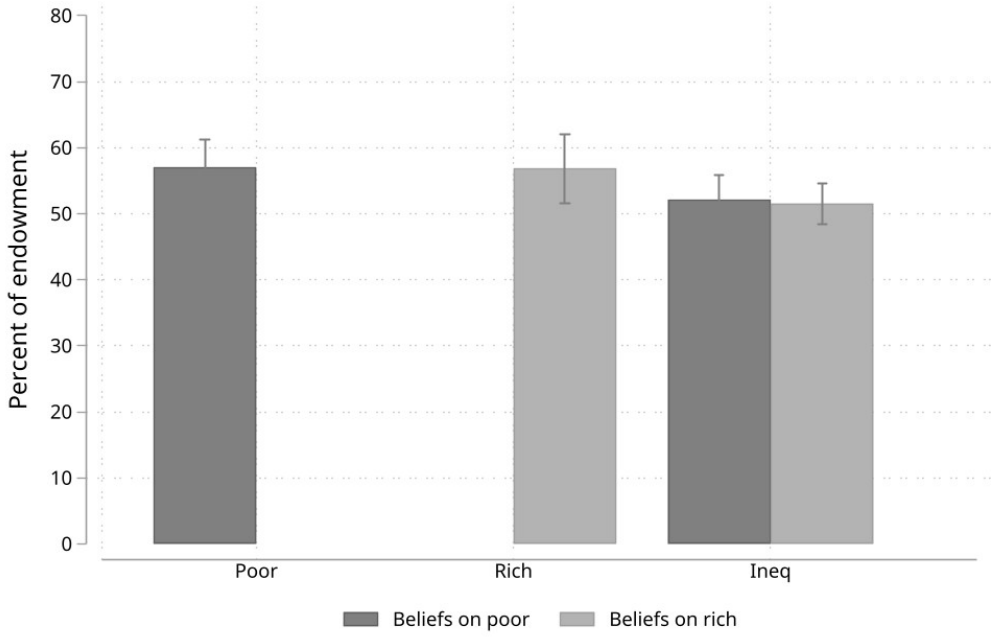
4.2 Beliefs about contributions of others

Figure 2 presents average beliefs about percent contributions of other participants across treatments.[13] Since beliefs were elicited before any interactions took place, each individual is an

[11] Beliefs are positive and significant. We discuss the role played by beliefs in greater detail in Section 4.2.
[12] Wald tests after the second regression confirm that contributions in *Inequality-Rich* are lower than in *Inequality-Poor* ($p = 0.042$) and in *Rich* ($p = 0.061$)
[13] Participants were asked to state their beliefs in absolute token amounts. We convert them to percentages for analysis.

independent observation. The number of observations is thus the number of individuals in each treatment. Since beliefs were elicited before participants were assigned to groups, we pool the observations in *Inequality-Poor* and *Inequality-Rich*.[14]

Figure 2. Average beliefs about percent contributions



Whiskers indicate 95% confidence intervals.

The Figure shows no difference between beliefs in *Poor* and in *Rich*, and that these beliefs are on average slightly higher than under *Inequality*. However, Wilcoxon ranksum tests show that none of the treatment comparisons are statistically significantly different (all $p > 0.10$). Moreover, participants seem to believe that, under inequality, percentage contributions will be the same in

[14] As a placebo test, we compare beliefs between *Inequality-Poor* and *Inequality-Rich*. In *Inequality-Poor*, the average belief on the poor's contributions is 51.96% and on the rich is 49.9%. In *Inequality-Rich*, it is 52.33% and 53.46% respectively. As expected, since no self-selection into treatments is possible by design, no difference is significant (Wilcoxon $p > 0.10$ for all comparisons).

rich and in poor groups, and this is not rejected by a ranksum test (p = 0.943). Regressions reported in Table B1 in Appendix B provide further support for these findings.

Result 3: *Between-group inequality does not affect beliefs about the average (percent) contributions of others.*

Another question related to beliefs is how good they are at predicting actual behaviour in the absence and in the presence of inequality. Inequality may make beliefs less accurate and this could in turn affect contributions if the game were to be repeated again. However, beliefs were elicited before the public goods game. The accuracy of beliefs is hence an endogenous ex-post measure in our experiment. Nevertheless, we present an analysis of ex-post belief accuracy in Appendix C.

4.3 Testing inequality aversion through beliefs

To test if inequality aversion played a role, we look more closely at the relation between beliefs and contributions. Figure 3 depicts the relation between average individual contributions and initial beliefs about others' contributions by treatment. Each data point in the Figure is weighted by the number of observations and the dashed line represents the best linear fit of the overall relation. The top panel focuses on beliefs about their own group, and the bottom panel on beliefs about the other group.

Individuals' contributions are increasing in beliefs about contributions of their own type (Prediction 3) in all treatments, indicating that individuals attempt to match the contributions of members of their own group[15]. Thus, we find evidence of conditional cooperation within groups

