2013

Motivations of Competing Altruists

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Preliminary and Incomplete: for distribution to WEAI 2012 conference participants.

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June 10, 2013

We experimentally investigate the motivations of altruists in situations where only one volunteer is needed to provide a benefit to an unfortunate recipient. Our experiment attempts to elicit utility payoffs from participants in a variation of the volunteers dilemma game which uses a timed mechanism to select a contributor. Results from the experiment allow us to reject the hypothesis that participants are only motivated by the recipient's outcome and "being the one" who contributes. Analysis of gratitude responses of recipients in the experiment suggest that, in addition to the recipient's outcome, agents may be motivated more by how their action compares to other volunteers rather than by being the one who contributes.

1 Introduction

In situations which present opportunities for altruism, many times more people are willing to help than are needed. When a sick patient needs a transplant, while there may be several willing donors, usually just one individual can provide the needed tissue. Similarly, on a full bus, several passengers might be willing to give up a seat to an older passenger. This paper explores the motivations of altruists in such situations.

We present a variation of a dynamic volunteers dilemma game with finite horizon where time is used to select a contributor but in which the value of the public good does not diminish with delay. Under a behavioral model with only standard consequentialist preferences, the game collapses into a standard asymmetric volunteers dilemma, but with the addition of agents who "want to be the one" to contribute, known here as *impact philanthropist* (Duncan, 2004), the timed mechanism can reveal agent types. We use this to motivate an experiment which attempts to elicit the utility payoffs of participants to sort among those with impact philanthropist, consequentialist, and egoist preferences and test the validity of this behavioral model.

In our experiment, subjects are split into small groups. Each member of the group is given \$10 (donors) except for one person from each group who gets \$0 (recipient). Each of the donors is asked if he/she would like to contribute \$1 to help the recipient get \$9 instead of \$0, however only one contribution is needed. A timed mechanism is used to elicit volunteers. The first donor to volunteer contributes the \$1. Ties are settled randomly. Our main treatment variable is the number of donors.

In section 2, we provide an overview of how our experiment fits in with previous research. In section 3, we provide the details of our experimental design. In section 4, we formalize the game embedded in our experiment, present our model of preferences, and derive testable hypotheses for our experiment. We then proceed to present the data from our experiment and test these hypotheses in section 5. Section 6 begins the task of revising our model by considering results on the gratitude responses of recipients in our experiments. Section 7 concludes.

2 Related Literature

The earliest line of research closely related to our current study can be found in the social psychology literature on bystander intervention starting with Darle, Latané (1968). In this paper, the authors argued that diffusion of responsibility led subjects in their study to report an emergency less often when they believed there to be larger numbers of other bystanders present. Since then, many studies have attempted to replicate the result, and meta-analyses by Latané, Nida, (1981) and Fischer et al. (2011) have found the diffusion of responsibility to be a robust effect.

A second line of related research began in the economics literature in the mid 1980's with two theoretical treatments of single provider public goods games. The first, Bliss and Nalebuff (1984) considers a game in which a public good can be provided by the contribution of a single individual from a group with asymmetric provision costs. Here, the provision decision is dynamic, but the quality of the public good is decreasing over time. The second is Diekmann's 1985 paper on the volunteers dilemma. In this original treatment of the volunteers dilemma, a public good can be provided by the effort of a single individual and the decision to contribute is made simultaneously with all contributing players paying a symmetric provision cost.

Key theoretical extensions to these two papers include Bilodeau, Slivinski (1996) which extends Bliss, Nalebuff (1984) by considering a finite horizon. Diekmann (1993) extends the original volunteers dilemma by adding asymmetric provision cost and public good valuation, and Wessie (1993) considers the further extension of the volunteers dilemma to a dynamic game with diminishing public good quality. In our game, time is used as a mechanism for deciding who contributes as in Bliss, Nalebuff (1984), Wessie (1993) and uses a finite horizon as in Bilodeau, Slivinski (1996). In our game, however, the public good can be provided at full quality regardless of volunteer time.

Experimental studies of the volunteers dilemma include Diekmann (1993), Goeree, Holt, Moore (2005), Healy, Pate (2009). Each of these studies assign monetary payoffs that are consistent with utility payoffs from a volunteers dilemma and compare outcomes to equilibrium predictions. We emphasize here that, in contrast, our experiment assigns monetary payoffs to induce a volunteers dilemma, but attempts to elicit utility payoffs using the timed mechanism.

3 Experimental Design

Our data was collected at the University of California, Santa Barbara Experimental and Behavior Economics Laboratory using ZTREE (Fischbacher, 2007). Subjects were recruited using the Online Recruitment System for Economic Experiments (Greiner, 2004). A total of 222 subjects participated in the experiment. Our treatment variable was group size and we conducted four sessions each of 3, 4 and 6 person group treatments. Since it will be more intuitive to refer to these treatments by the number of potential donors in each group, we will refer to these as the 2,3, and 5 donor treatments for the remainder of this paper. Total session size and gender composition was controlled as closely as possible via recruiting. Each session of the experiment lasted about 45 minutes. Subjects earned an average of $14.50 including a $5 show-up fee.

Each session consisted of three rounds- with one being randomly chosen to determine payment. In each round, participants were randomly placed into groups. Groups were determined using ZTREE's absolute stranger matching for the 2 and 3 donor treatments, and stranger matching for the 5 donor treatment[1].

