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Effort, inequality and cooperation: evidence from the lab

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Abstract

We investigate the impact of inequality on cooperation using a linear public good game and focusing on heterogeneity in the source of income, where some participants work for their endowment ("workers") while others do not ("non-workers"). The key finding of our paper is that cooperation is higher when workers are grouped with other workers, and we provide evidence that the underlying mechanism for this result is a higher degree of altruism between workers. Our results thus lend support to the concerns that inequality may have detrimental effects on economic efficiency .

Keywords: public goods; inequality; source of income heterogeneity;
JEL classification: C92; H41; D63

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1. Introduction

Inequality is on the rise, driven by inherited wealth, and there is a fear that this will lead to a society with less cooperation, more crime and lower economic growth (Piketty, 2014; Piketty and Zucman, 2014; Putnam, 2000). We investigate the impact of inequality on cooperation in an experimental setting, which allows us to explore causality and mechanisms. We measure cooperation using a linear public good game and focus on heterogeneity in source of income, in particular, how individuals whose endowment is derived from work ("workers") respond to being grouped with individuals who have received their endowment without exerting any effort ("non-workers").

In order to structure our thinking about mechanisms, we develop a simple theoretical model, which highlights the importance of altruism and reciprocity in determining contributions to a public good. We hypothesize that group composition affects contributions in a non-trivial way, as altruism and reciprocity pull in opposite directions: facing non-workers, workers are likely to feel less altruistic, based on a sense of entitlement, but at the same time feel a stronger duty to reciprocate, as they may expect non-workers to contribute more. We elicit expectations in the lab and derive altruism from a dictator game.

The key finding of our paper is that cooperation is higher when workers are grouped with other workers rather with than non-workers, and we provide evidence that the underlying mechanism for this result is that altruism dominates reciprocity. Our findings are important as they support the concern for the adverse consequences of inequality in society, pointing to a reduction in cooperation driven by a reduction in altruism.

Other studies that experimentally vary the source of income in a public good game include Cherry, Kroll and Shogren (2005), where earned income is derived from a quiz and unearned income in the form of a windfall. The authors find no significant differences in contribution to the public good between earner and non-earner groups, but do find that income inequality lowers contributions, due mainly to the relatively low contribution of the high-endowment participants. An important difference from our experiment is that in their case participants are not informed about the source of income of the other group members.[1] Similarly, Oxoby and Spraggon (2012) investigate public good contributions in groups where some participants have earned their income by working on a quiz, while others have received their endowment from a windfall. The authors investigate in more detail how group composition affects contributions and find that there is a stronger tendency for free-riding in groups with 'clear' minorities in terms of income source, but, at the same time find that the source of income itself does not matter. Their experiments do not, however, allow for a clean separation of heterogeneity in level and source of income, as groups always have both dimensions. Our analysis will demonstrate that this in fact is important.

The main contribution of our paper relative to the articles cited above is that we explore mechanisms. We do so by proposing a simple theoretical model, by eliciting beliefs as a proxy for reciprocity and by using a dictator game to capture altruism. Moreover, earnings in our experiment are derived from a manual and tedious exercise rather than from a cognitive task, which is typical in the literature. We believe this is important, as cognitive tasks could activate unintended

[1] Information about the endowment of the other group members may be important, as shown by for instance Anderson, Mellor, Milyo (2008) who find that inequality (in the level of income) reduces public goods contributions, but only when endowments are known to all participants. See also Chan et al. (1999) who also emphasize the importance of information and communication for public goods contributions.

psychological processes that confound the causal effect of effort. Furthermore, participants in most experiments are students, who may well have a 'taste' for cognitive activities, implying that such efforts can be seen as rewarding rather than the opposite.

Other related contributions include Jackson (2001) who focuses on group identity, and analyzes contributions to a non-linear public good by participants belonging to two different colleges. Muehlbacher and Kirchler (2009) find that greater effort leads to lower contribution in a public good game, and they ascribe this to effort increasing the subjective value of the endowment. The participants in their experiment were not informed about the characteristics of the other group members. Buckley and Croson (2006) consider inequality in the level of income, but not in the source, and find no difference in the absolute level of contribution between rich and poor. The authors suggest that this may be due to participants feeling they should contribute their "fair share" to public goods, which is interpreted as an equal contribution, irrespective of the level of income.

The remainder of the paper is organized as follows. We first develop a simple theoretical model that highlights altruism and expectations as driving forces of public good contributions. Section 3 describes the experiment and the participants. Section 4 contains the results of the analysis, and section 5 concludes.

2. Model

Here we propose a simple model, building on Cappelen et al. (2007), which highlights the importance of altruism and reciprocity in explaining contributions to a public fund when individuals are heterogeneous in the source of endowment, being either workers (*w*) or non-workers (*n*). Let the utility of an individual *i* paired with an individual of type *j*, where $i, j \in [w, n]$, be given by:

$$u_{ij} = (1 - t_i) - \frac{\left(t_i - t^e_{i|j}\right)^2}{2b_{i|j}} \qquad (1)$$

where the endowment is given by 1; t_i is the transfer to the public fund; $t^e_{i|j}$ is *i*'s expectation about contribution of the other group member *j*; $b_{i|j}$ is the degree of egoism of individual *i* conditional to being matched with a type *j*, where in the limit as $b_{i|j} \to \infty$ the individual is fully egoistic and for $b_{i|j} = 0$ fully altruistic. The first term of (1) thus captures the utility component based on what the decision-maker keeps for himself, while the second term is the decision-maker's disutility due to deviations from the fairness norm, that is, reciprocity. Note that a fully egoistic decision-maker chooses $t^*_i = 0$, while a fully altruistic individual chooses $t^*_i = t^e_{i|j}$. Group composition can shape both the level of egoism and expectations about others' contributions to the public fund. For an interior solution, the first-order condition for sharing implies[2]:

[2] Note that for $b_{i|j} \geq t^e_{i|j}$ we have a corner solution, where the decision maker keeps all the money for himself, $t^*_i = 0$.

$$t_i^* = t_{i|j}^e - b_{i|j}$$

Hence, contributions to the public fund depend on the expected contributions of the other group members, that is, conditional cooperation (Fehr and Fischbacher, 2002), and the level of altruism, which is also conditional on the identity of other group members. We make the following two hypotheses on the effects of group composition on the two parameters that shape contributions to the public fund:

Hypothesis 1. Egoism is lower when paired with a worker than when paired with a non-worker: $b_{(i|w)} < b_{(i|n)}$.

Hypothesis 2. The expected contribution is lower when paired with a worker than when paired with a non-worker: $t^e_{(i|w)} < t^e_{(i|n)}$.

We base these two hypotheses on the fairness ideal that holds people responsible for their efforts (Cappelen et al, 2007; Arkes et al 1994; Loewenstein and Issachoroff 1994). Accordingly, the willingness to share with a worker is stronger than with a non-worker as workers deserve to be compensated for their efforts. Similarly, we hypothesize that non-workers are expected to contribute more as they feel no strong entitlement to their endowment.

Group composition thus affects public good contributions through two channels: altruism and reciprocity. Keeping the expected contributions of other group members constant, the contribution of a worker in a group of other workers (homogenous group) can be expected to be higher than when grouped with non-workers (heterogeneous group), due to lower levels of conditional egoism (altruism channel). At the same time, if workers expect higher contributions from non-workers, this may pull in the opposite direction (reciprocity channel). In this way, the impact on cooperation from moving from a homogenous environment to a heterogeneous environment is not clear from a theoretical point of view, and hence calls for an empirical investigation.

3. The experiment, sample, and empirical approach

3.1 The experiment and sample

The experiment involved 240 students at the University of Bari, Italy, who took part in nine separate sessions (including a pilot) during two consecutive days.[3] The experiment was designed to test the effect of heterogeneity in the source of endowment on contributions in a public good game. For this purpose, a two-stage procedure was used. In the first stage, participants were randomly allocated to either a working session or a no-working session: in either case, the invitation to participated in the experiment was identical. The working sessions were all identical and consisted of a 30-minute repetitive manual task (cutting strips of paper) during which the participants were not allowed to interact with each other but could observe that they all had to do exactly the same kind of task. The workers received a lump sum payment for their work, while the non-workers simply received a windfall endowment.

In the second stage, the participants played a standard, linear public good game with three members in each group and with a multiplier of 50 percent. As is well known, the most efficient solution is to contribute everything to the common fund, but the Nash equilibrium, in the absence of other-regarding preferences, is to contribute nothing. We ensured that the participants understood the workings of the game by numerical examples and explanations before they made their choices. The participants also stated their expectations of the contributions of the other members, which is our measure of reciprocity.

The participants were placed both in a situation where all group members had the same source of income (homogenous case) and in a situation where they had different sources of income (heterogeneous case). We randomly assigned the order in which the participants were exposed to these two situations. In addition, we randomly assigned participants to different endowment levels: low (9 euros), middle (15 euros), and high (18 euros). For the workers, these endowments were framed as compensation for their work, while no such framing was given to the non-workers. In all groups, the sum of the endowment was kept constant at 45 euros. *Table 1* summarizes the sample size according to type, based on both source and level of income.

Table 1. Sample size according to type

Source of endowment	Level of endowment	Number of participants
Workers		180
	9 euros	60
	15 euros	60
	18 euros	60
Non-workers		60
	15 euros	30
	18 euros	30
Total		240

[3] The experiments were conducted in Italian. A translated version of the experimental protocol is provided in the Appendix.

Due to time and budget constraints, we recruited more workers than non-workers, and focus the analysis on how workers respond to being either in a group of only co-workers or in a group where the other members are non-workers.[4]

After the public good game, workers also received a five euro "bonus" and played a dictator game where they made contribution decisions both with another worker and with a non-worker. Hence, in the following, *endowment* always refers to the public good game and *bonus* always refers to the dictator game. At the end of the session, we collected background information.

Summary statistics on some observable characteristics of workers and non-workers are reported in *Table 2*, and suggest that the randomization procedure was effective as the two groups are not significantly different from each other. We observe that around half of the participants were male and that the average age was close to 22 years. 36 percent of the participants were residents of the university campus, which is reserved for students belonging to low-income households not living in Bari.

