Received: 7 December 2020 | Accepted: 23 March 2022

DOI: 10.1111/jpet.12588

ORIGINAL ARTICLE

JOURNAL OF PUBLIC ECONOMIC THEORY WILEY

An examination of the effect of inequality on lotteries for funding public goods

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Abstract

We experimentally study the impact of inequality on the effectiveness of contests for funding public goods in a development context. We observe that the typical result of a lottery funding mechanism leading to greater funding for the public good than predicted by theory extends to groups with inequality. However, while theory suggests that increased inequality should lower total contributions to a lottery funded public good, we observe the opposite pattern. This result differs from prior results for the standard voluntary contribution mechanism where increased inequality has been found to reduce public good provision. Moreover, we find that the poor do not contribute a greater share of their endowment to the public good than do the wealthy. Thus, overall our study demonstrates the potential for community development projects, when funded with a lottery mechanism, to be highly successful even in the presence of inequality and may facilitate a progressive redistribution of wealth.

1 | INTRODUCTION

The World Bank alone spent $85 billion on participatory development in a 10-year period in the early 2000s, and countless other organizations have provided at least as much additional funding for such efforts (see Mansuri & Rao, 2013). Of central importance to such efforts is how to encourage local participants to contribute to these public good projects. While difficult to assess in practice, under-provision relative to the first-best level is common in laboratory studies because of the free-rider problem (Andreoni, 1988a; Bergstrom et al., 1986; Isaac &

Walker, 1988). While a wide variety of solutions have been offered to solve the free-rider problem (see D′Aspremont & Gerard-Varet, 1979; Groves, 1973; Groves & Ledyard, 1977; Moore, 1992; Walker, 1981), these mechanisms are usually predicated on the ability to levy taxes or impose penalties. However, such levers are typically unavailable to nongovernment organizations or others trying to help developing communities, especially where government is weak or ineffective. Given the many circumstances where coercion is not feasible, there has been a concerted effort to identify alternative incentive-based mechanisms to encourage the provision of public goods.

One alternative approach for increasing the voluntary provision of public goods is to connect the funding to lotteries and auctions (Bose & Rabotyagov, 2018; Dale & Morgan, 2010; Davis et al., 2003; Franke & Leininger, 2014, 2018; Jindapon & Yang, 2020; Lange et al., 2007; Morgan, 2000). These mechanisms work by providing a private benefit to those who contribute to the public good. For example, a fundraiser could conduct an auction with the proceeds being used to fund the public good (Foster, 2020). Or a fundraiser could conduct a raffle for some prize and use the collected money to pay for the public good, or equivalently give those who donate to the public good raffle tickets based on their contributions.[1] Morgan (2000) and Lange et al. (2007) show that funding public goods using lotteries results in more money being provided for the public good than a simple voluntary contribution mechanism alone.[2] Bose and Rabotyagov (2018) report that combining a lottery with a small prize and setting a threshold level for total contributions yields higher levels of public goods provision than a lottery alone.[3] Comparing lotteries and auctions, Corazzini et al. (2010) and Duffy and Matros (2013) find lotteries outperform the all-pay-auction, and Davis et al. (2003) find lotteries outperform English auctions.

However, as argued by Mansuri and Rao (2013), actual development efforts often involve many complexities that have generally been ignored in the extant literature. Two such complexities that are critical to understand for development efforts are the heterogeneity in wealth among group members and the near subsistence conditions that are present in many communities, by which we mean a wealth level so low that all of one's wealth goes to sustenance. Oxoby and Spraggon (2013) argue that heterogeneity leads to less investment in social capital and consequently lower levels of public goods provision. Using data on US localities, Alesina and Ferrara (2000) find that income inequality has a strong negative influence on participation in supporting public goods. The funds from the World Bank and other nongovernment organizations have been invested in developing countries from South Africa, which has very high income inequality to Ukraine, which has a relatively low level of inequality.

Whether the success of lotteries in encouraging contributions to public goods in the laboratory can be translated into an effective tool in assisting developing communities depends, at least in part, on how factors such as inequality and subsistence poverty interact with the performance of such lottery schemes. Past research on inequality has generally found it to have

[1]An alternative approach is to use an all pay auction format where the prizes are awarded to the top donors as in Goeree et al (2005) and Faravelli (2011).

[2]This result is contingent on certain conditions like the interaction of group size, participation costs and rivalry of the public good, which together can support the Olson (1965) hypothesis even with the lottery mechanism (Pecorino and Temimi, 2007; and Conlon and Pecorino, 2021).

[3]Bose and Rabotyagov (2018) also show that lotteries with minimum funding thresholds also outperform public goods games with funding thresholds alone as in Cason and Zubrickas (2017).

a negative impact on investments with standard voluntary contributions mechanisms (e.g., Balafoutas et al., 2013; Cadigan et al., 2011; Cherry et al., 2005; Fung & Au, 2014; Hargreaves Heap et al., 2016; Keser et al., 2014; Nitta, 2014; Rapoport, 1993; Seçilmiş & Güran, 2012; and Gächter et al., 2017) although some have found inequality to have no effect (e.g., Bergstrom et al., 1986; Buckley & Croson,2006; Chan et al., 1996, 1999; Hofmeyr et al., 2007).[4]

Given that inequality can be quite stark in many developing communities, if inequality has a negative effect for lottery funding mechanism it would cast doubt on the ability of such schemes to work in development contexts. This paper seeks to provide insight into this issue using controlled laboratory experiments. Specifically, in a between-subjects design we systematically vary the level of wealth inequality while holding aggregate wealth fixed. The next section develops the theoretical model that serves as the basis for the experiments. Section 3 describes the experimental design that incorporates both inequality and subsistence poverty, while the experimental results are presented in Section 4. As a preview of the results, we find that, contrary to the theoretical predictions, total contributions do not decrease as inequality increases. Further, we find that groups with heterogeneous endowments become more egalitarian as the relatively wealthy agents contribute a greater share of their wealth.[5] A final section contains a brief discussion.

2 | THEORETICAL MODEL

First, consider a group of N agents who face a standard linear public goods problem. Agent i is endowed with $\omega_i$units of a resource. Each agent privately and simultaneously decides what amount of their endowment to consume privately and what amount to contribute toward the public good. Let x_i denote the amount agent i consumes privately, $g_i = \omega_i - x_i$ denote the amount the agent contributes to the public good, and G_{-i} denote the total contribution to the public good made by the $N-1$ agents excluding i. Without loss of generality, the marginal benefit of private consumption is normalized to 1 for all players. Further, the marginal benefit to every player of each unit of the resource contributed to the public good is $\alpha \in (1/N, 1)$. Considering the development setting motivating this study, we allow for the possibility that some agents may be at or below a subsistence level, $\bar{x}$, and hence not in a position to spend any of their endowment on the public good. That is, for any agent i such that $\omega_i \le \bar{x}$, $g_i \equiv 0$. The payoff to these "poor" agents is thus given by $\pi_i = \omega_i + \alpha(G_{-i})$. The payoff to players whose endowment exceeds the subsistence level is given $\pi_i = \omega_i - g_i + \alpha(g_i + G_{-i})$ with the constraint that $g_i \le \omega_i - \bar{x}$. Because all N agents receive α for each unit of resource contributed to the public good, the socially optimal outcome is for each agent to donate as much of their endowment as possible to the public good (i.e., $g_i = \omega_i - \bar{x}$ if the agent is not poor). However, because $\alpha < 1$, agent i has a dominant strategy to set $g_i = 0$ even if her endowment exceeds the subsistence level. Thus, absent other incentives all agents will free-ride on provision of the

[4]Other researchers have considered the effects of heterogeneity in other forms on public goods provision, such as variation in the individual returns from the public good (e.g., Gangadharan et al., 2017; Nikiforakis et al., 2012; Noussair & Tan, 2011; and), preferences (e.g., Chan et al 1999), or group size (e.g., Olson, 1965; and Pecorino & Temimi, 2008).

[5]This progressivity contrasts with studies of the voluntary contributions mechanism that find public goods provision is regressive (e.g., Buckley & Croson, 2006; Chan et al., 1996, 1999; Gächter et al. 2017; Hargreaves-Heap et al., 2016; Keser et al. 2014; Rapoport 1988).

public good in equilibrium and this outcome does not depend on the distribution of endowments.