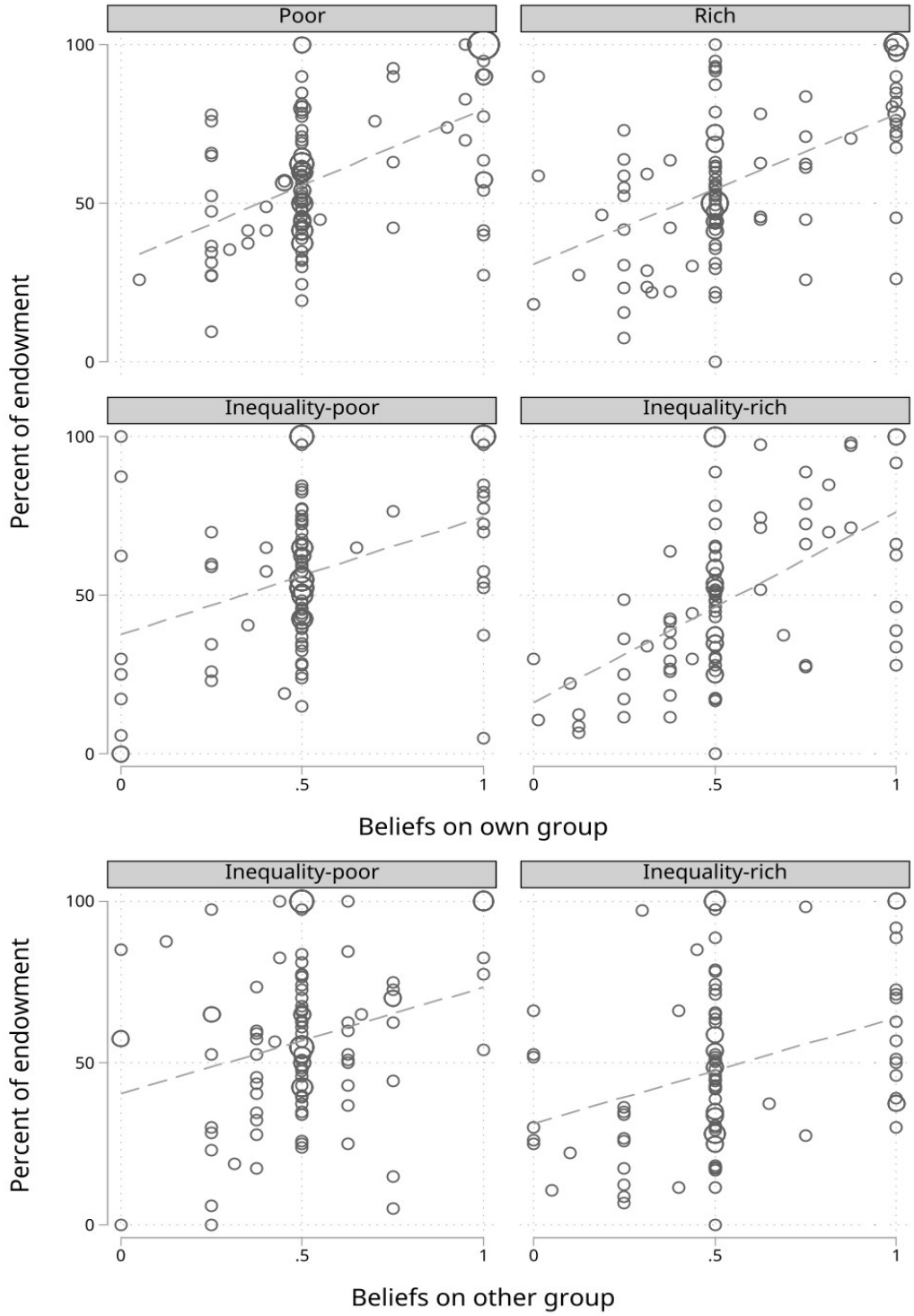
[15] The relation between beliefs and contributions also holds also at the group level: groups with higher average beliefs about contributions of their own group contribute more. The corresponding Figure is available from the authors on request.

(Fischbacher et al., 2001). For the associated statistical analysis, we will later rely on regressions at the individual level because contributions across all rounds are confounded by the history of the game and observations are thus not independent. We provide here non-parametric evidence on the first round, where each contribution decision is an independent observation. When splitting the sample at the belief of a 50% contribution and comparing participants below and above that threshold, Mann-Whitney ranksum tests show that initial contributions are increasing in beliefs in all treatments ($p < 0.0001$ in all four treatments). We thus find support for Prediction 3.

When considering beliefs on the other group in the presence of between-group inequality, (Prediction 4), the same relation between beliefs and contributions emerges – contributions are increasing in beliefs about contributions in the other group (see bottom panel of Figure 3)[16]. Again, we show evidence from regressions later but if we focus on the first round, we get a similar picture and all Mann-Whitney ranksum tests across the split at the 50% belief show a significant ($p < 0.01$) positive correlation between contributions and beliefs within each treatment.

[16] The same holds also at the group level: groups with higher average beliefs on the other group contribute more. The corresponding Figure is available from the authors on request.

Figure 3. Contributions and beliefs



Beliefs and average contributions by treatment. Circles represent the number of observations associated with each data point. The line represent a linear fit of the data.

To evaluate our Predictions more formally, we need to consider beliefs on the rich and on the poor at the same time[17] and see if each relation between contributions and beliefs holds while controlling for the other. Therefore, we turn to a multivariate analysis and run regressions based on those in Table 3. We restrict attention to the *Inequality* treatments where we introduce interactions between each level of endowment and beliefs (see Table 4). We do this both over the first round with an OLS regression and over all rounds with a random effects model where we further add the lagged deviation from the average contribution and dummies for rounds.

Table 4. Beliefs and contributions in the presence of between-group inequality

	Percent contribution	
	1st round	All rounds
(A) Lagged deviation	-	5.534*
		(2.972)
(B)*Inequality-poor*#Beliefs on poor	0.462***	0.249**
	(0.110)	(0.115)
(C) *Inequality-poor*#Beliefs on rich	0.222*	0.270**
	(0.133)	(0.120)
(D) *Inequality-rich*#Beliefs on poor	-0.0404	-0.0212
	(0.127)	(0.096)
(E) *Inequality-rich*#Beliefs on rich	0.573***	0.374***
	(0.135)	(0.119)
Constant	32.58	6.206
	(26.83)	(16.77)
Observations	192	1728
R^2	0.533	0.311

[17] We explore beliefs on the rich and on the poor more deeply in section 5.

Std. errors clustered on group in parentheses. Controls (not reported) include round dummies, demographic controls (age, gender, education, employment status, country of residence) and the number of previous experiments. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Regardless of the specification, the poor and the rich increase contributions as beliefs on their own group increase. The coefficients on (B) and (E) are of similar magnitude and a Wald test fails to reject the null that they are the same (p = 0.5047 over the 1st round, p = 0.3892 over all rounds). In *Inequality-Poor*, individual contributions react to beliefs on the rich too, as the associated coefficients (C) are positive and significant. This provides further support for Prediction 3 that within-group inequality is the first priority while also supporting Prediction 4 that higher (lower) expected between-group inequality can increase (decrease) contributions. In *Inequality-Rich*, individuals' contributions do not react significantly to beliefs on the poor (against Prediction 4, coefficient (D) is not significantly different than zero) by neither increasing nor decreasing contributions.

Result 4 (in support of Prediction 3 and partly in support of Prediction 4): *In the presence of between-group inequality, the contributions of both the rich and the poor are increasing in their beliefs about contributions of members of their own group. The contributions of the poor (rich) are increasing in (invariant to) their beliefs about the contributions of the rich (poor).*

Our results are largely in line with our predictions based on between-group inequality aversion. However, a few of our predictions are only partially supported. Specifically, the poor fail to increase their contributions under inequality relative to under equality (Result 2). This is likely due to the fact that it is easier for the rich to coordinate on low contributions while it is difficult for the poor to coordinate on high contributions. This is consistent with Result 4 that individuals, once they are assigned to rich groups, only follow beliefs on contributions by the rich. Given that they

adjust more easily to lower contributions, i.e. they have less of a coordination problem, they have less space for beliefs about the poor to affect their contributions.

