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Endowment Effects and Contribution Strategies in Public Good Experiments

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Keywords

Experiments; Public Goods; Voluntary Contribution Mechanism

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REVIEW ARTICLE

Endowment Effects and Contribution Strategies in Public Good Experiments

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JEL classification*:* C72; C90; H41

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1. INTRODUCTION

The voluntary contribution mechanism (VCM) is frequently used to investigate collective action in a public goods environment. Rational choice theory predicts that subjects won't contribute to the public good account, instead choosing to free-ride on the contributions of others (Olsen, 1965). Evidence from experimental VCM games finds the converse: subjects typically allocate a nonzero amount to the public good account, although these contributions tend to decay over time.[1] Prior

[1] For surveys of the literature, see Davis & Holt (1993), Ledyard (1995), Offerman (1997), Ostrom (2000), and Holt (2007).

research has identified several determinants of contribution levels in the VCM setting, including the marginal per capita return (MPCR) from the group account[2] and the size of endowment,[3] with an increase in either factor generating higher contribution levels. Punishment/sanctioning mechanism[4] or the presence of pre-play communication[5] have also been found to raise contribution levels. Behavioral explanations for deviations from the rational choice prediction are commonplace, focused on issues including altruism, social norms, other regarding preferences, confusion, and inequality aversion.

Despite the broad attention given to the VCM framework, limited research has been conducted to evaluate the impact of endowment effects on subject behavior in this setting (notable exceptions focus on endowment heterogeneity[6] and endowment origin[7]). Standard laboratory VCM experiments parcel out the total endowment in fixed intervals, a structure that constrains the timing and magnitude of contributions in a way that may influence the level of collective action that is observed. In the fixed interval framework, contribution decisions made in early rounds are binding—tokens allocated to the public account cannot be taken back and tokens allocated to the private account cannot be invested in the public account in a later period. Yet in practice, fundraising ventures for public goods frequently rely on "pledges" that provide potential information on other donors' willingness to contribute but that are not binding. Allocating the endowment in fixed intervals also limits the ability of conditional cooperators to reciprocate others contributions because funds contributed to a private account (perhaps early in a session while a subject waits to see if there is cooperation) are not available for future contributions. Similarly, to the extent that early contributions foster cooperative play, parceling endowments in fixed intervals limits the ability of subjects to signal a willingness to cooperate because they do not have access to the entire endowment. The primary purpose of this paper is to examine the impact of different endowment distribution schemes on the contribution decisions of subjects in a public goods game setting.

We use a total of four treatments—baseline, full endowment, carryover and pledge—described in detail below. In brief, our results suggest that the endowment scheme and ability to make non-binding pledges has a substantive impact on subject decision making. Relative to the baseline treatment, the non-binding rounds of the pledge treatment had higher contributions, but when

[2]For instance, see Marwell and Ames (1979), Isaac et al. (1984), Isaac and Walker (1988a), Isaac et al. (1994), Fisher et al (1995), Dickinson (1998), Laury et al. (1999), Goeree et al. (2002), and Cadigan et al. (2011).

[3]For instance, see Rapoport (1988), Van Dijk & Grodska (1992), Chan et al. (1999), Clark (2002), Cherry et al. (2005), Buckley & Croson (2006), Hofmeyr et al. (2007), De Cremer & Van Dijk (2009), Muehlbacher & Kirchler (2009), and Spraggon & Oxoby (2009).

[4]For instance, see Ostrom et al. (1992), Dickinson and Isaac (1998), Fehr and Gächter (2000), Dickinson (2001), Masclet et al. (2003), Walker & Halloran (2004), Egas and Riedl (2005), Cinyabuguma et al. (2005), Page et al. (2005), Anderson & Putterman (2006), Bochet et al. (2006), Gurerk et al. (2006), Carpenter (2007), Sefton et al. (2007), Ones and Putterman (2007), Nikiforakis(2008), Nikiforakis & Normann (2008), and Ertan et al. (2009).

[5]For instance, see Dawes et al. (1977), Isaac and Walker (1988b), Palfrey & Rosenthal (1991), Ostrom et al. (1992), Sally (1995), Wilson & Sell (1997), Brosig et al. (2003), Rege & Telle (2004), Bochet et al. (2006), and Chaudhuri (2006).

[6]For instance, see Rapoport (1988), Van Dijk & Grodska (1992), Chan et al. (1999), Cherry et al. (2005), Buckley & Croson (2006), Hofmeyr et al. (2007), De Cremer & Van Dijk (2009).

