CAEPR INDIANA UNIVERSITY

CENTER FOR APPLIED ECONOMICS AND POLICY RESEARCH

CAEPR Working Paper
#2006-007

Matching Contributions and the Voluntary Provision of a Pure Public Good: Experimental Evidence

Ronald J. Baker II
Millersville University of Pennsylvania

James M. Walker
Indiana University - Bloomington

Arlington W. Williams
Indiana University - Bloomington

September 1, 2006

This paper can be downloaded without charge from the Social Science Research Network electronic library at: http://ssrn.com/abstract=932687.

The Center for Applied Economics and Policy Research resides in the Department of Economics at Indiana University Bloomington. CAEPR can be found on the Internet at: http://www.indiana.edu/~caepr. CAEPR can be reached via email at caepr@indiana.edu or via phone at 812-855-4050.

Matching Contributions and the Voluntary Provision of a Pure Public Good: Experimental Evidence

Ronald J. Baker II
Department of Economics
Millersville University of Pennsylvania
(ronald.baker@millersville.edu)

James M. Walker
Department of Economics
Indiana University - Bloomington
(walkerj@indiana.edu)

Arlington W. Williams
Department of Economics
Indiana University - Bloomington
(williama@indiana.edu)

Version 1, August 2006*

Abstract:

Laboratory experiments are used to study the voluntary provision of a pure public good in the presence of an anonymous external donor. The external funds are used in two different settings, lump-sum matching and one-to-one matching, to examine how allocations to the public good are affected. The experimental results reveal that allocations to the public good under lump-sum matching are significantly higher, and have significantly lower within-group dispersion, relative to one-to-one matching and a baseline setting without external matching funds.

*Research support from the Indiana University Center on Philanthropy is gratefully acknowledged.

Matching Contributions and the Voluntary Provision of a Pure Public Good: Experimental Evidence

1. Introduction

Laboratory experimental research on the provision of public goods has focused primarily on decision making in what is referred to as the voluntary contributions mechanism (VCM). In the most standard VCM decision setting, a group is comprised of a fixed number of individuals. Each individual is endowed with resources that can be allocated to either a private good that benefits only the individual (the private account) or to a pure public good that benefits all members of the group (the group account). The benefits are structured so that group earnings are maximized if all endowed resources are allocated to the group account. Each individual, however, has an incentive to free ride on the group-account allocations of other group members by allocating their resource endowment to the private account.

One topic addressed in the experimental public goods literature is institutional arrangements that reduce collective action problems by creating incentives that facilitate cooperation. The research reported here examines voluntary contributions to a public good in the presence of an external source of resources that are used for matching the contributions of group members. Two matching settings are examined. In the first, referred to as lump-sum matching, a publicly announced fixed level of resources from the external source flow to the group account only if the internal contributions of group members reach or exceed a pre-announced threshold level. In the second, referred to as one-to-one matching, each resource unit contributed to the group account is matched by the external source up to a publicly announced maximum level. Undertaking a controlled laboratory comparison of these alternative matching-fund settings is motivated by the observation that both arrangements are commonplace in fund drives for the provision of public goods in field settings (e.g. public radio fund drives).

These changes in experimental settings can be thought of in the following way. Assume a public good is to be partially funded through voluntary contributions. Further assume that the fund drive organizers have prior funding commitments that can be used for matching other potential donors' contributions. From the perspective of agencies receiving contributions, the strategic question is what type of institution makes best use of the matching funds. As discussed below, in the standard VCM environment matching funds create incentives where equilibrium strategies exist that lead to non-zero provision of the public good.

The free rider problem is particularly relevant for charitable giving, volunteerism, and other forms of philanthropy. While some of these activities can no doubt be rationalized as privately optimal, and in this respect no different from other economic activities, a significant amount of these activities entails personal sacrifices in order to improve social outcomes. This research is informative about the origin of such behaviors and their maintenance within social groups, since experiment participants experience similar incentives, albeit in a more abstract setting. By focusing on such a setting, the effect of economic incentives per se is investigated and comparisons are made that control for other factors that may affect behavior. In this context, the research reported here studies the role of alternative philanthropic institutions for promoting charitable contributions and explores how such institutions affect individual incentives, behavior, and resulting group outcomes relative to a known socially optimal outcome that maximizes the group's monetary earnings.

The paper is organized as follows. Section 2 summarizes related literature. Section 3 provides details of the experimental design and procedures. Section 4 presents experimental results, and conclusions are offered in Section 5.

2. Related Literature

There is a substantial literature in experimental economics studying the VCM decision setting. The stylized facts emerging from this type of experiment are that contributions to the group account exceed the standard economic prediction of zero tokens, but are below the socially optimal level of 100% percent contributions. There is, however, considerable heterogeneity across individuals in their choice of contributions and across decision making settings where group size and the relative payoffs of the public good to the private good are varied. (See, for example, Ledyard [1995] and Isaac, Walker, and Williams [1994].)

Because outcomes in public goods settings have tended to be sub-optimal, researchers have investigated ways to foster cooperation through, for example, face-to-face communication, sanctions, and rewards. In addition, several scholars have investigated institutional changes that relate more directly to the research reported here. Eckel and Grossman (2003) examine charitable contributions in the context of a one shot, individual choice environment, referred to as a "modified" dictator game. Given endowments, subjects choose a contribution level to actual charities under alternative subsidies. Rebate and matching mechanisms are investigated that, under suitable parameterizations, are functionally equivalent. Holding monetary incentives constant, gross contributions are greater in the case of matching. One explanation for this phenomenon is purely framing; subjects may view the act of contributing with matching in a more favorable context than a rebate, leading to greater overall contributions. More recently, Karlan and List (2006) report the results of a field experiment that examines the impact of matching funds on contributions to a non-profit organization. Their design examines the impact of one-to-one matching funds under 1-to-1, 2-to-1, and 3-to-1 matching ratios. They conclude that matching increases both the probability of contributing and the magnitude of contributions, however, varying the matching ratio does not have a significant impact.

In addition, from the perspective of strategic behavior, the literature on provision-point public goods relates closely to the lump-sum matching setting investigated here. See Marks and Croson (1998) for a review of this literature. The addition of a provision point to the VCM decision setting designates a publicly announced minimum level of resources that must be allocated to the public good in order for the public good to yield a positive return. If the provision point is not met, a refund condition is specified. Under a no-refund condition, if the provision point is not met any contributions to the public good are lost and yield no return to the contributors. In contrast, under a full-refund condition, contributions are returned when the provision point is not met. If the provision point is exceeded, a rebate policy must be specified for how such contributions will be used. The provision-point setting leads to multiple Nash equilibria. While all individuals allocating zero resources to the group account remains a Nash equilibrium, the group income-maximizing Nash equilibrium is to meet the provision point exactly. Nevertheless, exactly reaching the provision point can be achieved by multiple combinations of individual allocations. This implies a distributional conflict across subjects, where some subjects may attempt to free ride on the allocations of others.

3. Experimental Design and Procedures

3.A. The Decision Settings

This study incorporates three basic decision settings: lump-sum matching, one-to-one matching, and a no-matching baseline. All decision settings utilize variations of the VCM framework of Isaac, Walker, and Williams (1994), henceforth referred to as the standard VCM setting. Individuals made decisions in fixed groups of size N. At the start of each round, individual i was endowed with Z_i tokens which were divided between a private account, earning a constant return of p_i per token, and a group account, earning a return based upon the total number of tokens allocated by the group. Tokens could not be carried across rounds. For a given round, let m_i represent individual i's allocation of tokens to the group account and $\sum m_j$ represent the sum of tokens placed in the group account by all other individuals ($j \neq i$). Each individual earned $[G(m_i + \sum m_j)]/N$ cents from the group account. Because each individual received a 1/N share of the total earnings from the group account, the group account was a pure public good. At the end of each decision round, subjects were informed of their group's allocation to the group account, as well as their earnings for that round. Subjects were not informed of the individual decisions of group members.

The experiments were parameterized with subjects in groups of size N = 4 and individual endowments of 25 tokens per round. The return from each individual's private account was one cent per token, and the group's return from a token placed in the group account was $G'(\cdot) = 2.4$

cents. Defining the marginal per-capita return from the group account (MPCR) as the ratio of private monetary benefits to private monetary costs for moving one token from the private account to the group account yields MPCR = $G'(\cdot)/N = 0.60$.

Under the assumption that it is common knowledge that subjects maximize own-earnings and play a finitely repeated game with a commonly known end point, the sub-game perfect non-cooperative Nash equilibrium in this standard VCM setting is for each subject to allocate zero tokens to the group account. As discussed below, however, the settings that incorporate matching funds have important consequences for equilibrium predictions. Finally, note that the payoff dominant Pareto optimum in the standard VCM setting, and for all decision settings investigated in this study, is for subjects to allocate all tokens to the group account.