Each group played the following game. In the beginning of the round all but one participant was informed that she had received a $10 endowment. Here, we refer to these people as *potential donors* or simply *donors*. However, this language was not used during the experiment. The remaining recipient received nothing. Here, we refer to this person as *recipient*. Again, this language was not used in the experiment. Rather, this person was referred to as *Person C*, *Person D*, or *Person X* in the 2,3,5 donor treatments respectively.

The recipient could get $9 instead of $0 for that round if any of the potential donors in her group was willing to contribute $1 of the initial $10. Only one contribution was needed. A timed mechanism was used to determine who, if anyone, would contribute the $1. Participants had 60 seconds in which to volunteer to contribute. The first to volunteer was chosen to actually contribute the $1 with ties broken randomly. An onscreen timer indicated how much time remained, and when one participant in a group volunteered, the timer for the other participants was not stopped. Thus, potential donors in each group made decisions without learning about the decisions made by others in that round.

We emphasize that our experimental approach was to elicit preferences from subjects rather than assigning direct payoffs and checking behavior against equilibrium predictions. For this approach, and according to the results of our model presented in *section 4*, the timed mechanism was chosen to give participants a way of expressing their preference for giving. Using this mechanism, we collected a strategy for each of the potential donors in a group- a choice to volunteer conditional on none of the other participants having volunteered before that time. A theoretically equivalent strategy could have been elicited by having participants indicate what time they would choose to volunteer in the 60 second window without making each participant actually experience the window. However, we felt that our mechanism was a more natural elicitation tool in this setting. To control for reaction times, before the 60 second window began, participants were given the option to volunteer at the first instant. Similarly, during the 60 second window, participants could check a box that would automatically volunteer them at the last instant. To choose not to volunteer, participants could either click a "don't volunteer" button or wait until time ran out.

After the 60 second window expired for all of the potential donors, each was asked a followup question. Anyone choosing to volunteer was asked whether they would prefer the money be taken from them or from someone else in the event that they tied for the earliest volunteer time. Non-volunteers were asked whether they would prefer to switch their decision or not in the event that all other group members also refused to volunteer.

Once the 60 second volunteer window and these followup questions were completed, the potential contributors were shown the outcome of the round. They were given the total number of volunteers in their group and whether they personally had to contribute the $1. The recipients in that round were not shown the outcome until the end of the experiment to prevent this information from affecting volunteering decisions in subsequent rounds. After this, in rounds one and two, participants were matched into new groups to participate in the next round. To collect as much data as possible from each participant, no one participated as a recipient in more than one round.

Once all three rounds were complete, the participants were given a series of hypothetical questions about scenarios similar to the one they had just participated in, but in which they were the only person who could

[1] Absolute stranger matching for the 5 donor sessions would have required a session of 36 participants which is more our lab can hold.

help. Three types of questions were given: "Would you be willing to give up $x of your initial $10 to ensure another person would get $9 instead of $0?", "Would you be willing to give up $1 of your initial $10 to ensure another person would get $x instead of $0" and "Would you be willing to give up $x of your initial $10 to ensure another person would get $(10-x) instead of $0?". A range of values for x were used for each type of question.

After answering these hypothetical questions, participants who had participated as a recipient in some round were shown the outcome of that round including the time each of their potential donors volunteered (if at all), and who was chosen to pay (if anyone). In the two and three donor treatments, we gave the participants one final hypothetical tasks of choosing how they would split a $4 bonus between their potential donors if they knew they could not keep any of the unallocated money. This was chosen to be hypothetical to prevent contamination of future altruism experiments in our lab by undermining the incentives in the main task. After this final allocation task, the paying round was randomly determined and participants were shown their final earnings for the experiment.

4 Model

4.1 Setup

Assume $N \geq 1$ players indexed by $i \in \{1, ..., N\}$. Each player is faced with a decision about whether to volunteer to provide a public good and, if so, what time to volunteer in a fixed window. The players simultaneously choose from the strategy set $a_i \in \{[0,1], -1\}$ where $a_i = -1$ represents not volunteering, and $a_i \in [0,1]$ represents volunteering when there is a_i proportion of the time remaining so that larger numbers represent earlier times. For instance, $a_i = 1$ represents volunteering at the first instant and $a_i = 0$ represents volunteering at the last instant.

As long as at least one player volunteers, the public good will be provided, giving all players a utility benefit of $v > 0$. The player who volunteers first is chosen to contribute. If more than one player volunteers at the same time and none volunteer earlier then one is chosen at random to contribute. The contributing player faces a cost of providing the good c_i. c_i is private knowledge, but is known to each player before choosing a_i. The cost c_i for each player is drawn from an identical distribution with density $f(c)$ over arbitrary support C which includes negative values.

Definition 1. One-pays timed volunteers dilemma.

Players:$i \in I = \{1, ..., N\}$

Types: $c_i \in C$: $Pr(c_i < c) = F(c)$

Actions:$a_i = \{-1, [0,1]\}$

Interim, expected payoff (where M is defined to be the number of volunteers who chose the earliest time):

$$\pi_i(A, c_i) = \begin{cases} 0 & \text{(No one volunteers): } \left(max\{a_j\}_{j=1}^N = -1\right) \\ v & \text{(Some volunteer, i is not earliest.): } \left(a_i \neq max\{a_j\}_{j=1}^N \neq -1\right) \\ \dfrac{v - c_i}{M} & \text{(Some volunteer, i is earliest.): } \left(a_i = max\{a_j\}_{j=1}^N \neq -1\right) \end{cases}$$

4.2 Type-Space Partition

Despite the large type-space C, it is possible to partition C into three specific motivational groups which correspond the the three potential preference orderings over outcomes in our game. These three groups are the *impact philanthropist, egoist,* and *consequential altruist.*

The impact philanthropist has $c_i < 0$. For this group, being selected to contribute is the best possible outcome.