[7]For instance, see Clark (2002), Cherry et al. (2005), Muehlbacher & Kirchler (2009), Spraggon & Oxoby (2009).

the decision was binding contributions were significantly lower. In the carryover and full endowment treatments, the higher effective endowment (relative to the baseline) appears to have played a substantive role in the evolution of subject contributions to the group account. In the carryover treatment, the effective endowment increased as rounds progressed, and this served to increase contributions to the group account early in the experiment. By contrast, in the full endowment treatment the effective endowment was decreased in each period by the amount contributed to the group account. In this treatment, contributions to the group account also declined. The remainder of the paper is organized as follows: section two details the experimental design and our behavioral hypotheses, section 3 outlines our procedures and experimental results, and section 4 concludes.

2. EXPERIMENTAL DESIGN AND PROCEDURE

In the basic VCM game, subjects in groups of size n are endowed with a number of tokens that may be allocated to a group account or a private account. Each subject's marginal per capita return (MPCR) from the group account is lower than that available from the private account, but the group account return accrues to all members of the group irrespective of their contribution decisions. For this specification the Nash equilibrium prediction has each subject allocate zero tokens to the group account, producing the common free-riding dilemma because the socially efficient outcome has each subject allocate all tokens to the group account. The presence of multiple periods (i.e. repeated stage games) does not change either the Nash prediction or the socially efficient contribution scheme. Our VCM framework follows the standard design, with the exception of altering some aspects of the endowment allocation. In every treatment, subjects were randomly and anonymously placed into groups of four subjects. In each of 10 periods the MPCR from the private account and the group account were constant: subjects received 1 experimental dollar (ED) for each token they allocated to the private account and ½ ED for each token allocated to the group account. Importantly, each member of the group received the ½ ED return for each token allocated to the group account, irrespective of their contribution decision. At the end of each period, subjects were shown a screen that displayed their contribution to the group account, the total number of tokens allocated to the group account, and their period payoff in ED. At the end of the experimental session, the EDs were exchanged for real dollar compensation at a rate of $0.10 per 1 ED. The total endowment (100 tokens) remained fixed across all treatments, although the distribution scheme varied. Despite the alternative distribution schemes (described below) the Nash equilibrium prediction and socially efficient outcome remain the same across treatments. Each subject earns 100 ED at the Nash equilibrium and 200 ED using the socially optimal contribution scheme.

2.1. Baseline

In the baseline treatment, subjects were endowed with 10 experimental tokens (W_i) at the beginning of every period. The effective per-period endowment to a subject in period t ($w_{i,t}$) of the baseline can be expressed as:

$$w_{i,t} = W_i$$

In each period, subjects decided independently and simultaneously how to allocate these tokens between the group account (C_i) and the private account ($W_i - C_i$). At the end of each round, subjects were informed of their contribution to the group account as well as the total contribution to the group account ($\sum_{i=1}^{4} C_i$). Per-token-returns from the private account of 1 ED and from the group account of ½ ED results in the following per-period-earnings formula for each subject (expressed in ED):

$$\pi_i = (W_i - C_i) + 0.5\sum_{i=1}^{4} C_i$$

2.2. Carryover

In the carryover treatment, subjects also received 10 experimental tokens each period. Each subject then decided how to allocate these tokens between the group account and the private account. Importantly, any tokens allocated to the private account were available for reallocation to the group account in all subsequent periods. As a result, the effective endowment for a subject in all periods beyond period 1 consisted of 10 tokens as well as all tokens currently allocated to the private account. In this way, the precise per-period endowment to subjects varied according to past allocation decisions, with effective endowment in period *t* expressed as:

$$w_{i,t} = W_{i,t} + \sum_{k=1}^{t-1}(W_{i,k} - C_{i,k})$$

where $\sum_{k=1}^{t-1}(W_{i,k} - C_{i,k})$ represents the sum of contributions to the private account in all previous periods. Note, this formula only applies to effective endowment for $t > 1$; the first period endowment is 10 tokens. While no per-period-earnings formula for subjects in this treatment is available since tokens allocated to the private account could always reallocated to the group account in a future period, the per-period earnings equation can be reinterpreted as a total earnings equation expressed as follows:

$$\hat{\pi}_i = (\widehat{W}_i - \hat{C}_i) + 0.5\sum_{i=1}^{4} \hat{C}_i$$

where ^ indicates that the variable represents a total (e.g. total profits, total endowment, total subject contribution to the group account, and total group contribution to the group account).

2.3. Full Endowment

In the full endowment treatment, subjects receive 100 tokens at the beginning of the first period, with no further endowment distributions. In each period, subjects decided how many tokens to allocate between the group account and the private account. As in the carryover treatment, any tokens allocated to the private account were available for reallocation to the group account in every subsequent period. As a result, the effective per-period endowment in period *t* depended on the past allocation decisions in periods 1 to *t*-1. Accordingly, one can express the effective endowment in period *t* as:

$$w_{i,t} = \widehat{W}_i - \sum_{k=1}^{t-1}(C_{i,k})$$

where $\widehat{W}_i$ is equal to the lump-sum endowment in period 1 and $\sum_{i=1}^{t-1}(C_{i,t})$ represents the sum of contributions to the group account by subject *i* in all preceding periods. Again, because of the design of this treatment, it is not possible to construct a per-period earnings equation. Instead, refer to the total earnings equation derived in the carryover treatment.

