2012-07

Competition and Cooperation in a Public Goods Game: A Field Experiment

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July 2012

Abstract

We explore the effects of competitive and cooperative motivations on contributions in a field experiment. 10,000 potential political donors received solicitations referencing past contribution behavior of members of the competing party (competition treatment), the same party (cooperative treatment), or no past contribution information (control). Contribution rates in the competitive, cooperative, and control treatments were 1.45%, 1.08%, and 0.78%, respectively. With the exception of one large contribution, the distribution of contributions in the competitive treatment first order stochastically dominates that of the cooperative treatment. Qualitatively, it appears that the cooperative treatment induced more contributions around the common monetary reference point, while the competitive treatment led to more contributions at twice this amount. These results suggest that eliciting competitive rather than cooperative motivations can lead to higher contributions in intergroup public good settings.

JEL Classification Numbers: D72, H41, C93

*We would like to thank Muriel Niederle, Doug Bernheim, Giacomo De Giorgi, Trey Miller, Scott Nicholson, Carla Roa, and Annika Todd for comments and suggestions. This research was funded by the George P. Shultz Fund and the B.F. Haley and E.S. Shaw Fellowship, both administered through the Stanford Institute for Economic Policy Research. Contact information. Augenblick, UC Berkeley, *ned@haas.berkeley.edu*. Cunha, Naval Postgraduate School and UC Santa Cruz, *jessecunha@gmail.com*

1 Introduction

People's contributions to public goods are affected by the contributions of others. For example, it has been demonstrated that individuals choose to match the past contribution decisions and amounts of other contributors to the same public good, a result commonly attributed to pro-social cooperative behavior (Fischbacher, Gächter, and Fehr 2001; Frey and Meier 2004; Shang and Croson 2009). It has also been suggested that *competitive* motivations across groups can lead to increased public good contributions within groups (Erev, Bornstein, and Galili 1993; Bornstein and Ben-Yossef 1994; Bornstein, Gneezy, and Nagel 2002). In this paper, we provide a test of this competition hypothesis using a natural field experiment, and we directly compare the effects of competitive and cooperative donating environments. Specifically, we solicited donors engaged in a competitive public good game and presented them with information about the contributions of members of their own group, contributions of members of the competing group, or no information about the contribution of others (the control group). Our results suggest that competitive motives are potentially more useful in driving higher contribution rates and total contributions.

The field experiment involved sending one of three types of solicitation postcards to 10,000 potential donors to a Democratic candidate's 2008 campaign for the U.S. House of Representatives. Two of the postcard designs contained a reference to average past contribution amounts of a reference group: either Democrats (the cooperative treatment) or Republicans (the competitive treatment). Specifically, the reference in the postcard for the competitive treatment reads "*Small Republican contributions have been averaging $28*" while the reference in the postcard for the cooperative treatment reads "*Small Democratic contributions have been averaging $28.*"[1] As both treatments reference the same monetary amount, we can independently identify the differential effect of the referenced group. The third postcard type (the control treatment) neither referenced past contribution amounts, nor mentioned

[1]Note that these are true statements given that we define "small" contributions as those less than $75 (see Section 2 below). For a similar use of this type of definition, see Frey and Meier (2004).

a reference group. As such, we can also identify the joint effect of referencing a group (one's own group or the competing group) and a past reference amount.

The political contribution environment we study can be seen as a close analog of the intergroup public good (IPG) game suggested by Rapoport and Bornstein (1987), which is commonly used in laboratory research on competitive effects in public good games. In the IPG, individuals in two groups choose contribution amounts and members of the group with the largest collective amount of contributions are given a larger reward than members of the other party. In political races, donors contribute to a party and larger contributions (amongst other factors) lead to a higher chance of that party winning the race, giving a larger benefit to donors to that party.

We find that the contribution rates in the competitive, cooperative, and control treatments were 1.45%, 1.08%, and 0.78%, respectively. Furthermore, with the exception of one larger contribution, the distribution of contributions (conditional on a positive contribution) in the competitive treatment first order stochastically dominates that of the cooperative treatment. The cooperative treatment induced more contributions concentrated near the common reference point ($28), while the competitive treatment induced more contributions at nearly twice the level of this reference point (about $50). As a result of these effects at both the intensive and extensive margins, the cooperative and competitive treatments yielded 15 percent and 82 percent higher total monetary contributions than the control, respectively. We temper these results by noting that the contribution rate and the total amount collected from the cooperative treatment is not statistically significantly different than that of the control, a result partially driven by low contribution rates.

These results demonstrate that intra-group competition can drive higher contribution rates and amounts than inter-group cooperation in a natural public good environment. This is an important finding for two reasons. First, it suggests that the competitive desire for own-group victory could be a strong motivator in other public good games. Second, this is the first paper to our knowledge that tests the impacts of different contribution motivations in a political environment. Political campaigns are one of the most important contribution environments, not least because of the sums of money involved, and our findings provide important insights into incentives

for such contributions.