5. An alternative explanation: Beliefs and stereotypes about the rich

Our findings suggest that observed behaviour in our experiment is consistent with a combination of between-group inequity aversion and a coordination problem for the poor. Nevertheless, we acknowledge that there may be alternative explanations, and examine a plausible one below.[18]

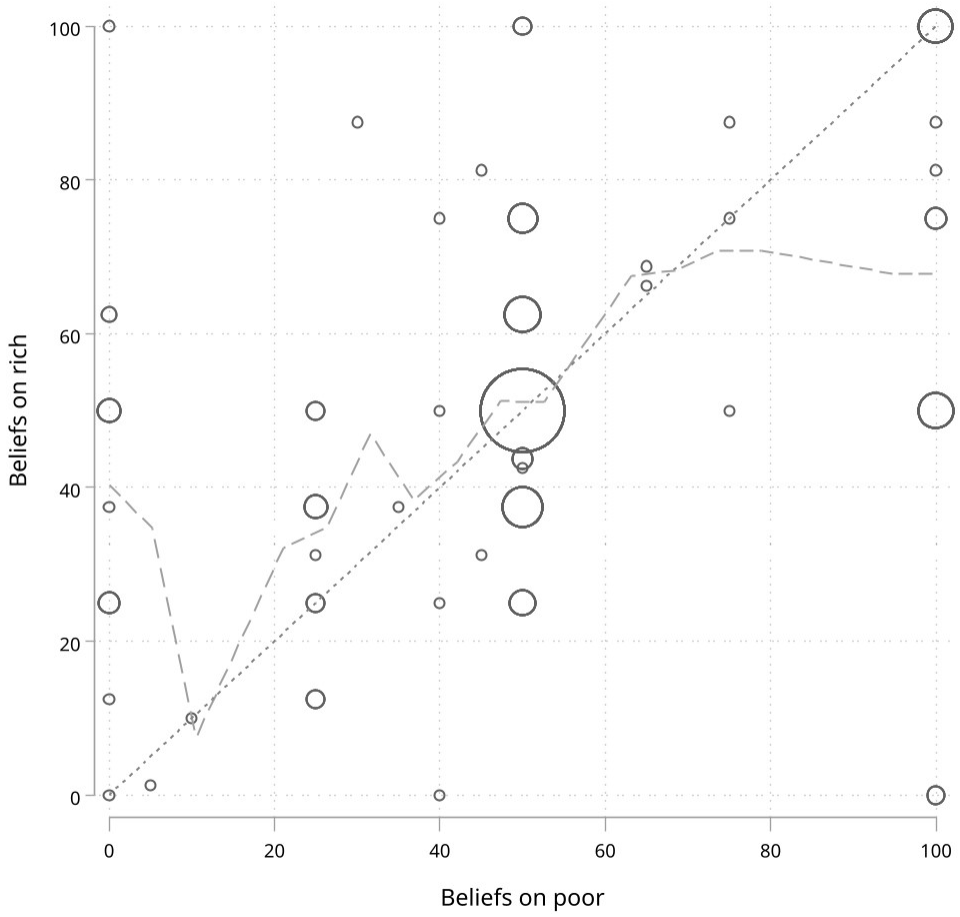
There is an argument from social psychology that the rich are greedier and show more unethical behaviour than the poor (e.g. Piff et al., 2012). Moreover, experiments show that the poor hold the correct stereotype about the rich (Fiske et al., 2002, Piff et al., 2018). Interestingly, in these experiments, the poor do not appear to hold a positive stereotype that the poor are more cooperative than a no-class individual, just that the rich are less cooperative. If participants in our study hold these stereotypes, they could contribute less when assigned to rich groups than when assigned to poor groups (we elicit beliefs before endowments are known). If this is so, the rich who hold this stereotype would contribute less (in percentage terms) in *Inequality-Rich* relative to *Inequality-Poor* and to *Rich*. We first test for the presence of this stereotype. Then, we investigate if participants with this stereotype indeed have lower contributions in *Inequality-Rich*.[19]

[18] We examine another plausible explanation in Appendix D. Based on the evidence from Gachter et al. (2022) we examine if the rich react more negatively to losses within the PGG. That is, once assigned to rich groups, do individuals become more loss averse? We find that they do not.

[19] In our experiment, we can test also for the possibility that the poor holding negative stereotypes about the rich become more cooperative. We explore this possibility too. Of course, individuals could have the opposite stereotype too where they believe that the poor are less cooperative than are the rich. We explore the presence and effect of this stereotype too.

We already know from Result 3 that, at the aggregate level, beliefs on the rich and on the poor are not statistically significantly different. To assess if there are individuals who hold such a stereotype about the rich, we look at the individual-level relation between beliefs on the rich and beliefs on the poor in the *Inequality* treatment. Figure 4 presents a scatter plot of these beliefs where the 45-degree line represents equal beliefs, and the dashed line is a polynomial fit of the beliefs on the rich over beliefs on the poor.

Figure 4. Beliefs on the rich and on the poor in the Inequality treatment



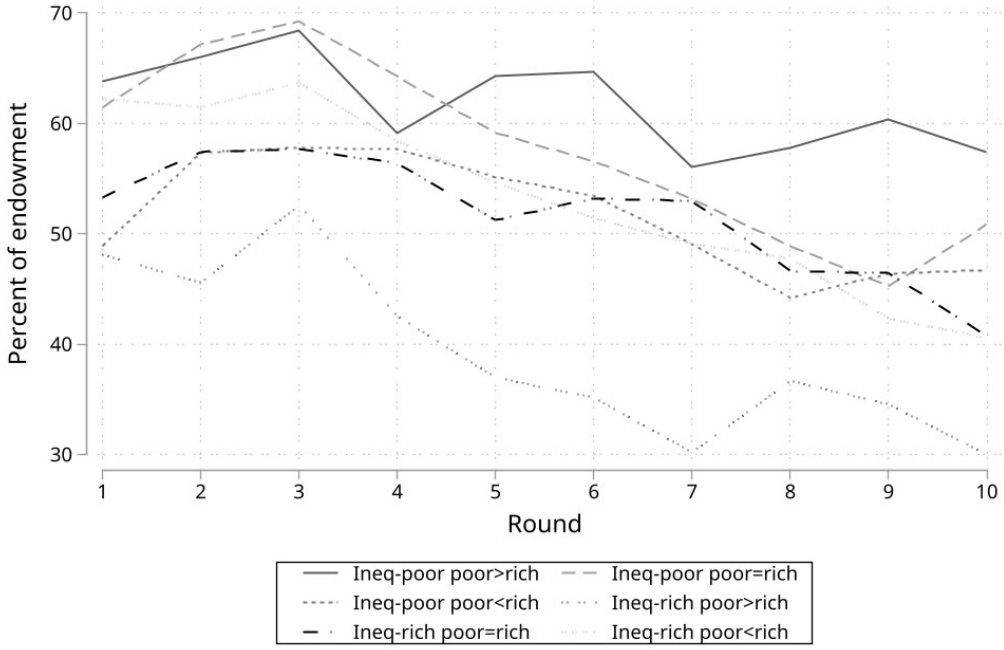
Beliefs in the Inequality treatment. Circles represent the number of observations associated with each data point. The polynomial fit is calculated with the Epanechnikov kernel in 20 points.