2.4. Pledge

In the pledge treatment, subjects received 100 tokens in the first period with no further endowment distributions. At the beginning of each period, subjects allocated tokens between the group account and the private account. Any tokens allocated to the private account could be reallocated to the group in the following periods. Additionally, subjects were given the option at the end of each period to reallocate tokens from the group account to the private account. Thus, the initial contribution to the group account by subject *i* represents a pledge, which can later be reneged. Since subjects could freely reallocate tokens between the group account and the private account in all rounds, the effective endowment of each subject in period *t* can be expressed simply as:

$$w_{i,t} = \widehat{W}_i$$

As such, only the allocation after the last round mattered in the determination of subject earnings, which can be similarly defined according to the total earnings equation derived earlier.

2.5. Behavioral hypotheses

Given the decay in contributions typically observed in VCM games, we expect endowment distribution schemes which provide subjects with the greatest opportunity to contribute early in an experimental session to have the highest contribution levels and, therefore, the greatest economic efficiency. The opportunity for contribution consists of two aspects: whether subject allocation decisions are binding and whether the effective endowment to subjects at a given point in the game is relatively large or small. Non-binding allocations decisions are those decisions that don't affect earnings outcomes. Because these decisions provide subjects with the chance to learn about the game without affecting final earnings, and because contributions have been observed to decay in prior research (as referenced in the introduction), we expect lower contributions in treatments where binding decisions occur in later rounds of the session. Non-binding allocation decisions may also be used strategically in the sense that subjects may try to engender cooperation by contributing in the non-binding rounds only to free ride when the decisions count. The size of the effective endowment also affects subject contributions. In particular, a relatively large effective endowment provided early in an experimental session may lead to increased contributions. Following this behavioral intuition, the baseline, carryover, and full endowment treatments should produce higher levels of contributions to the group account than the pledge treatment. While allocations to the public account are binding in the baseline, carryover, and full endowment treatments in every round, only the allocation decision in the final round is binding for the pledge treatment. Since earlier allocation decisions are not binding, subjects are free to learn about the intricacies of the treatment or to strategically signal cooperative intent without any costs. At the tenth period, we expect subjects will have learned the individually payoff maximizing strategy and will implement it. Ultimately, given that overall contributions to the group account depend solely on the allocation decisions in the final round when subjects are likely to contribute little to the group account, the pledge treatment should lead to the lowest level of efficiency.

Of the fully-binding treatments, we expect the full endowment treatment to produce the greatest overall level of contribution and economic efficiency. Unlike the baseline and carryover treatments, subjects are endowed with the full 100 tokens in the very first period, when they are the most inexperienced with the game. Therefore, the full endowment distribution scheme provides substantial opportunity for subjects to over-contribute to the group account, especially in the early periods when subjects have not experienced others free riding behavior and contribution decay. In contrast, the opportunity for subjects in the baseline and carryover treatments to over-contribute to the group account is consistently limited by their per-period endowment of 10 tokens. In effective endowment terms, the effective endowment in the full endowment treatment is greater than the effective endowments in either the baseline or the carryover treatments, particularly in earlier periods. Accordingly, the full endowment treatment should produce the highest contribution level and efficiency. Finally, the carryover treatment has a higher effective endowment than the baseline, which should lead to higher relative contributions and efficiency. In the carryover treatment, allocations to the private account in previous periods can be used for the group account in future periods, thereby increasing the effective endowment to subjects in every period following the first period. Thus, the effective endowment in each period of the carryover treatment is greater than or equal to that of the baseline, even though the total endowment remains fixed across treatment. As a result, we expect subject contribution to the group account to be higher in the carryover treatment than in the baseline.

In sum, considering whether allocations decisions are binding as well as the size of effective endowments, our behavioral expectations are as follows: the full endowment treatment generates the greatest contributions to the group account, the pledge treatment produces the lowest level, and the carryover treatment leads to a greater level of overall contributions than the baseline.

3. EXPERIMENTAL PROCEDURES AND RESULTS

3.1 Procedures

Subjects for the experiment were recruited by email from the student body at Gettysburg College. A total of one hundred and thirty-six subjects participated in nine sessions across four treatments. Sessions were conducted in the Gettysburg Lab for Experimental Economics and used the Z-Tree software (Fischbacher, 2007). Instructions for the experiment are provided in Appendix A. Upon conclusion of the experimental session, subjects were individually called to receive compensation privately. Experimental sessions typically lasted 45 minutes, including time spent reading instructions. Participant compensation ranged from $5.85-$21.75, with an average compensation of $14.98. The number of subjects per treatment and the average compensation per treatment can be found in Table 1.