Now consider the situation where there is a Tullock style contest implemented to encourage contributions to the public good as in Morgan (2000). In particular, there is a contest in which a prize Z is given to one of the agents who contributes to the public good.[6] Agent i's probability of winning the contest and thus receiving the prize is $\frac{g_i}{G_{-i}+g_i}$ if $g_i > 0$ and is 0 otherwise.[7]

The very poor agents whose endowment is at or below the subsistence threshold are forced to free-ride, which also makes them ineligible for the prize. The optimization problem for an agent for whom $\omega_i > \bar{x}$ is given by (1).

$$\max_{g_i} \omega_i - g_i + \frac{g_i}{G_{-i} + g_i} Z + \alpha(g_i + G_{-i}) \text{ subject to } g_i \le \omega_i - \bar{x}. \tag{1}$$

The equilibrium for this game is given in proposition 1.

Proposition 1. *In the unique equilibrium, there will be an endowment level* $\omega^+ \ge \bar{x}$ *such that any agent* j *for whom* $\omega_j \in (\bar{x}, {}^{\omega+})$ *will contribute* $g_j = \omega_j - \bar{x}$ *and all agents whose endowment exceeds* ω^+ *will contribute* $g^* = \frac{Z(N_I-1) - 2(1-a)N_I G^B + \sqrt[2]{4(1-\alpha)ZN_I^2G^B - 4(1-\alpha)N_I(N_1-1)ZG^B + Z^2(N_I-1)^2}}{2N_I^2(1-a)}$ *where* N_B *is the number of agents for whom the constraint in* (1) *is binding, and* N_I *is the number of agents contributing* g^*.

Proof. See Appendix A. □

Intuitively, Proposition 1 shows that all of the agents who are sufficiently poor (i.e., have an endowment below the threshold ω^+) will contribute all of the money they can to the public good. Wealthier agents will all contribute equally with the amount dependent on the number of wealthy agents and the amount spent by the poor agents.

3 | EXPERIMENTAL DESIGN

3.1 | Treatments

To examine the impact of inequality on behavior in a public goods provision game with a contest reward for contributions, we conducted a between-subjects design with four treatments. For every treatment, the group size is $N = 8$ and the marginal per capita return from the public good is $\alpha = 0.5$. The subsistence level is set at $\bar{x} = 90$ meaning any individual with an endowment below this level cannot contribute to the public good. The prize used to encourage giving to the public good is $Z = 240$. Because the prize is awarded to a single person, this could increase ex post inequality. An alternative approach would be to award the prize in proportion

[6]An alternative approach is to endogenize the reward by making it a fraction of the total amount contributed to the public good. However, the setting we have in mind is one where charitable agencies are providing aid for the purpose of fostering development in areas of extreme poverty.

[7]In the event no agent contributes to the public good then the prize is not awarded to anyone.

to each person's contribution. Under the assumption of risk neutrality, these two approaches should generate the same level of total contribution. However, Cason et al. (2020) and Chowdhury et al. (2014) show that the probabilistic prize that we implement generate greater investment. Thus, this design choice gives the contests the greatest chance of increasing funding for the public good.

The four treatments vary the endowments of the players in the group, while holding the total endowment of the group constant. The treatment *Low Inequality A* generally aligns with Corazzini et al. (2010), which compares public good funding using voluntary contributions mechanisms to lottery funding mechanisms in the presences of inequality, but does not consider the effect of varying inequality. However, there are some potentially important differences between the studies. First, in our study there are eight players in a group rather than four. Second, in our groups the number of agents with each endowment level was always two, whereas this number varied in Corazzini et al. (2010).[8] Additionally, in our study everyone had full information about the endowments of the other agents whereas in Corazzini et al. (2010) agents only knew the distribution of possible endowments for other members of the group.[9] For the *No Inequality* baseline, the 1440 total endowment is split equally among the eight participants so that each person starts with 180. The third treatment (*Low Inequality B)* considers a reallocation of endowments such that the initial GINI coefficient is 0.139 just as it is for *Low Inequality A*. This GINI value is very low in comparison to the inequality present in many developing countries. In fact, the World Bank data catalog indicates no country had a Gini coefficient as low as 0.139 between a reference period spanning 2010 to 2019.[10] The fourth treatment, *High Inequality*, was designed to yield a GINI coefficient of 0.5, which is approximately the 90th percentile of national level GINI coefficients around the world in the same 2010 to 2019 reference period.

Table 1 summarizes the four treatments. The table also provides the equilibrium contribution for each agent in each treatment as well as the total amount that would be contributed to the public good. Further, the table shows each agent's equilibrium probability of receiving the prize and expected payoff from the game. Table 1 reveals a clear ordering in terms of total contributions across the treatments with *No Inequality* expected to generate the most and *High Inequality* expected to generate the least. However, as *Low Inequality A* is expected to generate greater contributions than *Low Inequality B* despite the two treatments having the same GINI coefficient, it is clear that increased inequality as measured by the GINI coefficient does not necessarily result in reduced total contributions.

Table 1 also provides the expected ending GINI coefficient after accounting for the prize. It is important to keep in mind that the ending GINI coefficient is a random variable because the allocation of the prize is stochastic. For this reason, Table 1 shows the expected payoff for each player. Generally, the contest serves to lower expected inequality, although for *No Inequality* it necessarily creates inequality where there was none initially since someone receives the prize. Further, the reduction in inequality is most pronounced for the *High Inequality* treatment. As a final point, in all four treatments the amount contributed to the public good as a result of the

[8]We increased the size of the group and put two people at each endowment level so that the outcome was less sensitive to individual idiosyncrasies in behavior.

[9]We do not expect this aspect of our design to have much effect on behavior compared to the alternate design of Corazzini et al. (2010) since extreme deviations from the expected distribution is unlikely in their study. For instance, the probability that a group in Corazzini et al. (2010) is comprised of only poor or only rich subjects is less than 0.001.

[10]World development indicators. Washington, DC: The World Bank. Data retrieved April 27, 2020.

TABLE 1 Treatment parameters and equilibrium predictions

	No inequality				Low inequality A				Low inequality B				High inequality			
i	ω_i	g_i	pi	$E(\pi_i)$	ω_i	g_i	pi	$E(\pi_i)$	ω_i	g_i	pi	$E(\pi_i)$	ω_i	g_i	pi	$E(\pi_i)$
1	180	52.5	0.125	368	120	30	0.073	313	90	0.0	0.00	290	30	0.0	0.00	194
2	180	52.5	0.125	368	120	30	0.073	313	90	0.0	0.00	290	30	0.0	0.00	194
3	180	52.5	0.125	368	160	58.6	0.142	341	200	66.7	0.167	373	60	0.0	0.00	224
4	180	52.5	0.125	368	160	58.6	0.142	341	200	66.7	0.167	373	60	0.0	0.00	224
5	180	52.5	0.125	368	200	58.6	0.142	381	210	66.7	0.167	383	150	60	0.183	298
6	180	52.5	0.125	368	200	58.6	0.142	381	210	66.7	0.167	383	150	60	0.183	298
7	180	52.5	0.125	368	240	58.6	0.142	421	220	66.7	0.167	393	480	103.9	0.317	616
8	180	52.5	0.125	368	240	58.6	0.142	421	220	66.7	0.167	393	480	103.9	0.317	616
Σ	1440	420	1.000	2940	1440	411.6	1.000	2914	1440	400	1.000	2880	1440	327.8	1.00	2663
Initial GINI coefficient			0.000				0.139				0.139				0.500	
Expected ending GINI coefficient			0.071				0.114				0.105				0.263	
Contributions in excess of prize			1260				1234				1200				983	
g*			52.5				58.6				66.7				103.9	

contest is greater than the prize size. This means that an outside agency attempting to help with the provision of the public good would prefer to operate the contest rather than simply donating the prize money to the public good.