Several papers have previously estimated the effect of social information on solicitation behavior.[2] Frey and Meier (2004) conducted a field experiment in which students were asked to contribute to a university fundraising campaign. The authors find an increase, albeit small, in the contribution rate when students were informed that a higher percentage of students had contributed to the campaign in the past. Similarly, Shang and Croson (2006, 2009) and Shang, Reed, and Croson (2008) use multiple field experiments with a public radio fundraising drive to study the effect of social information on contribution amounts. These papers use a variety of social comparisons ("A member like you just contributed...", "*She* just contributed...") and an array of reference points to show that social comparisons can affect contribution rates and amounts.

Several papers have also studied the effect of intergroup competition on intragroup cooperation. In the laboratory, Bornstein and Ben-Yossef (1994) show that participants are twice as likely to cooperate in a prisoner's dilemma game when it is embedded in a game with intragroup competition. Similarly, Bornstein, Gneezy, and Nagel (2002) demonstrate that intergroup competition increases intergroup efficiency in a minimal-effort coordination game. In a laboratory-like field experiment, Erev, Bornstein, and Galili (1993) show that subjects' productivity increases (in picking oranges) when there is competition across groups.

Most of this research explores competitive effects using the IPG or close variations.[3] While our environment is reasonably close to a pure IPG, there are some important differences. First, the mapping from contributions to party success is noisy (the party with a smaller level of contributions could win).[4] Second, larger

[2]A large literature has also studied the independent effect of reference points on contribution behavior in cooperative situations (DeJong and Oopik 1992; Desmet and Feinberg 2003; Fraser, Hite and Sauer 1988; Schibrowsky and Peltier 1995; Smith and Berger 1996; Weyant 1996). Broadly, this literature concludes that the relative size of the referenced amount matter, with higher reference points increasing contribution amounts yet decreasing the propensity to contribute.

[3]The exception is Bornstein, Gneezy, and Nagel (2002), who use a "minimal-effort" game where the winning group is determined by comparing the smallest contribution made in each group

[4]This occurs because parties have other attributes which affect voter's decision. This can be modeled as an IPG in which both sides start with a different initial contribution base based on their attributes.

contributions might lead to larger individual rewards (such as political favors) as the game is not completely anonymous. Finally, in a broader context, the game is sequential rather than simultaneous, although our field experiment is essentially simultaneous. Even with these limitations, the political contribution environment reflects an important real-life example of the IPG game.

More generally, this paper relates to a growing literature on the motivations for charitable contributions and the effect of various incentives to make charitable contributions, such as matching schemes (Huck and Rasul 2008), seed money (List and Lucking-Reily 2002), rebates (Eckel and Grossman 2005), and gift exchange (Falk 2007).

In the next section, we describe the contribution environment and the field experiment. Section 3 presents the experimental results on differential contribution rates and amounts across treatment groups. Section 4 concludes with a discussion of these results.

2 The Field Experiment

2.1 The Congressional Election and the Intervention

The experiment took place during a 2008 campaign for the U.S. House of Representatives in the state of Florida. We worked with the Democratic challenger who had not previously run for a national public office; the incumbent was a long-serving Republican. Informal discussions with local Democrats made it clear that two factors were contributing to a general belief that their candidate could win the race, and this belief was driving contributions. First, there was expected to be a higher-than-usual turnout amongst Black voters for the concurrent presidential campaign (Barak Obama versus John McCain) - most Black voters in the district are Democrats and it was believed they would also vote the for the Democratic Congressional candidate. Second, the majority of votes cast in-district for the U.S. Senate race two years earlier had been for the Democratic candidate, signaling a shift in political preferences.

Working with the candidate, we identified 10,000 potential donors who were to

receive a solicitation postcard in the final weeks of the campaign. This sample was chosen from a list of past donors to Democratic campaigns and a set of voters identified as strong Democrats from their participation in past primary elections (as determined by public voting records). The majority (about 70 percent) of the recipients lived in the congressional district contested by our candidate, while the remainder lived in other districts in Florida.

Subjects received one of three treatment postcards. Each contained a large picture of the candidate and a short message urging them to contribute to the campaign: see Figure 1. The text of the postcard was written to convey the message that the race was close and that marginal contributions could be pivotal. The main difference between the treatments was a single emphasized sentence in the center of the message:[5]

Control treatment: "Your contribution can make a big difference."

Cooperative treatment: "Small Democratic contributions have been averaging $28."

Competitive treatment: "Small Republican contributions have been averaging $28."