The egoist has $c_i > v$. For this group, having someone else contribute is the best possible outcome. This group also prefers no one contributing to personal contribution.

The consequential altruist has $c_i \in [0, v]$. For this group, having someone else contribute is also the best possible outcome, but personal contribution is preferred to having no one contribute.

4.3 Equilibrium

For the remainder of this section, it will be assumed that there is a non-zero mass in each type-partition. If this is the case, the game has a unique symmetric pure strategy Bayesian Nash equilibrium in which all impact philanthropists volunteer at the first instant, egoists do not volunteer, and there is a threshold cost $c^* \in [0, v]$ in which all consequential altruists with $c_i < c^*$ volunteer at the last instant and all consequential altruists with $c_i \geq c^*$ do not volunteer.

Proposition 2. *There exists a unique c^* (decreasing in N) such that the following strategy is the unique symmetric pure strategy Bayesian Nash equilibrium for the one-pays timed volunteers dilemma.*

$$s^*(c_i) = \begin{cases} 1 & c_i < 0 \\ 0 & 0 < c_i < c^* \\ -1 & c_i \geq c^* \end{cases}$$

To prove this proposition, we start by working with the impact philanthropist and egoist type-partitions. These two partitions are shown to have strategies which are not dependent on N. We then show that consequential altruists volunteer at the last instant $(a_i = 0)$, if they volunteer at all, and that there is a unique cost threshold $c^* \in [0, v]$, which is decreasing in N, that partitions the consequential altruists into volunteers and non-volunteers.

Lemma 3. *In any equilibrium, if there is a non-zero mass of impact philanthropist types, they volunteer at the first instant.*

Proof. Consider a proposed set of strategies that does not meet the condition above. For any player who is proposed to volunteer at a time other than the first instant for some impact philanthropist type, such that there is a positive probability another player will volunteer at least as early, that player can improve expected payoff by volunteering at the first instant rather than the proposed time. □

Lemma 4. *In any equilibrium, if there is a non-zero mass of egoists, they do not volunteer.*

Proof. Consider a proposed set of strategies that does not meet the condition above. For any player who is proposed to volunteer at some time for some egoist type, such that there is a positive probability of being chosen to contribute, that player can improve expected payoff by choosing not to volunteer. □

Lemma 5. In any equilibrium, if there is a mass of consequential altruists types volunteering, they will volunteer at the last instant.

Proof. Assume players have chosen a symmetric strategy where a non-zero mass of consequential altruist types are proposed to volunteer earlier than the last instant. For any player of one of these types who has a non-zero probability of encountering another player choosing to volunteer at least as late, volunteering at the last instant is a better response than the proposed strategy since it decreases the probability of personally contributing without changing the probability that no one contributes. □

Lemma 6. *In any symmetric, pure strategy equilibrium, there is a unique threshold cost $c^* \in [0, v]$ such that consequential altruists with cost lower than c^* choose to volunteer at the last instant while those with costs above choose not to volunteer.*

Proof. Define $\gamma = Pr\left(c_i > v\right)$. $\beta = Pr\left(v > c_i > 0\right)$. $\alpha = Pr\left(c_i < 0\right)$. Further, for any proposed symmetric strategy s, define p to be the probability that a person volunteers conditional on being a consequential altruist $\left(c_i \in [0, v]\right)$.

By *lemma* 5, if $p > 0$, consequential altruists who choose to volunteer will volunteer at the last instant. Further, a consequential altruist has incentive to volunteer if and only if the following condition holds (derived in the appendix):

$$c_i \leq v \left(\sum_{x=0}^{N-1} \frac{\begin{pmatrix} N-1 \\ x \end{pmatrix} \left(\frac{p\beta}{\gamma + (1-p)\beta} \right)^x}{x+1} \right)^{-1}$$

Call $\tilde{C}$ the set of consequential altruist types who are proposed to volunteer in strategy s. By the above condition,$\tilde{C}$ must be a range $[0, c^*]$. Since p is the probability that a consequential altruist volunteers, it can now be written: $p = Pr\left(c_i \in [0, c^*]\right) = F\left(c^* | c_i \in [0, v]\right)$ which gives the following implicit condition for c^*.

$$c^* = v \left(\sum_{x=0}^{N-1} \frac{\begin{pmatrix} N-1 \\ x \end{pmatrix} \left(\frac{F(c^*|c_i \in [0,v])\beta}{\gamma + (1-F(c^*|c_i \in [0,v]))\beta} \right)^x}{x+1} \right)^{-1}$$

We now show that there is a unique solution for c^*. Define $g\left(\tilde{c}, N\right)$ as the right side of the above inequality. It is noted that for any $\tilde{c} \in [0, v]$:

$$g\left(\tilde{c}, N\right) \in \left[v \left(\sum_{x=0}^{N-1} \frac{\begin{pmatrix} N-1 \\ x \end{pmatrix} \left(\frac{\beta}{\gamma} \right)^x}{x+1} \right)^{-1}, v \right]$$

