Voluntary contributions to a public good: a natural field experiment*

Richard Martin† John Randal‡

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Abstract

This paper describes the results of a natural field experiment that investigated voluntary contributions to a public good. The experiment took place at an art gallery where admission was free, but donations could be deposited into a transparent box in the foyer. We manipulated the social information available to patrons by altering what was visible in the donation box. In particular, we investigated four treatments: one with very few large denomination bills, one with several small denomination bills, one with a large amount of coinage, and one empty. The social information had a statistically significant impact on donation composition, the propensity to donate, and the amount donated. The data demonstrates a tradeoff associated with the manipulation of the social information.

Key Words: natural field experiment, public goods, social influence, conditional cooperation

JEL: C93, H41

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†Corresponding author: School of Economics and Finance, Victoria University of Wellington, PO Box 600, Wellington, New Zealand. email: Richard.Martin@vuw.ac.nz

‡School of Economics and Finance, Victoria University of Wellington.

1 Introduction

In 2003, the average American adult donated $1115 to charities.[1] This magnitude of giving is clearly at odds with classical demand theory where preferences are over *consumption* bundles and exhibit local non-satiation. Various theories of 'other regarding preferences' have been developed to help explain charitable donations and voluntary contributions to public goods (Becker 1974, Margolis 1982, Sugden 1984, Andreoni 1990, Rabin 1993, Bernheim 1994, Dufwenberg & Kirchsteiger 2004). Charitable giving and voluntary contributions to public goods have been studied extensively in lab settings; for surveys see Dawes & Thaler (1988) and Ledyard (1995). However, recently economists have taken experiments out into the field in an attempt to study human behavior in a more natural setting (List & Lucking-Reiley 2002, Frey & Meier 2004, Shang & Croson 2005, Heldt 2005).

Our experiment took place at an art gallery where admission was free, but donations could be deposited into a transparent box in the foyer. In our experiment we manipulated social information by changing the initial contents of the donation box. We investigated four treatments: one with very few large denomination bills, one with several small denomination bills, one with a large amount of coinage, and one empty. The three non-empty treatments varied by composition but not total value. We anticipated that our manipulation of the contents would influence the visitors' beliefs concerning both the magnitude and frequency of previous donations. Alternatively, the contents of the donation box might serve as a cognitive anchor, which in turn would influence donation behavior.

Our study is not the first to investigate the influence of social information on charitable behavior in the field. However, previous studies have either

[1] There were $291 \times .743 = 216$ million Americans over the age of 18 (US Census Bureau), who donated a total of $241 billion to charity (Giving USA Foundation).

focused on the propensity to donate *or* the amount donated. For instance, Frey & Meier (2004) and Heldt (2005) study how providing potential donors with information regarding the historical donation frequency influences the propensity to donate. In Frey & Meier (2004) students at the University of Zurich have the option of donating (a fixed amount) to two social funds when they pay their tuition. Some students were informed of the historical donation frequency, and this information had a significant impact on their propensity to donate. In Heldt (2005), cross-country skiers in Sweden made a decision of whether or not to contribute (a fixed amount) towards track maintenance. Again, providing information regarding the historical frequency of donation had a significant impact on their propensity to donate.

In an alternative approach, Shang & Croson (2005) focus on how providing information concerning donation size influences both donation size and the probability of contributing again the following year. The context of their experiment is an on air fund drive for a public radio station. They find that donation size is significantly influenced by the provision of the social information. An important qualification is that their study focuses on how social information alters the behavior of people that had *already* made the decision to donate. Specifically, only the listeners that self-selected themselves by calling the radio station to donate were involved in the experiment.

One common thread among Frey & Meier (2004), Shang & Croson (2005), and Heldt (2005) is that they all provide support for a theory of conditional cooperation. This behavior has been documented in the lab by Fischbacher, Gachter & Fehr (2001). People are conditionally cooperative if their donation behavior is positively correlated with the average or aggregate donation behavior of others.

Our study differs in a number of respects from the previous literature. The first difference is that the social information is provided indirectly rather than

directly. Instead of informing donors of the behavior of previous donors, we let the donors draw their own conclusions from what they see in the donation box. The contents of the box provide information on both the typical donation size, and the frequency of donations. In both Frey & Meier (2004) and Heldt (2005) the manipulation concerned only the historical frequency of donations, and donation size was either predetermined or suggested. In our study, there was no such constraint on donation behavior. In Shang & Croson (2005) the manipulation concerned donation size, and the focus was on its effect on the amount donated. At least to a certain extent, callers were committed to making a donation before they were exposed to the social information. In such a case, measuring the effect of the social information on the propensity to donate would be biased towards zero.