Lump-Sum Matching

In addition to the instructions for the standard VCM setting, subjects were informed that if total allocations to the group account met or exceeded 60 tokens, the group account would automatically have an additional 60 tokens added to it from an "external source" of tokens, with the earnings from these additional tokens being identical to those allocated by group members.[1]

Lump-sum matching creates a discontinuity in the payoffs associated with the group account at the point where the subjects meet the minimum threshold of 60 tokens. This property of the payoff function implies strategic elements to the game that lead to alternative Nash equilibria. In particular, similar to experiments with provision points, there are now multiple Nash equilibria. While all individuals allocating zero tokens to the group account remains a Nash equilibrium, the group income-maximizing Nash equilibrium is to meet the lump-sum matching threshold exactly. Thus, the symmetric Nash equilibrium is 15 tokens from each group member, but any other (asymmetric) combination of group-account allocations that exactly meet the lump-sum match threshold is also a Nash equilibrium. From a non-cooperative perspective, subjects

[1] Subjects were explicitly informed that the external source was a computerized robot player, and loaded words such as "donor" or "contributor" were not used to describe the external source. Similarly, tokens were "allocated" to the group account, rather than "donated" or "contributed".

have an incentive to free ride on the allocations of others if they expect others to allocate sufficient funds to the group account to meet the lump-sum matching threshold. On the other hand, from a game theoretic perspective, the symmetric Nash equilibrium of 15 tokens per group member may serve as a focal point for subjects (see Marks and Croson [1998]).

It is important to note a key difference between this setting and the provision point setting discussed above. In the lump-sum setting, if allocations to the group account do not meet the minimum requirement of 60 tokens, those tokens are still utilized as group-account allocations and generate earnings for the group. In the provision-point environments studied to date, if group account allocations do not meet the provision point, those tokens are either refunded to the private account or lost, depending upon the particular setting under investigation.

One-to-One Matching

Subjects were informed that each token allocated to the group account, up to a group maximum of 60, automatically led to an additional token being added to the group account from an external source. The group account earnings generated by each additional external token was identical to those internally allocated by the four group members.

The experiments with one-to-one matching create an increase in the marginal gain from allocations to the group account up to the maximum level of matching. Since the experiment is parameterized with an MPCR = 0.6, one-to-one matching implies an MPCR of 1.2 for group-account allocations up to 60 tokens. This property of the payoff function implies the existence of multiple Nash equilibria. In particular, an allocation to the group account that is matched yields a marginal return to the group member above the $0.01 per-token opportunity cost. In this setting, all group members allocating zero tokens to the group account is no longer a Nash equilibrium. As with lump-sum matching, there are multiple Nash equilibria where group members' total allocations to the group account exactly meet the maximum level of matching, and the symmetric equilibrium may serve as a focal point. From a non-cooperative perspective, subjects have an incentive to free ride if they expect others' group-account allocations to be sufficient to extract the maximum level of matching funds.

Note that the earnings consequences of some allocations in the one-to-one setting differ substantially from those in the lump-sum setting. In particular, in both settings subjects face the problem of coordinating over whom will provide the group-account allocations to be matched. The penalty, however, for not meeting the full-match threshold in the lump-sum setting is larger than in the one-to-one setting. In the lump-sum setting, the penalty is $0.36 per individual, regardless of how close the total group allocation is to the threshold. In the one-to-one setting, the penalty per individual is $0.006 for each token the group falls short of the maximum level of matching. Thus, falling a few tokens short of the threshold in the lump-sum setting has a relatively large negative effect on earnings, while an identical group-account allocation in the one-to-one setting has a much smaller effect. Focusing on this difference in the group-account earnings functions leads to the conjecture that lump-sum matching will generate greater group-account allocations than one-to-one matching. On the other hand, if group members in the one-to-one setting realize that matching results in the marginal private benefit of a token allocated to the group account exceeding the marginal private cost (MPCR = 1.2), an alternative conjecture is that the one-to-one setting will lead to a higher level of group-account allocations.

Baseline: No Matching

In addition to the two settings with external matching funds, allocation decisions from control groups without matching funds were also obtained. The earnings opportunities in this no-matching baseline setting paralleled those in the matching-fund settings, but without the strategic elements related to matching. All group members received a message that in each decision round an external source would allocate 60 tokens to the group account regardless of the group members' internal allocations. Thus, the minimum possible group earnings from the group account was 60 x $0.024 = $1.44.

An alternative baseline setting was also implemented to investigate whether framing the additional 60 tokens as coming from an external source may have affected group members' allocation decisions.[2] In the alternative baseline, group members were not given a message regarding the source of the external tokens; they simply observed an earnings table that associated $1.44 with zero tokens allocated to the group account, instead of $0.00 when zero tokens were allocated.

The theoretical predictions for both baselines are identical to the standard VCM setting. The sub-game perfect Nash equilibrium is zero tokens allocated to the group account.

3.B. Procedures

Table 1 and Figure 1 summarize the key elements of each decision setting. Each experimental session utilized twelve subjects who were randomly assigned to three four-person groups in each of three phases within a session. Subjects participated in a sequence of ten (phase-one) decision rounds in a particular setting, were then randomly reassigned to a new four-person group for ten (phase-two) decision rounds using a different setting, and were then randomly reassigned to another four-person group for the final ten (phase-three) decision rounds using a different setting. Each phase corresponded to a specific decision setting (baseline, lump-sum matching, or one-to-one matching) and the order of experimental settings was systematically varied across sessions. Thus, data on nine four-person groups were collected in each 12-person experimental session: three groups in each of the three phases, yielding three replications of a particular ordering of decision settings.

The experiments were conducted using NovaNET software at the Interdisciplinary Experimental Laboratory at Indiana University-Bloomington during the 2004-2005 academic

[2] The baseline setting using the "external source" wording can be interpreted as framing the external tokens in a manner similar to a "leadership" contribution. This relates to a strand of the public goods literature that examines the extent to which leadership contributions that occur early in a fund drive can have a positive impact on the level of contributions; see for example, Potters, et al. (2001), List and Lucking-Reiley (2002), List and Rondeau (2003), and Gachter and Renner (2003).

year. Subjects were recruited from a database of volunteers.[3] After being seated at microcomputer workstations, subjects were given preliminary instructions that were projected on a large screen at the front of the room and read aloud by the experimenter.[4] Before beginning the first ten-round decision-making phase in the session, subjects were informed publicly that: 1) the experiment would consist of thirty decision rounds that were broken down into three ten-round sequences, 2) for each ten-round sequence they would be randomly reassigned to a four-person group, 3) earnings at the beginning of each ten-round sequence would be displayed on their computer screen as zero, but, 4) their final earnings would be the sum of earnings across all three ten-round sequences, plus a $5 payment for showing up. Subjects then privately read through a set of computerized instructions describing the decision setting and familiarizing them with specific screen displays. While subjects were privately reading the set of computerized instructions, an overhead was also presented with summary information related to the private and group accounts. Finally, in the transition from one phase to the next, summary information regarding the subsequent decision setting was publicly projected on a large screen at the front of the lab and then read aloud by the experimenter.

The initial experimental design called for two replications of each of the six unique permutation orders of the three decision settings. This led to twelve experimental sessions with 144 unique subjects. After completing these twelve sessions and examining the data from the baseline setting, which revealed unexpectedly large group-account allocations, the decision was made to collect additional data using the alternate baseline setting. Two sessions were conducted utilizing the following ordering of decision settings: 1) alternate baseline, lump-sum matching, one-to-one matching, and 2) alternate baseline, one-to-one matching, lump-sum matching. Thus, the results reported below are drawn from a total of fourteen experimental sessions using 168

[3] A representative from the lab visited various large introductory classes (psychology, geography, and economics) to ask students to enlist in the database if they were interested in participating in experiments. A wide variety of majors are represented in these large introductory classes.
[4] Instructions are provided in the Appendix for a baseline, lump-sum matching, one-to-one matching session. In addition, instructions are also included for the alternate baseline phase.

subjects to form 126 decision-making groups. Each group interacts over ten decision rounds resulting in a total of 1260 observations at the group level.

4. Experimental Results

Subject decisions are analyzed both graphically and econometrically at the group and individual level to examine the effects on allocations to the group account of changing the experimental setting. The analysis focuses on three performance measures. The first measure reported is the per-round token allocations to the group account by each four-person group, excluding any external matching allocations. The second performance measure is the per-round efficiency, where efficiency is defined as the percentage of maximum possible earnings extracted by the group.[5] The third performance measure is the per-round within-group dispersion of allocations to the group account. Specifically, the standard deviation about the mean group-member allocation is calculated.