However, $v\left(\sum_{x=0}^{N-1}\frac{\left(\begin{array}{c}N-1\\x\end{array}\right)\left(\frac{\beta}{\gamma}\right)^{x}}{x+1}\right)^{-1}>0$ and so $g\left(\tilde{c},n\right)\in[0,v]$ for any $\tilde{c}\in[0,v]$. Since, in addition, g is continuous in $\tilde{c}$, Brouwer's fixed point theorem guarantees a solution. Further, since $g\left(\tilde{c},N\right)$ is monotonically decreasing in $\tilde{c}$, the equilibrium threshold c^{*} is unique. Lastly, $g\left(\tilde{c},N\right)$ is decreasing in N also guarantees *Corollary 7:* □

Corollary 7. *Threshold cost c^{*} is decreasing in N.*

Proposition 2 can now be proven by combining *Lemmas 3,4,5,6* with *Corollary 7.*

4.4 Predictions

Proposition 2 provides four testable hypotheses for our experiment which are given below:

Hypothesis 1. No one will volunteer during the 60 second window.

Hypothesis 2. The proportion of subjects volunteering at the first instant will not change as the number of potential donors increases.

Hypothesis 3. The proportion of subjects volunteering at the last instant will decrease as the number of potential donors increases.

Hypothesis 4. The proportion of subjects not volunteering will increase as the number of potential donors increases.

While we have stated each of these hypotheses separately and will consider whether they can be independently rejected by our results, they may be understood as a joint hypothesis under the assumption that the data is generated by a process consistent with our model. Since, under *hypothesis 1*, the variance of the sample proportion of those volunteering during the round will be 0 it may be rejected if *anyone* volunteers during the round. Even if our model were otherwise very accurate in explaining behavior, a small amount of noise leading to during-round volunteering would lead to a rejection. Because of this, we will consider *hypothesis 1* in a more qualitative way and allow our model's validity to depend on the joint validity of *hypotheses 2-4.*

5 Results

Each subject participated in at least two rounds as a potential recipient. Behavior at the second or third opportunity may have been affected by history-of-play since some information is given to potential donors at the end of each round. The way that behavior is affected is interesting in its own right and may provide additional clues about the motivations of participants. A complete analysis of this will be provided in a final version. For now however, we focus data which is derived from a participants first opportunity to participate as a potential donor.

5.1 Mechanism Consistency

Because what we have attempted to do is elicit subjects preferences for contributing, we would like to motivate that our results are meaningful in this regard before considering the main results from our experiment. Our first result suggests that volunteer time is consistent internally with responses to hypothetical altruism scenarios. In *figure 5.1* we look at volunteer time compared to the most a participant said he/she would be willing to give up to provide an unlucky subject with \$9 instead of \$0 if he/she was the only one who could help. The results show a reasonable trend. Those who said they were willing to give up more in the hypothetical scenario volunteered more often and earlier than those who said they would not be willing to give up as much.

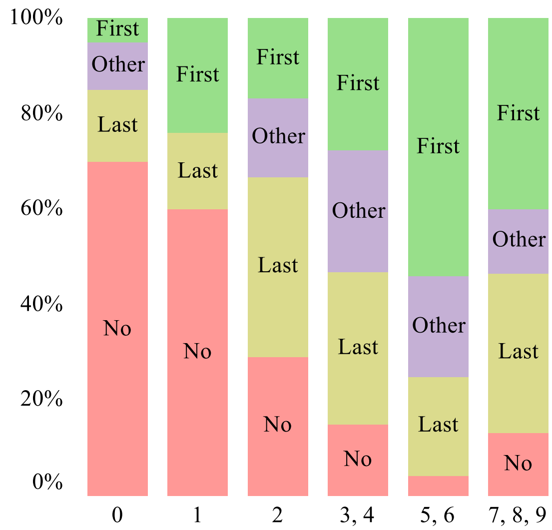

Figure 5.1: Volunteer time by cut-off for hypothetical contribution question.

In *figure* 5.2 we compare volunteer times between subjects based on whether they said they have donated blood in the past. Here, a significantly larger proportion of those who said they have never given blood also chose not to volunteer. Combined, these results provide some confidence that our mechanism is eliciting pro-social preferences.

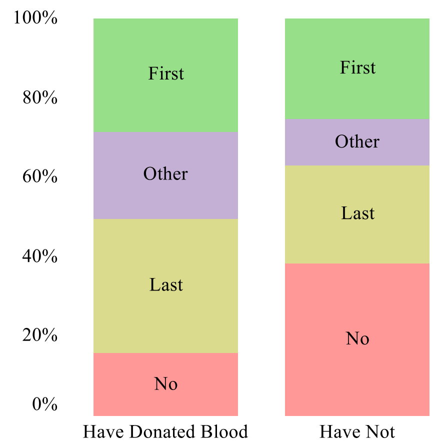

Figure 5.2: Volunteer time by whether participant has donated blood.

5.2 Overall Behavior

Roughly equivalent proportions of subjects chose to volunteer at the first instant (*27%*), last instant (*28%*) and not at all (*29%*). The remaining 16% of participants chose to volunteer at some time during the 60 second window. A histogram of this volunteer time is shown in *Figure 5.3.*

When projected onto our simple model of preferences, this suggests about a quarter of participants behave consistently with impact philanthropist type preferences. While consequentialist and egoists cannot be separately identified (since both may choose not to volunteer) over half of the participants would be labeled as either consequentialists or egoists with a lower bound on the proportion of consequentialists of 28%.