The structure of our experiment allows us to test a number of hypotheses regarding voluntary contributions and charitable giving.

Hypothesis 1 *Evidence of previous donations should crowd out actual donations.*

This is an implication of models of pure altruism, where people "[take] pleasure in others' pleasure" (Dawes & Thaler 1988, page 192). The more money the art gallery already has, the lower the marginal value of your donation. A similar argument applies for government grants crowding out voluntary contributions (Warr 1982, Roberts 1984).

Hypothesis 2 *Evidence of previous donations should have no effect on behaviour.*

This is predicted by models of 'warm glow' egoism (Andreoni 1990) and models of unconditional moral constraints (Collard 1983, Harsanyi 1980). A

donor gets a warm glow from giving, irrespective of the benefits created by the donation. The gift enters the donor's utility function directly, and the utility created is independent of the actions of others. Alternatively, donors might give because it is the 'right thing' to do. Again, if this is what motivates people to give, then the perception of other peoples' donations should not influence behaviour.

Hypothesis 3 *Evidence of previous donations should lead to an increase in actual donations.*

A positive relationship is consistent with the behavior known as conditional cooperation (Fischbacher et al. 2001). Conditional cooperation can be considered a motive in its own right, or it can be the consequence of a preference for fairness (Rabin 1993, Dufwenberg & Kirchsteiger 2004) or conformity (Bernheim 1994, Messick 1999). Conditional cooperation can also be the result of an information asymmetry. Evidence of previous donations may be viewed as a signal of the charity's hidden quality (Vesterlund 2003).

Hypothesis 4 *Donation behavior should not differ across the three non-empty treatments.*

Suppose that, regardless of the contents of the donation box, visitors are able to correctly guess the total value of the money in the box. In addition, suppose that visitors to the gallery are conditional cooperators who base their donation behavior on how much other people have donated (either in aggregate or per visitor). An implication of these two assumptions is that changing the composition of the previous donations but leaving the total unchanged should have no effect on donation behaviour.

Hypothesis 5 *Average donations (per visitor) should be increasing across treatments: empty, 50¢, $5, $50.*

Now suppose that people are conditionally cooperative, but suffer a cognitive bias. Anchoring can occur when a subject bases an estimation on the result of an incomplete calculation (Tversky & Kahneman 1974). In our scenario, calculating the total value of the box would be quite easy in the $50 treatment, but quite onerous in the 50¢ treatment. Cognitive anchoring would suggest that people's estimates of total box value would be, in ascending order: empty, 50¢, $5, $50. Thus, if people are conditionally cooperative and suffer from a cognitive bias, then the average donation size (per visitor) should increase across treatments.

Hypothesis 6 *Average donation size (per donor) should increase, and propensity to donate should decrease across treatments: 50¢, $5, $50.*

This is an implication of a model of social norms (Bernheim 1994, Messick 1999). The implied average or "normal" donation size increases across treatments, whereas the implied frequency of donation decreases.

Note the above hypotheses are neither mutually exclusive nor mutually exhaustive: they represent the implications of the leading models of prosocial behavior. The remainder of the paper is organized as follows. Section 2 describes the methodology, Section 3 describes the results, and Section 4 concludes.

2 Methodology

The experiment was conducted at City Gallery, Wellington, New Zealand, between January 12, 2005 and March 6, 2005. Admission was free and the

art on display was unchanged during the entire period. The art had been on display since December 12, 2004, and the exhibit ended March 6, 2005. Independent of our study, the art gallery performed a survey of 184 visitors over the period November 2004 to February 2005. Survey participants had the following characteristics: 53% were female, 97% were over the age of 18, 43% were between the ages of 18 and 29, 58% were visitors to the city, 22% were university or college students, and 53% had a household income under $40,000.

The experiment made use of the gallery's donation box, which was placed in a prominent location in the entrance lobby. The donation box has a solid base, but the remaining five sides are made of glass, allowing an unrestricted view of its contents. A single slot on the top of the box allows contributions to be made.

For a period of 52 days, the donation box was monitored (two days were lost due to technical problems). At the end of each day, the entire contents of the donation box were removed, the days' contributions recorded, and the box reset for the following day. During the day, the box was placed beneath a video camera, and the image streamed to a computer running ZoneMinder[2] software. This software allowed us to detect movement over the top of the donation box, and consequently allowed us to count the number of donations. In addition, the gallery independently monitored the number of daily visitors.

