Learning from (Failed) Replications: Cognitive Load Manipulations and Charitable Giving[*]

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Abstract:
Replication of empirical studies is much more than a tool to police the field. Failed replications force us to recognize that seemingly arbitrary design features may impact results in important ways. We describe a study that used a cognitive load manipulation to investigate the role of the deliberative system in charitable giving and a set of failed replications of that study. While the original study showed large and statistically significant results, we failed to replicate using the same protocol and the same subject pool. After the first failed replication, we hypothesized that the order our study was taken in a set of unrelated studies in a laboratory session generated the differences in effects. Three more replication attempts supported this hypothesis. The study demonstrates the importance of replication in advancing our understanding of the mechanisms driving a particular result and it questions the robustness of results established by cognitive load tests.

Introduction

Replication of empirical studies can help identify false positive results and uncover questionable research practices (see special section on replicability in *Perspectives in Psychological Science*, including Pashler & Wagenmakers, 2012). But running replications is about more than policing the field. Replications can elucidate how subtle differences in setting, subject pool, and protocol impact results. Specifically, failed replications force us to recognize that some seemingly arbitrary design features may be necessary for a result to arise, which can help us understand the mechanisms driving the effect (for a similar argument about laboratory and field experiments see Kessler, 2013).

This paper describes a set of studies in which we use a cognitive load manipulation to investigate the role of the deliberative system in charitable giving (for a discussion of mental processes on charitable giving, see Loewenstein and Small (2007)). Our original results suggested that people gave substantially more money to a charity when placed under high cognitive load, results that were consistent with other findings in the literature. Schulz et al. (in press) and Rand et al. (2012) have found similar effects; however, Hauge et al. (2009) found no impact of load on giving.

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Given our large treatment effect and statistically significant results, we were confident that our findings had pushed forward the frontiers of knowledge (see manuscript in SOM). While we were conducting more research, however, we failed to replicate our original result. We hypothesized that a subtle difference between the original study and the failed replication attempt — the order our study was taken in an hour-long laboratory session — generated the difference in effects. Three more replication attempts supported this hypothesis.

Method

The original study was a 2 (charity request or general request) x 2 (low or high cognitive load) between-subjects design. The replication attempts kept the same design, but here we focus only on the charity requests (see SOM for results from all sessions). Each study was one of several unrelated studies in an hour-long session at the Wharton Behavioral Lab. Sometimes our study was first in the session and sometimes it followed other studies. We were initially indifferent about the session order. Subsequently, we explicitly asked to be at the start of the session or fourth in the session as explained below.

Subjects

We analyze 405 University of Pennsylvania undergraduates (53.3% female) who participated in our charity request condition. Subjects received $10 payment for the hour-long session and whatever amount they chose to keep in our study. Across all studies, the subject pool and the instructions were kept the same.

Charity Request

Subjects were placed under high or low cognitive load, given an endowment of $3, and asked how much of their endowment they wanted to donate to the American Red Cross.