4.A. Graphical Overview

Figures 2-4 display the mean value of each performance measure for each round pooled across experimental phases. Several very general observations can be made from these figures.

Observation 1*:* Mean allocations to the group account are greatest in the lump-sum setting in all ten decision rounds, and smallest in the alternate baseline in eight of ten rounds.

Observation 2: Mean efficiency averaged over all decision rounds is lowest in the lump-sum setting.

Observation 3: Mean dispersion of group-account allocations within groups is lowest in the lump-sum setting in all ten decision rounds.

The lump-sum setting appears to be the most effective at generating allocations to the group account, as mean allocations in this setting are higher than all other settings for every round. In most rounds, however, average efficiency is lower in the lump-sum setting because of

---

[5] This measure of efficiency is highly positively correlated with the total tokens (group + external) allocated to the group account in a round (r = 0.9829).

the severe penalty (loss of 60 tokens) if the threshold for the match is not reached.[6] This penalty is not as severe in the one-to-one setting; and the full match was always present in both baseline settings. The lump-sum setting also appears to diminish the end-game effect (i.e. decreasing allocations to the group account in Rounds 9 and 10) that is present in the other experimental settings. However, dispersion of group-account allocations within groups increases in Rounds 9 and 10 for all experimental settings.

4.B. Statistical Analysis

This subsection offers formal tests of the observations presented above by using the performance measures as dependent variables in random-effects panel-data models estimated by GLS.

The analysis begins with a regression model estimated using all 1260 group-level observations where tokens allocated to the group account by a four-person group (the aggregate allocation excluding external tokens) is the dependent variable. The independent variables are: a lump-sum matching dummy variable (LUMP), a one-to-one matching dummy variable (1TO1), an alternative-baseline dummy variable (ALTBASE), two treatment-phase dummy variables (PHASEi, i=2, 3), and nine decision-round dummy variables (RNDi, i=2, 3, … ,10). The constant term thus gives the predicted group-account allocation for round 1 of phase 1 under the baseline experimental setting. To account for lack of independence across the ten decision-rounds generated by each of the 126 four-person groups, clustered robust standard errors are utilized where the data are clustered by these within-group observations.[7] Unobserved heterogeneity associated with the fourteen 12-person experimental sessions is modeled as a random-effect error component. Table 2 displays the regression coefficient point estimates, robust clustered standard errors, and two-tailed significance tests of the coefficients. In support

[6] Groups in the lump-sum setting failed to reach the threshold necessary for matching funds in 18.3% of all rounds.

[7] For a detailed discussion of the heteroskedasticity-robust Huber/White sandwich estimator of variance in clustered samples see, for example, Cameron and Trivedi (2005, Chapter 24, Section 24.5). The specific implementation utilized here is documented in Rogers (1993).

of *Observation* 1, the table reveals that lump-sum matching generates a significant increase in tokens allocated to the group account relative to the original no-matching baseline; however, the smaller increase generated by one-to-one matching is not significantly different from the original baseline. As expected, the ALTBASE coefficient is negative; removing the "external source" frame from the baseline group-account earnings function tends to reduce group-account allocations. This difference is not significant using a two-tailed test, but is marginally significant ($p < 0.10$) using a one-tailed test, which is justifiable given the clear *a priori* motivation for the framing change. Wald tests result in rejection of the following pair-wise null hypotheses: LUMP = 1TO1 ($p = 0.007$), LUMP = ALTBASE ($p = 0.003$), and 1TO1 = ALTBASE ($p = 0.069$).[8] While the primary focus here is on the effects of altering the experimental decision setting, note that the treatment-phase dummies are not significant but there are significant differences across decision rounds. In particular, relative to round 1, group-account allocations tend to be slightly higher on average in rounds 2-4 and there is a significant drop in group-account allocations in the final two rounds. Referring back to Figure 2, this end-game drop in allocations is evident in all except the lump-sum setting.

The next performance measure to analyze is efficiency.[9] The regression model described above is repeated using a group's per-round efficiency as the dependent variable. Table 3 displays the regression coefficients, robust standard errors, and 2-tailed significance tests for the coefficients. In support of *Observation* 2, the table reveals that lump-sum matching results in a small but marginally significant ($p = 0.054$) decrease in efficiency compared to the baseline.

[8] Approximately 2.5% of the observations on the dependent variable (31 of 1260) occur at the fixed upper boundary of 100 tokens to the group account, and one observation occurs at the lower boundary of zero. To account for these observations at the boundaries of the decision space a two-limit censored-normal (Tobit) regression model employing robust clustered standard errors was also estimated. The coefficients and standard errors are all very similar to what is shown in Table 2.

[9] The specific formula for calculating per-round efficiency is: $\frac{0.024 * (\text{tokens} + \text{external tokens}) + 0.01 * (100 - \text{tokens})}{0.024 * 160}$, where "tokens" is defined as the aggregate internal token allocation to the group account and "external tokens" is defined as the tokens allocated to the group account by the external source.

Average efficiencies in the other settings are not significantly different from the baseline. Despite the differences in penalties from failing to reach the full match, a Wald test comparing the pair-wise null hypothesis of LUMP = 1TO1 is not rejected (p = 0.503). One reason for the lack of significance between efficiencies in the lump-sum setting and the one-to-one setting is that there were substantially more full matches in the lump-sum setting compared to the one-to-one setting (81.7% of all rounds compared to 61.4% of all rounds, respectively). Again, an end-game effect is present; efficiency decreases by an average of 3% in round 9 and 4% in round 10 when compared to round 1. This result is consistent with Figure 3, which displays a decrease in efficiency for the final two rounds in all environments but lump-sum matching.[10]

The third performance measure to analyze is the dispersion of within-group allocations to the group account, where dispersion is calculated by the standard deviation about the mean individual allocation to the group account. The previously described regression model is estimated using per-round standard deviation of member allocations as the dependent variable. Table 4 displays the regression coefficients, robust standard errors, and 2-tailed significance tests for the coefficients. In support of *Observation* 3, the table reveals that the lump-sum setting results in a marginally significant (p = 0.086) decrease in dispersion compared to the baseline setting. Wald tests comparing pair-wise null hypotheses of LUMP = 1TO1 (p = 0.013) and LUMP = ALTBASE (p = 0.052) are also significant. A Wald test comparing the remaining pair-wise null hypothesis (1TO1 = ALTBASE) is not significant at the 10% level. As can be seen in Figure 4, dispersion increases during the final three rounds in each setting. This observation is supported by the regression results, as RND8 (p = 0.083), RND9 (p = 0.000), and RND10 (p = 0.000) are all positive and significant.

[10] Thirty-one of 1260 observations are at the upper efficiency limit (1) and one observation is at the variable lower efficiency limit. (The lower efficiency limits in the baseline and alternate baseline are larger than the lower limit in the matching environments.) To account for these observations at the boundaries of the decision space a two-limit censored normal model employing robust clustered standard errors was also estimated. The coefficients and standard errors were very similar to those shown in Table 3.

4.C. Individual Allocations to the Group Account: Benchmark Frequencies

This subsection analyzes group-account allocations at the individual level organized around the frequency of occurrence of three benchmark allocations: the individual maximum (25 tokens), the symmetric Nash equilibrium (15 tokens), and complete free-riding (0 tokens).[11] To avoid any possible impact on token allocations from an individual's participation in multiple decision settings, only the phase-one data is examined. Figure 5 displays relative frequencies of these benchmark allocations for each experimental decision setting, pooling across all ten decision rounds.[12] The percentage of occurrences of the maximum allocation is somewhat higher in the matching settings relative to the baseline settings. Further, the lump-sum setting results in more allocations that are consistent with the symmetric Nash equilibrium compared to the one-to-one setting, and complete free-riding occurs less frequently under lump-sum matching relative to the other three settings.

To formally examine the significance of these informal observations, negative binomial count-data regressions are performed where the dependent variable is the number of rounds that an individual submitted a specific benchmark allocation (an integer between 0 and 10). The independent variables are the LUMP, 1TO1, and ALTBASE dummy variables described at the beginning of section 4.B.[13] Because each individual is part of a four-person group, an individual's token allocations are likely to be influenced by the previous allocations of other group members. To account for this within-group dependence, robust clustered standard errors are reported where observations are clustered by decision groups.

---

[11] Allocations near the symmetric Nash equilibrium $(14 \le \text{tokens} \le 16)$ were also examined. The results were very similar to those of the symmetric Nash equilibrium.
[12] Note that the symmetric Nash equilibrium only applies to lump-sum matching and one-to-one matching. The unique Nash equilibrium allocation to the group account is zero tokens for each baseline environment.
[13] A Poisson regression model was estimated first, but the results indicated that the assumption of equidispersion (equality of the mean and variance inherent in a Poisson process) must be rejected. Following Long (Chapter 8, 1997) and Cameron & Trivedi (Chapter 20, 2005) the negative binomial model was utilized to capture overdispersion in the dependent variable.