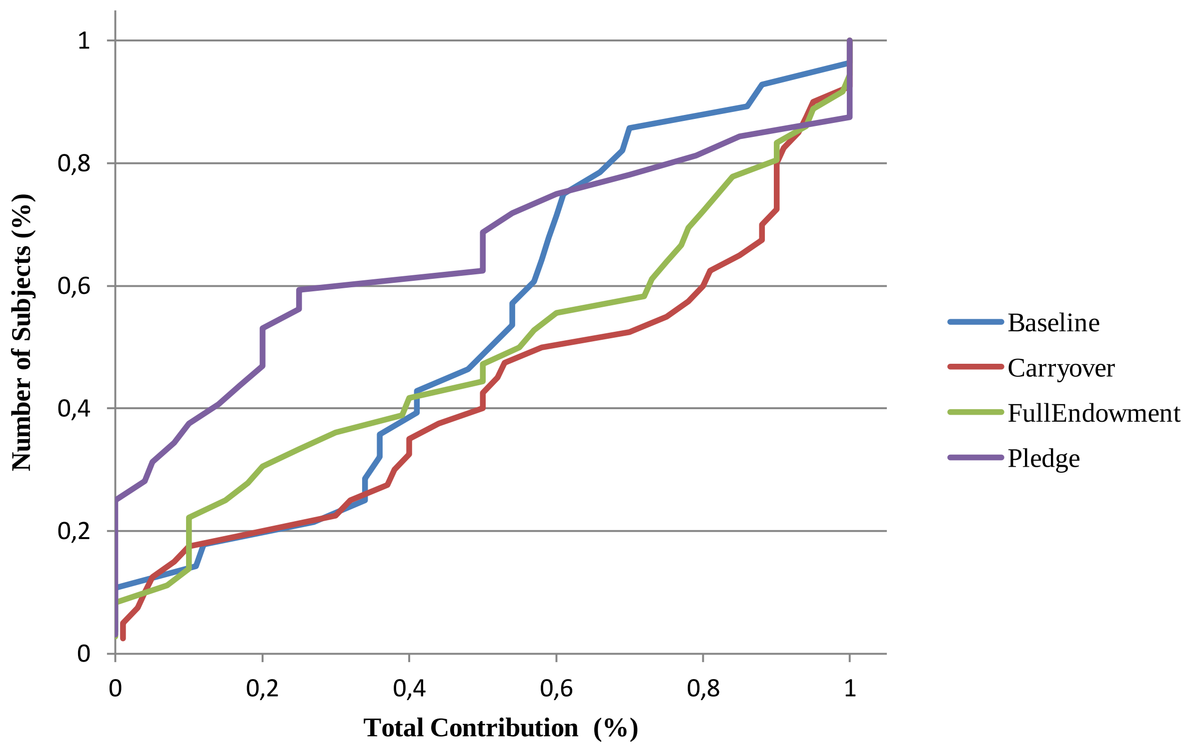
Table 1. Summary of Treatments

Treatment	Number of subjects	Average compensation
Baseline	28	$14.83
Carryover	40	$15.89
Full Endowment	36	$15.26
Pledge	32	$13.64

3.2 Total Contributions

Our analysis of the experimental results begins with total contribution percentages by treatment. In each treatment, subjects were endowed with a total of 100 tokens. We define the total contribution as the number of the 100 token endowment contributed to the public account over the course of the experiment. With the exception of the pledge treatment, the total contribution is the sum of contributions across the 10 periods. Because contributions were not binding in periods 1-9 for the Pledge treatment, we use the total contribution to the group account as determined after period 10. For each treatment, Figure 1 presents a cumulative frequency distribution with the percentage of subjects on the vertical axis and total contributions to the group account as a percentage on the horizontal axis.

Figure 1. Actual Contribution Frequencies by Amount



The pledge treatment possesses the largest percentage of subjects to contribute zero tokens to the group account (exactly 25%). Furthermore, with approximately 60% of subjects contributing less than 25% of endowment, the pledge treatment produced the results closest to the Nash equilibrium prediction. Note also that the cumulative distributions for the carryover and full endowment treatments indicate greater contributions, with roughly 80% of subjects contributing 90% or less of total endowment for both treatments. In contrast, the pledge and baseline treatments had 80% of subjects contributing 75% and 65% or less of the total endowment, respectively. The carryover treatment in particular appears to have had higher contributions as evidenced by its consistent position furthest to the right side of the chart. Interestingly, the effect of the carryover and full endowment treatments appears most prevalent on the upper 50% of the total contribution distribution, at which point both actual frequencies diverge substantially from the baseline treatment. To test whether differences across treatments are statistically significant, we utilize a Wilcoxon rank-sum test on total contributions. The results are shown in Table 2.