Table 2. Balance workers and non-workers

	Full sample	**Workers**	**Non-workers**	**Difference**
Male	0.529	0.517	0.567	-0.05
	(0.5)	*(0.5)*	*(0.499)*	*(0.504)*
Age	21.74	21.72	21.83	-0.11
	(2.68)	*(2.83)*	*(2.20)*	*(0.77)*
Grades	82.5	82.97	80.95	2.02
	(11.87)	*(11.31)*	*(13.41)*	*(0.254)*
Campus	36.2	35.0	40.0	-5
	(0.48)	*(0.48)*	*(0.49)*	*(0.48)*
Observations	240	180	60	

Note: Male is a dummy taking the value one if the participant is male and zero if female; Age is the participant's age in years; Grades refers to the grades at high school (0-100); Campus refers to whether the participant is a resident of one of the student campuses. Standard deviations in parenthesis, except for Difference, where parenthesis shows standard errors.

3.2 Empirical approach

The main empirical question is how workers respond to changes in the group environment. Accordingly, when running regressions, we limit ourselves to the sample of workers. However, we include the decisions of non-workers when discussing total contributions (see Section 4.4).

As shown in Table 1, there are 180 workers in our sample. They made decisions both in the homogenous group case and in the heterogeneous group case. Using a within-subject design, this means that for public goods we have 360 observations. We lack information for one participant on expectations and the dictator game. For expectations, the number of observations is therefore 358. For the dictator game, the low and high endowment participants made contribution choices in four

[4] Non-workers were either grouped with two non-workers or with one non-worker and one worker; the latter in order to be able to calculate aggregate contributions in a situation with one worker and two non-workers.

situations: when the recipient was low (nine euros) or high (18 euros) endowment worker, and low or high endowment non-worker.[5] The middle-endowment workers (15 euros) only played against a similarly endowed worker and non-worker. Hence, with information for one participant missing, we have 598 observations in the dictator game. Our main regression results are based on the following empirical specification:

$$Y_i = \alpha + \beta_1 W + \beta_2 Controls + \varepsilon_i . \quad (1)$$

Here, Y_i refers to either contributions to the public fund in the public good game, expectations about the contribution of other group members in the public good game, or contributions in the dictator game, while *W* is a dummy which takes the value one if the worker is grouped with other workers (homogenous group) and zero if grouped with non-workers (heterogeneous group). We run regressions both without and with controls, which include endowment levels as well as the variables listed in Table 2.

We are also interested in how introducing inequality in income affects cooperation in the homogenous and heterogeneous group cases, and for this purpose we run regressions of the kind described in (1) separately for equal and unequal endowment groups.

4. Results

We start by presenting the main results, and then move on to analyzing mechanisms. We also discuss how introducing an additional source of inequality, namely in income levels, affects the results, and how group composition affects total contributions to the public good, by also taking into consideration the contributions by non-workers.

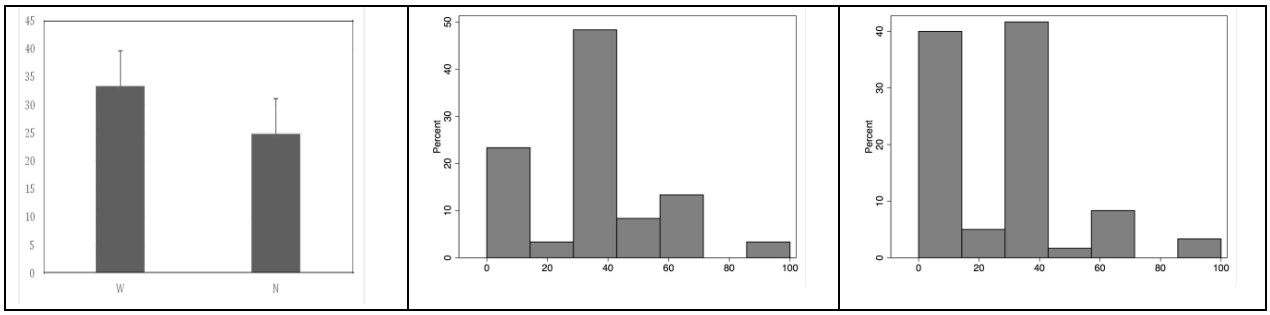
4.1 Main result

Figure 1 illustrates the main result of our experimental setting. Panel A shows that workers contribute 33.4 percent of their endowment to the public fund when teamed up with other workers, compared to only 24.8 percent when grouped with non-workers (p=0.06). Hence, in our experiment, altruism, based on fairness considerations, seems to dominate reciprocity, based on expectations about others' contributions. As expected, the share of free-riders among workers is higher in heterogeneous groups. Panels B and C show the distribution of contributions in the two scenarios: there are almost twice as many zero-contributors among the workers when grouped with non-workers compared to when they are grouped with co-workers.

[5] The actual payments were based on decisions made in a pilot lab, which also included non-workers with an endowment of nin euros.

Figure 1. Cooperation

Panel A. Comparison Panel B. Worker Panel C. Non-worker



Note: Figure 1 shows workers' contributions to the public fund in a public good game, as a share of their endowment, when grouped with workers (W) and with non-workers (N), all with an endowment of 15 euros, and with Panel A including the 95% confidence band. Panel B shows the distribution of contributions to the public fund when the other group members are also workers, while Panel C shows the same when the other group members are non-workers.

Table 3 shows the regression results on contributions in the public good game, both as a share of the endowment (regressions 1-3) and as a dummy for positive contributions (regressions 4-6).