The regression results for each benchmark allocation appear in Tables 5, 6, and 7. A convenient way to interpret the regression coefficients in the negative binomial model is to examine incidence-rate ratios (IRR), where $\text{IRR} = e^{\beta_i}$. IRRs reveal the percentage change in the expected count of a benchmark allocation due to a change in the treatment condition, holding all other independent variables constant. For example, in Table 5, the lump-sum setting increases the expected frequency for the maximum allocation by a multiple of 1.18 compared to the baseline setting, an 18% increase [i.e. 100*(IRR – 1)]. Overall, however, Table 5 shows the regression model is not significant when the maximum allocation count is used as the dependent variable (p = 0.251). Table 6 shows that the coefficient for the LUMP dummy is positive and significant (p = 0.009); the IRR indicates a 79% increase over one-to-one matching in the expected number of rounds where the symmetric Nash equilibrium allocation is submitted. Finally, Table 7 shows that the coefficient for the LUMP dummy is negative and marginally significant (p = 0.064); the IRR indicates a 62% decrease in the number of complete free-riding rounds relative to the baseline level. Wald tests of null hypotheses LUMP = 1TO1 (p = 0.0112) and LUMP = ALTBASE (p = 0.0634) are significant. The remaining pair-wise null hypothesis, 1TO1 = ALTBASE, is not rejected at the 10% level. In summary, lump-sum matching appears to: 1) significantly increase the frequency of individual allocations consistent with the symmetric Nash equilibrium relative to one-to-one matching, and 2) significantly decrease the frequency of complete free riding allocations relative to the other decision settings examined here.

5. Summary and Conclusions

In the experimental literature on the voluntary provision of public goods, a wide range of studies examine alternative institutional arrangements intended to reduce collective action problems by creating incentives that facilitate cooperation. The research reported in this study adds to this literature by examining behavior in two fund-raising institutions found commonly in the field: lump-sum matching and one-to-one matching, where matching funds are provided by an "external" donor.

The experimental results reveal higher "internal" (within-group) resource allocations to the public good under lump-sum matching. An explanation supporting this result is that missing the threshold required to provide the full match results in a larger earnings loss in the lump-sum setting when compared to the one-to-one setting. Internal allocations in the lump-sum setting are also less dispersed, with more individual allocations at or near the symmetric Nash equilibrium prediction and fewer individual allocations consistent with complete free riding. Neither the lump-sum nor the one-to-one setting provides strong support for play of the symmetric Nash equilibrium. Finally, although lump-sum matching leads to greater internal allocations to the public good, there is not a significant difference in efficiency between the two matching-funds settings due to decision rounds where groups under lump-sum matching do not reach the threshold and thus receive no matching funds. In the experimental settings investigated here, external matching funds that are not extracted by a four-person group are wasted rather than being carried over to future decision rounds. In naturally-occurring field settings the validity of this rather harsh component of the experimental environment is doubtful. To the extent that unused matching funds are transferred to future endeavors that augment the provision of the public good, the efficiency comparisons reported here are of less relevance than the comparison of internal resource allocations to the public good.

Fund-raising drives suggest several other interesting extensions to the experiments reported here. In particular, in field applications organizations often provide information on the current status of the fund drive with respect to donations. Future research will examine this issue, using both lump-sum and one-to-one matching, by giving subjects intra-round information on the current aggregate allocation to the public good in conjunction with intra-round updating of individual allocation decisions. An "increase-only" allocation rule can be applied to intra-round updates of individual decisions. Larger group sizes, other group-account earnings structures, and the use of nonmonetary rewards will also be investigated.

References

Cameron, A.C. and P. K. Trivedi, *Microeconometrics: Methods and Applications*, New York: Cambridge University Press, 2005.

Eckel, C. and P. Grossman, "Rebate versus Matching: Does How We Subsidize Charitable Contributions Matter?," *Journal of Public Economics*, 87, 2003, 681-701.

Gachter, S. and E. Renner, "Leading By Example in the Presence of Free-Rider Incentives," working paper, 2004.

Isaac, M., J. Walker, and A. Williams, "Group Size and the Voluntary Provision of Public Goods: Experimental Evidence Utilizing Large Groups," *Journal of Public Economics*, 54(1), 1994, 1-36.

Karlan, D., and J. List, "Does Price Matter in Charitable Giving? Evidence from a Large-Scale Natural Field Experiment," working paper, Yale Working Papers on Economic Applications and Policy, no.13, 2006.

Ledyard, J.,"Public Goods: A Survey of Experimental Research," in Kagel, J. and A. Roth (eds) *Handbook of Experimental Economics*, Princeton University Press, 1995.

List, J. and D. Lucking-Reiley, "The Effects of Seed Money and Refunds on Charitable Giving: Experimental Evidence from a University Capital Campaign," *Journal of Political Economy*, 110(1), February 2002, 215-233.

List, J. and D. Rondeau, "The Impact of Challenge Gifts on Charitable Giving: An Experimental Investigation," *Economics Letters*, 79, 2003, 153-159.

Long, J. S., *Regression Models for Categorical and Limited Dependent Variables*, California: SAGE Publications, Inc., 1997.

Marks, M. and R. Croson, "Alternative Rebate Rules in the Provision of a Threshold Public Good: An Experimental Investigation," *Journal of Public Economics,* 67, 1998, 195-220.

Potters, J., M. Sefton, and L.Vesterlund, "Why Announce Leadership Contributions? An Experimental Study of the Signaling and Reciprocity Hypotheses." *CentER DP* 2001-100, University of Tilburg, 2001.

Rogers, W. H. 'Regression standard errors in clustered samples', *Stata Technical Bulletin Reprints*, vol. 3, 1993, 88-94.

Table 1. Characteristics of Decision Settings

	Baseline	Lump-Sum Matching	One-to-One Matching
Individual Token Endowment Per-Round	25	25	25
Decision Rounds	10	10	10
Per-Token Return to Private Account	\$0.01	\$0.01	\$0.01
Individual Per-Token Return from Group Account	\$0.006	\$0.006 for tokens other than the 60th token	\$0.012 for tokens 1-60, \$0.006 for tokens 61 and above
Total Individual Earnings: All Tokens to the Private Account	\$6.10	\$2.50	\$2.50
Total Individual Earnings: Symmetric Nash Equilibrium of 15 tokens	NA	\$8.20	\$8.20
Total Individual Earnings: All Tokens to the Group Account	\$9.60	\$9.60	\$9.60

Table 2. Linear Model: Group Allocations to Group Account

Independent Variable	Coefficient Estimate	Robust Clustered Standard Error	Ho: Coefficient = 0 Z	p-value
CONSTANT	62.2475	3.6981	16.83	0.000
LUMP	9.0784	3.3413	2.72	0.007
1TO1	2.4903	3.4299	0.73	0.468
ALTBASE	-8.3085	6.3368	-1.31	0.190
PHASE2	-2.5347	2.8036	-0.90	0.366
PHASE3	-2.6133	2.6629	-0.98	0.326
RND2	4.0476	1.1829	3.42	0.001
RND3	2.6825	1.4151	1.90	0.058
RND4	3.4048	1.4653	2.32	0.020
RND5	1.2937	1.5544	0.83	0.405
RND6	-0.1349	1.5595	-0.09	0.931
RND7	0.0873	1.5450	0.06	0.955
RND8	-0.5238	1.5052	-0.35	0.728
RND9	-2.7381	1.5614	-1.75	0.080
RND10	-4.9921	1.7931	-2.78	0.005

Total Number of Observations = 1260 = 126 clusters of 10 observations
Model: $\chi 2(15) = 983.75$, $p = 0.000$
Fraction of variance due to session-specific random effect: 0.058

Table 3. Linear Model: Group Efficiency

Independent Variable	Coefficient Estimate	Robust Clustered Standard Error	Ho: Coefficient = 0 Z	p-value
CONSTANT	0.8781	0.0173	50.64	0.000
LUMP	-0.0357	0.0185	-1.93	0.054
1TO1	-0.0230	0.0160	-1.44	0.150
ALTBASE	-0.0390	0.0291	-1.34	0.179
PHASE2	-0.0176	0.0163	-1.08	0.279
PHASE3	-0.0178	0.0169	-1.05	0.294
RND2	0.0204	0.0103	1.97	0.049
RND3	0.0074	0.0132	0.56	0.575
RND4	0.0055	0.0129	0.43	0.670
RND5	-0.0091	0.0141	-0.64	0.521
RND6	-0.0134	0.0149	-0.90	0.367
RND7	-0.0149	0.0135	-1.11	0.269
RND8	-0.0141	0.0129	-1.09	0.275
RND9	-0.0286	0.0143	-2.00	0.046
RND10	-0.0396	0.0137	-2.90	0.004