3.2 | Procedures

In each session there were two separate groups of eight participants each seated at individual computer stations visually separated by privacy dividers. Having multiple groups in each session helped to ensure that no one knew who was in their group. Subjects read computerized instructions, which are provided in Appendix B. Once everyone in the group had completed the instructions, each person was informed of their endowment and the endowments of the other group members. The participants were also informed that both group members and endowments were fixed for the duration of the study, which was 20 periods. Endowments were held fixed rather than randomized each period so as not to suggest an egalitarian motive or preference on the part of the researcher which could generate an experimenter demand effect (Zizzo, 2010). This procedural aspect of our study is also consistent with Corazzini et al. (2010) where each subject's endowment level is fixed throughout the experiment. However, while we maintain fixed groups in the experiment (partners protocol), Corazzini et al. (2010) employ random rematching each period (strangers protocol). The choice between a partners and strangers protocol relates to the effect they may have on cooperation in public goods experiments. However, it is not clear that fixed groups lead to more (or less) cooperation relative to random rematching. Morgan and Sefton (2000) use both fixed and rematched groups and found that the base level behavior does not vary substantially between the two. Moreover, studies such as Andreoni (1988b) and Palfrey and Prisbrey (1996) found that fixed groups made lower contributions, while other studies such as Keser (1996), and Keser and van Winden (2000) found the opposite. Furthermore, we believe the fixed matching protocol better matches the development setting on which we are focusing and therefore chose to implement that.

In this finitely repeated game with a known horizon, the Nash-equilibrium is for each player to follow their stage game Nash-equilibrium strategy in every period. In each of the 20 decision periods, every person decides how to allocate his or her endowment to either an *individual account* or a *group account*, assuming the endowment exceeded the subsistence threshold (i.e., $\omega_i > \bar{x}$). After each of the 20 decision periods, participants received feedback regarding the total amount contributed to the *group account*, their own payoff, and whether they received the prize or not.[11] Subjects were paid based on earnings across all periods, which is consistent with our model's assumption of risk neutrality and reflects our development setting of interest where there may be many public goods that needs funding, some of which may need regular support.

The experiment was conducted at (Removed for Review) Lab. A total of 160 subjects completed the study as there were five replicates of each of the four treatments. The participants were drawn from the lab's standing pool of volunteers and excluded anyone who had participated in a previous study about contests or public good provision. Participants were paid $5 plus their salient earnings for a 1-hour session. Salient earnings averaged $9.91 (ranging

[11]The computerized experiment was programmed using z-Tree (Fischbacher, 2007).

from \$3.84 to \$17.11). Nominal amounts in the experiment were denoted in tokens and cumulative earnings were converted at the rate of 1 cent for every eight tokens.

4 | RESULTS

The two primary research questions are whether the amount contributed to the public good matches the predictions shown in Table 1 and if inequality leads to lower total contributions to the public good in the presence of a lottery. Figure 1 shows the average total contributions across groups by treatment. To allow for learning, we focus on data from the last half of the periods.

Table 2 provides regression analysis of the total contribution to the public good with standard errors clustered at the group level. In the regression analysis, *No Inequality* is captured by the constant term and there is a separate indicator variable for each of the other treatments (*LowA*, *LowB*, and *High*). *Period* variable is the number of periods after the halfway point in the study. The coefficient on *Period* is not significant indicating that total contributions are stable over the last half of the study.

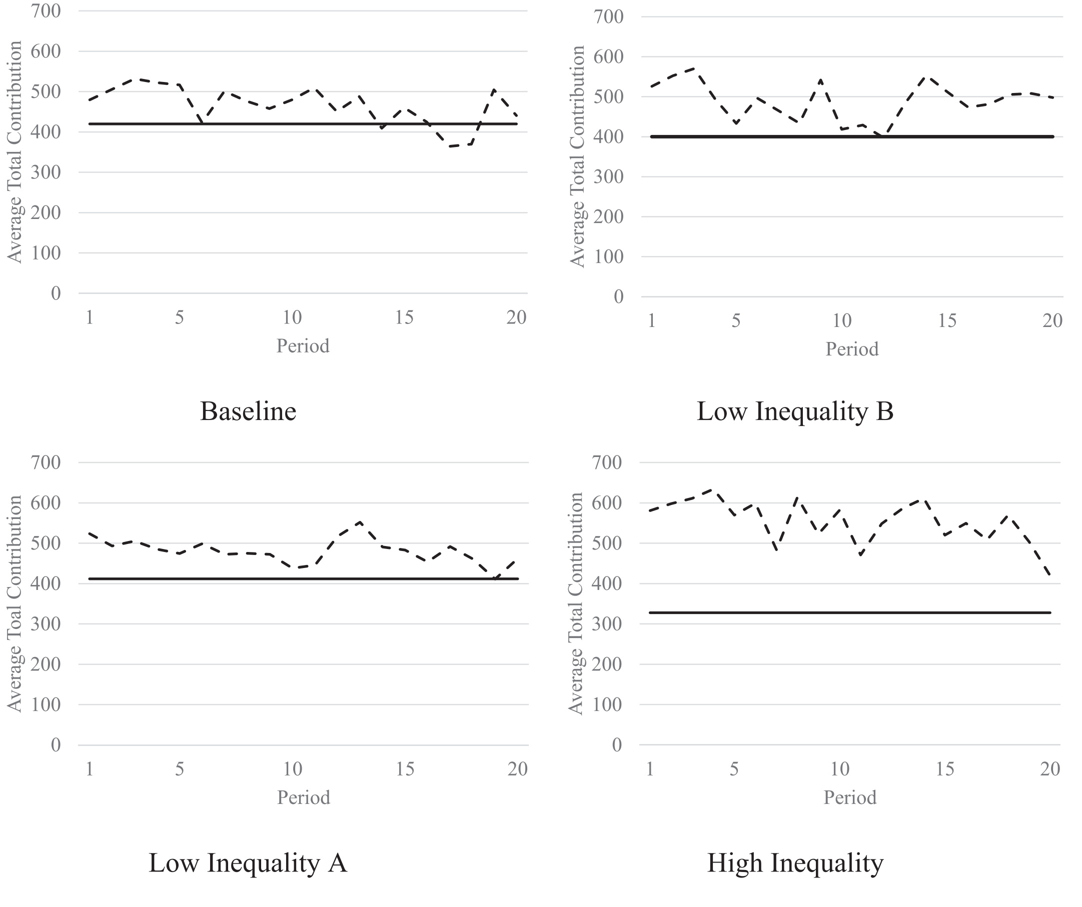

FIGURE 1 Average total contribution to the public good by treatment

TABLE 2 Regression analysis of total contribution

	Coefficient
Constant	458.47 (21.82)***
LowA	34.76 (39.52)
LowB	41.98 (27.21)
High	86.74 (87.21)
Period	−2.96 (3.19)
Tests against predicted levels	***p* value**
No Inequality	
Constant = 420	0.079
Low Inequality A	
Constant + LowA = 411.6	0.0370
Low Inequality B	
Constant + LowB = 400	0.0012
High Inequality	
Constant + High = 327.8	0.0209

Note: Number of observations = 200 with data from periods 11–20. Standard errors, shown in parentheses are clustered at the group level.

***Significance at the 0.01 level.

For all four treatments, the observed mean is statistically larger than predicted. The constant term is statistically different from 420 (two-sided p value = 0.0079), which is the predicted level for *No Inequality*. Behavior in *Low Inequality A* is statistically different from the predicted level of 411.6 (p value = 0.0370).[12] Further, observed total contributions in *Low Inequality B* differs from the predicted level of 400 (p value = 0.0012) and observed contributions in *High Inequality* differs from the predicted level of 327.8 (p value = 0.0209). Such overbidding is typical of contest experiments (see e.g., Sheremeta, 2011).

We now turn to the comparative static effects of changing inequality. The regression analysis shown in Table 2 also indicates that the predicted ordering of the treatments does not hold. In fact, nominally total contributions are increasing across treatments whereas the equilibrium prediction is for total contributions to fall across treatments. To test if total contributions are in fact increasing we rely on the non-parametric Joncheere–Terpstra trend test using the mean total contribution in a group. This is a conservative approach and yet the p value = 0.1005 indicating at least marginal evidence that increased inequality is actually

[12]Testing if the observed level of contribution matches the theoretical prediction for each treatment is done by testing that the sum of the constant term plus the coefficient on the treatment variable equals the predicted amount.