Table 3. Cooperation and effort

	Cooperation: Contributions in Public Good Game, % share			**Cooperation dummy**: Positive contribution in Public Good Game		
	(1) Tobit	(2) Tobit	(3) FE	(4) Probit	(5) Probit	(6) FE Probit
Co-worker	7.97**	7.93**	5.94***	0.33**	0.33**	0.67***
	(3.63)	(3.49)	(1.74)	(0.15)	(0.16)	(0.24)
Low endowment		17.33***			0.51***	
		(4.38)			(0.19)	
High endowment		5.21			0.51***	
		(4.36)			(0.19)	
Male		0.52			-0.036	
		(3.56)			(0.16)	
Age		0.51			-0.01	
		(0.63)			(0.03)	
Grades		-0.08			0.00	
		(0.16)			(0.01)	
Campus		8.17**			-0.23	
		(3.81)			(0.17)	
Constant	28.45***	13.19	32.32***	0.71***	0.41	1.46***
	(2.59)	(19.16)	(1.23)	(0.10)	(0.85)	(0.31)
Sigma	33.64***	32.29***				
	(1.56)	(1.50)				
Observations	*360*	*360*	*360*	*360*	*360*	*360*
Number of id			*180*			*180*
Pseudo R2	*0.002*	*0.010*		*0.013*	*0.043*	

Note: Estimation results from Tobit (models 1-2) and Probit (models 4-5) regressions. Individual fixed-effects are included in models (3) and (6). Dependent variables are expressed as shares of total endowments in models 1-3 and as a dummy for positive contributions in models 4-6; *Co-worker* is a dummy that takes the value one if the other group members are workers, and zero otherwise; *Low endowment* indicating that the participant has an endowment of 9 euros; *High endowment* indicating that the participant has an endowment of 18 euros; the other explanatory variables are described in Table 2. Standard errors in parentheses, with *** = p <0.01; ** = p < 0.05; * = p<0.1.

Regression 1 confirms what was illustrated in Figure 1, showing that contributions to the public good are higher when grouped with co-workers, a significant difference both statistically and

economically (a six percentage point increase from a base of 32 percent). Regression 2 adds controls, which does not have any significant impact on the estimated coefficient on Co-worker. Moreover, we observe that low-endowment participants contribute a much larger share of their endowment than middle-endowment or high-endowment participants, a result which is in line with other findings in the literature, as discussed in the introduction.

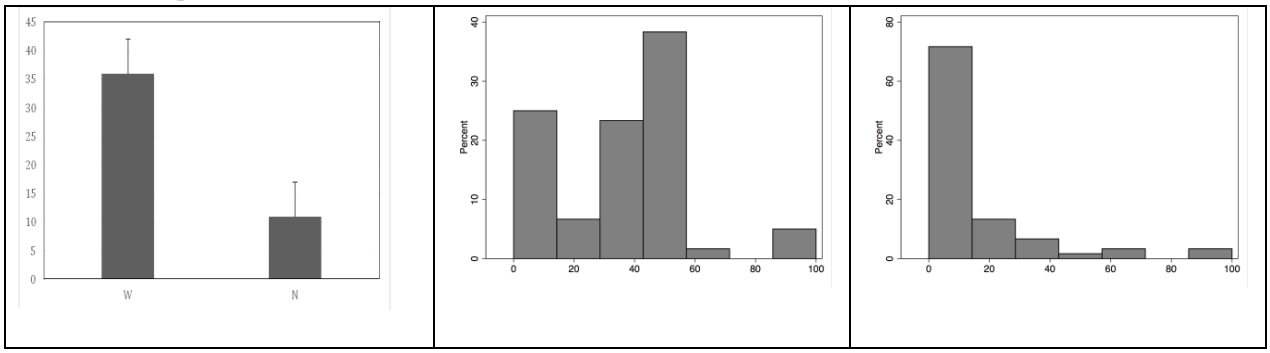
Regressions 4 to 6 show the results where the dependent variable is a dummy, which takes the value one with positive contributions to the public fund and zero otherwise (that is, with free riding). The findings with this specification harmonize very much with what we found when measuring cooperation as contribution share in regressions 1-3.

4.2 Mechanisms

The theoretical model highlights altruism and reciprocity as channels through which group composition may affect cooperation. *Figure 2* illustrates average dictator game transfers by workers, as a share of their five euro bonus, when paired with another worker ("W") and with a non-worker ("N"), all with an initial endowment of 15 euros. We observe from Panel A that workers are significantly more willing to share with other workers than with non-workers (35.7 vs 11.3, p=0.00), which pulls in the direction of higher contributions to the public good in the former case than in the latter. In more detail, Panels B and C show that while around 70 percent of the workers share nothing with a non-worker, the most common division between workers is an equal share.

