Real-effort in the Multilevel Public Goods Game☆

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Abstract

We investigate the extent to which a real-effort effect and an inequality effect impact individuals' prosocial behavior in the multilevel public goods game. We explore two symmetrical treatments: one where everyone participates in a preliminary task to obtain their initial endowment, and another where no one does, to assess the real-effort effect. Additionally, we examine two asymmetrical treatments where only individuals from one local group engage in the preliminary task to study the inequality effect. We find evidence that the contribution to the local public good is stable across all treatments, while the contribution to the global public good is significantly lower when both groups perform the preliminary task.

JEL classification: $C90$; $D71$; $H4$
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☆The preregistration and the replication files can be accessed at: https://osf.io/yrz4g/.

1 Introduction

Horizontal inequality, which denotes disparities between social groups, represents a significant socioeconomic challenge that poses threats to societal cohesion and group integration across diverse contexts. Indeed, group segregation and unequal access to fundamental resources, like education, often exacerbate these inequalities, fostering in-group favoritism and hindering social cooperation (Tajfel, 1982). We aim to leverage the structure of the Multilevel Public Goods Game (MLPGG) to examine how intergroup disparities impact individuals' pro-sociality. Specifically, we aim to investigate to what extent between-group inequality in the effort required to access the initial endowment affects subjects' propensity to cooperate and to include out-group members within the benefit of social cooperation.

The MLPGG entails experimental subjects having the possibility to contribute to two public goods connected in a nested structure (Blackwell and McKee, 2003). Each subject is assigned to a local group, that is embedded in a global group composed of other local groups. Thus, a trade-off between contributing to the public good of the local group (local public good, henceforth) and the global one (global public good, henceforth) emerges and subjects are in the position to decide to what extent including or excluding members of the other group into the benefit of cooperation (Buchan et al., 2009, 2011; Chakravarty and Fonseca, 2017). While the MLPGG literature has thoroughly investigated the role of efficiency,[1] there is still limited exploration of inequality among subjects belonging to different groups. Yet, the MLPGG's group structure proves to be well-suited for examining the behavioral consequences not only of vertical but also horizontal inequality. To the best of our knowledge, only Lange et al. (2022) addressed horizontal inequality by studying how differences in the initial endowment affect participants' contributions in a MLPGG. Their results suggest that inequality arising from the arbitrary allocation of different initial endowments (i) reduces contributions to the global good from individuals with a high endowment and (ii) enhances cooperation among individuals with a low endowment for their local good.

In this paper, we move beyond the kind of inequality that arises from the windfall distribution of economic resources and address (in)equality of opportunities resulting from disparities in individuals' effort to access those resources.

To achieve this, our MLPGG comprises four conditions. On the one hand, by designing two symmetric conditions where either *i*) local groups have to gain their personal endowment by performing a real-effort task or *ii*) they both obtain their endowment without any effort, we are able to investigate whether the source of the endowment has an effect on contribution decisions *per se* (real-effort effect). On the other hand, by designing two asymmetric conditions where either *i*) only the subject's local group has to perform the real-effort task, while the other local group has not to, or *ii*) the subject's local group receives personal endowments without performing the real-effort task while the other have to perform it, we are able to investigate whether the perception of between-group inequality affects contributions to the different public goods (inequality effect).

[1] A common result is that while agents tend to contribute to public goods that directly benefit their local group, they also respond to efficiency by contributing more to the PG with higher returns (Gallier et al., 2019; Catola et al., 2023)

The disentanglement between the effect due to the origin of the endowment, also known as the house money effect, and the effect stemming from the unequal distribution of the endowment within group, has been extensively investigated in the literature on standard public good games (Clark, 2002; Cherry et al., 2005; Harrison and El Mouden, 2011; Muehlbacher and Kirchler, 2009; Spraggon and Oxoby, 2009). For instance, Cherry et al. (2005) underscored that while the origin of wealth does not influence contributions, within-group earnings heterogeneity leads to decreased contributions in a linear public goods game, emphasizing the impact of within-group heterogeneity. Interestingly, Antinyan et al. (2015) introduced a novel source of heterogeneity. In their experimental design, with all other things being equal, half of the individuals in the group receive their endowments conditional on succeeding in a real-effort task, while the other half of the same group receive their endowments as a windfall. They found that, in heterogeneous groups, both effort and windfall subjects tend to make similar contributions.