The additional 16% of the sample who choose to volunteer sometime during the round cannot be labeled according to our model and provide evidence against *Hypothesis 1.* Although we have no predictions about volunteers in this range, those volunteering early in the 60 second window are likely to be motivated differently than those volunteering near the end of the window. Because of this, and for the analysis that follows, we have chosen to split up the during-round data into first 15, middle 30, and last 15 second groups.

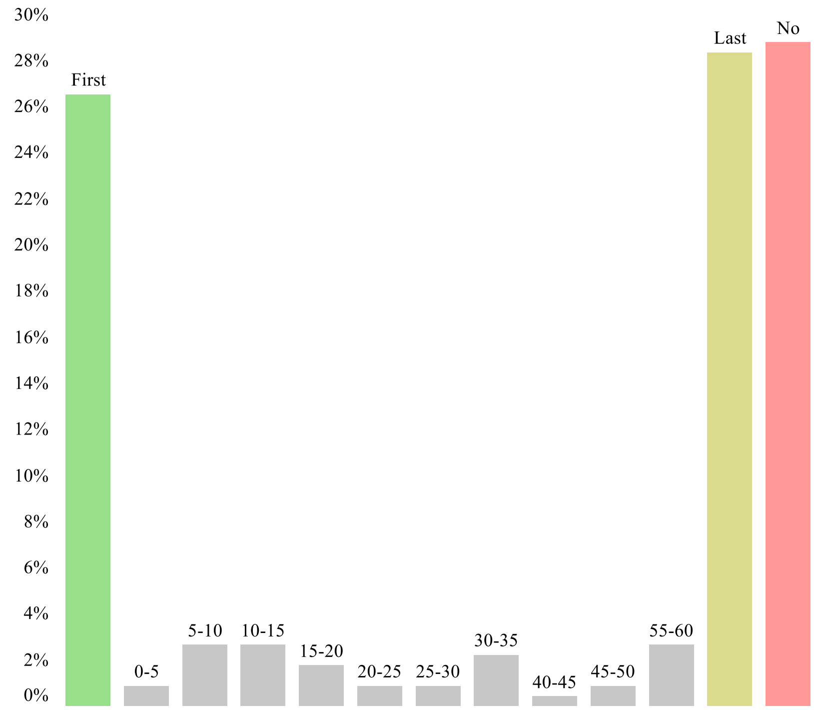

Figure 5.3: Histogram of the volunteer times (first opportunity) chosen by all subjects in all treatments.

5.3 Treatment Comparison

A comparison of the treatments is shown in *Figure 5.4*. The treatment has significant effects on the distribution of behavior in our experiment. There is sufficient evidence, using a Fisher exact test, to reject the hypothesis that behavior is drawn from the same distribution for all three treatments. However, these distributional changes are not consistent with the hypothesis that our data is generated from a process consistent with our model.

Hypothesis 2 predicts that the proportion of first-instant volunteers will remain fixed as the number of potential donors increases, however our treatment has significant effects on this proportion. When there were two potential donors, 38.5% volunteered right away, while 18.1% and 22.2% volunteered at the first instant in the three and five potential donor cases respectively. The assumption that the differences between the two and three and two and five potential donor treatment proportions are due to noise can be rejected with more than 95% confidence. This provides evidence to reject *hypothesis 2.*

Hypothesis 4 predicts that the proportion of volunteers will decrease as the number of potential donors increases. Our data shows an interesting non-monotonic pattern for the proportions of non-volunteers. For the two potential donors treatment, the proportion of those who choose not to volunteer is 19.2%. This proportion does increase to 40.2% for three potential donors but *decreases* again to 27.8% in the case of five potential donors. The increase from two to three potential donors is significant at the 1% level. The decreases from three to five potential donors is only marginally significant, and although this does not provide overwhelming evidence for the rejection of *hypothesis 4*, the independent rejection of *hypothesis 2* for our data is sufficient for a joint rejection of our model for the overall data.

	2	3	5
First	38.46%	18.06%	22.22%
First 15	3.85%	5.56%	9.72%
Middle 30	2.56%	6.94%	9.72%
Last 15	6.41%	2.78%	1.39%
Last	29.49%	26.39%	29.17%
No	19.23%	40.28%	27.78%

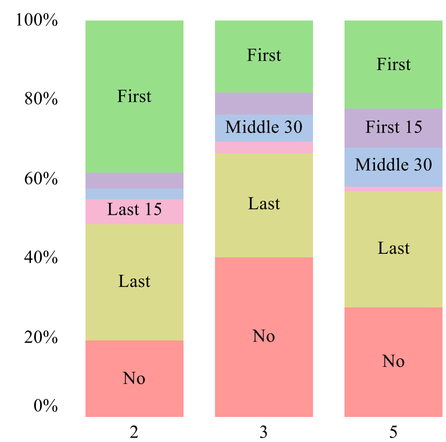

Figure 5.4: Treatment comparison: proportion of subjects by volunteer time.

5.4 Gender Comparison

Previous work in the experimental literature suggests there may be baseline differences in men and women's pro-social tendencies. For instance, Eckel and Grossman (1998) found that women are more generous than men in dictator experiments. Andreoni and Vesterlund (2001), found that men's generosity is more sensitive than women's to price of giving. Mellström and Johannesson (2008) found that, while the introduction of a monetary compensation for blood donation significantly decreased the number of women willing to donate, it had no effect on men. With these results as motivation, we now consider the effect of gender in our experiment.