Figure 2. Altruism

Panel A. Comparison | Panel B. Worker | Panel C. Non-worker

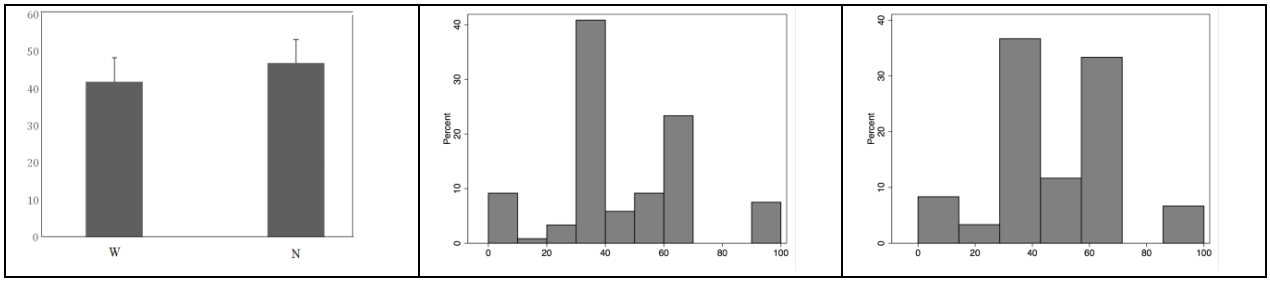


Note: The figure shows workers' dictator game contributions, as a share of their endowment, to workers (W) and non-workers (N), all with endowment 15 euros, and with Panel A including the 95% confidence band. Panel B shows the distribution of contributions when the recipient is also a worker, while Panel C shows the same when the recipient is a non-worker.

Figure 3 shows the workers' expectation of the contribution of the other group members when grouped with other workers ("W") and when grouped with non-workers ("N"), when all participants have equal endowment (15 euros). In line with our hypotheses, Panel A shows that workers expect non-workers to contribute somewhat more than workers, although the difference is not significant (47.7 vs 42.1, p=0.21). Panels B and C show the distribution of expectations in the two scenarios, where around one third of the workers believe that non-workers will contribute two thirds of their endowment to the public good, whereas the corresponding expectation about the contribution of workers is much lower.

Figure 3. Reciprocity (expectations)

Panel A. Comparison Panel B. Homogenous Panel C. Heterogeneous



Note: The figure shows expectations held by workers about the contributions by other group members, workers (W) and non-workers (N), all with an endowment of 15 euros, and with Panel A including the 95% confidence band. Panel B shows the distribution of expectations when the other group members are also workers, while Panel C shows the same when the other group members are non-workers.

Table 4 shows regression results on altruism (1-3) and expectations (4-6). We observe that contributions in the dictator game are significantly higher, in fact, twice as high, when a worker is paired with another worker than with a non-worker. This is in line with what was shown in *Figure 2*. Regressions (2) and (3) include controls, and we observe that individuals with a low endowment (from the public good game) share a lower fraction of their dictator game bonus (regressions 5 and 6), which is as expected, given that they are sharing their five euro bonus with someone who received a higher endowment from the previously played public good game. We also see that males are less generous than females.

Table 4. Altruism and reciprocity

	Altruism: Contributions in Dictator Game, in %			**Reciprocity**: Expected contributions in Public Good Game, in %		
	(1)	(2)	(3)	(4)	(5)	(6)
Co-worker	35.48***	35.99***	36.10***	-1.23	-1.23	-1.27
	(4.37)	(4.35)	(4.30)	(3.12)	(3.06)	(2.95)
Low endowment		-12.96**	-13.68**		13.41***	10.67***
		(5.69)	(5.71)		(3.75)	(3.70)
High endowment		-3.68	-3.96		4.58	1.86
		(5.61)	(5.59)		(3.75)	(3.68)
Male			-15.47***			4.32
			(4.24)			(3.02)
Age			-0.11			-0.018
			(0.79)			(0.52)
Grades			-0.23			0.066
			(0.19)			(0.14)
Campus			-0.90			15.16***
			(4.43)			(3.23)
Constant	-18.35***	-11.93**	18.28	51.23***	45.22***	34.41**
	(3.69)	(5.41)	(23.14)	(2.20)	(3.05)	(16.2)
Sigma	*45.50****	*45.11****	*44.42****	*29.21*** (1.24)*	*28.65*** (1.22)*	*27.64*** (1.17)*
	(2.26)	*(2.24)*	*(2.20)*			
Pseudo R2	*0.020*	*0.022*	*0.027*	*0.0001*	*0.004*	*0.013*
Observations	*598*	*598*	*598*	*358*	*358*	*358*

Note: The table shows expectations in a public good game and dictator game transfers, with results from Tobit regressions. *Contribution to dictator game* is expressed as a share of the bonus; *Expected contributions to public fund* as a share of the endowment. Explanatory variables are described in note to Table 3. Standard errors in parentheses, with *** p<0.01, ** p<0.05, * p<0.1

Table 4 shows that for expectations, the co-worker dummy is negative but not significant, which is in line with what was illustrated in *Figure 3*. Hence, workers expect higher contributions from a group of non-workers than from a group of co-workers, but not significantly so. Regressions 5 and 6 include additional controls, and we see that the low-endowment participants, that is, those with an endowment of nine euros, expect higher contributions from their fellow group members, which makes sense, as a low-endowment participant in our experiments will be grouped with high-endowment participants (18 euros).

Table 4 thus demonstrates that being grouped with co-workers has a strongly positive effect on willingness to share, and a slightly negative, although far from statistically significant, effect on expectations. Hence, our findings lend strong support to Hypothesis 1 in our theoretical framework, implying that $b_{(i|w)} < b_{(i|n)}$. In contrast, we find much less support for Hypothesis 2, implying that we cannot rule out that $t^e_{(i|w)} = t^e_{(i|n)}$. In sum, therefore, the driving mechanism of greater cooperation among workers in a homogenous group compared to a heterogeneous group is the higher degree of altruism between workers.

4.3 Inequality in both source and level of endowment

We run regressions on cooperation, altruism and expectations for equal and unequal endowment levels separately to see whether the response to inequality in source depends on inequality on other dimensions. Arguably, adding income inequality reduces the salience of effort, which may make respondents less sensitive to effort as source of inequality.