Based on these findings, we anticipate that the house money effect could impact subjects' level of pro-sociality. We expect that in the treatment where all subjects must exert real-effort to obtain their initial endowment, prosocial behavior will be lower compared to the treatment where no one has to make an effort, due to the absence of attachment to earned money in the latter case. However, the MLPGG renders nontrivial the impact of the house money effect: the extent to which it influences decisions on contributing to local, global, or both goods is a novel aspect not observable in a standard public good game. On the other hand, considering the mixed evidence produced by the disparities in the distribution of endowments in the literature on standard public good games, we seek to explore the impact of extending these disparities into the horizontal dimension between groups on individual decision-making – i.e., our asymmetric conditions. In fact, the MLPGG's structure would not only allow us to isolate this feature but also examine whether social expectations between groups and group identity, albeit minimal, play a role in the contribution decisions of subjects.

We find evidence of the absolute effect of the real-effort task. In line with the house money effect literature - especially Harrison (2007) - performing the real-effort task in the symmetric condition makes subjects less prosocial. Nevertheless, by implementing a MLPGG rather than a standard public good, we have observed that subjects decrease their aggregate contribution by contributing less to the global PG. In the asymmetric cases, where only one group performs the real-effort task, no significant differences are observed, thus leaving us with no substantial results concerning the inequality effect. In what follows, we present the details of our design (sec 2) and results (sec 3), before discussing a possible interpretation of the produced evidence in terms of entitlement, group identity, and sense of justice (sec 4).

2 Design and Procedure

The experiment was pre-registered on AsPredicted (#130463), implemented using oTree (Chen et al., 2016), and conducted on Prolific (Palan and Schitter, 2018) in April 2023. All participants in our study participated in a one-shot MLPGG task, structured as follows. Each subject was randomly and anonymously assigned to a local group of 4 members, which together with another local group of equal size forms

a global group of 8 players (Figure 1).

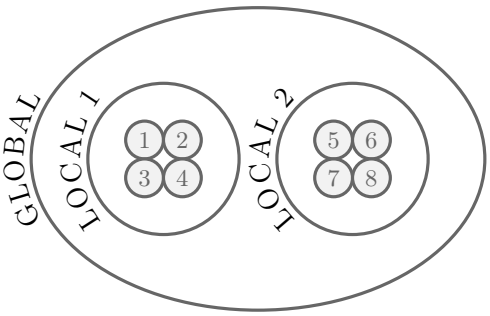

Figure 1: Structure of a Multilevel Public Goods Game.

Subjects decided how to allocate their initial endowment of 10 tokens among three alternatives: their private account, the local PG and the global PG. Accordingly, the payoff of player i was equal to:

$$\pi_i = 10 - c_i - C_i + \alpha \sum_{j=1}^{4} c_j + \beta \sum_{k=1}^{8} C_k. \tag{1}$$

where c is the individual contribution to the local PG, and C the individual contribution to the global PG; α and β are the MPCRs of the local and global PGs, respectively. We fixed $\alpha = 0.6$ and $\beta = 0.45$ to impose a trade-off between the two kinds of contribution. Indeed, the local contribution has a lower opportunity cost (since $\alpha > \beta$) while the global PG can potentially provide higher earnings (as $4\alpha < 8\beta$). These parameters are the same as those in treatment T3 in Catola et al. (2023), where subjects contributed higher shares of their endowments to the global public good than to the local.

We devised a 2x2 design with 4 treatments that vary following two kinds of manipulations. The first kind of manipulation concerns the source of the endowment *per se*, i.e. whether the individuals have to perform the real-effort task to obtain the endowment to be contributed in the MLPGG task. The second kind of manipulation concerns inequality between groups in the source of the endowment, i.e. whether there is symmetry or asymmetry in the effort required to obtain the initial endowment between groups. For the real-effort task, we relied on the *encryption task* that consisted of encoding letters from a string of numbers given a conversion table (Erkal et al., 2011). Subjects were asked to complete three correct encodings before being allowed to move to the MLPGG task. After the MLPGG task, subjects were asked to reply to four non-incentivized questions aimed at eliciting their expectations about contributions and normative beliefs by members of the other local group and two questions eliciting social and risk preferences (Dohmen et al., 2011; Falk et al., 2023, respectively).[2]

We recruited 527 subjects in the US, distributed across treatments almost in equal numbers. We determined the sample size through an ex-ante power analysis aiming to detect small standardized effect sizes (0.25) at a significance level of 5%

[2]Experimental instructions are in the Appendix D.

with a minimum power of 80%.[3] Table 1 summarises the treatments including sample sizes:[4]

Treatment	Task	Symmetry	N
Baseline (BL)	No	Yes	140
Group effort (GE)	Yes	No	135
Other effort (OE)	No	No	131
Both effort (BE)	Yes	Yes	121
Total			527

Table 1: List of treatments indicating the number of observations (N) for each treatment and specifying whether real effort (Task) and between-group (a)symmetry (Simmetry) is implemented.