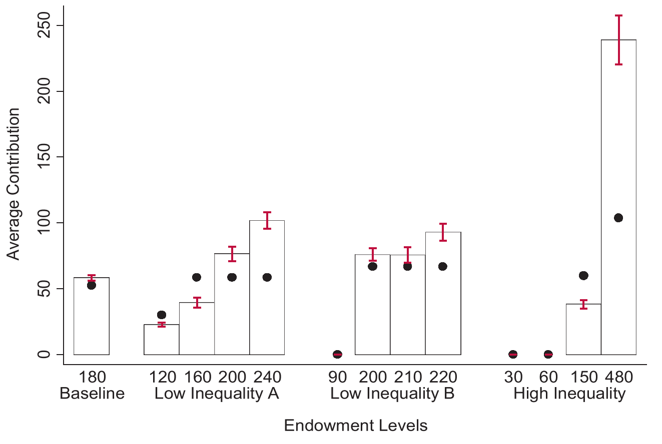

FIGURE 2 Average contribution by endowment type by treatment

leading to greater total contributions to the public good in opposition to the theoretical prediction.[13] The preceding discussion is summarized in our first result.

Result 1. *We observe that increasing inequality leads to greater total contributions to the public good in opposition to the theoretical prediction. Figure 2 shows average observed contributions by endowment level for each treatment. This figure illustrates how the higher the inequality the more the top quartile tend to give relative to the predicted contribution level, while the other people tended to stay closer to the predicted level. This observation leads to the question of what are the possible effects of using lotteries to fund public goods on the distribution of wealth? The general result from previous studies on the effect of heterogeneity in endowment on the voluntary contributions mechanism is that inequality leads to regressive redistribution due to relative overcontribution by the poor* (*Buckley & Croson*, 2006*; Chan et al.*, 1996, 1999*; Gächter et al.*, 2017*; Hargreaves Heap et al.*, 2016*; Keser et al.*, 2014*; Rapoport*, 1988). *To test whether this regressive redistributive pattern holds in our lottery setting where each subject was required to first meet a subsistence level of private consumption, we investigate contribution rates for the wealthiest quartile of subjects* (*"the rich"*) *and the contribution rates for the other three quartiles* (*"the poorest 75%"*) *across treatments. If the rich contribute a lower share of their endowment to the public good this would imply a regressive redistribution. Table 3 shows the results of a fractional probit regression for the percentage of endowment that was actually contributed to the public good. The* No Inequality *baseline is used as the comparison group since there are no rich or poor players in this treatment. The results show that the fraction of their total endowment that the rich contribute to the public good is consistently* higher *than that contributed by the poorest 75% in each treatment with inequality. This suggests that funding the public good through a lottery contest is progressive in our setting. This provides the support for our second result.*

[13]To determine how likely the observed result of the Joncheere–Terpstra test would be if mean contributions for each treatment matched the theoretical predictions, we simulated the test using data drawn from normal distributions with the theoretically predicted means and the treatment specific observed variances. The result of the simulation indicates that a test statistic as extreme or more extreme than what we actually observed would occur by chance with a probability less than 0.001.

TABLE 3 Contribution rates for the wealthy and for others across treatments

	Marginal effects
Constant (No inequality)	0.336*** (0.016)
LowA × Rich	0.122*** (0.040)
LowA × 75 P	−0.028 (0.033)
LowB × Rich	0.033 (0.042)
LowB × 75P	−0.050 (0.044)
High × Rich	0.153 (0.097)
High × 75P	−0.196*** (0.045)
Period	−0.001 (0.002)
Tests by wealth type and treatment	***p* value**
The rich	
LowA × Rich = LowB × Rich = High × Rich = 0	<0.01
The 75 percenters	
LowA × 75P = LowB × 75P = High × 75P = 0	<0.01
Low inequality A	
LowA × Rich = LowA × 75P	<0.01
Low inequality B	
LowB × Rich = LowB × 75P	0.17
High inequality	
High × Rich = High × 75P	<0.01

Note: Coefficients are based on a fractional probit regression. The contribution rate is defined as the percent of endowment that is contributed to the public good and the observational unit is an income group in a session in a period. Rich is a dummy variable indicating the observation was based on subjects in the top quartile of the income distribution in a session, and 75P is a dummy variable indicating the observation was based on subjects in the three lowest income quartiles in the session (i.e., the poorest 75%). Number of observations = 350. There are not 400 observations because there is no notion of rich or poor agents in the baseline so there are only 50 observations from that treatment (= 10 periods/replication × 5 replicates). Standard errors are clustered at the group level. Treatment-period interactions excluded from table.

***Significance at the 0.01 level.

Result 2. *We observe that funding public goods through a lottery contest can be progressive.*

Each bar represents a different endowment level in each treatment. The height of each bar represents the average contribution for the last 10 periods. Whiskers on top of a bar provide the 95% confidence interval of the mean and a dot denotes the equilibrium prediction.

TABLE 4 Impact of contest and public good funding on inequality

	Average realized expected GINI coefficient	*p* value for test that realized expected inequality: Initial inequality	Predicted final expected inequality
No inequality	0.097	0.0431	0.0431
Low inequality A	0.100	0.0431	0.1380
Low inequality B	0.102	0.0431	0.6858
High inequality	0.189	0.0431	0.1380

Note: Observation is at the group level. Results are based on the normal approximation to the Wilcoxon signed rank sum paired sample test.

Finally, we consider how the contest and resulting contributions to the public good impacted inequality. As shown in Table 1, with the exception of the *No Inequality* baseline where the contest necessarily increases inequality, the contest funded public good is expected to lead to a reduction in inequality. Rather than relying on the observed inequality that depends on who happened to win the contest, we use the expected realized GINI coefficient that takes into account each players' probability of winning the prize. Table 4 reports the average (across groups) expected realized GINI coefficient for each treatment. Column 2 of Table 4 reports the *p* values for Wilcoxon Signed-Rank Sum tests of whether inequality changed from the initial level by treatment. In all four treatments the change in inequality was significant and in the direction predicted. Column 3 of Table 4 reports the *p* values for tests comparing the expected realized GINI coefficients with the predicted expected final GINI coefficients. In the *No Inequality* treatment, the observed expected realized inequality significantly exceeded the predicted level due to heterogeneity in behavior while theory predicts that each agent will make an identical choice. For the three treatments with initial inequality, the realized inequality does not differ from the predicted final level. Taken together, these patterns demonstrate that potential that using contests to fund public goods have in reducing inequality when it exists and provide the basis for our final result.

Result 3. *Using contests to fund public goods may reduce inequality when it exists.*

5 | DISCUSSION

Lottery funding mechanisms are viewed as an attractive method for funding public goods and other development projects. Such systems theoretically overcome the free-rider problem associated with voluntary contributions mechanisms and can be implemented without the coercive power necessary to implement taxes or punishments. Past laboratory experiments have reliably demonstrated contributions often exceed the theoretical predictions leading to even greater welfare gains than expected. However, most of the existing literature has ignored features that are present in many development settings such as high degrees of inequality and subsistence poverty limiting the ability of some people in the group to contribute to the public good. Absent lottery incentives, past studies have found that an increase in inequality is often associated with reduced cooperation and provision of public goods (e.g., Cardenas, 2003;

Cherry et al., 2005; Fung & Au, 2014; Gächter et al., 2017; Hargreaves Heap et al., 2016; Keser et al., 2014; Nitta, 2014; Rapoport, 1993; Seçilmiş & Güran, 2012). Should the negative effects of inequality extend to lottery funding mechanisms as well, then the practical promise of such procedures may be minimal.

This paper reports a series of experimental treatments that directly investigate how inequality and poverty impact contributions to a lottery funded public good. While theory predicts that the greatest contributions will occur in the treatment with no inequality and the amount contributed will be the least in the treatment with the greatest inequality, this is the opposite of the pattern that we actually observed. This result, combined with the fact that total contributions greatly exceeded the theoretical prediction in every treatment, provides further evidence for the potential of lottery mechanisms to be an effective tool for development efforts.

Two additional aspects of our results warrant highlighting. First, in every case we find that the amount contributed to the public good by the group members exceeded the size of the prize in the lottery. Thus, in terms of the total amount contributed to the public good and the overall welfare of the group, this result suggest that a nongovernment agency may do better with the lottery mechanism than it would expect to do by contributing the prize money directly to the public good. Second, because the wealthiest members of our groups typically put in a greater share of their endowment than did the poorer members of the group, inequality was actually reduced even more than predicted in heterogeneous groups, even after accounting for the sizeable prize going to a single group member.[14] Both of these patterns are consistent with previous experimental work on contests. Specifically, Sheremeta (2011) shows that spending in contests often exceeds the prize. Additionally, Sheremeta (2011) shows that as people have more money they spend more in the contest and that as the number of contestants decreases people spend a greater percentage of their endowment in the contest. As we increase inequality, both effects are occurring: poorer players are forced out of the contest while wealthier players have more money, leading to the progressive result.