Table 2. Treatment Contribution Comparisons (Wilcoxon Rank Sum Test)	
Treatment Combination	**Prob > |z|**
Baseline/Carryover	0.16
Baseline/Full	0.56
Baseline/Pledge	0.10
Carryover/Full	0.44
Carryover/Pledge	0.01
Full/Pledge	0.07

Consistent with our expectations, differences between the pledge and other treatments are significant at the 10% level or better. While the carryover treatment had the highest total contributions, differences between the carryover and baseline treatment are at best marginally significant. Overall, both the ordering of the actual distributions and the statistical results are consistent with the behavioral predictions: contributions increased in the baseline treatment relative to the pledge treatment as well as in the full endowment and carryover treatments relative to the baseline treatment, although the magnitude of the increase was not always sufficient to be deemed statistically significant.

In addition to predicting that the different treatments would affect total contributions differently, the behavioral hypotheses developed earlier also predicted that each treatment would uniquely affect economic efficiency. Define a total efficiency index for treatment *s* with *n* subjects indexed by *i* as:

$$Efficiency = \left(\frac{\sum_{i=1}^{n} Total\ Contribution\ (\%)_i}{n}\right)$$

The efficiency calculations for each treatment are provided in Table 3.

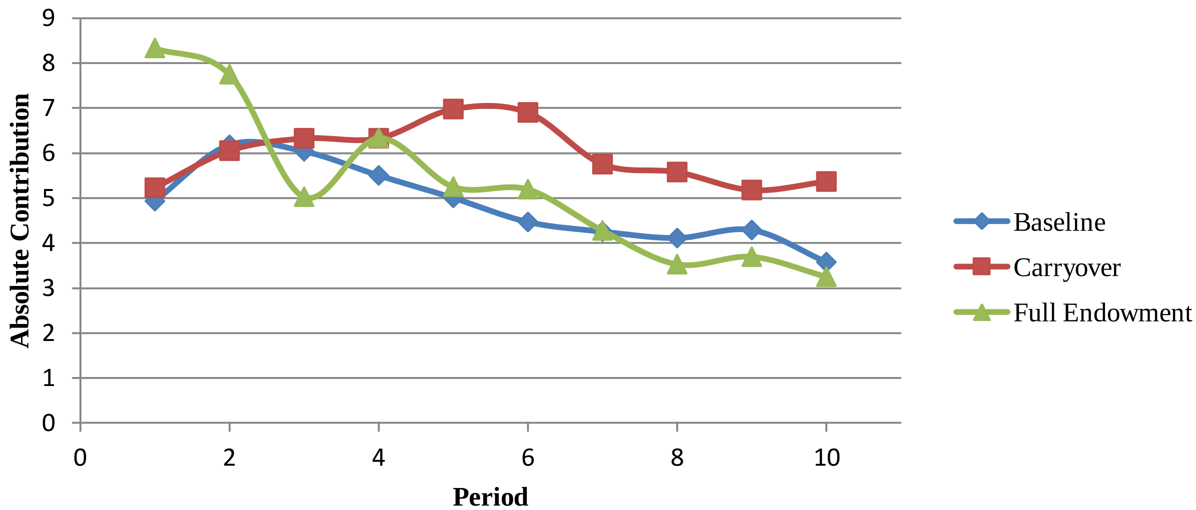
Table 3. Efficiency Results	
Treatment	**Efficiency**
Baseline	48.32%
Carryover	58.85%
Full Endowment	52.64%
Pledge	36.44%

This efficiency index characterizes the average level of total contribution for each treatment. In this way, the Nash equilibrium of zero contributions to the group account corresponds to an efficiency of 0% while the socially efficient equilibrium of contribute all corresponds to an efficiency of 100%.

3.3 Per-Period Contributions

In addition to the analysis of aggregate contributions provided above, we are interested in the distribution of contributions by period. Our endowment schemes provide a wide range of potential contributions, and as such we investigate both the level of contributions and the percent of the effective endowment contributed. Figure 2 depicts the average per-period contribution (in level) to the group account across treatment and period. The pledge treatment is excluded from the figure because of substantial volatility in per-period, absolute contributions, a consequence of the non-binding nature of allocation decisions that obfuscates any meaningful comparison between the pledge treatment and the other treatments on a round-by-round basis.