Past contribution data was obtained from the publicly available Federal Election Commission online database (www.fec.gov). We implicitly define "small" contributions as those less than $75: the average of current election cycle contributions less than $75 was equal for our Democratic candidate ($28) and the Republican candidate ($28) at this cutoff.[6] We performed the experiment with two broad hypotheses:

Hypothesis 1. *Social information about one's peers, whether cooperative or competitive, will make a recipient more likely to donate.*

[5]The other difference is that the $28 reference point in the Cooperative and Competitive treatments is repeated in small text stating how contributions can be spent (see Figure 1).

[6]This specific (implicit) cutoff choice was chosen so that we could truthfully state the same reference amount for both experimental groups. However, by not explicitly stating the cutoff amount, there is a concern that people might interpret these messages differently depending on their definition of "small." Campaign staff believed the message would be interpreted in a consistent way and (strongly) discouraged the message "... contributions less than $75 have been averaging $28" due to its specificity and complexity.

Hypothesis 2. *The amount donated will be affected by both the monetary reference point and the referenced peer group.*

2.2 Data and Identification

Recipients were randomly assigned to one of the three treatment groups using a simple randomization algorithm. After the election, we obtained demographic and voting characteristics of the recipients by matching names and addresses with Florida's public-record voter files. This match was successful for 88 percent of the sample, including all of the actual contributors.[7] In order to include non-matched recipients in the regression analysis below, we include an indicator for missing demographic information.

Table 1 summarizes our data. Column 1 characterizes the sample as a whole. Recipients are mostly older (around 61 years old) and white (around 84 percent), largely reflecting the demographic make-up of the Democratic voting population in this congressional district. As expected, the majority of the sample consists of registered Democrats, although 6 percent are registered Republicans. Furthermore, 72 percent of the postcard recipients had voted in a past primary, reflecting a relatively large interest in politics amongst this sample.

Columns 2 through 4 of Table 1 contain mean characteristics by treatment group, and columns 5 through 7 contain p-values from F-tests of the pair-wise equality of the means across groups. These data suggest the randomization was successful; the pre-treatment demographics are for the most part indistinguishable across groups. For two variables, there are significant differences across groups: age differs between control and both cooperative and competitive groups, and there are significantly more registered Republicans in the control versus cooperative groups. Under the assumption that the sample is also balanced across unobserved covariates of contribution outcomes, the random assignment to treatment allows us to identify the causal impact of treatments relative to one another.

[7]Unmatched recipients likely either had significantly misspelled names or had recently moved. Unmatched recipients account for 12.25, 13.13, and 12.42 percent of the control, competitive, and cooperative groups, respectively (differences between these levels are not statistically significant).

Soon after the mailings were sent out, the candidate began to receive contributions in the mail and online which were recorded by campaign staff. Two data collection issues are of note.

First, concurrent with our experiment, the candidate was involved in other campaign activities (such as a fund-raising concert) which may have prompted contributions from recipients of the experimental postcards. In most cases, such contributions were identified by the campaign staff and we do not include them in our analysis. In a few cases, however, it was impossible to determine the impetus for a contribution. To isolate the impact of our solicitation postcards, we only use contributions that were made one week after the receipt of the mailing. The results presented below are robust to changes in this window of acceptance.

Second, it was discovered after the mailings were sent out that some recipients were accidentally sent two postcards, and hence were placed in two different treatment groups; as these recipients were exposed to more than one treatment, we drop them in the subsequent analysis, leaving a total of 9,954 subjects.[8]

3 Results

Contribution Rates

Our first main result concerns contribution rates. Table 2 contains contribution rates for the sample as a whole and across groups, along with p-values from F-tests of equality of means across groups. Overall, the contribution rate was 1.11 percent (column 1), which was close to the expectation of the campaign (they expected around a 1 percent contribution rate in general). This table suggests our first main result:

Finding 1. *The use of social information and a reference point increased the likelihood of contributing. The contribution rate in the competitive treatment was*

[8]After this correction, the control, competitive, cooperative treatments contain 3315, 3321, and 3318 subjects, respectively. There is no significant difference in the percentage of duplicated subjects in each treatment group.

85 percent higher than that of the control treatment (p-value=0.01), and 34 percent higher than the cooperative treatment (p-value=0.16). The cooperative treatment induced a 38 percent higher contribution rate than the control, although not significantly so (p-value=0.24).

While this first finding suggests that the competitive treatment led to a greater effect on the extensive margin than the control, the effect of the cooperative treatment is less clear, due to large standard errors and that the point estimate falls nearly exactly between the estimates of other groups.

Due to the slight imbalance across groups in some baseline observable characteristics, a preferred model may be one which controls for these variables. Table 3, columns 1 and 2, present estimates from Probit models estimating relative probabilities of contributing, with and without controlling for pre-treatment demographics; perhaps not surprisingly, these models give similar results to the comparison in means.[9] Table 3 also demonstrates that older recipients are more likely to contribute to our Democratic candidate, while registered Republicans (relative to registered Democrats) and Black recipients (relative to White recipients) are less likely to contribute.