Total Number of Observations = 1260 = 126 clusters of 10 observations
Model: $\chi 2(15) = 4713.82$, $p = 0.000$
Fraction of variance due to session-specific random effect: 0.045

Table 4. Linear Model: Within Group-Standard Deviation of Individual Allocations to Group Account

Independent Variable	Coefficient Estimate	Robust Clustered Standard Error	Ho: Coefficient = 0 Z	p-value
CONSTANT	7.4274	0.7486	9.92	0.000
LUMP	-0.9988	0.5817	-1.72	0.086
1TO1	0.1257	0.5423	0.23	0.817
ALTBASE	0.8650	1.0414	0.83	0.406
PHASE2	-0.0421	0.4809	-0.09	0.930
PHASE3	-0.0647	0.5016	-0.13	0.897
RND2	-0.2424	0.2249	-1.08	0.281
RND3	0.1594	0.2796	0.57	0.569
RND4	0.0351	0.2855	0.12	0.902
RND5	0.3553	0.3130	1.14	0.256
RND6	0.4774	0.3198	1.49	0.135
RND7	0.4384	0.3211	1.37	0.172
RND8	0.5451	0.3144	1.73	0.083
RND9	1.3791	0.3153	4.37	0.000
RND10	1.6131	0.3501	4.61	0.000

Total Number of Observations = 1260 = 126 clusters of 10 observations
Model: $\chi 2(15) = 243.35$, $p = 0.000$
Fraction of variance due to session-specific random effect: 0.099

Table 5. Count Data Model: Maximum Allocation

Independent Variable	IRR	Coefficient Estimate	Robust Clustered Standard Error	Ho: Coefficient = 0 Z	p-value
CONSTANT		1.0488	0.0908	11.56	0.000
LUMP	1.1825	0.1676	0.1515	1.11	0.269
1TO1	1.2482	0.2217	0.1487	1.49	0.136
ALTBASE	0.9051	-0.0997	0.1790	-0.56	0.578

Total Number of Observations = 168 = 42 clusters of 4 observations
Model: $\chi 2(3) = 4.10$, $p = 0.251$

Table 6. Count Data Model: Symmetric Nash Equilibrium Allocation

Independent Variable	IRR	Coefficient Estimate	Robust Clustered Standard Error	Ho: Coefficient = 0 Z	p-value
CONSTANT		-0.2336	0.1693	-1.38	0.168
LUMP	1.7895	0.5819	0.2227	2.61	0.009

Total Number of Observations = 96 = 24 clusters of 4 observations
Model: $\chi 2(1) = 6.83$, $p = 0.009$

Table 7. Count Data Model: Complete Free-Riding Allocation

Independent Variable	IRR	Coefficient Estimate	Robust Clustered Standard Error	Ho: Coefficient = 0 Z	p-value
CONSTANT		-0.1335	0.2902	-0.46	0.645
LUMP	0.3810	-0.9651	0.5205	-1.85	0.064
1TO1	1.3333	0.2877	0.3758	0.77	0.444
ALTBASE	1.1429	0.1335	0.4978	0.27	0.789

Total Number of Observations = 168 = 42 clusters of 4 observations
Model: $\chi 2(3) = 6.54$, $p = 0.088$