A large number of individuals believe others will contribute half their endowment, with most observations lying close to the 45-degree line. It appears that equal beliefs about the rich and the poor, especially with contributions equal to 50% of the endowment, are a very strong focal point. However, there also are quite a few observations that fall above or below the 45-degree line – 28.6% (28.1%) of participants believe rich individuals contribute less (more) than the poor. Thus, there are similar proportions of individuals with higher beliefs on the poor than on the rich and vice versa.

Result 5: *Beliefs on the rich and on the poor are strongly correlated. However, higher beliefs on the poor are often associated with lower beliefs on the rich, and vice versa*.

The above discussion notes that 56.7% of the individuals in *Inequality* have some kind of stereotype about the relative contributions of the rich and the poor. We investigate if they drive differences in contributions (Result 2). We classify individuals in the *Inequality* treatment by their beliefs – if they believe the poor contribute more than the rich, the same as the rich, or less than the rich – and show in Figure 5 the evolution of average contributions over time by endowment and by (relative) beliefs.

Figure 5. Average percent contributions over time in the *Inequality* treatment by beliefs



If the poor have a stereotype that the poor contribute less than the rich, they also contribute less on average than those who do not have any stereotype or those who have the opposite stereotype. However, the differences are not large and the three lines are almost overlapping. On the contrary, the rich who have the stereotype that the rich contribute less than the poor tend to contribute around 10-15% less than the rich who do not have any stereotype or who have the opposite stereotype. To provide statistical support, we run an individual-level regression based on that in Table 3 in which the *Inequality-Rich* dummy is further interacted with stereotype dummies (Belief rich>poor and Belief rich<poor; Belief rich=poor is the baseline category) and the stereotype dummies themselves are included as controls (Table 5). The regression in the second column additionally controls for average beliefs to assess if the possible results on stereotypes are driven by the general beliefs on cooperativeness we explored in the previous section.

Table 5. Contributions and stereotypes

	Percent contribution	
Lagged deviation	8.722***	7.233***
	(2.002)	(2.012)
Beliefs	-	0.417***
		(0.054)
Rich	-9.795	-5.424
	(6.696)	(6.053)
Inequality-Poor	-5.609	-0.904
	(5.110)	(4.788)
Inequality-Rich	-12.77*	-8.761
	(7.098)	(6.398)
Belief rich>poor	-5.249	-0.587
	(5.596)	(5.326)
Belief rich<poor	2.818	2.792
	(6.067)	(5.866)
*Inequality-Rich#*Belief rich>poor	5.785	5.893
	(7.344)	(6.910)
*Inequality-Rich#*Belief rich<poor	-16.05**	-13.51*
	(8.025)	(7.323)
Constant	96.71***	49.91***
	(16.49)	(16.30)
Observations	3,699	3,699
R^2	0.196	0.261

Std. errors clustered on group in parentheses. Controls (not reported) include round dummies, demographic controls (age, gender, education, employment status, country of residence) and the number of previous experiments. *Poor* is the baseline category for the treatments, Belief rich=poor for the stereotype dummies. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The regressions provide support for the idea that stereotypes on the rich play a role in explaining Result 2; the coefficient of the interaction between Belief rich<poor and *Inequality-Rich* is negative and significant while the *Inequality-rich* coefficient is not strongly significant anymore. Furthermore, by a post-estimation test, the sum of the interaction term and the two baseline ones

(*Inequality-Rich* and Belief rich<poor) is still significantly different from zero at the 1% level ($p<0.001$). Controlling for average beliefs reduces the coefficient – which is not surprising given the correlation between beliefs – but the effect is still significant at 10% and the post-estimation test over the sum of coefficients is still significantly different from zero at 1% level ($p<0.01$).

The coefficient on the stereotype alone (Belief rich<poor) is not significant in either specification, indicating that the poor are not affected by the stereotype. Further, the coefficients associated with the opposite stereotype (Belief rich>poor) and its interactions with treatments are not significant in either specification. Thus, the opposite stereotype, while held by an equal fraction of individuals, does not influence contribution behaviour – of the poor or the rich. Under between-group inequality, those who believe the stereotype that the rich are less cooperative than the poor contribute lower amounts to the public good when in rich groups, thus lowering average contributions in *Inequality-Rich* relative to other treatments.

Result 6: *Individuals who believe that the rich contribute less than the poor contribute significantly less than those who do not share that belief when they end up in a rich group.*

6. Conclusion

There is plenty of evidence that inequality in resources (such as income and wealth) negatively affects outcomes in groups and communities. In particular, inequality lowers community spirit and leads to lower voluntary engagement of individuals with one another, and with projects that generate value for the entire group. Previous work examining the effects of inequality has focused on inequality *within* groups. Despite the fact that inequality *across* groups is ubiquitous and that common theories associated with inequality predict changes in behaviour, its effects are not well-understood. Using an online experiment, we test the effects of between-group inequality on

contributions to public goods in equal groups.

We find that between-group inequality negatively affects cooperation in rich groups but not in poor groups. The contributions of the rich under inequality are lower than those of the poor (with or without inequality), and those of the rich in the absence of inequality. Thus, mere knowledge of one's relative wealth has a detrimental effect on cooperation levels, while knowledge of one's relative poverty does not.