Contribution Distribution

Our second main result concerns the intensive margin of contributing. The second and third rows of Table 2 compare mean contribution amounts, for both the entire sample and for the sample of those who actually contributed. For the sample as a whole (column 1), the mean contribution is \$0.70, while the mean contribution conditional on donating is \$63.10. Note that while the unconditional mean contribution is marginally different between the control and competitive treatment (p-value = 0.13), this difference is largely driven by the differential contribution rates; upon conditioning on a strictly positive contribution, mean contribution amounts are indistinguishable across all groups. We again test for the robustness of this comparison

[9]These results are robust to the "rare event bias" described in King and Zeng (1999a), a bias arising in discrete dependent variable models when the event (a contribution, in our case) is observed a relatively low percentage of the time.

in means by controlling for all observable individual characteristics in a regression setting. Columns 3 and 4 in Table 3 show that treatment effects are virtually unchanged by the slight baseline differences in observables.

Average contribution amounts, however, mask important and significant differences in the distributions of conditional contributions across treatments, as can be seen in Figure 2. To see these differences more clearly, the histograms in Figure 3 plot the difference in contribution distributions between the competitive group and the control, and the cooperative group and the control. (We remove contributions over $100, which represent 6 percent of contributions, for visual ease.) The randomized assignment of treatment allows us to interpret these histograms as the "additional" effect of the cooperative and competitive treatments above the control. The majority of additional contributions in the cooperative treatment appear to be centered in the $20 to $30 range, whereas there are multiple additional contributions in the competitive treatment at $28, $50, and $100, with the majority located at $50.

Qualitatively, the common reference point of $28 in the cooperative and competitive treatments appears to have induced different contribution behavior depending on the context. The cooperative treatment induced a large concentration of contributions in the $20 to $30 range, while the competitive treatment induced an even larger number of $50 contributions, close to twice the reference amount.[10] Note that the reference point had an absolute effect as well, in that there are numerous contributions of $28 from competitive and cooperative subjects and none from control subjects.

Figure 4 compares the cumulative distribution functions of contribution amounts in the cooperative and competitive treatments where, again for visual ease, we trun-

[10]The probabilities of contributing between $20 and $30, conditional on contributing, are 29.2, 50.0, and 30.8 percent for the competitive, cooperative, and control groups, respectively. The probabilities of contributing $50, conditional on contributing, are 35.4, 19.4, and 23.1 percent for the competitive, cooperative, and control groups, respectively. Given the ex post determination of these contribution bins, we are reluctant to draw strong conclusions. However, we note that the rate of contributing $20 to $30 is statistically greater in the cooperative group compared to the competitive group (p-value=0.05) and marginally greater than the control (p-value=0.13), while the rate of contributing $50 is marginally greater in the competitive group compared to the cooperative group (p-value=0.11).

cate the distribution above $100. The contribution distribution from the competitive treatment first order stochastically dominates the distribution from the competitive treatment in this region (one contribution of $200 breaks this relationship in contributions higher than $100). The p-value from the Kolmogorov–Smirnov test of the equality of these distributions is 0.10 (this test does not exclude contributions above $100).[11]

These observations lead to our second main result:

Finding 2. *The distribution of contributions of the competitive group first-order stochastically dominates that of the competitive group for the vast majority of the distribution. It appears that the cooperative treatment induces more contributions than the competitive treatment in the range near the reference point ($20-$30), while the competitive treatment induces more contributions than the cooperative treatment at close to twice the reference point ($50).*

We conclude by noting a lack of evidence for heterogeneous effects in our data. For example, recent research suggests that men and women have different preferences for competition; specifically, that men prefer competition more than women (Niederle and Vesterlund 2007). A natural corollary to this theory is that women may prefer cooperation to competition, while men may prefer competition to cooperation. We test for evidence of these gender differences in preferences in our setting, but find no evidence of significant differences across the gender of the donor on either the intensive or extensive margin.

4 Discussion and Conclusion

We present the results of a field experiment in which campaign contribution solicitations were sent to a large group of potential donors. The solicitations contained

[11] The cooperative and competitive distributions are not significantly different from the control (not shown) with Kolmogorov–Smirnov p-values of 0.76 and 0.32, respectively.

either information about recent contributions of those in the same political group (a cooperative message) or the opposing political group (a competitive message), or no information about past contributions (a control message). The competitive message induced a significantly higher contribution than the control. The distribution of contributions in the competitive treatment (nearly) first order stochastically dominates that of the cooperative treatment. It appears that, while members of the cooperative group were more likely to contribute around the stated reference point of their peers, the members of the competitive group were more likely to contribute an amount of nearly twice the stated reference point.

The behavior elicited in this experiment is consistent with a variety of explanations, which we cannot distinguish with our experimental design. In their experiment, Frey and Meier (2004) identify three potential explanations for people to contribute more to a public good as a result of social information about their peers: people may desire to conform to social norms; people may exhibit some level of fairness-based preferences; and contributions by others may signal the quality of the public good (in this case, the candidate).