Figure 1. Group Account Earnings for the Decision Settings

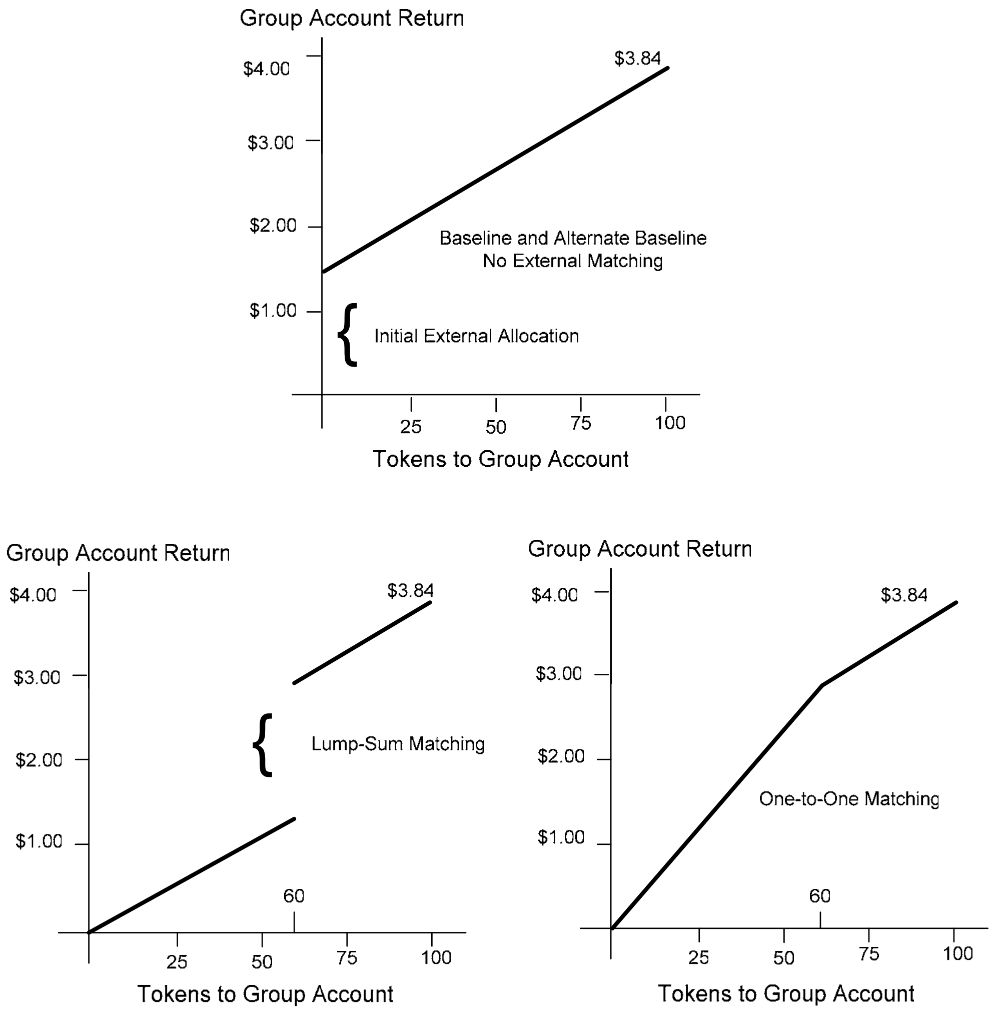


Figure 2. Mean Internal Token Allocation to the Group Account

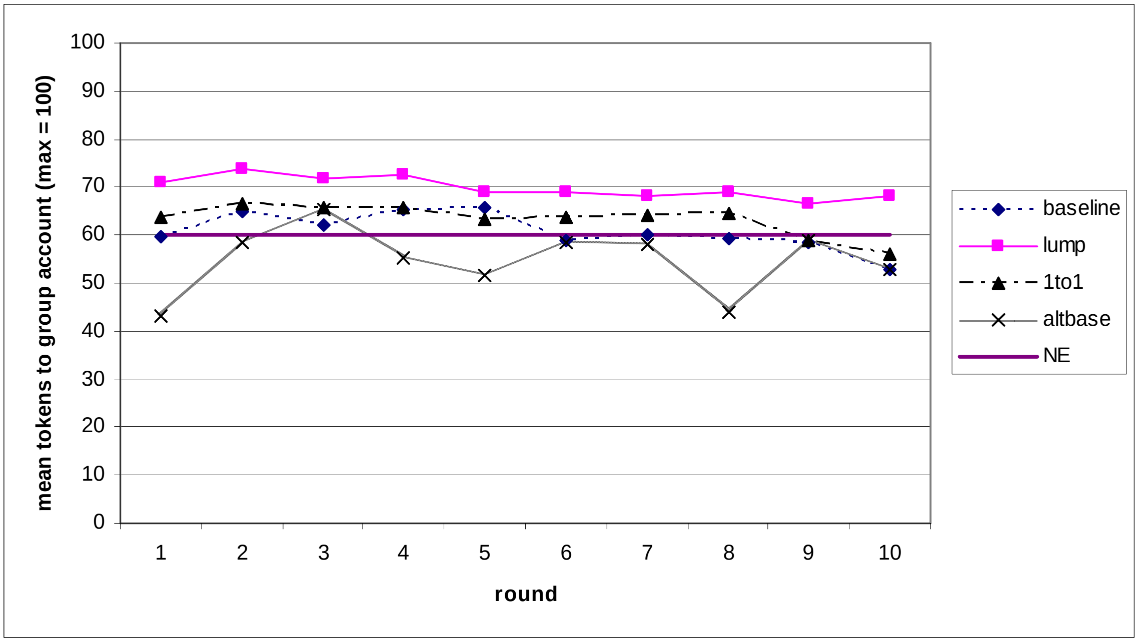


Figure 3. Mean Efficiency

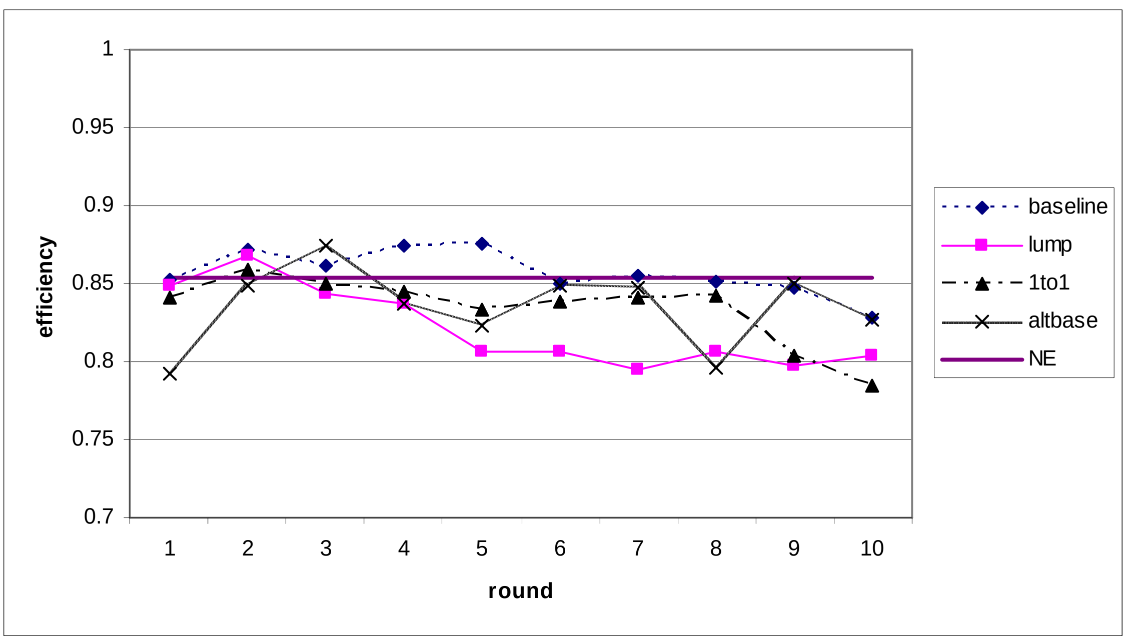


Figure 4. Mean Group-by-Group Standard Deviation of Tokens to the Group Account

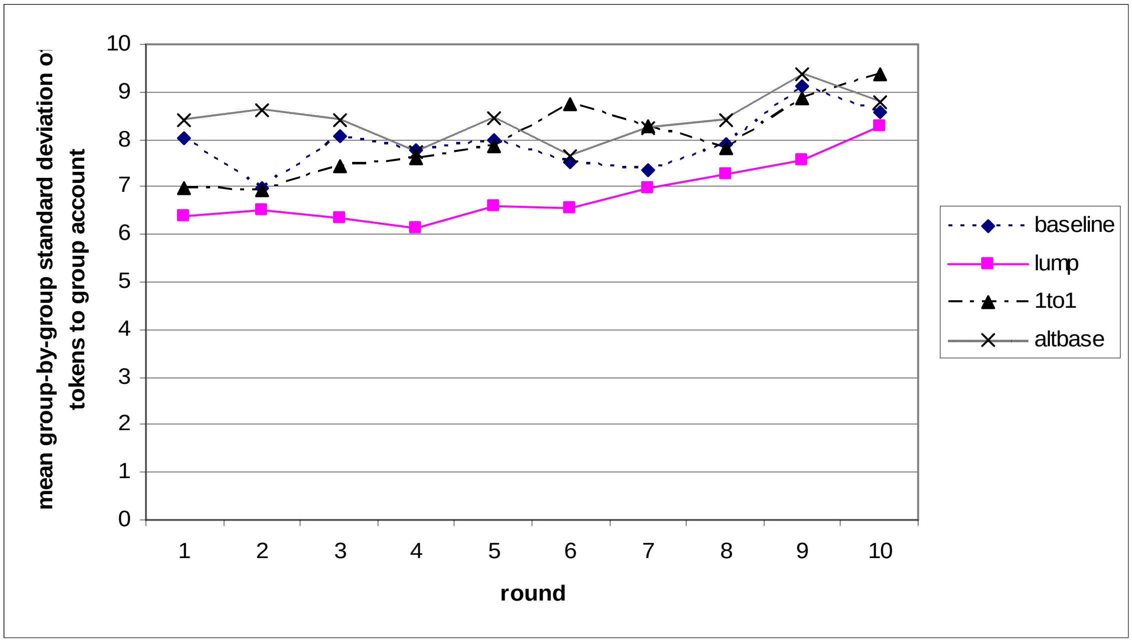
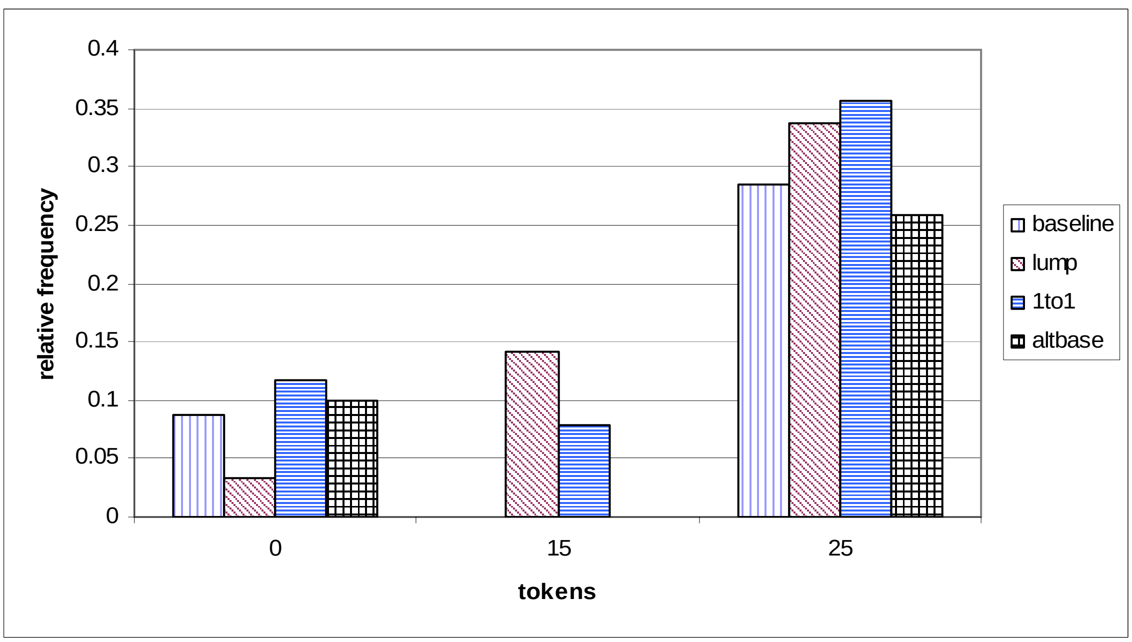


Figure 5. Individual Token Allocations to the Group Account: All Rounds, Phase 1



Appendix

(These instructions present what a subject saw when participating in a Baseline, Lump-Sum Match, and One-to-One Match Sequenced Experiment)

ADDITIONAL INSTRUCTIONS
(First Overhead)

You will participate in a total of 30 decision rounds consisting of three 10-round sequences.

For each 10-round sequence, you will be assigned to a 4-person decision-making group. Groups will be reassigned randomly before the start of each 10-round sequence.

Your earnings for each 10-round sequence begin at zero. At the end of all three 10-round sequences you will be paid privately in cash the sum of your earnings from all three sequences plus the $5 show-up fee.

All decisions are made privately and remain anonymous throughout the experiment.

DO NOT TALK TO OTHER PARTICIPANTS AT ANY TIME DURING THE EXPERIMENT, INCLUDING BETWEEN SEQUENCES.

SUMMARY INFORMATION
(Presented on Overhead while subjects were reading the NovaNET Instructions)

1) All participants are placed into a group of 4.

2) All participants receive 25 tokens at the start of each round.

3) In each round all participants receive $0.01 for each token placed into the private account.

4) In each round all participants receive $0.006 for each token placed into their group account, regardless of which group member placed the token into the group account.