Our results are partly consistent with a desire to minimise payoff differences (inequality aversion) both within and between groups. Inequality aversion implies that the rich will lower contributions in the presence of inequality while the poor will increase them. The former prediction for the rich is supported by our data while the latter for the poor is not. This is consistent with coordinating on a contribution profile being more of a problem for the poor than for the rich.

Our results are also consistent with contribution behaviour being affected by the presence of stereotypes about the relative cooperativeness of the rich and the poor. Those who believe that the rich are less cooperative than are the poor contribute less to the public good when they are in rich groups than those who do not share the stereotype. This lower contribution by (only) the rich lowers contributions in rich groups in the presence of between-group inequality.

We are not able to fully discriminate between these different explanations, as we do not provide any information in our setup that could exogenously manipulate beliefs or stereotypes. In this sense, our explanations are suggestive of the psychological underpinnings of our results and can be seen as a first step in trying to understand how exposure to inequalities affects cooperation. Nevertheless, it is reassuring that we find evidence consistent with well-established theories in behavioural economics and social psychology.

Regarding explanations, we have an additional note that comes from comparing the results with the literature. Our main result on between-group inequality parallels the finding on within-group inequality in that both types of inequality lower contributions to public goods, and that it is the rich who lower contributions under inequality. However, it also suggests that the impact of inequality on cooperation is not fully explained by reciprocity motives such as conditional cooperation; by design, this is not possible under between-group inequality. In particular, unlike relative performance feedback, we find that merely knowing about the *potential* for different outcomes in other groups affects behaviour (of the rich).[20]

More work is needed to explore this phenomenon, and the channels that drive the effects of between-group inequality. Future work can explore the relation between mechanisms that generate between-group inequality in the first place and cooperation levels. For instance, what is the effect of such inequality if 'rich' and 'poor' endowments are based on performance on a prior task? Further, can involuntary or voluntary redistribution of resources between groups influence future cooperation levels in (formerly) rich and poor groups?

Finally, our results suggest that the issue of finding an appropriate policy response to inequality is perhaps more nuanced than is implied by the recent focus on small-scale experiments on local redistribution or basic income schemes (e.g. in Finland in 2017). If, as we find, individuals are influenced by resource endowments in other unrelated groups, then reducing inequality within local communities alone may not help boost overall cooperation. That is, a "Big Push" approach to inequality reduction may be called for. Building strong communities at the local level may

[20] Note that this is different from the literature that looks at the relevance of irrelevant alternatives that one may not have (e.g. Chadd et al., 2021) or irrelevant information on others' actual performance in unrelated tasks (e.g. Mas and Moretti, 2009). Here, we have a situation where behaviour may be influenced by what others *can* do.

nevertheless entail efforts to reduce inequality at higher levels, such as state and national levels. Our findings point to the need to continue to search for effective policies to tackle the negative effects of inequality in society.

Acknowledgements

The authors thank Lata Gangadharan, Shaun Hargreaves Heap, Anmol Ratan, Brock Stoddard, and seminar participants at Masaryk University for helpful comments and suggestions. Funding from Appalachian State University is gratefully acknowledged. This study has been exempted from review by the Institutional Review Board at Appalachian State University (Study No. 21-0106). The authors declare that they have no relevant or material financial interests that relate to the research described in this paper.

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ONLINE ONLY

Supplementary Material

Absolute vs. relative poverty and wealth: Cooperation in the presence of between-group inequality

Appendix A. Experimental instructions for the Inequality treatments

The differences across treatments are highlighted.

Screen 1

Informed Consent

Characteristics of the study: You are about to participate in a decision-making experiment. No deception is involved. All your decisions will remain confidential and your choices will not be identified. Your participation in this experiment is voluntary and you can stop participating at any time.

Earnings: You will receive the fee posted in Prolific for completing the experiment. In addition, you will earn several bonuses during the experiment. **Be careful that there are timeouts during the experiment: if you do not comply with the timeouts or withdraw before the end of the experiment, you will not receive any payment.**

Length of the experiment: 12 minutes without possible interruptions. Please make sure that you have a stable internet connection and that you will not be distracted while the experiment is in progress. If you do not complete the experiment, you will not be paid.

You must be at least 18 years of age to participate in this study. Questions regarding the protection of human subjects may be addressed to the IRB Administrator, Research and Sponsored Programs, Appalachian State University, Boone, NC 28608, United States, irb@appstate.edu

By clicking Continue, you agree that you have had the chance to review this information, and agree to participate in this research. Please return the study to Prolific if you do not wish to participate.

Screen 2

Introduction to the experiment

Please read the instructions carefully. **After the last screen of instructions, you will have to answer a few questions before being able to engage in the decision stages.** The instructions are **identical** for all participants with whom you will interact.

General information:

- The experiment consists of 10 consecutive decision rounds.
- At the beginning of the experiment, you will be randomly assigned to groups with 3 subjects (you and two others). The composition of the groups will remain the same in each round. The identities of all participants will remain confidential.
- At the beginning of each round, you receive an endowment of either 20 tokens OR 80 tokens. (At the beginning of each round, you receive an endowment of 20 (80) tokens.)
- The endowment is the same for all members within a group and for each round.

- Half the groups (randomly chosen) will have participants receiving an endowment of 20 tokens each for each round. The other half of the groups will have participants receiving an endowment of 80 tokens each for each round. (All groups will have participants receiving an endowment of 20 (80) tokens each for each round.)
- You will be informed if the endowments in your group are 20 or 80 at the beginning of the experiment.

Screen 3

Your decisions and earnings

Decision in each round:

- Your task is to allocate your endowment of tokens between your private account and a group account.
- Tokens not allocated to the group account will automatically be allocated to your private account.
- You will have 30 seconds to submit your decision. After 30 seconds, a random decision will be submitted for you. A timer on the screen will help you keep track of the time.

Earnings in each round:

- You will earn 1 token for each token in your private account.
- Allocations to the group account by all three group members will be added up, multiplied by 1.5 and then divided evenly between you and your two fellow group members. That is, for each token allocated to the group account by yourself or other member of the group, each will earn 0.5 tokens regardless of who made the decision.

Your earnings in each round = Tokens in your private account + 0.5*(Total tokens allocated to the group account by all three group members)

Screen 4

Examples

Example

- Suppose all members of your group receive an endowment of 20 tokens each round.
- Suppose that you allocated 0 tokens to the group account.
- Suppose that the two other group members allocated a total of 0 tokens to the group account.
- The total number of tokens in the group account would be 0.
- Your bonus earnings in this round would be 20 tokens (= 20 tokens from your private account + 0.5*0 = 20 tokens from the group account).