Table 5. Cooperation, altruism and reciprocity, by level of endowment

	Cooperation. Contributions in Public Good Game (Tobit)		**Reciprocity**. Expected contributions in Public Good Game (Tobit)		**Altruism**. Contributions in Dictator Game (Tobit)	
	(1)	(2)	(3)	(4)	(5)	(6)
Endowment levels	*Equal endowment*	*Unequal endowment*	*Equal endowment*	*Unequal endowment*	*Equal endowment*	*Unequal endowment*
Co-worker	12.60**	5.72	-5.75	0.96	49.50***	32.81***
	(6.20)	(4.17)	(5.27)	(3.51)	(9.39)	(4.77)
Low endowment		13.03***		9.20**		-10.75**
		(4.23)		(3.56)		(4.66)
Male	0.58	-1. 31	2.04	5.06	13.27	-20.60***
	(6.26)	(4.36)	(5.35)	(3.68)	(8.95)	(4.84)
Age	-0.72	1.89**	-0.54	0.57	2.72**	-1.47
	(0.87)	(0.93)	(0.73)	(0.78)	(1.21)	(1.03)
Grades	-0.31	-0.002	-0.16	0.11	-0.43	-0.16
	(0.29)	(0.19)	(0.25)	(0.16)	(0.41)	(0.21)
Campus	12.67*	6.30	5.56	18.57***	-0.44	-1.93
	(7.36)	(4.44)	(6.28)	(3.75)	(10.41)	(4.82)
Constant	56.48**	-15.12**	70.33**	17.15	-49.32	42.90
	(32.48)	(23.99)	(27.84)	(20.20)	(46.04)	(26.43)
Sigma	32.61***	31.68***	28.55***	26.74***	42.21***	43.90***
	(2.80)	(1.74)	(2.14)	(1.38)	(4.52)	(2.45)
Observations	120	240	120	238	120	478
Pseudo R2	0.0096	0.0079	0.003	0.0175	0.0510	0.0274

Note: Results from Tobit regressions where we group participants in *Equal endowment* (all 15 euros) and *Unequal endowment* (nine or 18 euros). Explanatory variables are described in Tables 3 and 4. Standard errors in parentheses, with *** p<0.01, ** p<0.05, * p<0.1

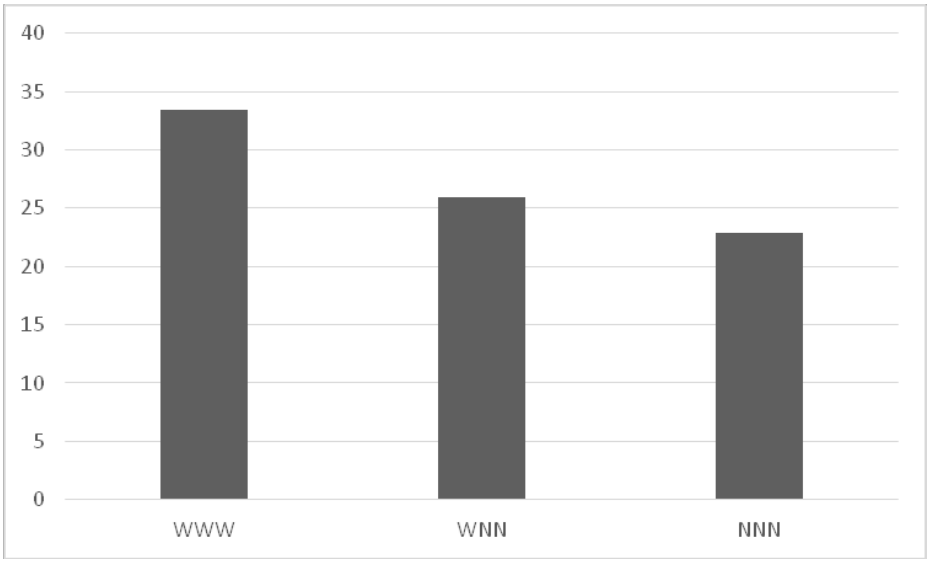
Table 5 shows that, in fact, the estimated coefficients on the Co-worker dummy for contributions both in the public good game and in the dictator game are much larger with equal endowments than with unequal endowments. These results speak to the experimental literature studying the importance of multiple types of inequality for cooperation: adding layers of inequality may well crowd out treatment effects.

4.4 Total public good contribution

So far, we have considered the impact of group composition on individual contributions to the public good. We have seen that workers' contribution goes down when grouped with non-workers compared to when grouped with other workers. But what happens to the contribution of non-workers? Source inequality might not be an issue in terms of sustaining the overall funding of a public good if, for instance, non-workers increase their contributions significantly when grouped with workers. In this case, the total effect on the public fund from increasing the level of inequality might not necessarily be negative.

Figure 4 illustrates the effect of group composition on total public good contribution in a situation of equal endowments (15 euros). We observe that the lowest total contribution to the group fund is in the all non-worker setting (NNN), with a contribution of around 23 percent of the total endowment, compared to the all-worker group with a contribution share of 33.4 percent. The middle bar shows total contribution in the case with one worker and two non-workers (WNN), and we observe that although non-workers slightly increase their average contribution (+3,6 percent) this effect does not compensate for the reduction in the contribution of the worker (-8,6 percent), resulting in total contribution of 26 percent, which is somewhat higher than in the all non-worker scenario, but far lower than in the all-worker scenario (WWW).