Of course, there are many potentially significant differences between the lab and the field that may affect the interaction of inequality and public good contributions using a lottery mechanism. In practice, people in a community have reputations to maintain, the ability to communicate with each other, and the opportunity to monitor what others do. Additionally, the group size is likely to be larger in practice, a factor known to affect behavior in both public goods (Isaac & Walker, 1988) and contests (Sheremeta, 2011). Thus, while we believe our results are encouraging, more research on this topic is necessary.

ACKNOWLEDGMENTS

We thank Paul Pecorino, Peter Brummond, participants at the Department of Economics, Finance and Legal Studies' Brown Bag seminar series at The University of Alabama, as well as the editor and two anonymous reviewers for helpful comments. We gratefully acknowledge funding from the Culverhouse College of Business at The University of Alabama.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

[14]For the treatment with no initial inequality, the lottery must increase ex post inequality.

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REFERENCES

Alesina, A., & Ferrara, S. L. (2000). Participation in heterogeneous communities. *The Quarterly Journal of Economics*, *115*(3), 847–904.

Andreoni, J. (1988a). Privately provided public goods in a large economy. *Journal of Public Economics*, *35*, 57–73.

Andreoni, J. (1988b). Why free ride?: Strategies and learning in public goods experiments. *Journal of Public Economics*, *37*(3), 291–304.

Balafoutas, L., Kocher, M. G., Putterman, L., & Sutter, M. (2013). Equality, equity and incentives: An experiment. *European Economic Review*, *60*, 32–51.

Bergstrom, T., Blume, L., & Varian, H. (1986). On the private provision of public goods. *Journal of Public Economics*, *29*, 25–49.

Bose, B., & Rabotyagov, S. (2018). Provision of public goods using a combination of lottery and a provision point. *Journal of Behavioral and Experimental Economics*, *73*, 99–115.

Buckley, E., & Croson, R. (2006). Income and wealth heterogeneity in the voluntary provision of linear public goods. *Journal of Public Economics*, *90*(4–5), 935–955.

Cadigan, J., Wayland, P. T., Schmitt, P., & Swope, K. (2011). An experimental dynamic public goods game with carryover. *Journal of Economic Behavior and Organization*, *80*, 523–531.

Cardenas, J. (2003). Real wealth and experimental cooperation: Experiments in the field lab. *Journal of Development Economics*, *70*, 263–289.

Cason, T. N., Masters, W. A., & Sheremeta, R. M. (2020). Winner-take-all and proportional-prize contests: Theory and experimental results. *Journal of Economic Behavior and Organization*, *175*, 314–327.

Cason, T. N., & Zubrickas, R. (2017). Enhancing fundraising with refund bonuses. *Games and Economic Behavior*, *101*, 218–233.

Chan, K. S., Mestelman, S., Moir, R., & Muller, R. (1996). The voluntary provision of public goods under varying income distributions. *The Canadian Journal of Economics*, *29*(1), 54–69.

Chan, K. S., Mestelman, S., Moir, R., & Muller, R. (1999). Heterogeneity and the voluntary provision of public goods. *Experimental Economics*, *2*, 5–30.

Cherry, T. L., Kroll, S., & Shogren, J. F. (2005). The impact of endowment heterogeneity and origin on public good contributions: Evidence from the lab. *Journal of Economic Behavior and Organization*, *57*, 357–365.

Chowdhury, S. M., Sheremeta, R. M., & Turocy, T. L. (2014). Overbidding and overspreading in rent-seeking experiments: Cost structure and prize allocation rules. *Games and Economic Behavior*, *87*, 224–238.

Conlon, J. R., & Pecorino, P. (2021). Public good provision with participation costs. *Journal of Public Economic Theory*, *24*, 241–258. https://doi.org/10.1111/jpet.12551

Corazzini, L., Faravelli, M., & Stanca, L. (2010). A prize to give for: An experiment on public goods funding mechanism. *The Economic Journal*, *120*, 944–967.

Dale, D. J., & Morgan, J. (2010). *Silence is golden. Suggested donations in voluntary contribution games*. Working Paper.

D'Aspremont, C., & Gerard-Varet, L. (1979). Incentives and incomplete information. *Journal of Public Economics*, *11*, 25–45.

Davis, D., Razzolini, L., Reilly, R., & Wilson, B. J. (2003). Raising revenues for charity: Auctions versus lotteries. *Research in Experimental Economics*, *11*, 47–91.

Duffy, J., & Matros, A. (2013). *All-pay auctions vs. lotteries as provisional fixed-prize fundraising mechanisms: Theory and evidence*. Working Paper.

Faravelli, M. (2011). The important this is not (always) winning but taking part: Funding public goods with contests. *Journal of Public Economic Theory*, *13*(1), 1–22.

Fischbacher, U. (2007). z-Tree: Zurich toolbox for ready-made economic experiments. *Experimental Economics*, *10*, 171–178.

Foster, J. (2020). Loss aversion and sunk cost sensitivity in all-pay auctions for charity: Theory and experiments. *Journal of Behavioral and Experimental Economics*, *84*, 101486.

Franke, J., & Leininger, W. (2014). On the efficient provision of public goods by means of biased lotteries: The two player case. *Economics Letters*, *125*, 436–439.

Franke, J., & Leininger, W. (2018). Lotteries and Lindahl prices in public good provision. *Journal of Public Economic Theory*, *20*, 840–848.

Fung, J. M. Y., & Au, W. (2014). Effect of inequality on cooperation: Heterogeneity and hegemony in public goods dilemma. *Organizational Behavior and Human Decision Processes*, *123*, 9–22.

Gächter, S., Mengel, F., Tsakas, E., & Vostroknutov, A. (2017). Growth and inequality in public good provision. *Journal of Public Economics*, *150*, 1–13.

Gangadharan, L., Nikiforakis, N., & Villeval, M. C. (2017). Normative conflict and the limits of self-governance in heterogeneous populations. *European Economic Review*, *100*, 143–156.

Goeree, J., Maasland, E., Onderstal, S., & Turner, J. (2005). How (not) to raise money. *Journal of Political Economy*, *113*(4), 897–918.

Groves, T. (1973). Incentives in teams. *Econometrica*, *41*, 617–631.

Groves, T., & Ledyard, J. (1977). Optimal allocation of public goods: A solution to the free rider problem. *Econometrica*, *45*, 783–809.

Hargreaves Heap, S. P., Ramalingam, A., & Stoddard, B. V. (2016). Endowment inequality in public goods games: A re-examination. *Economics Letters*, *146*, 4–7.

Hofmeyr, A., Burns, J., & Visser, M. (2007). Income inequality, reciprocity and public good provision: An experimental analysis. *South African Journal of Economics*, *75*, 508–520.

Isaac, R. M., & Walker, J. M. (1988). Group size effects in public goods provision: The voluntary contributions mechanism. *The Quarterly Journal of Economics*, *103*, 179–199.

Jindapon, P., & Yang, Z. (2020). Free riders and the optimal prize in public-good funding lotteries. *Journal of Public Economic Theory*, *22*, 12189–1312.

Keser, C. (1996). Voluntary contributions to a public good when partial contribution is a dominant strategy. *Economics Letters*, *50*(3), 359–66.

Keser, C., Markstädter, A., Schmidtc, M., & Schnitzlerd, C. (2014). *Social costs of inequality: heterogeneous endowments in public-good experiments*. Cege Discussion Papers, No. 217, University of Göttingen, Center for European, Governance and Economic Development Research (cege), Göttingen.

Keser, C., & vanWinden, F. (2000). Conditional cooperation in voluntary contributions to public goods. *Scandinavian Journal of Economics*, *102*(1), 23–39.

Lange, A., List, J. A., & Price, M. K. (2007). Using lotteries to finance public goods: Theory and experimental evidence. *International Economic Review*, *48*(3), 901–927.

Mansuri, G., & Rao, V. (2013). *Localizing development: Does participation work?* Washington, DC: World Bank. https://doi.org/10.1596/978-0-8213-8256-1. License: Creative Commons Attribution CC BY 3.0.