We alternated between four treatments, corresponding to the daily initialisation of the donation box's contents. These treatments were: the $50 regime, consisting of $100 cash (approximately US$75), including a $50 note; the $5 regime, consisting of $100 cash, primarily $5 notes; the 50¢ regime, consisting of $100 cash made primarily from 50¢ and 20¢ coins; and the empty regime, for which the box was left empty.

[2]See `http://www.zoneminder.com/`

Regime	Denomination										Average
	\$50	\$20	\$10	\$5	\$2	\$1	50¢	20¢	10¢	5¢	
\$50	1	1	2	1	1	2	2	0	0	0	\$10.00
\$5	0	1	1	13	1	2	1	1	2	2	\$4.17
50¢	0	1	1	1	3	15	71	36	12	2	\$0.70

Table 1. The initial contents of the donation box for the first three regimes.

Figure 1. The typical appearance of the initial contents of the donation box for the first three regimes. From left to right: the \$50 regime, the \$5 regime, and the 50¢ regime.

The initial setups of the \$50, \$5 and 50¢ regimes are described in detail in Table 1, and the typical visual appearance of the donation box in each of these regimes shown in Figure 1. For these three regimes, any donations made during the day were allowed to accumulate in the box until the gallery closed. Total donations during these three regimes were \$932.75 over the span of 41 days: the average daily donation was \$22.75. Consequently, donors at the end of the day observed essentially the same contents as donors early in the day. In the empty regime, the box was initially empty, and was regularly emptied during the day. While the box was not empty for every donation in this regime, most donors faced an empty donation box.

We measured the following variables: $n_{i,t}$ = the number of donations on day t of regime i, and $T_{i,t}$ = the total dollar value of donations on day t of regime i. In addition, City Gallery independently measured $N_{i,t}$ = the number of visitors to the gallery on day t of regime i. From these variables

we can calculate the average donation per donor on day t of regime i, given by $\bar{X}_{i,t} = T_{i,t}/n_{i,t}$, and the average donation per visitor on day t of regime i, given by $\tilde{X}_{i,t} = T_{i,t}/N_{i,t}$. Unfortunately the video footage was not of high enough quality to determine the value of every donation. As the next best thing, we analyse daily averages. We also sorted the daily collections, and later test whether the compositions of the collection were different across regimes.

3 Results

3.1 Donation composition

The composition of the donations for each of the four regimes is shown in Table 2. We amalgamate these observed frequencies to count the number of notes (including the \$20, \$10, and \$5 contributions), the number of gold coins (the \$2 and \$1 contributions) and the silver coins (the 50¢, 20¢, 10¢ and 5¢ contributions). Based on this amalgamated data, we conduct a test of whether or not the contribution type is independent of the donation box regime. Using the standard contingency table test, we find overwhelming evidence against independence ($p < 0.01\%$). This indicates that the contributions differ significantly according to the initial contents of the donation box.

This dependence between regime and composition is further investigated in Figure 2. The left-hand plot shows the relative frequencies of notes, gold coins and silver coins. It is clear from this plot, that the most commonly donated object is a silver coin, though this is most striking under the 50¢ regime, where roughly an additional 10% of the contributions are silver. We also note that notes are most commonly donated in the \$50 regime, followed

	Denomination											
Regime	\$20	\$10	\$5	\$2	\$1	50¢	20¢	10¢	5¢	Notes	Gold	Coin
\$50	0	3	19	55	28	36	41	30	32	22	83	139
\$5	1	1	17	63	37	46	54	29	39	19	100	168
50¢	0	1	6	70	56	81	112	59	64	7	126	316
empty	0	1	9	50	25	24	42	35	27	10	75	128

Table 2. The donation composition for each of the four regimes. Notes includes the \$20, \$10, and \$5 contributions; Gold, the \$2 and \$1; and Silver the 50¢, 20¢, 10¢ and 5¢.

by the \$5 regime. Very few notes are donated in the 50¢ regime, but more in the empty regime. Gold coin contributions are roughly equal in the \$50, \$5 and empty regimes, but are clearly lower in the 50¢ regime.