In a competitive public goods framework, players also have reasons to change their behavior when given information about contributions of players on the opposing group. For example, as demonstrated in past research (Cox et al. 1983, Holt and Sherman 1994), people appear to receive utility from winning in competitive settings, perhaps leading them to contribute higher amounts. However, even a purely outcome-oriented person might be induced to change her contribution decision as a result of social information if it changes her perception about the distribution of potential total contributions of the opposing group. Future research should strive to understand the precise way that these motivations interact, and their potential impact on profit-maximizing solicitation behavior.

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Figure 1: The solitication postcards. From left to right, the control, cooperative, and competitive treatments.

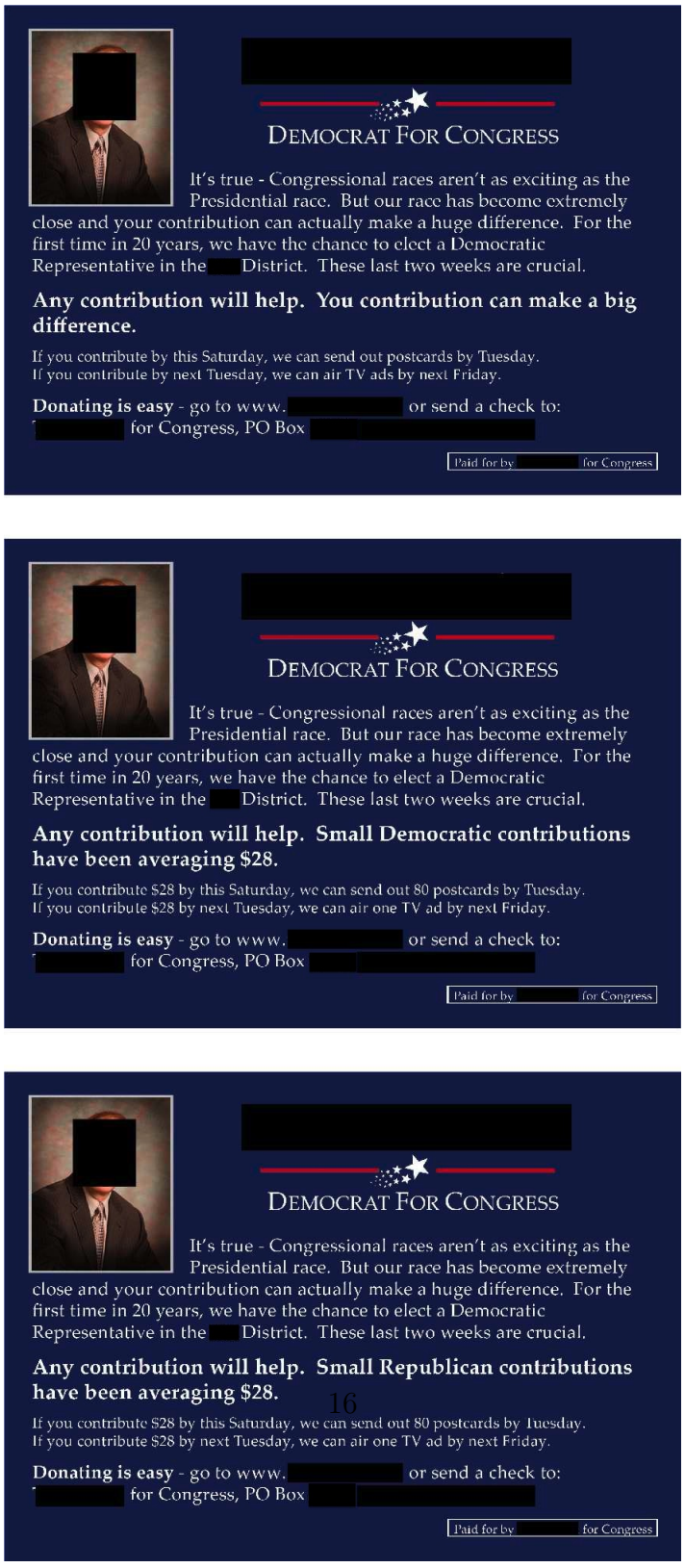


Figure 2: Histograms of the non-zero contribution amounts for the control, cooperative treatment, and competitive treatment.