Moore, J. (1992). Implementation, contracts, and renegotiation in environments with complete information. In J.-J.Laffont (Ed.), *Advances in Economic Theory: Sixth World Congress* (Vol. 1). Cambridge University Press.

Morgan, J. (2000). Financing public goods by means of lotteries. *The Review of Economic Studies*, *67*, 761–784.

Morgan, J., & Sefton, M. (2000). Financing public goods by means of lotteries: Experimental evidence. *The Review of Economic Studies*, *67*, 785–710.

Nikiforakis, N., Noussair, C. N., & Wilkening, T. (2012). Normative conflict and feuds: The limits of self-enforcement. *Journal of Public Economics*, *96*, 797–807.

Nitta, K. (2014). *The effect of income heterogeneity in an experiment with global and local public goods*. University of Hawaii at Mānoa Department of Economics Working Paper.

Noussair, C. N., & Tan, F. (2011). Voting on punishment systems within a heterogeneous group. *Journal of Public Economic Theory*, *13*(5), 661–693.

Olson, M. (1965). *The logic of collective action*. Harvard University Press.

Oxoby, R. J., & Spraggon, J. (2013). A clear and present minority: Heterogeneity in the source of endowments and the provision of public goods. *Economic Inquiry*, *51*(4), 2071–2082.

Palfrey, T. R., & Prisbrey, J. E. (1996). Altruism, reputation and noise in linear public goods experiments. *Journal of Public Economics*, *61*(3), 409–427.

Pecorino, P., & Temimi, A. (2007). Lotteries, group size and public good provision. *Journal of Public Economic Theory*, *9*, 451–465.

Pecorino, P., & Temimi, A. (2008). The group-size paradox revisited. *Journal of Public Economic Theory*, *10*, 785–799.

Rapoport, A. (1988). Provision of step-level public goods: Effects of inequality in resources. *Journal of Personality and Social Psychology*, *54*, 432–440.

Rapoport, A. (1993). Incremental contribution in step-level public goods games with asymmetric players. *Organizational Behavior and Decision Processes*, *55*, 171–194.

Seçilmiş, I. E., & Güran, M. C. (2012). Income heterogeneity in the voluntary provision of dynamic public goods. *Pacific Economic Review*, *17*(5), 693–707.

Sheremeta, R. M. (2011). Contest design: An experimental investigation. *Economic Inquiry*, *49*, 573–590.

Walker, M. (1981). A simple incentive compatible scheme for attaining lindahl allocations. *Econometrica*, *49*, 65–71.

Zizzo, D. (2010). Experimenter demand effects in economics experiments. *Experimental Economics*, *13*(1), 75–98.

How to cite this article: Oconnor, C., Zhang, L., & Deck, C. (2022). An examination of the effect of inequality on lotteries for funding public goods. *Journal of Public Economic Theory*, 24, 733–755. https://doi.org/10.1111/jpet.12588

APPENDIX A: PROOF OF PROPOSITION 1

Proposition 1. *In equilibrium, there will be an endowment level* $\omega^+ \geq \bar{x}$ *such that any agent* j *for whom* $\omega_j \in (\bar{x}, \omega+)$ *will contribute* $g_j = \omega_j - \bar{x}$ *and all agents whose endowment exceeds* ω^+ *will contribute* $g^* = \frac{Z(N_I-1) - 2(1-a)N_I G^B + \sqrt[2]{4(1-\alpha)ZN_I^2G^B - 4(1-\alpha)N_I(N_I-1)ZG^B + Z^2(N_I-1)^2}}{2N_I^2(1-a)}$, *where* N_B *is the number of agents for whom the constraint in Equation* (1) *given in the main text is binding, and* N_I *is the number of agents contributing* g^*.

Proof. Suppose such an equilibrium exists. Let N_0 be the number of poor agents. Then $N_0 + N_B + N_I = N$. The amount contributed by the agents for whom the constraint is binding is $G^B = \sum_{j=1}^{N_B}(\omega_j - \bar{x})$. The first-order condition of (1) when the constraint is not binding can be written as (2) after rearranging terms. □

$$g_i = \left[Z\frac{G_{-i}}{1-a}\right]^{.5} - G_{-i}. \tag{2}$$

Given the symmetry among the agents for whom the constraint does not bind, (2) can be rewritten as (3)

$$g^* = \left[Z\frac{G^B + (N_I - 1)g^*}{1-a}\right]^{.5} - [G^B + (N_I - 1)g^*] \tag{3}$$

and after some algebra, (3) yields g^* as shown in the proposition. It is straightforward to verify the second-order condition for the objective function in (1) is negative. Thus, the interior optimal for the agents for whom the constraint does not bind is a global maximum. It is also straightforward to show that the objective function in (1) is strictly increasing in $g_i$for $g_i < g^*$ and hence any agent whose endowment is below g^* will optimally choose to contribute $g_i = \omega_i - \bar{x}$, the maximum amount that they can give. Thus g^* serves as the ω^+ identified in the proposition. Further, because player i's profit function is strictly increasing in $g_i \forall i$ over $(0, g^*)$, this equilibrium is unique consistent with Morgan (2002). □

APPENDIX B: EXPERIMENT INSTRUCTIONS

This section outlines the instructions that were given to subjects as well as provide an example of what subjects would have seen while participating in the study. The first 11 images are identical to what was seen by each subject in each treatment. The information displayed on images after the 11th image would be treatment and endowment specific.

Image 1

Introduction

This is a study about decision making. The instructions are simple and, if you follow them, you may earn a substantial amount of money which will be given to you at the end of the study, so it is important that you understand the instructions completely. If you have any questions about the instructions or during the study, please raise your hand and someone will come to answer your question.

You will be placed in a group with 7 other randomly selected participants and will remain in that group for the entire study. You will never know the identity of the individuals in your group nor will they know your identity. The study will take place over the course of 20 periods and you will earn money in each period based on the decisions you and the other people in your group make. At the beginning of each period, you will be given a specific number of tokens which you will divide between an individual account and/or a group account; you may either place your tokens into only one of the two accounts or in both accounts, if you so desire. At the end of the study you will receive a payment of 1 cent for every 8 points you earn throughout the course of the study.

OK

Image 2

Individual Account

You can place money in the individual account. You will receive a return of 1 point for each token you placed in the individual account. From your endowment, at least 90 tokens must be placed in the individual account and the additional tokens can also placed into the individual account, if you so desire. For example, if you are allocated 150 tokens, 90 tokens will be mandatorily allocated to the individual account and your decision is how many of the remaining 60 tokens you want to allocate in the individual account. Other people in your group have their own individual accounts and make their own allocation decisions.

OK

Image 3

Group Account

The Group account gives every member of your group (you plus the other 7 people) ½ point for each token placed in it by anyone in the group. For example, if participants in total place 1000 tokens into the group account, you (and each of the 7 other people in your group) will receive ½*1000=500 points regardless of your (or their) personal allocation to the group account. IN ADDITION, if you allocate tokens to the group account you will be assigned a range of numbers where you will receive a prize if the number that is drawn is in your range. The assignment of the range of numbers and the drawing of the winning number will be done automatically on a computer. Your probability of winning is given by the number of tokens you place in the group account divided by the total number of tokens placed in the group account by members of your group. For example, if in total members of your group (including yourself) placed 500 tokens in the group account and, in this amount, your own personal allocation was 100 tokens, then your probability of winning was 100/500 or 20%. If the lottery number that is drawn is in your range you will win an ADDITIONAL prize of 240 tokens. From your endowment, at least 90 tokens must be placed in the individual account and the additional tokens can be placed into the group account, if you so desire. For example, if you are allocated 150 tokens, 90 tokens will be mandatorily allocated to the individual account and your decision is how many of the remaining 60 tokens you want to allocate in the group account and how many you want to allocate the individual account.

OK

Image 4

Before you make your first decision you will be told the number of tokens each member of the group will have available to allocate in each round. Note that some participants may receive the same number of tokens, and others may receive different number of tokens. The number of tokens that you and the other participants receive in each round will not change from round to round. After tokens have been distributed, you and all other participants will simultaneously and anonymously decide how to allocate your tokens. Recall that at least 90 tokens must be allocated to the individual account, so the decision you must make is how many of the remaining tokens you want to allocate to the individual and/or group accounts. If the tokens you receive at the start of the round is less than 90 tokens, then your excess tokens are 0 and you must place all of your tokens in the individual account.