Figure 4. Total group funds, percent



Note: The figure reports total group contribution in the public good game with equal endowments (15 euros)

5. Conclusion

We measure cooperation using a linear public good game and randomly assign some individuals to endowment derived from work ("workers") and some to endowment without any effort ("non-workers"). Using a simple theoretical model, we propose altruism and reciprocity as key determinants of cooperation, and measure altruism based on a dictator game and reciprocity as expectations based on the public good game. We find that workers are significantly more cooperative when grouped with other workers than when grouped with non-workers.

In terms of mechanisms, we find large differences in altruism: workers are far more willing to share with other workers than with non-workers in a dictator game. In contrast, reciprocity is to a lesser extent contingent on group composition. Our paper thus lends support to the concerns regarding the adverse societal effects of inequality: increased inequality may lead to less cooperation and thus a less efficient outcome, driven by lower levels of altruism.

While our paper focuses on the choices of workers, we also explore how non-workers respond to different group environments. In particular, we are interested in whether increased contributions by non-workers can compensate for reduced contributions by workers in a heterogeneous group setting. We find that this is not the case: the total contribution to the public good is lower in a heterogeneous group than in a homogeneous group of workers. Finally, we analyze how adding inequality in income affects the sensitivity of workers to being grouped with non-workers, and find that adding this layer of inequality makes them less responsive to effort. Hence, there is a crowding out effect between the two, which we ascribe to the lower salience of inequality in effort in a more complex environment.

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Appendix 1: On the recruitment, sessions overview and pictures from the lab

A total number of 256 were recruited among students of the University of Bari "Aldo Moro" (Bari, Italy). Recruitment was done in several Faculties and from students belonging to different study levels in order to minimize the existence of previous links between participants in each group. Selected participants were randomly allocated to 9 different sessions that took place in two consecutive days in November 2015. A pilot (Session 1; composed by 16 participants) was initially conducted in order to test the experimental setting and define additional organizational details. The actual experiment was structured in eight additional sessions (Sessions 2-9)

Table A1. Description of the sequence of experimental sessions

Session number	Source of endowment	Endowment level (euros)	Number of participants
2, 5	Worker	15	60
3, 4, 6, 7	Worker	18	60
3, 4, 6, 7	Worker	9	60
8, 9	Non-worker	15	30
8, 9	Non-worker	18	30

Each participant performs a manual and repetitive task of cutting stripes of papers for 30 minutes. The task is performed in silence and without interactions with other participants.

The instructor explains the public goods game

Appendix 2. Lab instructions

This appendix contains the instructions for session 2, which was composed of participants who had undertaken an effort prior to making decisions ("workers") and who were allocated to equal endowments treatments, i.e., where all individuals received an initial endowment of 15 €.

The instructions are translated from Italian; the original instructions are available upon request from the authors.

Workshop 2 – time 11.30

Instructions (to be read to the participants before entering the lab-room)
Welcome and thank you for participating in this research workshop. All participants in this workshop are, like you, students of the University of Bari.

The purpose of the workshop is to analyse economic choices and is jointly organized by the University of Bari and the Norwegian School of Economics. All the information collected in this workshop will be treated confidentially, anonymously and will only be used for research purposes.

You will earn some money in this workshop. The money will be given to you in an envelope at the end of the workshop.

We ask that you do not talk to any other participant in the room during the entire duration of the workshop. If, at any time, you have a question, please raise your hand, and the research assistant will answer your question. Failure to comply with these instructions means that you will be asked to leave the workshop and you will receive no payment.

As there will be other workshops like this in the coming days, we kindly ask you not to talk about the content of this workshop until the end of the week.

There are 30 numbered seats in the room. A research assistant is waiting for you inside with a bag containing seat numbers. You will be asked to pick a seat number from the bag, proceed to the corresponding seat and wait silently until further instructions are given.

Do you have any questions at this point? If not, you may now enter the room.

First stage (only for those participants randomly allocated to treatments where a task has to be performed, i.e. workers)

Second stage. Instructions for the participants

- Please fill in your ID-number here:
  [ID number corresponding to the seat]

- We kindly ask that you to not talk to other participant in the room during the entire duration of the workshop

- Remain seated until the workshop is concluded.

- The duration of the workshop will be approximately 90 minutes. We will ask you to make economic decisions on which you can earn money.

- At the end of the session, a sealed envelope identified with your ID n° containing the earned money will be distributed to you by the research assistant in this room.

DO NOT TURN THIS PAGE UNTIL INSTRUCTED TO DO SO

1.1 Introduction to lab activity 1

As compensation for your work *[only for workers]*, you have received an **initial sum of 15 €.** *[or alternatively 9 € or 18€ in unequal endowment treatments]*,

In this first activity, you are randomly assigned to a group. The group is composed by yourself and two other participants.
You can decide to put your 15 € in two different accounts: **your private account** and a **group account**. Whatever is placed in the group account by the three members of your group is increased by 50% by us, and shared equally between the three of you. The money you put in the private account is not increased but goes directly to you.