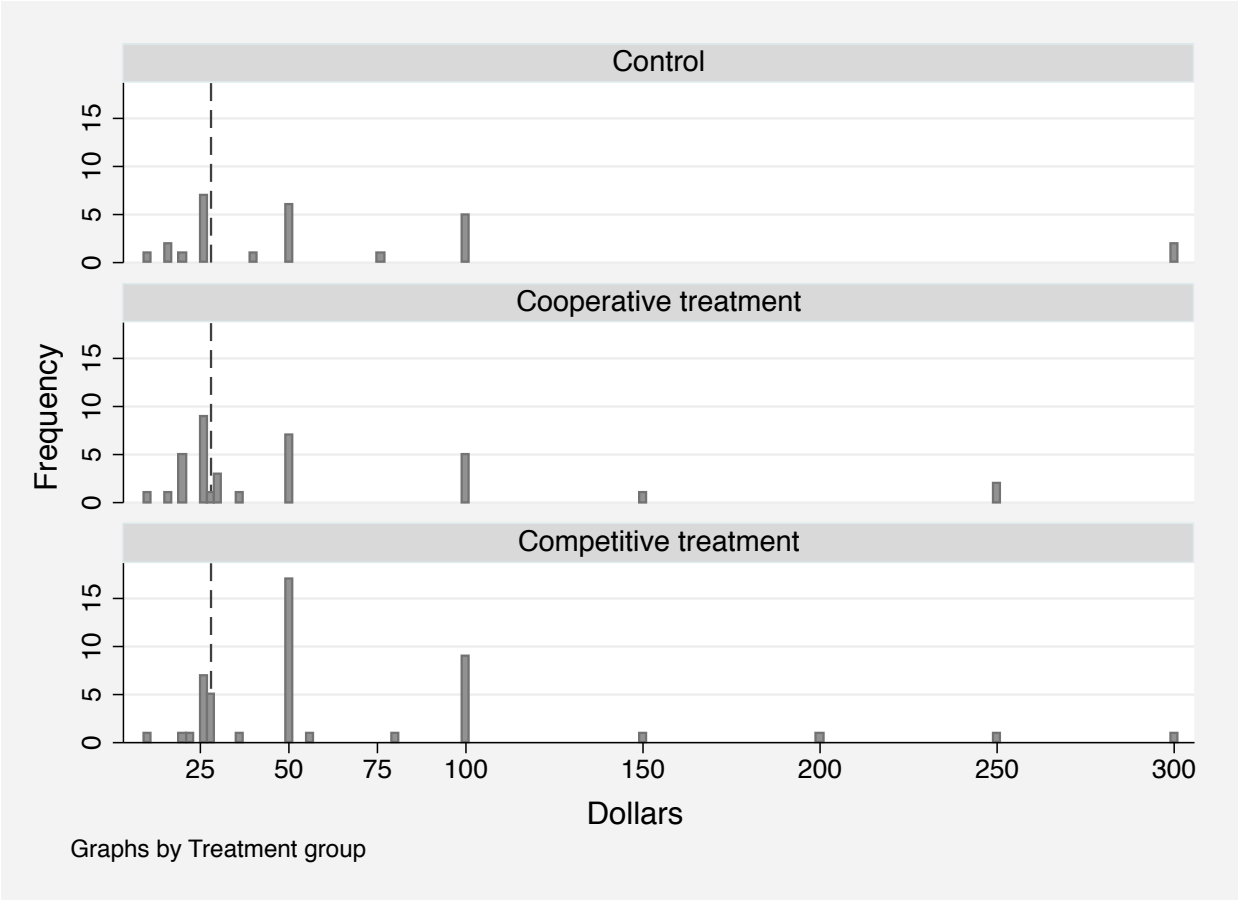
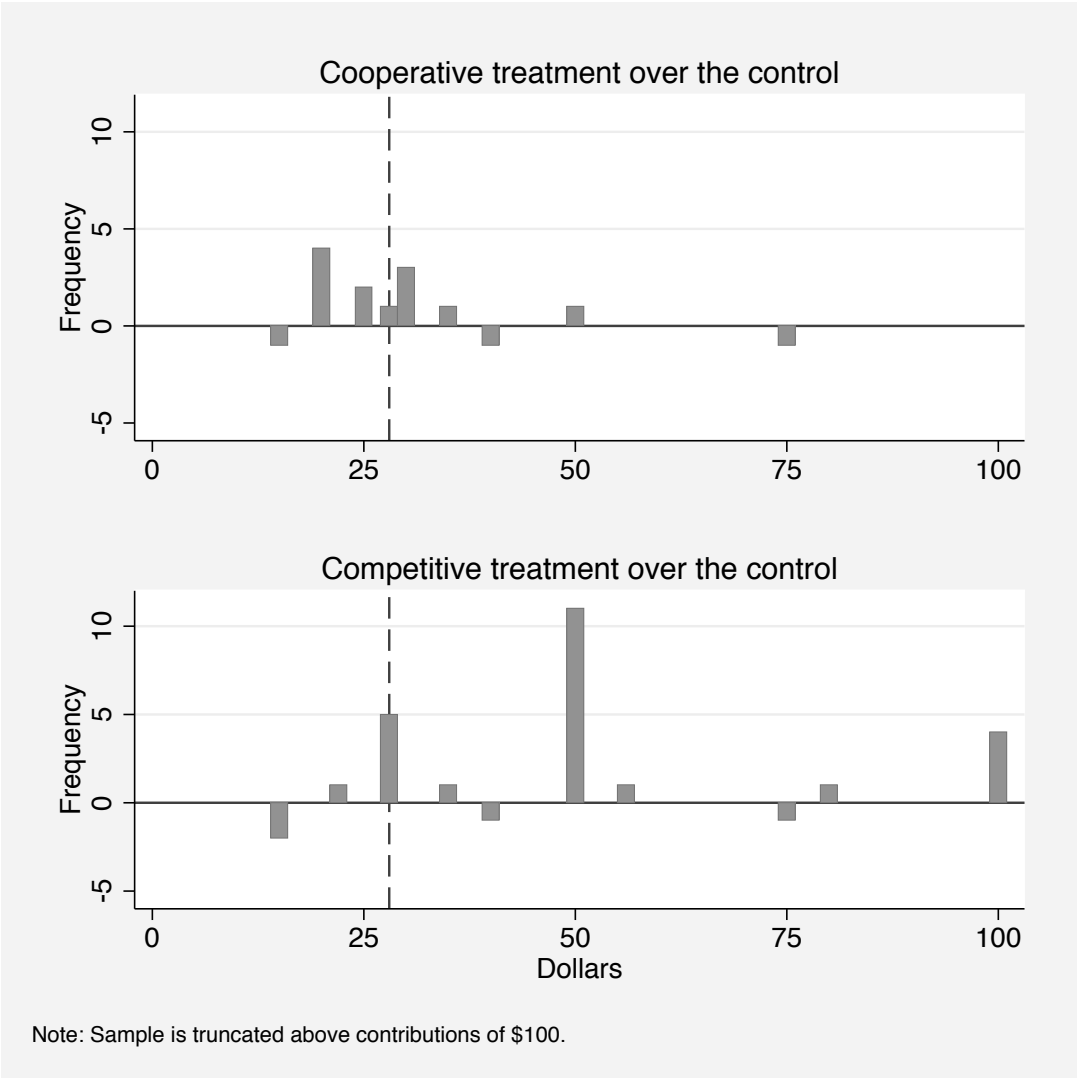