The right-hand plot of Figure 2 shows the proportion of the various contributions by value. While the notes have high value, these contributions are relatively infrequent, and for no regime do they contribute the most value. In each regime, the gold coin donations are responsible for the largest proportion of the revenue, and this is higher than 50% in all but the \$50 regime. Due to their low values, the common silver coins contribute only in a minor way to the revenue, with the exception of the 50¢ regime, where they are more important than the notes.

3.2 Donation size and frequency

The test of independence between regime and the composition of the donations indicates that the initial contents of the donation box have some influence on the composition of the money that is donated. We now investigate how the individual donations are affected, examining any tradeoff between individual donation size, and overall propensity to donate. Throughout the following analysis, we treat the sample sizes as fixed.

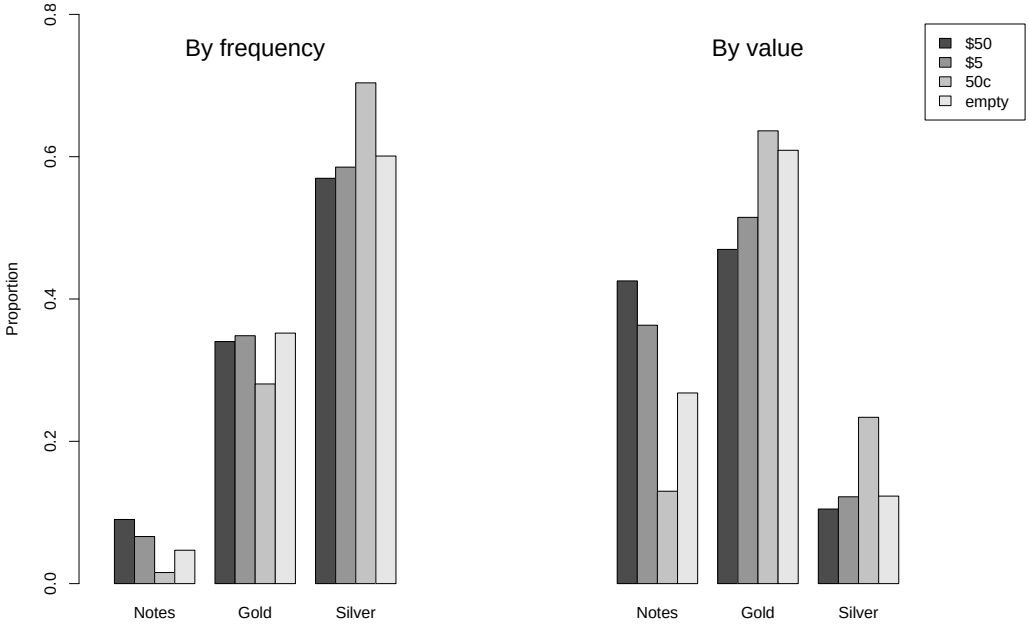

Figure 2. Composition of the donations for each regime. On the left, the composition is plotted by relative frequency. On the right, it is plotted on a value-weighted basis. Notes includes the $20, $10, and $5 contributions; Gold, the $2 and $1; and Silver the 50¢, 20¢, 10¢ and 5¢.

Over the course of the study, we observed 123, 133, 182 and 104 donations for the \$50, \$5, 50¢ and empty regimes respectively. The numbers of visitors during each of these regimes were 5249, 5031, 5394, and 5585, giving propensities to donate equal to 2.3%, 2.6%, 3.3%, and 1.8% respectively.[3]Conducting a formal hypothesis test for independence between the regime, and whether or not someone donates, we find strong evidence against the null hypothesis of independence ($p < 0.01\%$).

We now analyse the differences in the average donations for significance, on both a per donor, and a per visitor basis. We have seen that the propensity to donate is affected by the regime, and now examine whether the size of the donations is affected. In each case, we have in mind the model $X_{i,j} = \mu_i + \varepsilon_{i,j}$, where $X_{i,j}$ is the jth donation for regime i, and this is decomposed into a mean plus an error term. The errors $\varepsilon_{i,j}$ are assumed to be independent random variables with zero mean and constant variance across treatments and observations. The population mean will either be per donor, or per visitor, with the sample of observed donations augmented by an appropriate number of zero donations for the per visitor analysis.

Initially, we wish to test the null hypothesis that the mean donation is the same for all four regimes, against the alternative that at least one mean is different. We will use an F-test, and if this is rejected, pairs of means will be investigated using post-hoc tests.