Example

- Suppose all members of your group receive an endowment of 80 tokens each round.
- Suppose that you allocated 80 tokens to the group account.

- Suppose that the two other group members allocated a total of 160 tokens to the group account.
- The total number of tokens in the group account would be 240.
- Your bonus earnings in this round would be 120 tokens (= 0 tokens from your private account + 0.5*240 = 120 tokens from the group account).

Screen 5

Information

Total earnings:

- At the end of a round, you will be shown the total allocation to the group account in your group and your bonus earnings in tokens from the round.
- Your total bonus earnings from the experiment will be the sum of your earnings from all 10 rounds. However, you will not be paid for rounds in which the computer enters a decision for you, i.e., if you do not submit your decision within 30 seconds.
- If you do not submit decisions on time in two rounds, the experiment will end for you, i.e. you will not be paid. The remaining group members will continue the experiment.
- Your token earnings will be converted to cash at this exchange rate:

400 tokens = $1

The exchange rate will be the same whether your endowment is 20 tokens or 80 tokens (only in Ineq treatment)

Before the experiment itself starts, a brief quiz will check whether you understand your task.

Screen 6

Please answer the following questions:

You will be assigned different partners in each round.

- True
- False

The other members of your group receive the same endowment as you in each round.

- True
- False

All groups receive the same endowment of tokens.

- True
- False. Half the groups receive an endowment of 20 tokens each, while the other half receive 80 tokens each. (last sentence only in Ineq treatment)

4. Example:

- Suppose all members of your group receive an endowment of 20 tokens each round.

- Suppose that you allocated 10 tokens to the group account.
- Suppose that the two other group members allocated a total of 20 tokens to the group account.

The total number of tokens in the group account would be:
Your bonus earnings in this round would be:

Your earnings in each round = Tokens in your private account + 0.5*(Total tokens allocated to the group account by all three group members)

[*NOTE: By clicking a button, subjects could see the instructions from the previous screens. Moreover, if they answered the open question incorrectly, they received a hint on the correct answer.*]

Screen 7

Additional bonus opportunity

You can earn an additional bonus by answering the following questions.

In your estimate, how many tokens will a person with an endowment of 20 tokens allocate to the group account in his/her group?

In your estimate, how many tokens will a person with an endowment of 80 tokens allocate to the group account in his/her group? (both questions only in Ineq treatment)

At the end of the experiment, one of the two questions will be randomly chosen. (only in Ineq treatment) If your answer to that question is within 1 token (+/- 1) of the actual average allocation at the end of the experiment, you will receive an additional bonus payment of 100 tokens.

Screen 8 – Waiting screen

Forming Groups

Please wait until the group is formed. You will not wait more than 3 minutes. We kindly ask you to be patient and not to move away from the screen, as the timeouts start from the next screen.

Remember, if you do not submit a decision within 30 seconds in each round, a random decision will be entered for you, and you will not be paid for the round. A timer on the screen will help you keep track of the time. If you do not submit decisions on time in two rounds, the experiment will end for you, i.e. you will not be paid.

Endowment information and decision screen

Time left to take your decision: **0:22**

Round 4 of 10

Members of half the groups receive an endowment of 20 tokens each. Members of half the groups receive an endowment of 80 tokens each.

Every member of your group, including you, has an endowment of **20 tokens** in each round.

How many tokens would you like to allocate to the group account?

Submit

Instructions from the previous screens

Information on earnings

Round 4 of 10

Total allocation to the group account in this round: 7

Your earnings from the private account: 19

Your earnings from the group account: 3.5 (=0.5*7)

Your total bonus earnings in this round: 22.5

Next

Appendix B. Regression results

Table B1. Comparisons of beliefs across treatments

To provide further support for Result 3, Table B1 reports OLS regressions of individual percent beliefs on treatment dummies first for beliefs on the poor (excluded = *Poor*) and on the rich (excluded = *Rich*), then on the average beliefs (excluded = *Poor*). We use the same individual controls as in the regressions on contributions described in section 4.1 in the paper. While the coefficients associated with *Inequality* are negative for all types of beliefs, standard errors are very high confirming that there is no evidence in support of significant differences in beliefs by treatment.

	Beliefs on poor	Beliefs on rich	Average beliefs
Rich			0.714
			(3.405)
Inequality	-3.349	-4.099	-3.405
	(3.328)	(3.179)	(2.930)
Observations	309	294	411
R^2	0.159	0.211	0.126

OLS regressions. Std. errors in parentheses. Baseline for regressions on beliefs on poor and on average beliefs: *Poor*. Baseline for regressions on beliefs on rich: *Rich*. Controls (not reported) include demographic controls (age, gender, education, employment status, country of residence) and the number of previous experiments. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix C. The accuracy of beliefs

We next turn to comparing beliefs with actual contributions, i.e. to the accuracy of beliefs. We test if there are systematic errors in prediction by the rich and/or the poor and how inequality influences them. We already know from the results in the paper that inequality does not lead to changes in beliefs but that it leads to changes in behaviour. Therefore, we can expect inequality to affect the precision of individuals' estimates on contributions. Table C1 presents the average error in beliefs across endowment levels and treatments.[1] The error is calculated as the difference between an individual's stated percentage belief and the actual average percentage contribution by individuals in the corresponding treatment (and endowment level) over all 10 rounds. Thus, a negative (positive) error signifies an underestimate (overestimate). The Table also indicates if two-sided Wilcoxon signrank tests find errors to be significantly different from zero.

Table C1. Average error in initial beliefs

	Obs.	Beliefs on Poor	Beliefs on Rich
Poor	117	-2.10*	-
		(23.31)	
		p = 0.057	
Rich	102	-	-0.806
			(26.51)
			p = 0.213
Inequality	192	-4.80***	3.15***
		(26.39)	(21.70)
		p < 0.0001	p = 0.001

Figures in parentheses are standard deviations. Error = Stated belief – (Actual average contribution of all individuals in the condition over 10 rounds). Asterisks indicate significance levels of a signed rank test for whether errors are equal to zero. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In the absence of inequality, both the rich and the poor underestimate the contributions of others. However, these underestimates are only weakly significant in *Poor* and not significant in *Rich*. Thus, beliefs are rather accurate in the absence of inequality. Under inequality, participants are significantly more pessimistic about the contributions of the poor: the average underestimation is close to 5%, and the vast majority underestimate the contributions of the

[1] Again, we pool observations from *Inequality-Poor* and *Inequality-Rich* because beliefs are elicited before the assignment to groups and before the endowment is known.

poor (37 overestimation vs. 155 underestimation). However, they are 3.15% overoptimistic about the contributions of the rich (138 overestimation vs. 54 underestimation), and this overestimation is statistically significant. Thus, inequality negatively affects the accuracy of beliefs with respect to both the contributions of the poor and of the rich. This is also supported by ranksum tests on the difference in errors in beliefs between *Poor* and *Inequality* ($p = 0.000$) and between *Rich* and *Inequality* ($p = 0.007$).