Screen Prints for NovaNET Instructions: Baseline Setting

INSTRUCTIONS

This is an exercise in the economics of group decision making. When you logged into the exercise for the first time, you where randomly assigned to a particular group along with 3 other people.

The exercise will occur over a sequence of ten decision-making rounds. At the start of each round you will be endowed with 25 "tokens". In each round, you must decide how to divide your tokens between your "PRIVATE ACCOUNT" and a "GROUP ACCOUNT". Each person in the group has a Private Account, however, there is only one Group Account for the entire group. You will earn $0.01 for each token that you retain in your private account in any decision making round. Thus, if you choose to retain all your 25 tokens in your private account you will earn $0.25 in that round from your private account.

Everyone in the group will receive the same portion of the earnings from the GROUP ACCOUNT. Thus, if 4 people are in the group, you will receive ¼ = 25% of the group earnings from the group account regardless of the number of tokens that you place in the group account.

It is important to realize that EVERYONE in the group receives a ¼ share of the earnings from the group account. This is true for each individual regardless of the number of tokens that the individual places in the group account.

Here is a table that shows how both group earnings and your individual earnings from the group account will vary with the number of tokens placed in the group account. This table will be displayed on your viewing screen during each round of the exercise.

Examples of Possible Earnings from the GROUP ACCOUNT

Tokens in Group Account (from the entire group)	Total Group Earnings	Your 25% share of Group Earnings
0	$0.000	$0.000
6	$0.144	$0.036
13	$0.312	$0.078
19	$0.456	$0.114
25	$0.600	$0.150
31	$0.744	$0.186
38	$0.912	$0.228
44	$1.056	$0.264
50	$1.200	$0.300
56	$1.344	$0.336
63	$1.512	$0.378
69	$1.656	$0.414
75	$1.800	$0.450
81	$1.944	$0.486
88	$2.112	$0.528
94	$2.256	$0.564
100	$2.400	$0.600

The first row of the table indicates that the MINIMUM number of tokens that can be placed in the group account is zero. This will occur if everyone in the group places no tokens in the group account and will result in group earnings from the group account of $0.

The last row indicates that the MAXIMUM number of tokens that can be placed in the group account is 100. This is the summation of the individual token endowments for the entire group and would result in group earnings from the group account of $2.4.

The table reveals that for token 1 through token 100 placed in the group account, total group earnings from the group account increase by $0.024 per token. Thus, each individual's earnings from the group account increase by $0.024 / 4 = $0.006 per token over this range.

YOUR ENDOWMENT of tokens per round: 25 ; Group size: 4
TOTAL GROUP ENDOWMENT of tokens per round: 100
Each token placed in your PRIVATE ACCOUNT earns $0.01

The information that just appeared above the table will appear on your display each round. You will also be able to see "Total Group Earnings" and "Your Share of Group Earnings" for any level of “Tokens in Group Account” not already displayed in the table. You will be able to access this option by pressing the -LAB- key.

Prior to entering your decisions for rounds 2 – 10 you will be shown the results from the previous round. You will also be able to review the results from any previous round by pressing the -DATA- key.

You will be able to review the instructions prior to making your decision in any round by pressing the -HELP- key.

In order to make sure you understand how each round will proceed, let’s work through an instructive example of the decision entry process that you will go through each round.

SPECIAL INSTRUCTIONS AFFECTING EARNINGS FROM THE GROUP ACCOUNT

In each decision round an “external source” will place 60 tokens in the group account in addition to any tokens allocated to the group account by group members. The external source is a computerized robot player that is not a human group member. The tokens placed in the group account by the external source will increase all group members’ earnings from the group account.

The maximum possible tokens placed in the group account is 100 from group members and 60 from the external source for a total of 160. The table showing group and individual earnings from various levels of tokens allocated to the group account will be adjusted to reflect this expanded upper limit..

Authors note: During the decision phase, subjects viewed a payoff table for the group account that went from 0 to 160 possible tokens.

Overhead Shown Prior to the Second 10-round Sequence of Lump-Sum Matching:

You have now completed the first 10-round sequence and will begin the second 10-round sequence.

You will now be assigned randomly to a new 4-person group.

The class file for this 10-round sequence is “(insert class file name).”

Log in with the same last name.

The instructions for the experiment remain the same, except for the “special instructions” that occur at the end of the instructions.

Carefully read the “special instructions.” They explain a change in how the tokens from the external source are placed into the Group Account.

Your earnings for each 10-round sequence begin at zero. At the end of all three 10-round sequences you will be paid privately in cash the sum of your earnings from all three sequences plus the $5 show-up fee.

DO NOT TALK TO OTHER PARTICIPANTS AT ANY TIME DURING THE EXPERIMENT, INCLUDING BETWEEN SEQUENCES.

SUMMARY INFORMATION for Phase 2
(Presented on Overhead while subjects were reading the NovaNET Instructions)

1) All participants are placed into a group of 4.

2) All participants receive 25 tokens at the start of each round.

3) In each round all participants receive $0.01 for each token placed into the private account.

4) In each round all participants receive $0.006 for each token placed into their group account, regardless of which group member placed the token into the group account.

5) In each round where the total number of tokens allocated to the group account equals or exceeds 60 tokens, an “external source” will place an additional 60 additional tokens in the group account. The external source is a computerized robot player that is not a human group member.

In other words, if group members allocate a total of 0 through 59 tokens to the group account, then the external source will not place any additional tokens in the group account. If group members place 60 through 100 tokens in the group account, the external source will place an additional 60 tokens in the group account. These tokens will increase all group members’ earnings from the group account.

Screen Prints for NovaNET Instructions: Lump-Sum Match Setting

INSTRUCTIONS

This is an exercise in the economics of group decision making. When you logged into the exercise for the first time, you where randomly assigned to a particular group along with 3 other people.

The exercise will occur over a sequence of ten decision-making rounds. At the start of each round you will be endowed with 25 “tokens”. In each round, you must decide how to divide your tokens between your “PRIVATE ACCOUNT” and a “GROUP ACCOUNT”. Each person in the group has a Private Account, however, there is only one Group Account for the entire group. You will earn $0.01 for each token that you retain in your private account in any decision making round. Thus, if you choose to retain all your 25 tokens in your private account you will earn $0.25 in that round from your private account.

Everyone in the group will receive the same portion of the earnings from the GROUP ACCOUNT. Thus, if 4 people are in the group, you will receive ¼ = 25% of the group earnings from the group account regardless of the number of tokens that you place in the group account.

It is important to realize that EVERYONE in the group receives a ¼ share of the earnings from the group account. This is true for each individual regardless of the number of tokens that the individual places in the group account.

Here is a table that shows how both group earnings and your individual earnings from the group account will vary with the number of tokens placed in the group account. This table will be displayed on your viewing screen during each round of the exercise.

Examples of Possible Earnings from the GROUP ACCOUNT

Tokens in Group Account (from the entire group)	Total Group Earnings	Your 25% share of Group Earnings
0	$0.000	$0.000
6	$0.144	$0.036
13	$0.312	$0.078
19	$0.456	$0.114
25	$0.600	$0.150
31	$0.744	$0.186
38	$0.912	$0.228
44	$1.056	$0.264
50	$1.200	$0.300
56	$1.344	$0.336
63	$1.512	$0.378
69	$1.656	$0.414
75	$1.800	$0.450
81	$1.944	$0.486
88	$2.112	$0.528
94	$2.256	$0.564
100	$2.400	$0.600

The first row of the table indicates that the MINIMUM number of tokens that can be placed in the group account is zero. This will occur if everyone in the group places no tokens in the group account and will result in group earnings from the group account of $0.

The last row indicates that the MAXIMUM number of tokens that can be placed in the group account is 100. This is the summation of the individual token endowments for the entire group and would result in group earnings from the group account of $2.4.

The table reveals that for token 1 through token 100 placed in the group account, total group earnings from the group account increase by $0.024 per token. Thus, each individual's earnings from the group account increase by $0.024 / 4 = $0.006 per token over this range.

YOUR ENDOWMENT of tokens per round: 25 ; Group size: 4
TOTAL GROUP ENDOWMENT of tokens per round: 100
Each token placed in your PRIVATE ACCOUNT earns $0.01

The information that just appeared above the table will appear on your display each round. You will also be able to see "Total Group Earnings" and "Your Share of Group Earnings" for any level of "Tokens in Group Account" not already displayed in the table. You will be able to access this option by pressing the -LAB- key.

Prior to entering your decisions for rounds 2 – 10 you will be shown the results from the previous round. You will also be able to review the results from any previous round by pressing the -DATA- key.

You will be able to review the instructions prior to making your decision in any round by pressing the -HELP- key.

In order to make sure you understand how each round will proceed, let's work through an instructive example of the decision entry process that you will go through each round.