On the next few pages you will be shown four examples to clarify the earnings structure:

OK

Image 5

Example 1											
	1	2	3	4	5	6	7	8	9	10	11
Participant	Endowments	Mandatory	Excess Tokens(1-2)	Excess Tokens Allocated to Group Account	Excess Tokens Allocated to Individual Account (3-4)	Total tokens in Individual Account (2+5)	Probability to Win the Lottery (%)	Return from group account (Total group*0.5)	Return from Individual Account (=6)	Lottery Winnings	Total Return (8+9+10)
a	120	90	30	30	0	90	4.2	360	90	0	450
b	120	90	30	30	0	90	4.2	360	90	0	450
c	160	90	70	70	0	90	9.7	360	90	0	450
d	160	90	70	70	0	90	9.7	360	90	0	450
e	200	90	110	110	0	90	15.3	360	90	240	690
f	200	90	110	110	0	90	15.3	360	90	0	450
g	240	90	150	150	0	90	20.8	360	90	0	450
h	240	90	150	150	0	90	20.8	360	90	0	450
Total				720							

Suppose that there are 8 persons in your group and their endowments are given in the table above (column 1). In this example everyone allocates all their excess tokens to the group account. The total allocated to the group account is therefore 720 tokens. The total return from the group account that each person receive is 360 points (720*0.5=360). Subject "e" was randomly drawn as the lottery winner and so she received an additional 240 points. Total return received by each person is given in column 11 which is the sum of columns 8, 9 and 10.

OK

Image 6

Example 2											
	1	2	3	4	5	6	7	8	9	10	11
Participant	Endowments	Mandatory	Excess Tokens(1-2)	Excess Tokens Allocated to Group Account	Excess Tokens Allocated to Individual Account (3-4)	Total tokens in Individual Account (2+5)	Probability to Win the Lottery (%)	Return from group account (Total group*0.5)	Return from Individual Account (=6)	Lottery Winnings	Total Return (8+9+10)
a	120	90	30	0	30	120	0.0	0	120	0	120
b	120	90	30	0	30	120	0.0	0	120	0	120
c	160	90	70	0	70	160	0.0	0	160	0	160
d	160	90	70	0	70	160	0.0	0	160	0	160
e	200	90	110	0	110	200	0.0	0	200	0	200
f	200	90	110	0	110	200	0.0	0	200	0	200
g	240	90	150	0	150	240	0.0	0	240	0	240
h	240	90	150	0	150	240	0.0	0	240	0	240
Total				0							

Suppose that there are 8 persons in your group and their endowments are given in the table above (column 1). In this example nobody allocates any of their excess tokens to the group account. There is no return from the group account and nobody wins the lottery as nobody allocated tokens to the group account. All return is earned from the allocation to the individual account. Total return received by each person is given in column 11 which is the sum of columns 8, 9 and 10.

OK

Image 7

Example 3											
	1	2	3	4	5	6	7	8	9	10	11
Participant	Endowments	Mandatory	Excess Tokens(1-2)	Excess Tokens Allocated to Group Account	Excess Tokens Allocated to Individual Account (3-4)	Total tokens in Individual Account (2+5)	Probability to Win the Lottery (%)	Return from group account (Total group*0.5)	Return from Individual Account (=6)	Lottery Winnings	Total Return (8+9+10)
a	120	90	30	15	15	105	3.3	228	105	0	333
b	120	90	30	20	10	100	4.4	228	100	0	328
c	160	90	70	30	40	130	6.6	228	130	0	358
d	160	90	70	11	59	149	2.4	228	149	0	377
e	200	90	110	100	10	100	21.9	228	100	0	328
f	200	90	110	80	30	120	17.5	228	120	0	348
g	240	90	150	100	50	140	21.9	228	140	240	608
h	240	90	150	100	50	140	21.9	228	140	0	368
Total				456							

Suppose that there are 8 persons in your group and their endowments are given in the table above (column 1). In this example, participants made their own allocation to the group account. The total allocated to the group account is therefore 456 tokens. The total return from the group account for all individuals is therefore 228 points (456*0.5=228). Subject "g" was randomly drawn as the lottery winner and so he received an additional 240 points. Total return received by each person is given in column 11 which is the sum of columns 8, 9 and 10.

OK

Image 8

Example 4											
	1	2	3	4	5	6	7	8	9	10	11
Participant	Endowments	Mandatory	Excess Tokens(1-2)	Excess Tokens Allocated to Group Account	Excess Tokens Allocated to Individual Account (3-4)	Total tokens in Individual Account (2+5)	Probability to Win the Lottery (%)	Return from group account (Total group*0.5)	Return from Individual Account (=6)	Lottery Winnings	Total Return (8+9+10)
a	30	30	0	0	0	30	0.0	215	30	0	245
b	30	30	0	0	0	30	0.0	215	30	0	245
c	60	60	0	0	0	60	0.0	215	60	0	275
d	60	60	0	0	0	60	0.0	215	60	0	275
e	150	90	60	60	0	90	14.0	215	90	0	305
f	150	90	60	50	10	100	11.6	215	100	0	315
g	480	90	390	220	170	260	51.2	215	260	240	715
h	480	90	390	100	290	380	23.3	215	380	0	595
Total				430							

Suppose that there are 8 persons in your group and their endowments are given in the table above (column 1). Notice participants "a" through "d" were endowed with less than 90 tokens so they have zero excess tokens. In this example, all other persons (those with excess tokens greater than zero) made their own allocations to the group account. The total allocated to the group account in therefore 430 tokens. The total return from the group account for all individuals is therefore 215 points (430*0.5=215). A winner of the lottery prize from amongst everyone who allocated to the group account-which in this example are persons "e" through "h" was drawn. In this example the winner of the lotter was subject "g" and so she received an additional 240 points. Total return received by each person is given in column 11 which is the sum of columns 8, 9 and 10.

OK

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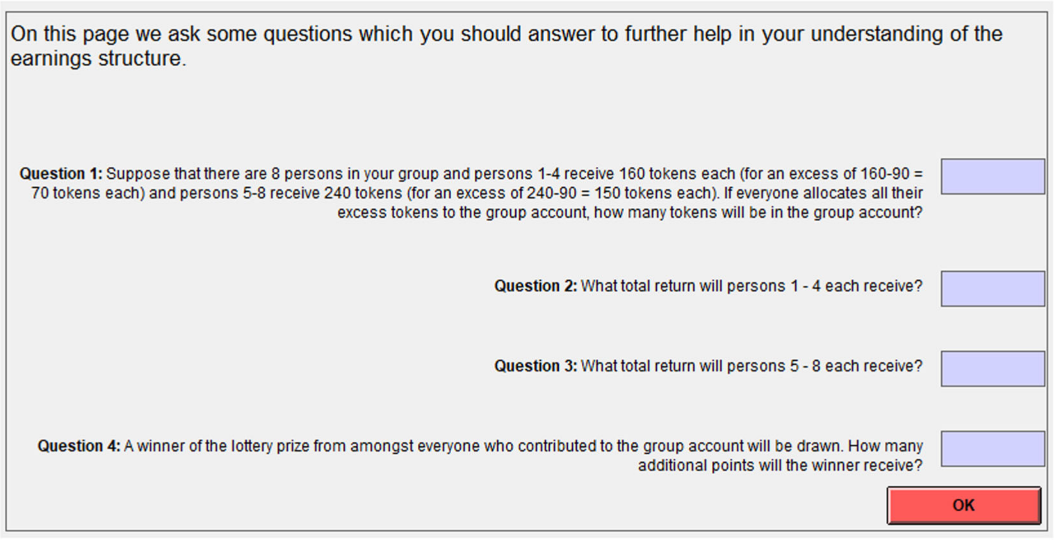
Image 9


On this page we ask some questions which you should answer to further help in your understanding of the earnings structure.

Question 1: Suppose that there are 8 persons in your group and persons 1-4 receive 160 tokens each (for an excess of 160-90 = 70 tokens each) and persons 5-8 receive 240 tokens (for an excess of 240-90 = 150 tokens each). If everyone allocates all their excess tokens to the group account, how many tokens will be in the group account?