The unconditional distributions of volunteer times are very similar for men and women. These distributions are shown in *figure 5.5*. The null-hypothesis that men and women have behavior drawn from the same distribution cannot be rejected at any conventional level. The proportions of men and women volunteering in the time ranges shown are also statistically indistinguishable (using binomial tests). However, men and women appear to respond differently to the treatment. These distributions are shown in *figure* 5.6.

	Female	Male
First Instant	26.85%	26.32%
First 15	6.48%	6.14%
Middle 30	6.48%	6.14%
Last 15	4.63%	2.63%
Last Instant	25.93%	30.70%
No	29.63%	28.07%

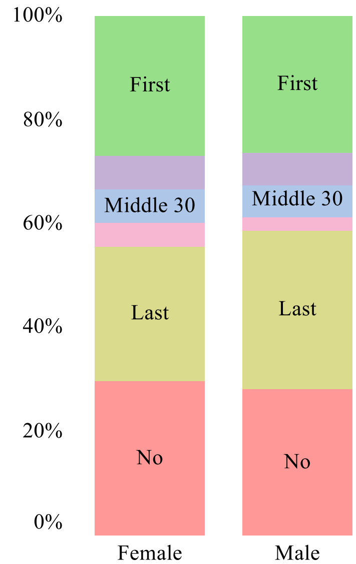

Figure 5.5: Gender comparison: proportion of subjects in all treatments by volunteer time.

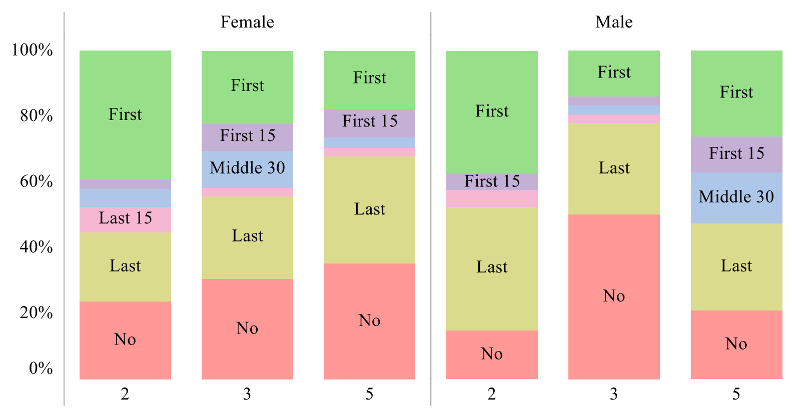

Figure 5.6: Treatment comparison by gender: proportion of subjects by volunteer time.

Although the behavior of women looks more consistent in that the proportions of first, last and non-volunteers change monotonically with the number of donors, these changes are not consistent with predictions from our model. The proportion of women volunteering at the first instant decreases from 39.5% to 22.2% and then to 17.7% in the 2,3, and 5 potential donor treatments respectively. The decrease from 2 to 5 is statistically significant at the 5% level and so *hypothesis 2* can be rejected for women. The proportion of women choosing not to volunteer increases with the number of potential donors, and so there is no evidence to reject *Hypothesis 4* independently. There is also an increase in the proportion of women volunteering at the last instant. While this is qualitatively inconsistent with *hypothesis 3* it also cannot be empirically rejected. However, the independent rejection of *hypothesis 2* is sufficient for the rejection of our model for women.

The pattern of behavior among men is more curious with regards to our simple model, and it appears that the non-monotonic pattern for non-volunteers in the data as a whole is driven by the behavior of men. Men chose to volunteer least often in the treatment with *three* potential donors. 50.0% of men chose not to volunteer in the three donor treatment while 15.0% and 21.1% chose not to volunteer in the two and five donor treatment respectively. Both of these decreases are significant at the 1% level. The significant decrease from three to five donors gives us evidence to reject *hypothesis 4*.

To further emphasize that the this curious non-monotonic result for men is not merely statistical anomaly, it is worth noting that the result is also significant at the session level. If all 12 of our sessions are sorted by the proportion of men choosing not to volunteer, the top four sessions are the four sessions of the three potential donor treatment. This analysis is shown graphically in *figure* 5.7. If the proportion of men choosing not to volunteer was independent of the treatment, the probability of having this outcome for one of the three treatment types is less than 1%.

In addition to being least likely to volunteer overall in the three donor treatment, men also choose to volunteer at the first instant least often in three donor treatment at 13.9% compared to 37.5% and 26.3% in the two and five donor cases respectively. The difference in proportions for the two and three donor treatments is significant at better than the 5% level and provides evidence to reject *hypothesis 2* for men. These independent rejections of *hypotheses 2* and *4* are sufficient to reject our model for men.