Figure 3: The difference between contribution amounts for non-zero contributions: cooperative treatment minus control (top), and competitive treatment minus control (bottom).



Note: Sample is truncated above contributions of $100.

Figure 4: CDFs of non-zero contribution amounts for the cooperative and competitive treatments.

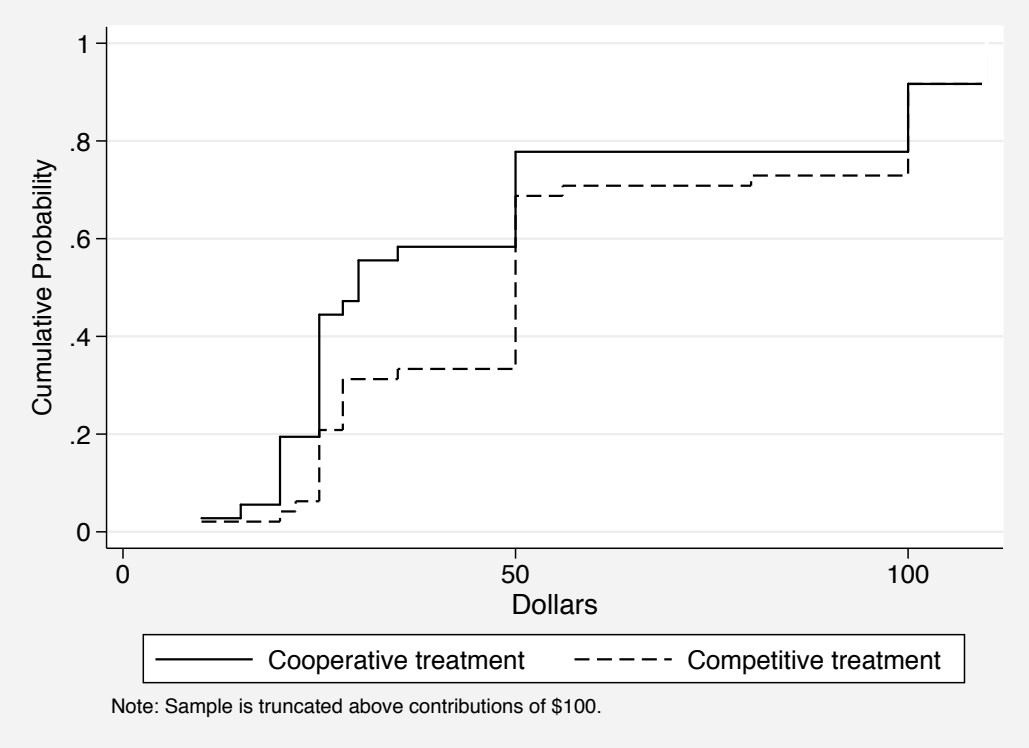


Table 1: Pre-treatment summary statistics and balance across groups.