Figure 2. Average Absolute Contribution (by Period and Treatment)

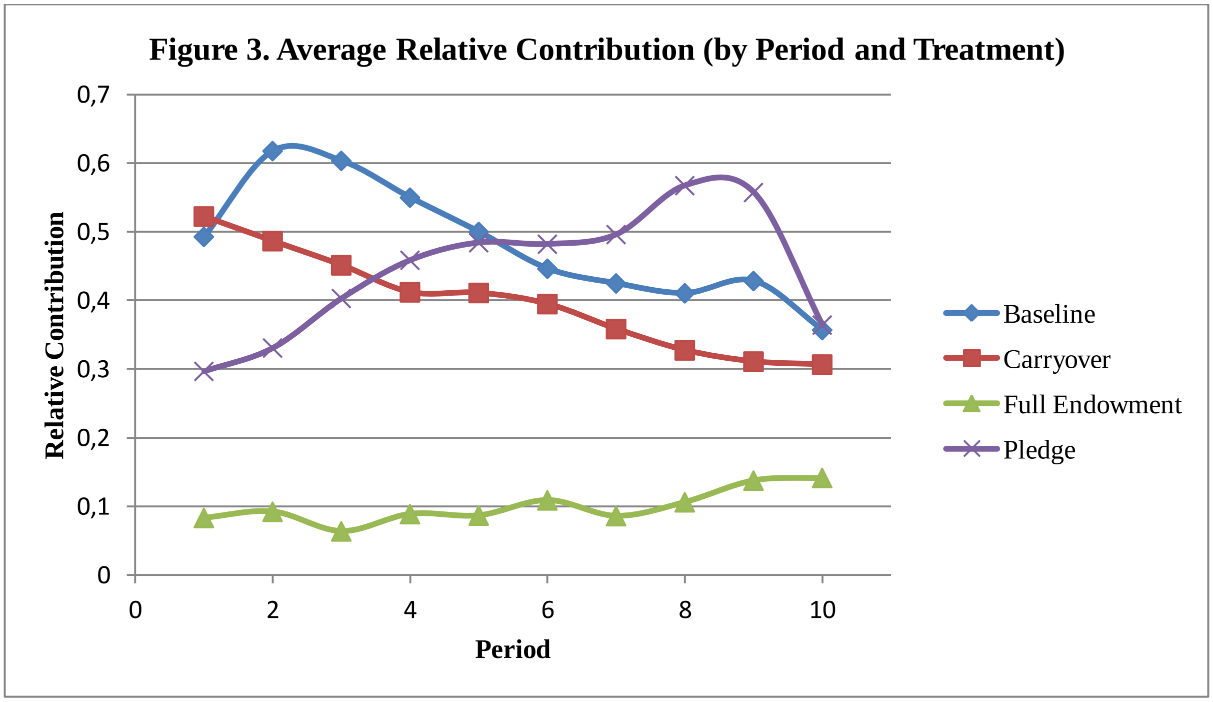


Contributions in the baseline treatment are consistent with those observed in the literature for VCM experiments using similarly sized groups and MPCR levels, and show decay from around 50% of the endowment in early rounds to about around 30% in the final period. While the level of contributions also fell in the full endowment treatment, contributions in the carryover treatment remained fairly constant, moving between 5 and 7 tokens per period. It is important to keep in mind that while the level of contributions was relatively constant, the effective endowment was increasing. For example, a subject contributing 5 tokens in the first period (out of the 10 token endowment) would see their second period endowment increase to 15. A second period contribution of 5 would then lead to a third period endowment of 20. It may be that the increase in endowment served as a focal point for subjects, preventing the decay typically observed in public goods experiments. Note also that the level of contributions was decreasing for the full endowment treatment. In this case the effective endowment was falling in every period by the amount contributed to the group account. As was the case for the carryover treatment, this may have served as a focal point—as the endowment decreased, subjects reduced contributions to the group account.

Figure 3 displays the average, relative contribution to the group account across treatment and period. Relative contribution ($R_{i,t,s}$) for subject *i* in period *t* of treatment *s* is defined as:

$$R_{i,t,s} = \frac{C_{i,t,s}}{w_{i,t,s}}$$

where $C_{i,t,s}$ represents the contribution to the group account and $w_{i,t,s}$ represents the effective endowment, calculated for each treatment previously.



As a percentage of the effective endowment, contributions to the group account decayed in the baseline, carryover, and pledge treatments. Importantly, the decay in contributions for the pledge did not occur until the final period—at which point the contribution was binding and very close to the final relative contribution from the baseline. As shown earlier, the efficiency of the pledge treatment was low relative to that in the baseline. While subject contributions to the group account were binding in the baseline, they appear to have been used strategically in the pledge, with subjects increasing their relative contributions right up to the point that it mattered. Thus, the binding nature of early contributions in the baseline led to higher aggregate contributions and efficiency.

With respect to the full endowment and carryover treatments, relative contributions were consistently lower than the baseline treatment. While the level of contributions in those treatments was higher, so was the effective endowment. For the full endowment treatment, starting with the entire 100 token endowment made the relative contribution low—it remained around 10% throughout the experiment. As previously described, the effective endowment in the carryover treatment was increasing as the experiment progressed and tokens allocated to the private account were made available for future use. This, even though the level of contributions was basically flat, the relative contribution was decreasing.