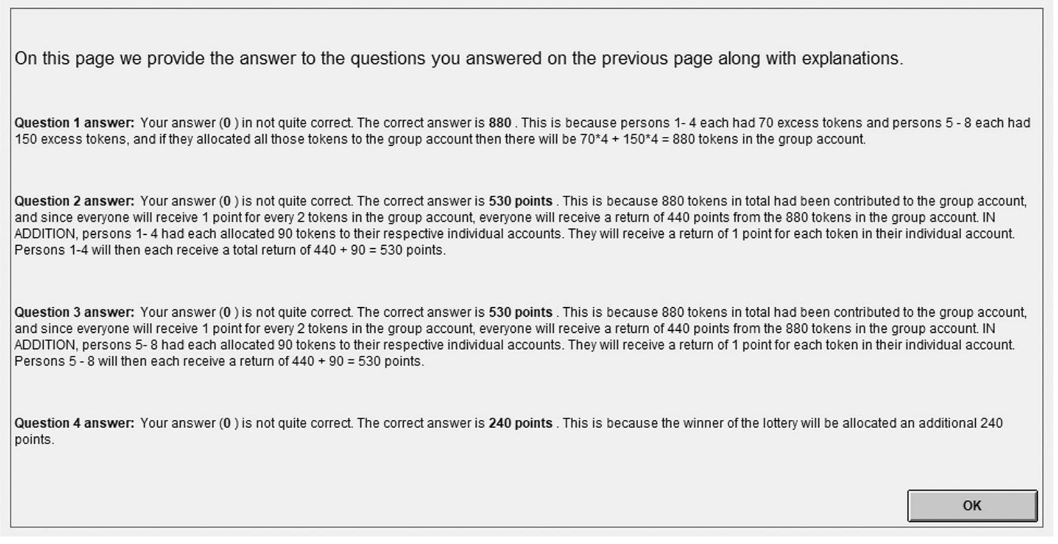
Question 2: What total return will persons 1 - 4 each receive?

Question 3: What total return will persons 5 - 8 each receive?

Question 4: A winner of the lottery prize from amongst everyone who contributed to the group account will be drawn. How many additional points will the winner receive?

OK

Image 10


On this page we provide the answer to the questions you answered on the previous page along with explanations.

Question 1 answer: Your answer (**0**) in not quite correct. The correct answer is **880** . This is because persons 1- 4 each had 70 excess tokens and persons 5 - 8 each had 150 excess tokens, and if they allocated all those tokens to the group account then there will be 70*4 + 150*4 = 880 tokens in the group account.

Question 2 answer: Your answer (**0**) is not quite correct. The correct answer is **530 points** . This is because 880 tokens in total had been contributed to the group account, and since everyone will receive 1 point for every 2 tokens in the group account, everyone will receive a return of 440 points from the 880 tokens in the group account. IN ADDITION, persons 1- 4 had each allocated 90 tokens to their respective individual accounts. They will receive a return of 1 point for each token in their individual account. Persons 1-4 will then each receive a total return of 440 + 90 = 530 points.

Question 3 answer: Your answer (**0**) is not quite correct. The correct answer is **530 points** . This is because 880 tokens in total had been contributed to the group account, and since everyone will receive 1 point for every 2 tokens in the group account, everyone will receive a return of 440 points from the 880 tokens in the group account. IN ADDITION, persons 5- 8 had each allocated 90 tokens to their respective individual accounts. They will receive a return of 1 point for each token in their individual account. Persons 5 - 8 will then each receive a return of 440 + 90 = 530 points.

Question 4 answer: Your answer (**0**) is not quite correct. The correct answer is **240 points** . This is because the winner of the lottery will be allocated an additional 240 points.

OK

This screen illustrates what subjects would have seen if they entered wrong answers for the practice questions (Image 9).

Image 11

On this page we provide the answer to the questions you answered on the previous page along with explanations.

Question 1 answer: You are correct, the answer is **880 tokens** . This is because persons 1- 4 each had 70 excess tokens and persons 5 - 8 each had 150 excess tokens, and if they allocated all those tokens to the group account then there will be 70*4 + 150*4 = 880 tokens in the group account

Question 2 answer: You are correct, the answer is **530 points** . This is because 880 tokens in total had been contributed to the group account, and since everyone will receive 1 point for every 2 tokens in the group account, everyone will receive a return of 440 points from the 880 tokens in the group account. IN ADDITION, persons 1- 4 had each allocated 90 tokens to their respective individual accounts. They will receive a return of 1 point for each token in their individual account. Persons 1-4 will then each receive a total return of 440 + 90 = 530 points

Question 3 answer: You are correct, the answer is **530 points** . This is because 880 tokens in total had been contributed to the group account, and since everyone will receive 1 point for every 2 tokens in the group account, everyone will receive a return of 440 points from the 880 tokens in the group account. IN ADDITION, persons 5- 8 had each allocated 90 tokens to their respective individual accounts. They will receive a return of 1 point for each token in their individual account. Persons 5 - 8 will then each receive a return of 440 + 90 = 530 points

Question 4 answer: You are correct, the answer is **240 points** . This is because the winner of the lottery will be allocated an additional 240 points.

OK

This screen illustrates what subjects would have seen if they entered correct answers for the practice questions (Image 9).

Image 12

The tokens that were distributed to you and the 7 other members in your group were:

120
120
160
160
200
200
240
240

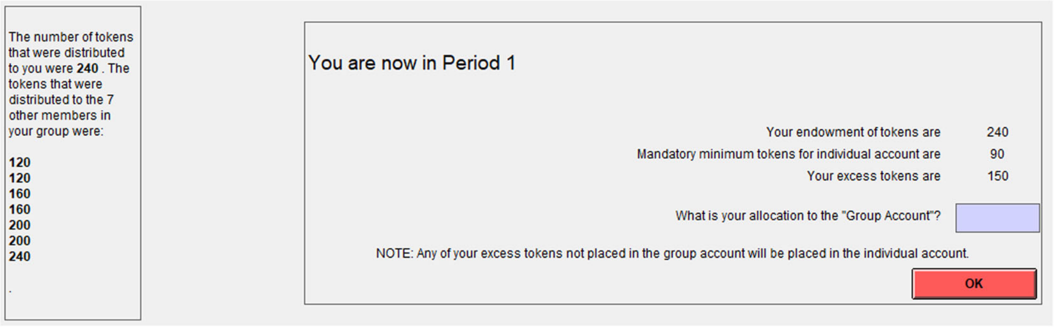
From the 8 set of tokens above that were distributed, the amount that you are endowed with is **240** tokens.You should quitely contemplate your decision and not talk, communicate or interact with other participants. If you have any questions, please raise your hand now.

If you have no questions click OK to continue then please wait.

OK

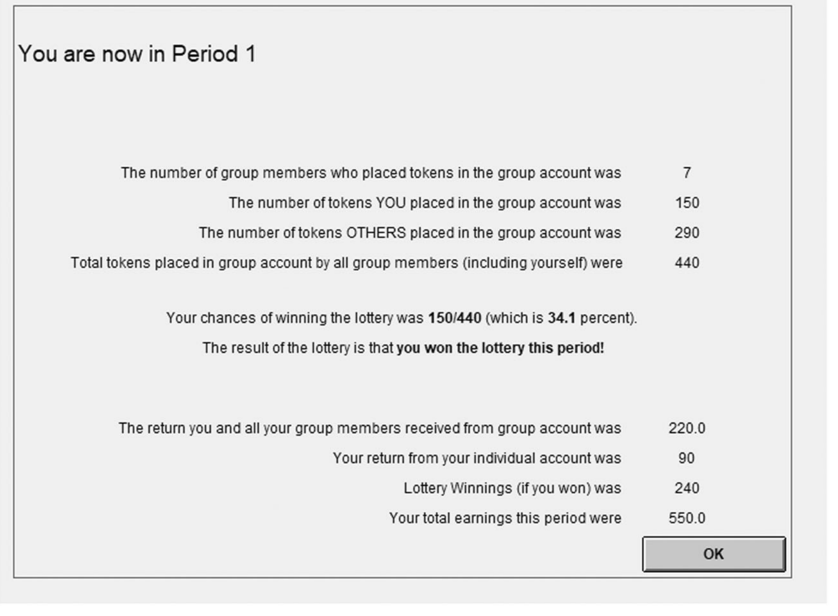
The information displayed on these images would have been slightly different for each subject and/or treatment.

Image 13



This is the decision screen.

Image 14



This is the result screen.