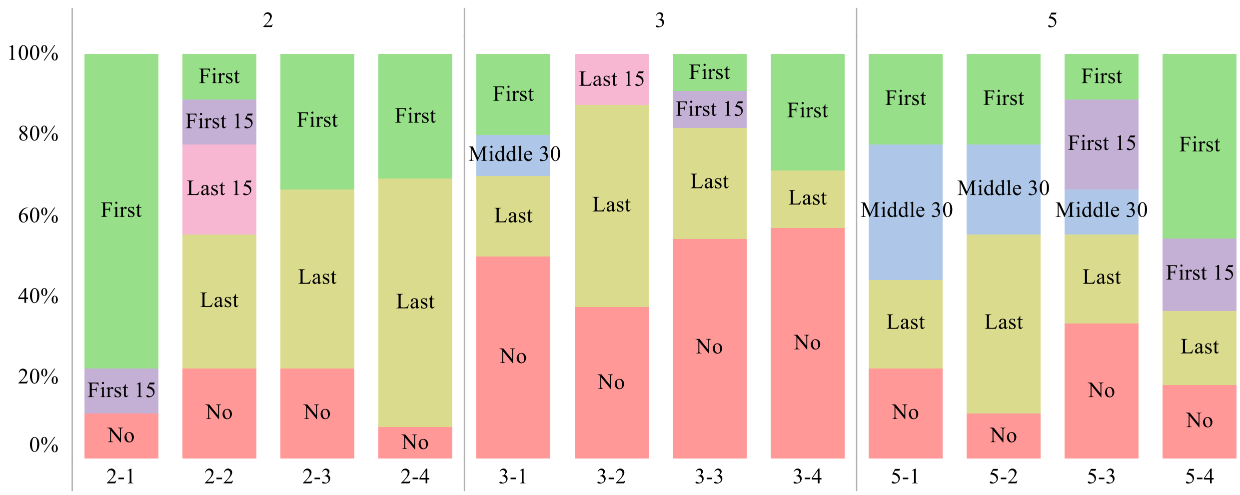

Figure 5.7: Session comparison for proportion of men by volunteer time.

6 Model Revision

With our initial model rejected both in the overall data and individually for men and women, we now turn to looking at how we may construct a more valid model of donor motivation. Our first step is to consider what the results from our gratitude response task suggest about which outcomes may be motivating donors. In the final version, we intend to use this analysis to construct a new model to test against the results of the main task. For now, we simply consider what features these results suggest adding to our revision.

6.1 Gratitude Response Results

Altruistic acts may be motivated, in part, by the gratitude others will feel in response to the action. Such motivation is consistent with the hypothesis that gratitude facilitates reciprocal altruism (McCullough, Kimeldorf, Cohen, 2008). Our experimental design allows us to test the gratitude felt by recipients through our final allocation task. Here, after finding out the volunteer times of their potential donors and who, if anyone, contributed the $1, recipients were given a hypothetical[2] bonus of $4 to allocate among the donors. By looking at the relative levels of allocation, we can get a rough sense of the relative levels of gratitude felt by the recipients for various actions taken by the donors. For now, we will focus on the two donor sessions since they are the most accessible in terms of analysis.

[2]We reiterate that this was chosen to be hypothetical to avoid undermining the incentives of the main task and prevent behavioral contamination in any future altruism experiments in our lab.

Figure 6.1 gives a summary of the difference in the amount of money the recipients chose to allocate to the donor who was chosen to contribute to him/her (either because he/she volunteered first, or because he/she was randomly chosen in the case of a tie) and the other potential donor. Allocations are shown for each combination of volunteer times. Circle size indicates the frequency with which a particular allocation was chosen. This frequency in terms of raw count is also shown as a label below each circle. The average difference in allocation for the same volunteer time combinations is shown in *Figure* 6.2.

Two main results are apparent in this data. The first is that relative gratitude difference is increasing in the difference between the chosen actions. The can be seen, for instance, by fixing contributor's time to first instant and noting the increasing average difference in allocation as the non-contributing player's time increases. The second result is that the act of contributing does not appear to change gratitude response by very much. For instance, there were 13 cases of first instant ties, 5 of the 13 allocated the same amount to both donors, and 7 of 13 returned one more dollar (the cost of contributing). Thus, in 12 of the 13 cases, recipients either equalized the hypothetical allocations to the tied volunteers or equalized their hypothetical final payoff. In only 1 case did the recipient return two dollars more to the contributor. In the case of last instant ties, 7 of 9 equalized allocation, 1 equalized hypothetical final payoff and again only 1 allocated two dollars more the contributor. This suggests that the act of contributing may not, in itself, be very important in determining the gratitude that a recipient feels towards a volunteer.

Our model provides agents with preferences that are dependent on becoming the contributor but not dependent on relative actions. However, if gratitude of the recipient is a strong motivator, these results suggest that relative actions may be important but becoming the contributor may not be so important in motivating potential donors.

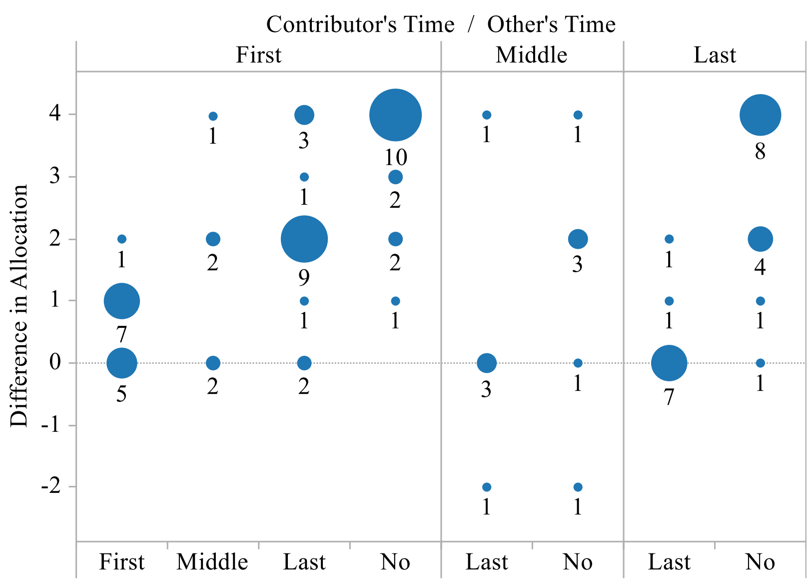

Figure 6.1: Frequency of allocation to contributor by volunteer times of contributor and other.