Let us explain with three examples:

Example 1: If all the components of the group place 5 € in the group account, then there will be 5*3 = 15 € to which we will add 50% (equal to 7.5 €). The group account will now contain 15 + 7.5 = 22.5 €, which will then be divided equally in the group, so that each of you will get (22.5 € / 3 =) 7.5 €. Your total earning from this activity would then be:

> **17.5 €** = 10 € placed in your private account + 7.5 € from the group account.

***Example 2*:** If you place 0 € in the group account, and the other two participants place 5 € each, the group account will contain 5*2 = 10 € to which we will add 50% (equal to 5 €). The group account will now contain 10 + 5 = 15 €, which will then be divided equally in the group, so that each of you will get (15 € / 3 =) 5 €. Your total earning from this activity would then be:

> **20 €** = 15 € placed in your private account + 5 € from the group account.

Is this understood? Think about the following example:

***Example 3*:** If you place 15 € in the group account, and one participant places 5 € and the other 0 €, how much will you get?

The group account will contain _____€ to which we will add 50% (equal to ____€). The group account will now contain _____€, which will then be divided equally in the group, so that each of you will get _____€. Your total earning from this activity would then be:

> **_____€** = _____€ placed in your private account + _____€ from the group account.

[also read by the instructor] As you understand, your earnings in this activity will depend on both how much you and the other two participants decide to place in the group account.
We will ask you in this first activity to **make 2 choices** and, depending on your choices and similar choices made by others participants to whom you are randomly

allocated, your final earnings can be more, equal or less than 15 €. Your earnings will be based on only *one* of the two choices that you make. We will determine which choice is selected for the final payment randomly, one of the participants will throw of a die at the end of this workshop.

[Participants play the Public Good Game twice, respectively in homogeneous and heterogeneous groups; the sequence of choices has been randomized within and between sessions in order to avoid potential round effects]

1.2 Choice 1 *[heterogeneous group]*

You are randomly assigned to a group composed of three participants. The two other participants in your group have also received 15 €, which they can either place in their private account or in the group account. However, unlike yourself, the other participants in your group have received the 15 € *without making any effort*. Hence your group is composed of:

Group member 1 (yourself):	worker, 15 €
Group member 2:	non-worker, 15 €
Group member 3:	non-worker, 15 €

Your belief:
How much do you expect *on average* that the other members in your group will contribute to the group account? *Please write in the box below the amount of €, between 0 and 15, you expect they will contribute on average*:

I believe the other members in my group on average will contribute to the group account:	€

Your choice:
How much would *you* like to contribute to the group account? *Please write in the box below the total amount of €, between 0 and 15, you want to contribute*.

I would like to contribute to the group account with:	€

1.3 Choice 2 *[homogeneous group]*
You are randomly assigned to a group composed of three participants. All participants in your group have received 15 € which can either place in their private account or in the group account.

Like you, the two other participants have received 15 € as compensation for their work. Hence your group is composed of:

Group member 1 (yourself):	worker, 15 €
Group member 2:	worker, 15 €
Group member 3:	worker, 15 €

Your belief:
How much do you expect *on average* that the other members in your group will contribute to the group account? *Please write in the box below the amount of €, between 0 and 15, you expect they will contribute on average*:

I believe the other members in my group on average will contribute to the group account:	€

Your choice:
How much would *you* like to contribute to the group account? *Please write in the box below the total amount of €, between 0 and 15, you want to contribute*.

I would like to contribute to the group account with:	€

[Participants play the Dictator Game twice in equal endowment sessions, respectively in homogeneous and heterogeneous groups; the sequence of choices has been randomized within and between sessions in order to avoid potential round effects]

2.1 Introduction to lab activity 2

Randomly, half of you will be given a bonus of **5 €** from your activities.

We will again ask you to **make 2 choices**, and as before your earnings will be based randomly on one of the two decisions that you make.

The choices in this lab activity are different from the ones in the previous activity.

You can decide to place all or part of the 5 € in you own account or in the account of another participant that is randomly assigned to you, and who has not received the bonus. The other participant will get exactly what you give, and you will keep the rest.

2.2 Choice 1 *[paired with a worker]*

You have been paired with a participant who has been working and, like you, initially received 15 € for this effort. Hence, the pair consists of:

You:	worker, initial pay 15 €
Other participant:	worker, initial pay 15 €

How much of the 5 € bonus would you like to give to this other participant? *Please write in the box below the amount of €, between 0 and 5, that you wish to give:*

I want to give to the other participant:	€

2.3 Choice 2 *[paired with a non-worker]*

You have been paired with a participant who has *not* been working, but has also initially received 15 €. Hence, the pair consists of:

You:	worker, initial pay 15 €
Other participant:	non-worker, initial pay 15 €

How much of the 5 € bonus would you like to give to this other participant? *Please write in the box below the amount of €, between 0 and 5, that you wish to give:*

I want to give to the other participant:	€

Final stage. Selection of rewarded choices and payments

The Instructor asks one participants to toss a die with only two values (1 and 2) in order to select which choices will be rewarded [example: if 2 is selected, final payoffs will be computed based on choice 2 both for the Public Good Game and the Dictator Game.

The Instructor asks one participants to toss a die with only two values (1 and 2) in order to determine which participants (from 1 to 15 or from 16 to 30) will be rewarded based on their selected choice on the Dictator Game.

While the experimenters compute the final rewards and prepare the envelops containing final payments participants are asked to complete a brief questionnaire which collects basic information.

Envelopes are distributed and the experimenter thanks participants asking them again not to talk about the content of this workshop until the end of the week.