For the average donation per donor, we interpret the $X_{i,j}$ to be the donations placed in the donation box. While these are unobserved, their daily totals $T_{i,t}$ are observed, with $\sum_t T_{i,t} = \sum_j X_{i,j}$. Consequently, the point estimates

[3]These low propensities must be put in the context of the situation. For one, the cultural norm in New Zealand is to not tip: not to waiters, cab drivers, bell hops, etc. Second, the Gallery receives a large proportion of its revenue from municipal taxes. For this reason, local property owners might feel a sense of entitlement, and abstain from donating.

of the population average donation per donor are unaffected by the data limitations (the fact that we do not observe the x_{ij}). For the average donation per visitor, we augment the daily donations by $n'_{i,t} = N_{i,t} - n_{i,t}$ zero donations, i.e., for every visitor to the gallery who did not make a donation, we set $X_{i,j} = 0$. As before, the population average donation per visitor is unaffected by our data limitations.

The average donations per donor are \$2.39, \$2.38, \$1.69 and \$1.97, for the \$50, \$5, 50¢, and empty regimes respectively. These averages are shown graphically in the left hand plot of Figure 3, along with their estimated standard errors. Apparent is the clear separation between the 50¢ regime, and the \$50 and \$5 regimes, and the intermediate location of the empty regime.

Using an F-test, the differences between these averages are significant at the 5% level, but not at the 1% level ($p = 3.7\%$). The conservative Tukey's (honestly significant difference) post-hoc tests on the pairwise differences indicate mild significance in the differences between the \$50 and 50¢, and \$5 and 50¢ average donations (p-values of 7.2% and 6.8% respectively). We can conclude that the contents of the donation box have an influence on the amount of money individuals place in the donation box. The \$50 and \$5 regimes elicit similarly sized donations, while the 50¢ regime yields significantly lower donations. The empty box yields donations which average very close to \$2, a figure which lies approximately half-way between the averages for the note-laden \$50 and \$5 regimes, and the coin-laden 50¢ regime.

The average donations per visitor are 5.6¢, 6.3¢, 5.7¢, and 3.7¢, for the \$50, \$5, 50¢, and empty regimes respectively. Thus, the maximum average donation per visitor is attained using the \$5 regime. Here, we see evidence of lower propensities to donate offsetting the average (non-zero) donations, with the empty and \$50 regimes suffering most. The averages and their

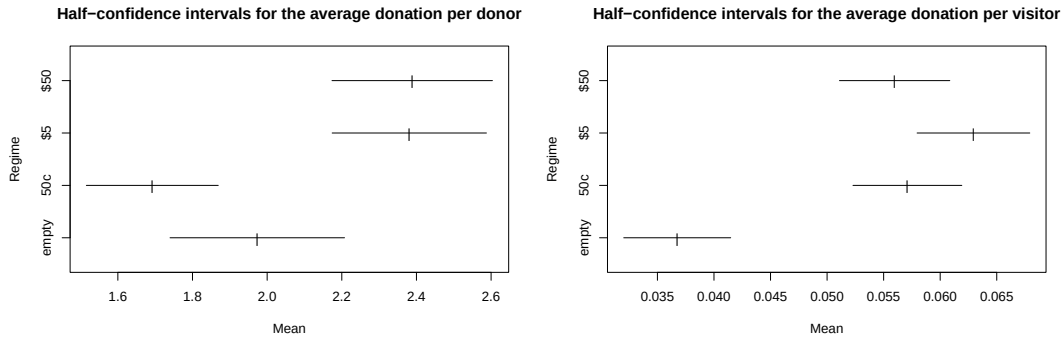

Figure 3. Average donations ± one standard error. The averages are per donor in the left plot, and per visitor in the right plot.

associated confidence intervals are shown in the right-hand plot of Figure 3. Here, we see clear separation between the empty, and non-empty regimes, and substantial overlap among the three cash-laden regimes.

Using an F-test, the observed differences are highly significant ($p = 0.07\%$), and we conclude that the initial contents of the donation box are having an effect on the per visitor donation revenue of the gallery. Tukey's post-hoc tests indicate pairwise significance between the empty regime, and each of the other three regimes (p-values of 2.4%, 0.08% and 1.4% for the \$50, \$5 and 50¢ regimes respectively).