Result C1: (a) *Under between-group inequality, individuals underestimate the contributions of the poor and overestimate the contributions of the rich.*

(b) *In the absence of inequality, there is no significant under/overestimation of others' contributions.*

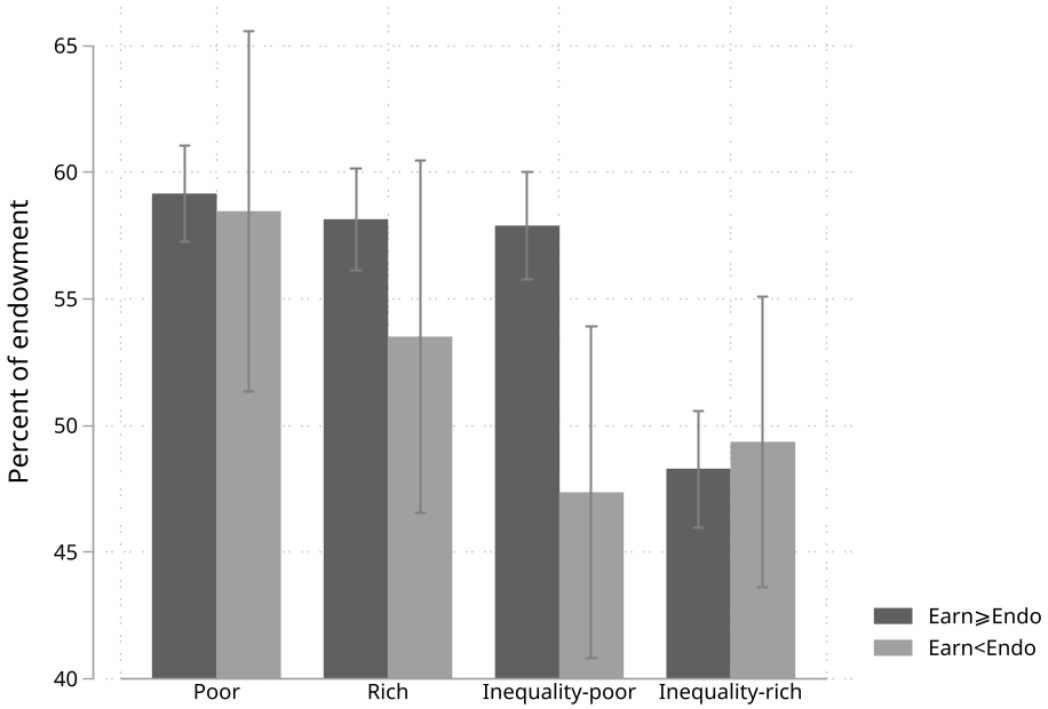
Appendix D. Loss aversion as a potential explanation for observed behaviour

We explore the potential role played by loss aversion. Gächter et al. (2022) show that the rich are more loss averse than the poor. They elicit loss aversion in riskless and risky tasks in a lab-in-the-field experiment in Germany and find, among other things, that loss aversion increases with the wealth of the respondent. If this is true, the rich in our experiment may react strongly to losing earnings (relative to their starting endowment in the PGG) by lowering their contributions in the next round compared to the rich who have not lost anything. While the existing evidence on loss aversion and wealth suggests that we should expect this behaviour only from the rich, we will test if the poor react the same way. That is, if the poor react to losing earnings by contributing less in the subsequent round relative to the other poor who have not lost anything. Importantly, we will examine if the extent of loss aversion is affected by the presence of between-group inequality, both for the rich and the poor.

To test for these possibilities, we classify individual decisions in each treatment in two groups: those for whom earnings were strictly lower than the endowment (Earn<Endo) in the previous round and those who earn at least their endowment (Earn≥Endo) in the previous round.[2] Figure D1 presents average contributions by these two classes of individuals in each treatment.

[2] Approximately 10% of instances are classified as Earn < Endo. We also consider other possible classifications allowing for the possibility that participants react differently depending on how much they lose (>5 or >10) and on how little they earn (<10 or <5). The results are not sensitive to these different classification procedures.

Figure D1. Average contribution by the earnings in the previous round



Whiskers indicate 95% confidence intervals.

Average contributions in *Inequality-Rich* after a 'losing' (Earn < Endo) round are not very different than those after a 'winning' (Earn ≥ Endo) round. In *Inequality-Poor*, however, individuals seem to lower contributions as a reaction to losing from 57.9% to 47.4% on average. To provide formal evidence, we introduce a variable representing the extent of the losses (Endo – Earn if the individual experienced a loss, i.e. if Endo – Earn > 0) in the usual regression (Table D1), both interacted with the treatment dummies and as additional control. Again, we add average beliefs in the second column. The coefficient associated with losses is statistically significant and negative in all regressions, meaning that subjects lower their contributions as losses increase in all treatments. This is evidence of loss aversion, and this holds even when we control for lagged deviation from the average contribution.

Table D1. Contributions and loss aversion

	Percent contribution	
Lagged deviation	16.72***	14.82***
	(2.216)	(2.253)
Beliefs	-	0.402***
		(0.0529)
Rich	-1.991	-2.305
	(3.920)	(3.393)
Inequality-Poor	-1.324	0.140
	(3.738)	(3.396)
Inequality-Rich	-11.33***	-10.13***
	(4.185)	(3.567)
Endo – Earn if >0	-4.041***	-3.940***
	(1.023)	(0.943)
*Rich#*Endo – Earn if >0	3.172***	3.103***
	(1.063)	(0.989)
*Inequality-Poor#*Endo – Earn if >0	-0.036	0.048
	(1.381)	(1.307)
*Inequality-Rich#*Endo – Earn if >0	3.458***	3.364***
	(1.027)	(0.948)
Constant	93.68***	52.73***
	(14.88)	(14.71)
Observations	3,699	3,699
R^2	0.222	0.281

Std. errors clustered on group in parentheses. Excluded category = *Poor*. Controls (not reported) include round dummies, demographic controls (age, gender, education, employment status, country of residence) and the number of previous experiments. * p < 0.10, ** p < 0.05, *** p < 0.01

Then, the interaction coefficients associated with *Rich* and *Inequality-Rich* are statistically significant and positive, meaning that loss aversion has a lower influence on rich individuals. The difference between the two coefficients is not statistically significant (p = 0.4882) suggesting that inequality does not affect the loss aversion of the rich. The interaction coefficient with *Inequality-Poor* is also not statistically significant, suggesting that inequality does not affect the loss aversion of the poor either. Importantly, the coefficient associated with *Inequality-Rich* is always negative, strongly statistically significant and of comparable magnitudes with Table 3, suggesting that loss aversion does not explain much of our findings.