The conversion rate was 1 token = 0.025 USD and the average payment was 0.93 USD (12.19 USD per hour), inclusive of a show-up fee of 0.50 USD. On average, the entire experiment lasted approximately 4 minutes, with the real-effort task taking approximately 70 seconds to complete.

3 Results

Figure 2 presents the average contributions to both the local and the global PGs and their sum. Starting from the baseline, the global contribution is higher than the local contribution (Wilcoxon signed-rank, p = 0.0158), aligning with the findings of Catola et al. (2023). However, in the other three treatments, there is no significant difference between local and global contributions.

We observe similar levels of contribution to the local PG but a greater heterogeneity concerning contribution to the global one. Specifically, the contribution to the global PG is lower in *BE* compared to *BL* and *GE*, but it is not significantly different with respect to *OE* (Mann–Whitney: $BEvsBL$, p = 0.0090, $BEvsOE$, p = 0.1653, $BEvsGE$, p = 0.0287). The total contribution – i.e. the sum of the contributions to the local and the global public goods – is lower in *BE* compared to all other treatments (Mann–Whitney: $BEvsBL$, p = 0.0788, $BEvsOE$, p = 0.0326, $BEvsGE$, p = 0.0318).[5] To corroborate our results, we conduct an OLS regression analysis using the local, global, and total contributions as dependent variables and our treatments as regressors. The results confirm the previous analysis (see Table 2 and Appendix C.1 for the complete table).[6] Moreover, Hurdle models show that most effects of our treatments (compared to the BL) occur on the intensive margin. Specifically, we observe a significant negative intensive margin both in the BE

[3] Our sample size is based on an ex-ante analysis that aligns with Gallier et al. (2019), who also implemented online a one-shot MLPGG design, but testing for MPCR effects. Although our treatment intervention differs, it can still be considered a reasonable prior for the effect size.

[4] While sample sizes vary across treatments, we have ruled out endogenous dropout as a factor influenced by experimental conditions, as detailed in Appendix B.

[5] These results remain robust after implementing corrections for multiple testing using the Benjamini and Hochberg (1995) method. The corrected p-values for contributions to the Global PG are as follows: $BEvsBL$, q = 0.0270, $BEvsOE$, q = 0.1653, $BEvsGE$, q = 0.0431, while for total contributions: $BEvsBL$, q = 0.778, $BEvsOE$, q = 0.0489, $BEvsGE$, q = 0.0489.

[6] In Appendix C.2, we report Tobit models that confirm our main findings.

condition for global and total contributions and in the OE condition for global contribution. Concerning the extensive margin, participants in the OE condition exhibit a higher inclination to contribute to the local public good (see Appendix C.3).

An exploratory investigation concerning empirical expectations – subjects' beliefs about contribution decisions by members of the other local group – suggests that a form of conditional cooperation might explain decisions in our MLPGG setting. First, participants expect others to contribute less to the global public good in BE than in BL. Second, empirical expectations tend to affect participants' contribution behavior. Specifically, once contributions are regressed against empirical expectations, we observe that a) participants contribute less (more) to the local public good if they expect that members of the other group contribute less (more) to their local public good; b) participants contribute less (more) to the global public good, if they expect that members of the other group contribute less (more) to the global public good (see Appendix C.4).[7]

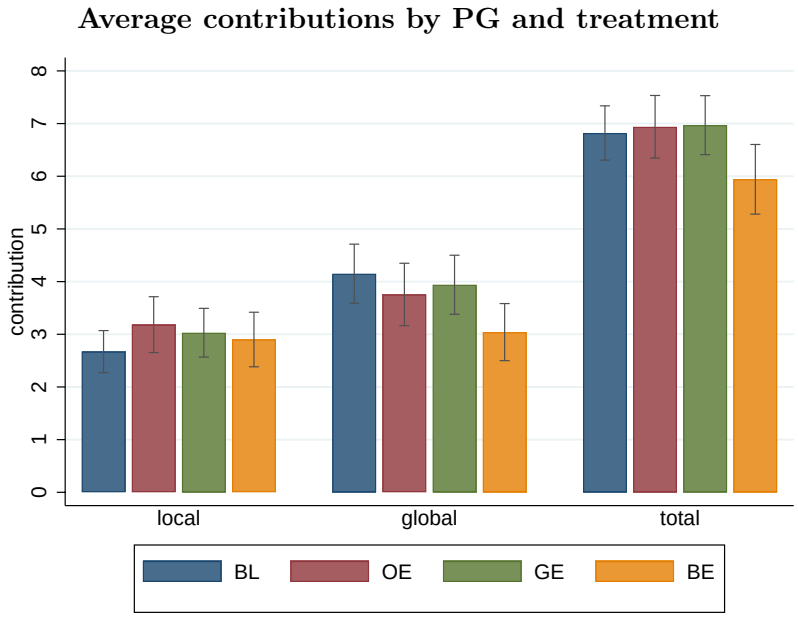

Figure 2: Average contributions by PG and treatment. The left stacks report the average contribution to the local public good by treatment. The central stacks report the average contribution to the global public good by treatment. The right stacks report the average total contribution (local + global) by treatment. Treatments are identified by color. Confidence intervals are at 95%.