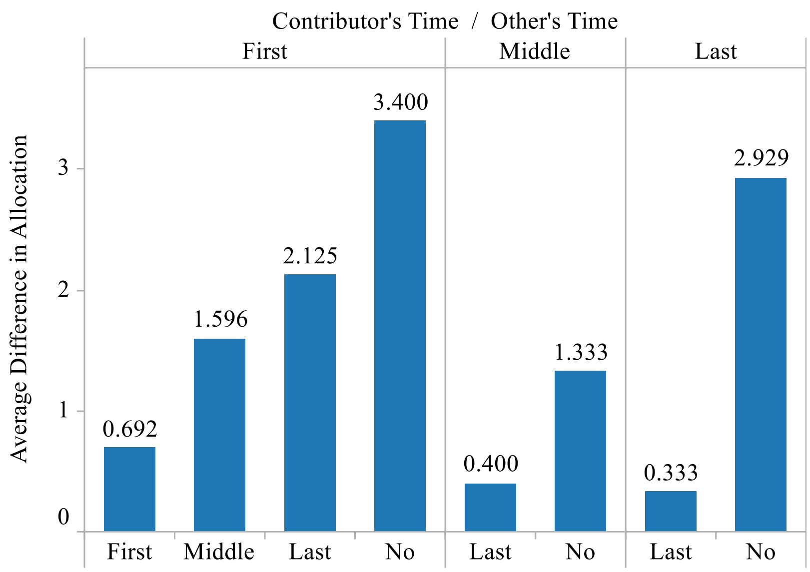

Figure 6.2: Average allocation to contributor by volunteer times of contributor and other.

7 Conclusion

In this paper, we have presented a variation of the volunteers dilemma game which uses a timed mechanism to select a contributor. We implemented this game in the lab with an experimental strategy of eliciting rather than assigning utility payoffs and checking outcomes against equilibrium predictions. The results from this experiment allow us to reject a simple model which posits, in addition to standard consequentialist and egoist preferences, the presence of *impact philanthropists* who want to "be the one" to contribute. Analysis of the gratitude responses of recipients in the experiment suggest that, in addition to the recipient's outcome, agents may be motivated more by how their action compares to other volunteers rather than by being the one who contributes.

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9 Appendix

9.1 Consequential Altruist Volunteer Condition

Claim. Consequential altruists have incentive to volunteer if and only if:

$$c_i \leq v \left(\sum_{x=0}^{N-1} \frac{\binom{N-1}{x} \left[\frac{\beta p}{\gamma+\beta(1-p)}\right]^x}{x+1} \right)^{-1}$$

Proof. If a consequential altruist volunteers at the last instant, she gets value v for sure and may pay c_i if chosen to contribute. The sum multiplying c_i represents the probability of paying.

$$v - c_i \left(\sum_{x=0}^{N-1} \frac{\binom{N-1}{x} (\gamma + \beta (1-p))^{n-1-x} (\beta p)^x}{x+1} \right)$$

If a consequentialist does not volunteer she will get v only if someone else volunteers. The probability that someone else volunteers is expressed here as one minus the probability that no one else volunteers.

$$v\left(1-(\gamma+\beta\,(1-p))^{N-1}\right)=v-v\,(\gamma+\beta\,(1-p))^{N-1}$$

These expressions give a condition for volunteering which simplifies to the claimed condition through the following steps:

$$v-c_i\left(\sum_{x=0}^{N-1}\frac{\binom{N-1}{x}(\gamma+\beta\,(1-p))^{N-1-x}(\beta p)^x}{x+1}\right)\geq v-v\,(\gamma+\beta\,(1-p))^{N-1}$$

$$v\,(\gamma+\beta\,(1-p))^{N-1}\geq c_i\left(\sum_{x=0}^{N-1}\frac{\binom{N-1}{x}(\gamma+\beta\,(1-p))^{N-1-x}(\beta p)^x}{x+1}\right)$$

$$v\,(\gamma+\beta\,(1-p))^{N-1}\geq c_i\,(\gamma+\beta\,(1-p))^{N-1}\left(\sum_{x=0}^{N-1}\frac{\binom{N-1}{x}(\gamma+\beta\,(1-p))^{-x}(\beta p)^x}{x+1}\right)$$

$$v\geq c_i\left(\sum_{x=0}^{N-1}\frac{\binom{N-1}{x}(\gamma+\beta\,(1-p))^{-x}(\beta p)^x}{x+1}\right)$$

$$v\geq c_i\left(\sum_{x=0}^{N-1}\frac{\binom{N-1}{x}\left[\frac{\beta p}{\gamma+\beta(1-p)}\right]^x}{x+1}\right)$$

$$c_i\leq v\left(\sum_{x=0}^{N-1}\frac{\binom{N-1}{x}\left[\frac{\beta p}{\gamma+\beta(1-p)}\right]^x}{x+1}\right)^{-1}$$

□