In order to confirm the aggregate interpretation of relative, per-period contributions, a model of individual per-period, decision-making is now developed. Using random effects regression estimates, the following contribution model is estimated:

$$R_{i,t} = \alpha + \varphi_n + \omega_t + \psi_{t,n} + \mu_{i,t-1} + \rho + \lambda + \varepsilon_i$$

where $R_{i,t}$ is the relative contribution to the group account by subject i in period t, φ_n is a vector of dummies controlling for treatment (baseline is omitted condition), ω_t is a vector for period, $\psi_{t,n}$ is a vector of interaction terms between period and treatment, $\mu_{i,t-1}$ is a vector of lagged controls for past subject behavior, ρ is a dummy variable for the last period (all other periods are omitted condition), λ is an interaction term between the pledge treatment and the final period dummy variable, and $\varepsilon_{i,t}$ is the stochastic, contemporaneous error term. To elaborate, $\mu_{i,t-1}$ is a vector that consists of subject i's relative contribution to the group account in the previous period ($R_{i,t-1}$) and subject i's deviation from the average, relative contribution of her group in the previous period ($R_{i,t-1} - \bar{R}_{G,t-1}$). All control variables follow from prior research.[8] The regression results are given in Table 4.

Table 4. Random Effects Regression Results*

Independent Variable	**Coefficient Estimate (two-tailed p-values)**
Carryover	-0.0717749 (0.077)
FullEndowment	-0.1147246 (0.001)
Pledge	0.015186 (0.743)
Period	-0.0101347 (0.046)
*Period*Carryover*	0.0075213 (0.226)
*Period*FullEndowment*	0.0150233 (0.019)
*Period*Pledge*	0.0086663 (0.248)
LastPeriod	-0.0319348 (0.188)
*LastPeriod*Pledge*	-0.1736916 (0.003)
RelContLagged	0.8852845 (0.000)
RelContLaggedDeviate	-0.1721071 (0.000)
Constant	.106315 (0.003)
R^2 *overall*	0.6995
Wald χ^2	2821.65
Prob > χ^2	0.0000
N	1224

*Robust standard errors

[8] In particular, see Dickinson (1998), Galbiati & Vertova (2008), Nikiforakis (2008), and Cadigan et al. (2011).

The coefficient estimates on the full endowment treatment variable, the period variable, the interaction term between these two variables, the lagged contribution variable, the interaction term between pledge and the last period, and the lagged contribution deviate variable are all statistically significant at the 0.05 significance level. Furthermore, the coefficient estimates on these variables are in the correct direction. Of the treatment dummies, only the full endowment variable coefficient estimate was statistically significant at the 0.05 significance level, although the carryover estimate was very close to being as well. The negative signs of the coefficient estimates on the carryover and treatment variables support the previous interpretation of the per-period, relative contributions trends. Also, the coefficient estimate on the full endowment dummy is the third most substantial, revealing the importance of the full endowment treatment in the per-period relative contribution decision of individuals. The coefficient estimate on the interaction term between period and full endowment indicates that relative contributions in the full endowment treatment increased each period, relative to the baseline. These results lend credence to the upward sloping trend of relative contributions in the full endowment treatment observed earlier. The entire effect of the full endowment treatment on relative contribution is characterized by the joint effect of its dummy variable and its interaction term, itself a function of period. This interpretation applies to all treatment variables.

The statistical significance and sign of the coefficient estimate on period reveals that subjects' relative contribution to the group account exhibited decay over time, an observation consistently substantiated. These results suggest that subject behavior does converge toward the Nash equilibrium outcome where all subjects contribute 0 tokens to the group account in all periods.

Notably, the coefficient estimate on the interaction term between the pledge treatment dummy variable and the dummy variable for the last period is statistically significant in difference from zero at the 0.05 significance level. The sign of this estimate supports the existence of a sharp and distinct decline in subject contributions in the final period of the pledge treatment, as documented earlier, a result of subjects learning to free-ride. This sharp decay is also suggestive of subjects learning how to free-ride most effectively; subjects appear to actively attempt to deceive other players into over-contributing to the group account. Rising relative contributions in non-binding rounds represents subjects signaling their willingness to contribute to the group account to their group members. However, relative contributions decline sharply in the final round, contrary to signaling in prior rounds, as subjects renege on their initial pledges. This behavior is entirely consistent with the strategic framework of Nash equilibrium in which subjects free-ride on the contributions of others, although it does also suggest that subjects actively attempt to encourage other members to over-contribute in addition to simply contributing zero tokens to the group account. Notably, however, all contributions do not collapse to zero in the final round of the pledge treatment, indicating that some subjects maintain a willingness to cooperate and contribute despite being given ample opportunity to learn the incentive to free ride on others' contributions.