Result D1: *Between-group inequality does not affect how participants in Inequality-Rich and Inequality-Poor react to losing earnings in the previous round. However, participants in rich groups lower contributions less than participants in poor groups after losing earnings in the previous round.*

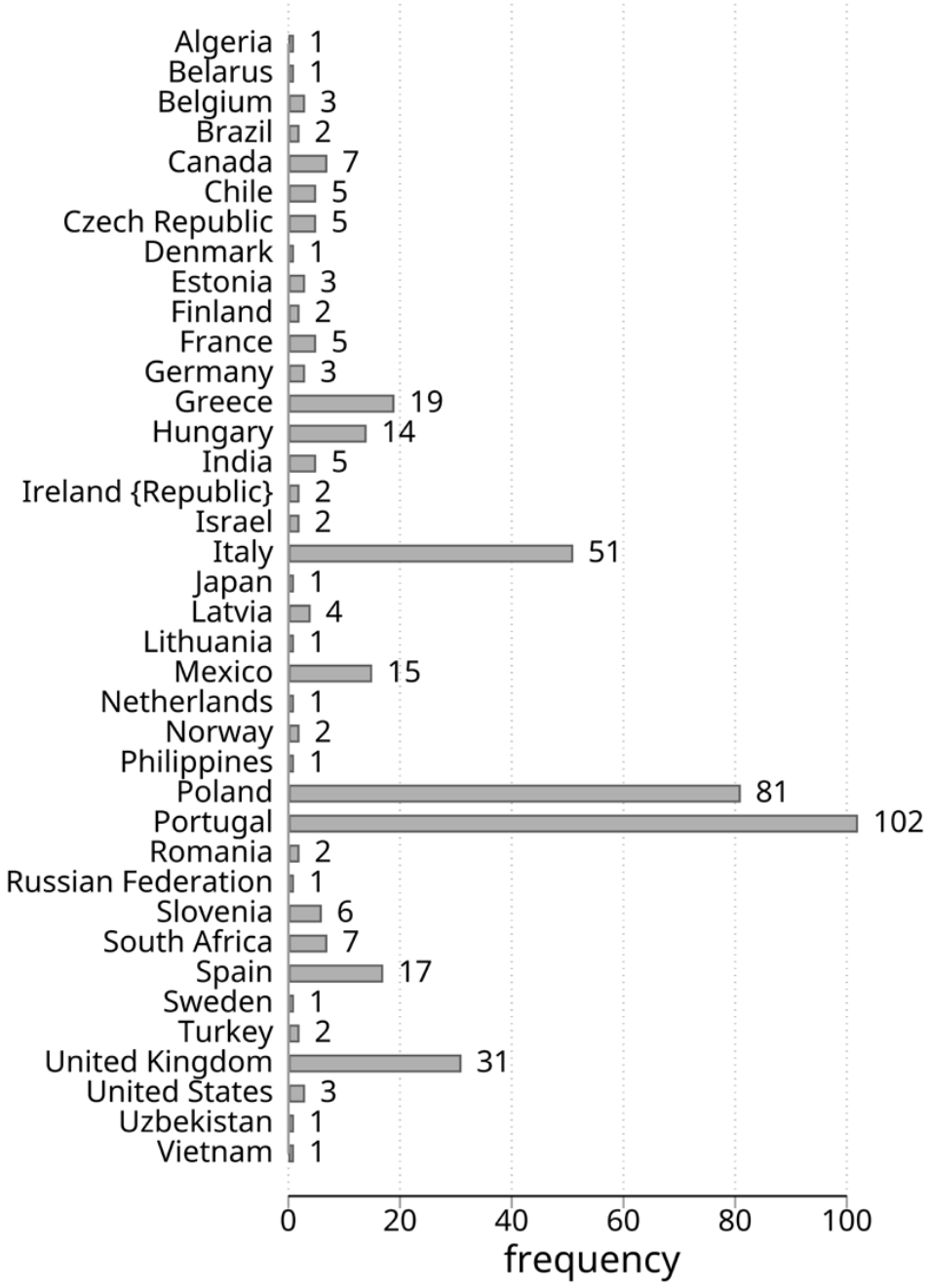
Appendix E. Characteristics of our sample

Table E1. Descriptive statistics of the sample

	Mean or frequency
N	411
Gender	
Male	234 (56.9%)
Female	172 (41.8%)
Self-identify/other	3 (0.7%)
Prefer not to say	2 (0.5%)
Age	26.068 (7.888)
Education	
Below high school	7 (1.7%)
High school	120 (29.2%)
Some undergraduate university training	66 (16.1%)
Undergraduate degree	124 (30.2%)
Master's degree	77 (18.7%)
Doctorate or Professional qualification	11 (2.7%)
Prefer not to say	6 (1.5%)
Employment status	
Employed	151 (36.7%)
Unemployed	54 (13.1%)
Retired	1 (0.2%)
Student	198 (48.2%)
Not looking for a job	4 (1.0%)
Prefer not to say	3 (0.7%)
Number of experiments	1.944 (2.794)

The summary statistics in Table E1 give a picture of the distribution of the gender, employment status and education level of individuals together with the average age and number of experiments. With respect to the average individual, the distributions are skewed towards students and individuals with higher education. Still, the skewness is lower than in laboratory experiments. Subjects were recruited by Prolific from 40 different countries (see Figure E1): the most frequent ones are Portugal, Poland and Italy with more than 50 subjects each, followed by United Kingdom, Greece, Spain, Mexico and Hungary in double numbers. We use all these variables as controls in all regressions presented in the paper and they rarely are significant in any.

Figure E1. Distribution of country of residence



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