[7]In Appendix C.4, we also present descriptive statistics and analyses about normative expectations – i.e. subjects expectations about the normative beliefs held by members of the other local group. The results concerning the correlation between normative expectations and contribution decisions are consistent with the ones concerning empirical expectations. Despite its relevance, the evidence concerning empirical and normative expectations is subject to limitations mainly due to the circumstance that their elicitation is not incentivized.

	(1) local	(2) global	(3) total	(4) local	(5) global	(6) total
BL (omitted):						
▷ OE	0.512	-0.394	0.118	0.536	-0.482	0.0542
	(0.338)	(0.416)	(0.400)	(0.335)	(0.408)	(0.407)
▷ GE	0.358	-0.209	0.149	0.336	-0.272	0.0635
	(0.311)	(0.404)	(0.387)	(0.314)	(0.398)	(0.393)
▷ BE	0.229	-1.109***	-0.879**	0.254	-1.155***	-0.901**
	(0.333)	(0.397)	(0.427)	(0.327)	(0.401)	(0.429)
controls				✓	✓	✓
Wald test (p-values):						
▷ OEvsGE	0.6683	0.4543	0.7157	0.5745	0.4471	0.8165
▷ OEvsBE	0.6560	0.0811	0.0237	0.6072	0.1009	0.0281
▷ GEvsBE	0.9397	0.0280	0.0201	0.9821	0.0330	0.0273
N	527	527	527	527	527	527

Table 2: OLS regressions with standard errors in parenthesis. The dependent variable is either local contribution (columns 1 and 4), global contribution (columns 2 and 5) or total contribution (columns 3 and 6). The main explanatory variables are the treatment dummies. The coefficients of the control variables are available in Appendix C.1. For each column we also report the p-values of the pairwise Wald tests on the null hypothesis that there is no difference between coefficients of the different treatment dummies. *p<.10, **p<.05, ***p<.01.

4 Discussion and Conclusion

Our multilevel public good game study produced two main results. First, in our Baseline setting subjects contribute more to the global public good than to the local one, thus replicating the benchmark evidence of Catola et al. (2023). Second, we find evidence of a real-effort effect, since in the symmetric setting with no differences in the initial conditions of the local groups, the real-effort task makes subjects decrease their total contribution while decreasing only the contribution to the global public good. The evidence concerning asymmetry and inequality in the initial condition of the two groups produced no clear evidence and would need further investigation.

We propose a twofold interpretation of the real-effort effect in the BE treatment: the sense of entitlement (Ortiz et al., 2023; Harvey and Martinko, 2009; Cherry et al., 2005) and the house money effect (Bailey et al., 2023; Hackinger, 2016). The former refers to what individuals believe, namely the fact that they inherently deserve certain privileges or resources. Here, individuals might display less prosocial behavior as their actions might be influenced by the awareness of having performed a real-effort task. This task could emphasize their effort, overshadowing the game's rules and the most socially efficient solution to the MLPGG. The latter connects to the perception of money and risk-taking decisions based on the source of the endowment. Subjects might exhibit a greater willingness to take risks or make higher contributions when perceiving the money as 'won' or separate from their personal funds. Since our participants in BE exerted an effort, they could have perceived their initial

endowment as 'their own money', leading them to make less risky contributions and keep more money for themselves - this would explain the difference observed in contributions between BE and the baseline.

Regarding the inequality effect, one could expect that introducing asymmetry would induce subjects to contribute relatively more to the local public good, as inequalities could tend to reinforce in-group favoritism. Even though Lange et al. (2022) provided unequal initial endowments by exogenously creating rich and poor groups, our aim here was to generate inequality in the access to resources - indeed our subjects' initial endowment remains identical for everyone, regardless of whether it was earned through the task or received effortlessly. The fact that the members of the two local groups had the same endowment could have made the initial inequality less focal, thus potentially cancel out the treatment effect. Moreover, it must be observed that the effect of inequality cannot be fully disentangled from the real-effort effect. A more comprehensive design, investigating potential interactions between the two effects could help in clarifying the role of inequality in the access to resources in the multilevel public good structure.

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