Lagged relative contribution to the group account ($R_{i,t-1}$) influenced subject's contribution decision significantly. Intuitively, one would expect that a subject that had contributed a large amount to the group account in the previous period would also contribute a lot to the group account in the current period. This relationship is borne out with a coefficient estimate of approximately 0.8853, easily the most substantial factor in the contribution decision. Similarly, lagged relative contribution deviation ($R_{i,t-1} - \bar{R}_{G,t-1}$) factored both substantially, and significantly, into the contribution decision. With a coefficient estimate of roughly -0.1721, the intuition behind this estimate is clear: if a subject contributed more to the group account relative to the rest of the group, she would respond by contributing less in the subsequent period. Similarly, if a subject contributed less to the group account relative to the rest of the group, she would respond by contributing more in the following period.

4. Concluding Remarks

Our research evaluates the impact of different endowment schemes on subject decision making in a standard VCM framework. Our treatments varied whether a subject's decision was binding and the effective endowment available to subjects. The treatments that had binding allocation decisions and high effective endowment were predicted to generate the greatest overall levels of contribution. Evidence from the lab supported these basic behavioral predictions. Most notably, the pledge treatment possessed the lowest level of overall contribution, followed by the baseline treatment and the full endowment, respectively, with the carryover treatment possessing the highest level of contribution. Only the latter result (i.e. the carryover treatment achieving greater contribution than full endowment treatment) was unexpected. This result may be linked to the impact of increasing effective endowments for the carryover and decreasing effective endowments for the full endowment. Testing differences between the frequency distributions of total contribution for each treatment provided further support of the behavioral hypotheses.

In addition to analyzing overall outcomes, per-period, absolute and relative contribution trends for each treatment were analyzed. These results were largely complementary to the primary, aggregate analysis. With respect to absolute contributions, the carryover treatment and full endowment treatment had the largest absolute contribution levels while the baseline treatment consistently had the lowest. Concerning relative contributions, the pledge and the baseline treatments possessed the largest relative contributions, while the carryover and full endowment treatments had the lowest. Given that relative contribution was a function of absolute contribution and effective endowment, these results suggested that absolute contributions rose less than one-for-one with increases in effective endowment in the full endowment and carryover treatments.

Finally, to reinforce the nonparametric analysis, an individual model of relative contribution decision-making was developed. The coefficient estimates were consistent with previous literature as well as all analyses herein. For instance, the coefficient estimate on period was statistically significant and negative, indicating decay, while the coefficient estimates on lagged relative contribution and lagged relative deviation were positive and negative, respectively, as well statistically significant. Interestingly, the coefficient estimates on the full endowment and carryover treatment dummies were both negative and either statistically significant or very close to being so, results that agreed with the nonparametric analyses summarized above. Future research could investigate the carryover and full endowment treatments in greater depth. In contrast to the behavioral predictions, the carryover treatment generated greater total contributions and greater economic efficiency than the full endowment treatment, although these differences were not statistically significant. A rationale for this discrepancy may provide insight into the endowment distribution schemes most capable of achieving greater total contributions and economic efficiency. Additionally, the notion that economic efficiency and total contributions may be maximized by imposing mechanisms that take advantage of subject unfamiliarity is worth further consideration.

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APPENDIX

Instructions (Baseline)[9]

This is an experiment about decision-making. The instructions are simple and if you follow them carefully and make good decisions you might earn a fair amount of money that will be paid to you privately and in cash at the end of today's session. The amount of money you earn depends on the decisions that you and the other participants make. You will never be asked to reveal your identity to anyone during the course of the experiment. Your name will never be associated with any of your decisions. In order to keep your decisions private do not reveal your choices to any other participant.

The Experiment

For this experiment you will be placed in a group of **four people** (you plus three other people). We have already randomly assigned you to a group. **You will remain in this group for the duration of the experiment**. However, you *will not* be told each other's identities. Your earnings will depend upon the decisions that you make and the decisions that the other people in your group make.

The experiment will consist of ten rounds.

At the beginning of round one, each person in the group will be **endowed with 10 tokens**. You must choose how many of these tokens to keep in your **private account** and how many tokens to allocate to a **group account**. The amount of money that you earn in each decision round depends on how many tokens you have in your private account, how many tokens you allocate to the group account, and how many tokens the others in your group allocate to the group account.

You will earn 10 cents for each token you have in your private account. Your will earn 5 cents for each token you have allocated to the group account, plus 5 cents from each token allocated to the group account by the other persons in your group.

To summarize, in each round you will earn:

$0.10 times the number of tokens you have in your private account +

$0.05 times the total number of tokens allocated to the group account by your group

After you have made your decision for the round, please wait while the others in your group finish making their decisions. At the end of each round, there will be a summary screen that allows you to see how many tokens were allocated to the group account, as well as your personal earnings. You will not be able to see which individuals allocated tokens to the group account, or how much a specific individual allocated.

The same process will be repeated for all ten rounds. At the conclusion of all ten rounds, each participant's earnings will be totaled and shown privately.

If you have any questions at this time, please raise your hand. Otherwise, please press the "Continue" button at the bottom right of your screen.

[9]Instructions for other treatments available upon request.