	All	Control	Cooperative	Competitive	(2)=(3) p-value	(2)=(4) p-value	(3)=(4) p-value
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Male	0.47	0.46	0.48	0.47	0.23	0.57	0.53
		(0.01)	(0.01)	(0.01)			
Age	61.42	61.90	61.14	61.22	0.04**	0.07*	0.82
		(0.26)	(0.26)	(0.26)			
Registered Democrat	0.91	0.90	0.91	0.90	0.22	1.00	0.22
		(0.01)	(0.01)	(0.01)			
Registered Republican	0.06	0.07	0.05	0.06	0.07*	0.63	0.18
		(0.00)	(0.00)	(0.00)			
Registered with other party	0.01	0.01	0.01	0.01	0.68	0.12	0.25
		(0.00)	(0.00)	(0.00)			
Registered with no party	0.03	0.03	0.03	0.02	0.81	0.83	0.65
		(0.00)	(0.00)	(0.00)			
Voted in a primary	0.72	0.72	0.72	0.72	0.68	0.51	0.80
		(0.01)	(0.01)	(0.01)			
White	0.84	0.84	0.83	0.85	0.26	0.88	0.20
		(0.01)	(0.01)	(0.01)			
Black	0.11	0.11	0.11	0.10	0.54	0.18	0.46
		(0.01)	(0.01)	(0.01)			
Observations	8,712	2909	2913	2890			
Missing public-record voter demographics	0.12	0.12	0.12	0.13	0.96	0.37	0.34
		(0.01)	(0.01)	(0.01)			
Observations	9,954	3315	3318	3321			

Notes: *** p<0.01, ** p<0.05, * p<0.1

(1) All characteristics were obtained from Florida's public-record voter files and were self-reported when the recipient registred to vote.

(2) A voter is defined as having voted in a primary if they voted in any primary election between the years of 1996 and 2008.

(3) Standard errors are in parentheses.

Table 2: Contribution rates and amounts across treatment groups.

	All	Control	Cooperative	Competitive	(2)=(3) p-value	(2)=(4) p-value	(3)=(4) p-value	(2)=(3)=(4) p-value
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Contribution rate	1.11	0.78	1.08	1.45	0.24	0.01***	0.16	0.04**
		(0.18)	(0.18)	(0.18)				
Mean contribution ($)	0.70	0.53	0.60	0.96	0.74	0.06*	0.12	0.13
		(0.16)	(0.16)	(0.16)				
Mean contribution conditional on contributing ($)	63.10	67.31	55.64	66.42	0.47	0.95	0.43	0.68
		(12.17)	(10.34)	(8.95)				
Number of contributors	110	26	36	48				
Number of recipients	9,954	3,315	3,318	3,321				

Notes: *** p<0.01, ** p<0.05, * p<0.1
(1) Standard errors in parentheses.

Table 3: Contribution rates and amounts, controlling for pre-treatment observables.

Estimation method =	Probit	Probit	OLS	OLS
Outcome =	Contributed	Contributed	Contribution amount ($)	Contribution amount ($)
	(1)	(2)	(3)	(4)
Cooperative treatment	0.004	0.003	0.076	0.073
	(0.003)	(0.003)	(0.227)	(0.227)
Competitive treatment	0.007**	0.006**	0.432*	0.427*
	(0.003)	(0.003)	(0.227)	(0.227)
Male		-0.000		0.065
		(0.002)		(0.201)
Age		0.000**		0.004
		(0.000)		(0.007)
Registered Republican		-0.006***		-0.505
		(0.002)		(0.427)
Registered with other party		-0.000		0.549
		(0.009)		(1.060)
Registered with no party		-0.005		-0.380
		(0.004)		(0.642)
Voted in a primary		0.003		0.346
		(0.002)		(0.231)
Black		-0.009***		-0.811**
		(0.002)		(0.321)
Other race		-0.001		-0.458
		(0.004)		(0.463)
Indicator for missing demographics		yes		yes
Observations	9,954	9,954	9,954	9,954
Log likelihood	-601.62	-581.62		
R-squared			0.0004	0.0019
H_0: Cooperative treatment = Competitive treatment, p-value	0.19	0.15	0.12	0.12

Notes: *** p<0.01, ** p<0.05, * p<0.1
(1) Columns (1) and (2) contain estimated marginal effects from probit models; standard errors in parentheses.
(2) Columns (3) and (4) contain estimated coefficients from OLS regressions; standard errors in parentheses.
(3) All donor characteristics were obtained from Florida's public-record voter files and were self-reported when the recipient registred to vote.
(4) A voter is defined as having voted in a primary if they voted in any primary election between the years of 1996 and 2008
(5) The omitted categories are the Control treatment, registered Democrat, and White.