SPECIAL INSTRUCTIONS AFFECTING EARNINGS FROM THE GROUP ACCOUNT

In each decision round where the total number of tokens allocated to the group account by group members equals or exceeds 60 tokens, an "external source" will place 60 additional tokens in the group account. The external source is a computerized robot player that is not a human group member.

In other words, if group members allocate a total of 0 through 59 tokens to the group account, then the external source will not place any additional tokens in the group account. If group members place 60 through 100 tokens in the group account, the external source will place an additional 60 tokens in the group account. These tokens will increase all group members' earnings from the group account.

The maximum possible tokens placed in the group account is 100 from group members and 60 from the external source for a total of 160. The table showing group and individual earnings from various levels of tokens allocated to the group account will be adjusted to reflect this expanded upper limit.

Authors note: During the decision phase, subjects viewed a payoff table for the group account that went from 0 to 160 possible tokens.

Overhead Shown Prior to the Third 10-round Sequence of One-to-One Matching:

You have now completed the second 10-round sequence and will begin the third 10-round sequence.

You will now be assigned randomly to a new 4-person group.

The class file for this 10-round sequence is "(insert class file name)."

Log in with the same last name.

The instructions for the experiment remain the same, except for the "special instructions" that occur at the end of the instructions.

Carefully read the "special instructions." They explain a change in how the tokens from the external source are placed into the Group Account.

Your earnings for each 10-round sequence begin at zero. At the end of all three 10-round sequences you will be paid privately in cash the sum of your earnings from all three sequences plus the $5 show-up fee.

DO NOT TALK TO OTHER PARTICIPANTS AT ANY TIME DURING THE EXPERIMENT, INCLUDING BETWEEN SEQUENCES

SUMMARY INFORMATION for Phase 3
(Presented on Overhead while subjects were reading the NovaNET Instructions)

1) All participants are placed into a group of 4.

2) All participants receive 25 tokens at the start of each round.

3) In each round all participants receive $0.01 for each token placed into the private account.

4) In each round all participants receive $0.006 for each token placed into their group account, regardless of which group member placed the token into the group account.

5) In each decision round, for each token allocated to the group account by group members in the range of 1 through 60 tokens, an "external source" will also place a token in the group account. The external source is a computerized robot player that is not a group member.

In other words, in the range from 1 through 60 tokens allocated to the group account, the external source will match each token on a one-for-one basis. The one-for-one matching ends when the external source has placed 60 tokens in the group account.

Screen Prints for NovaNET Instructions: One-to-One Match Setting

INSTRUCTIONS

This is an exercise in the economics of group decision making. When you logged into the exercise for the first time, you where randomly assigned to a particular group along with 3 other people.

The exercise will occur over a sequence of ten decision-making rounds. At the start of each round you will be endowed with 25 "tokens". In each round, you must decide how to divide your tokens between your "PRIVATE ACCOUNT" and a "GROUP ACCOUNT". Each person in the group has a Private Account, however, there is only one Group Account for the entire group. You will earn $0.01 for each token that you retain in your private account in any decision making round. Thus, if you choose to retain all your 25 tokens in your private account you will earn $0.25 in that round from your private account.

Everyone in the group will receive the same portion of the earnings from the GROUP ACCOUNT. Thus, if 4 people are in the group, you will receive ¼ = 25% of the group earnings from the group account regardless of the number of tokens that you place in the group account.

It is important to realize that EVERYONE in the group receives a ¼ share of the earnings from the group account. This is true for each individual regardless of the number of tokens that the individual places in the group account.

Here is a table that shows how both group earnings and your individual earnings from the group account will vary with the number of tokens placed in the group account. This table will be displayed on your viewing screen during each round of the exercise.

Examples of Possible Earnings from the GROUP ACCOUNT

Tokens in Group Account (from the entire group)	Total Group Earnings	Your 25% share of Group Earnings
0	$0.000	$0.000
6	$0.144	$0.036
13	$0.312	$0.078
19	$0.456	$0.114
25	$0.600	$0.150
31	$0.744	$0.186
38	$0.912	$0.228
44	$1.056	$0.264
50	$1.200	$0.300
56	$1.344	$0.336
63	$1.512	$0.378
69	$1.656	$0.414
75	$1.800	$0.450
81	$1.944	$0.486
88	$2.112	$0.528
94	$2.256	$0.564
100	$2.400	$0.600

The first row of the table indicates that the MINIMUM number of tokens that can be placed in the group account is zero. This will occur if everyone in the group places no tokens in the group account and will result in group earnings from the group account of $0.

The last row indicates that the MAXIMUM number of tokens that can be placed in the group account is 100. This is the summation of the individual token endowments for the entire group and would result in group earnings from the group account of $2.4.

The table reveals that for token 1 through token 100 placed in the group account, total group earnings from the group account increase by $0.024 per token. Thus, each individual's earnings from the group account increase by $0.024 / 4 = $0.006 per token over this range.

YOUR ENDOWMENT of tokens per round: 25 ; Group size: 4
TOTAL GROUP ENDOWMENT of tokens per round: 100
Each token placed in your PRIVATE ACCOUNT earns $0.01

The information that just appeared above the table will appear on your display each round. You will also be able to see "Total Group Earnings" and "Your Share of Group Earnings" for any level of "Tokens in Group Account" not already displayed in the table. You will be able to access this option by pressing the -LAB- key.

Prior to entering your decisions for rounds 2 – 10 you will be shown the results from the previous round. You will also be able to review the results from any previous round by pressing the -DATA- key.

You will be able to review the instructions prior to making your decision in any round by pressing the -HELP- key.

In order to make sure you understand how each round will proceed, let's work through an instructive example of the decision entry process that you will go through each round.

SPECIAL INSTRUCTIONS AFFECTING EARNINGS FROM THE GROUP ACCOUNT

In each decision round, for each token allocated to the group account by group members in the range from 1 through 60 tokens, an "external source" will also place a token in the group account. The external source is a computerized robot player that is not a group member.

In other words, in the range from 1 through 60 tokens allocated to the group account, the external source will match each token on a one-for-one basis. The one-for-one matching ends when the external source has placed 60 tokens in the group account.

For example, if group members allocate a total of 30 tokens to the group account, then the external source will add 30 tokens to the group account. Alternatively, if group members allocate 70 tokens to the group account the external source will add 60 tokens to the group account (the one-for-one matching maximum). These extra tokens will increase all group members' earnings from the group account.

The maximum possible tokens placed in the group account is 100 from group members and 60 from the external source for a total of 160. The table showing group and individual earnings from various levels of tokens allocated to the group account will be adjusted to reflect this expanded upper limit.

Instructions for the Alternate Baseline Phase

ADDITIONAL INSTRUCTIONS
(First Overhead)

You will participate in a total of 30 decision rounds consisting of three 10-round sequences.

For each 10-round sequence, you will be assigned to a 4-person decision-making group. Groups will be reassigned randomly before the start of each 10-round sequence.

Your earnings for each 10-round sequence begin at zero. At the end of all three 10-round sequences you will be paid privately in cash the sum of your earnings from all three sequences plus the $5 show-up fee.

All decisions are made privately and remain anonymous throughout the experiment.

DO NOT TALK TO OTHER PARTICIPANTS AT ANY TIME DURING THE EXPERIMENT, INCLUDING BETWEEN SEQUENCES.

SUMMARY INFORMATION
(Presented on Overhead while subjects were reading the NovaNET Instructions)

1) All participants are placed into a group of 4.

2) All participants receive 25 tokens at the start of each round.

3) In each round all participants receive $0.01 for each token placed into the private account.

4) In each round all participants receive $0.006 for each token placed into their group account, regardless of which group member placed the token into the group account.

Screen Prints for NovaNET Instructions: Alternate Baseline Setting

Authors note: The instructions for the alternate baseline setting are identical to the baseline setting with two exceptions: 1) the table now has $1.44 as earnings when 0 tokens are placed in the group account; and 2) no special instructions occur after the example is presented.

Overhead Shown Prior to the Second 10-round Sequence:

You have now completed the first 10-round sequence and will begin the second 10-round sequence.

You will now be assigned randomly to a new 4-person group.

The class file for this 10-round sequence is "(insert class file name)."

Log in with the same last name.

The instructions for the experiment remain the same, except for two changes.

First, look carefully at the group account earnings table and note that zero tokens to the group account will generate zero earnings from the group account.

Second, carefully read the "special instructions" that occur at the end of the instructions. They explain that now an "external source" may place additional tokens into the Group Account. These tokens will increase all group members' earnings from the group account. The "external source" is a computerized robot player that is not a human group member.

Your earnings for each 10-round sequence begin at zero. At the end of all three 10-round sequences you will be paid privately in cash the sum of your earnings from all three sequences plus the $5 show-up fee.