4 Conclusion

Conclusion 1 *Evidence of previous donations significantly increases the propensity to donate, resulting in higher average donations (per visitor).*

We reject models of pure altruism (Margolis 1982),'warm glow' egoism (Andreoni 1990) and models of unconditional moral constraints (Collard 1983, Harsanyi 1980). Pure altruism would predict that evidence of previous donations would crowd out actual donations. A theory of warm glow egoism would

predict that the contents of the box would not influence the donors behavior. Likewise, theories of unconditional moral constraints would predict no difference across treatments. This aspect of the data is however consistent with conditional cooperation (Fischbacher et al. 2001), reciprocity (Sugden 1984, Rabin 1993, Dufwenberg & Kirchsteiger 2004), social norms (Bernheim 1994, Messick 1999) and signalling (Vesterlund 2003).

Conclusion 2 *Donation behavior differs significantly across the three non-empty treatments.*

We find that both the propensity to donate and the average donation (per donor) vary significantly across the three non-empty treatments. In the absence of a cognitive bias, we view this as evidence against conditional cooperators conditioning on the amount donated (either in aggregate or per visitor).

Conclusion 3 *The average donation (per visitor) is highest in the $5 treatment.*

Cognitive anchoring based on an incomplete calculation implies that people's estimates of total box value would be ranked in ascending order: empty, 50¢, $5, $50. We considered collecting data concerning visitor beliefs, but decided that maintaining the natural setting in which the donation behaviour was being studied was more important. It is hard to imagine how this data could be collected without alerting visitors to the fact that their donation behaviour was being studied.

As an alternative, we decided to perform a separate experiment using the first year commerce students as a subject pool. Students were randomly allocated to treatments based on their student number. We investigated 3

treatments, which corresponded to the three non-empty treatments at the gallery. Students were shown a picture of the donation box, and asked to guess the dollar value of the money in the donation box. In order to make the task salient, students were told that whoever was best able to guess the dollar value of the donation box would win $20. We found evidence of a bias that is consistent with estimation based on an incomplete calculation. In particular, in the 50¢ treatment, the correct guess was made by students at the 89th percentile (sample size 138). In other words, only 11 percent of the students thought there was more than $100 in the box. In the $5 treatment, the percentile drops to 67 (sample size 148). In the $50, the percentile drops further to 54 (sample size 155).

If visitors to the art gallery suffer from the same cognitive bias as first year commerce students *and* are conditionally cooperative, then one would expect that the average donation (per visitor) should be ordered: empty, 50¢, $5, $50. This prediction can be contrasted with the observed behavior, where the average donation (per visitor) peaks in the $5 treatment.

Conclusion 4 *Average donation size (per donor) weakly increased, and propensity to donate decreased across the non-empty treatments: 50¢, $5, $50.*

The reason why the average donation (per donor) did not strictly increase across treatments was because there was no significant difference between the $5 and $50 treatments. This threshold effect is consistent with Conclusion 3 of Cason & Mui (1998). The authors investigate how the provision of social information (information concerning the behaviour of others) influences actual behavior. One of the issues studied was whether or not dramatic social information (others are making allocations much different from your own) would have a different influence to social information that is less dramatic. The authors find that dramatic social information is *not* more likely

to change behavior than moderate social information.

Conclusion 5 *There is a tradeoff between propensity to donate, and average donation size (per donor) when the social information is manipulated.*

Note that the 50¢ treatment generated roughly the same amount of revenue (per visitor) as the $5 and $50 treatments, even though the average donation (per donor) was significantly higher in the $5 and $50 treatments. This tradeoff could not be observed by Frey & Meier (2004) and Heldt (2005) (donation size fixed) and Shang & Croson (2005) (probability of contributing fixed).

Hypothesis	Consistent with	Inconsistent with
1		Conclusion 1
2		Conclusion 1
3	Conclusion 1	
4		Conclusion 2
5		Conclusion 3
6		Conclusion 4

Table 3. Summary of results. Reconciliation between each of the hypotheses listed in Section 1 and the conclusions of this section

Table 3 reconciles the hypotheses we list in Section 1 with these conclusions. Collectively, the results allow us to rule out Hypotheses 1, 2, 4, 5 and 6, leaving only Hypothesis 3, which indicated that the non-empty regimes should elicit higher donations than the empty treatment.

Our study makes three contributions to the literature. First, it demonstrates that social information that is provided indirectly can influence behavior. Second, it demonstrates the existence of a tradeoff when manipulating social information. When confronted by a donation box with a small number of large denomination bills, the resulting average donation (per donor) is high

but it comes at a cost: the propensity to donate is low. Third, it allows us to dispense with a number of theories of charitable behavior, and focus future research on the remaining contenders: reciprocity, conditional cooperation, and social norms.

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