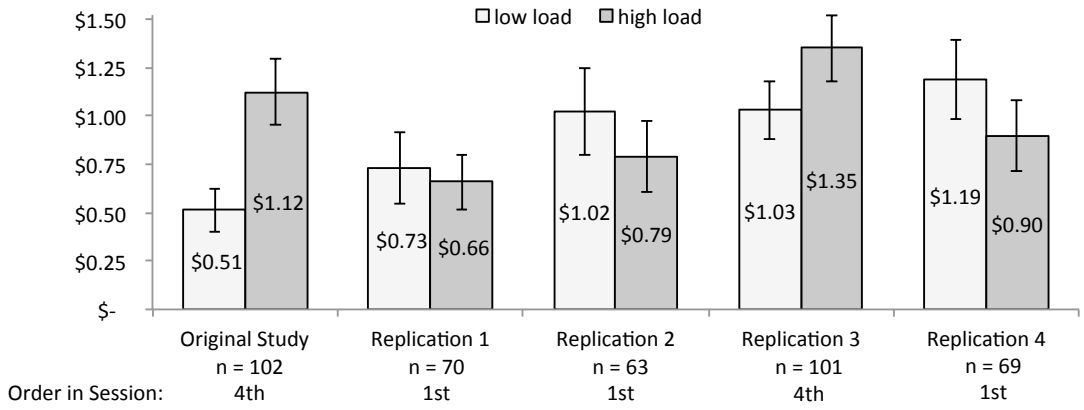
Cognitive load manipulation

Cognitive load manipulations often involve memorizing a sequence (e.g., Gilbert et al., 1995; Gilbert & Osborne, 1989; Shiv & Fedorikhin, 1999). Since subjects made numeric giving decisions, we used a sequence of letters to avoid anchoring effects (Tversky, 1974). Subjects were randomly assigned to memorize a 3-letter sequence ("GXN") (low cognitive load), or a 9-letter sequence ("GXNTDPLRW") (high cognitive load). We did not incentivize the load manipulation to avoid income effects.

Results

Figure 1 shows donations by cognitive load condition in the original study and in four replication attempts. In the original study subjects under high load give twice as much ($0.51 vs. $1.12; 102 obs; t-test, $t=2.99$ $p=0.004$) and are 50% more likely to give (38% vs. 58%; 102 obs; pr-test, $z=1.97$ $p=0.048$). In Replications 1, 2 and 4 the sign of the effect is reversed and the effect on average donation is statistically significantly different from the effect in the original study ($p<0.05$ for all tests). We only replicate in attempt 3: under high load probability of donation increases (60% vs. 79%; 101 obs; pr-test $z=2.00$, $p=0.046$) and average donation directionally increases ($1.03 vs. $1.35, t-test, $t=1.39$ $p=0.168$).

Panel A: Average Donation by Treatment and Study



Panel B: Probability of Donation by Treatment and Study

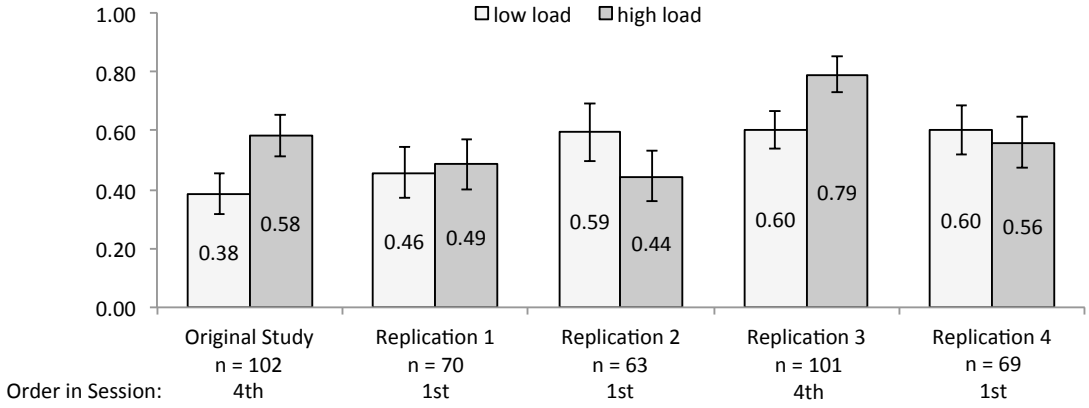


Fig. 1. Original Study and Four Replication Attempts. Panel A shows average amount of the $3 endowment donated to the American Red Cross (means ± SEM). Panel B shows percent of subject who donated a positive amount to the American Red Cross (± SEM).

Order in Session
After our first failed replication attempt, we hypothesized that the difference in results was due to the order in the hour-long session our study was conducted. The original study was run fourth and Replication 1 was run first. Starting with Replication 2, we specifically asked to be run either first (Replication 2 and Replication 4) or fourth (Replication 3).

Our data confirms our hypothesis that session order matters. When our study is first in the session, cognitive load directionally *reduces* charitable giving ($0.97 vs. $0.78); when it is later in the session, cognitive load *increases* charitable giving ($0.78 vs. $1.23; 203 obs; t-test, t=2.84 *p*=0.005). The effect of load on giving statistically significantly interacts with session order (405 obs; OLS on average donation p=0.004; OLS on probability of donation p=0.020). The effect gets stronger when we control for the calendar date on which a session was run, allowing subjects who participate on different dates to have different baseline levels of generosity (405 obs; OLS on average donation p=0.001; OLS on probability of donation p=0.006).

This pattern of results holds when looking only at the three replications conducted after forming our session-order hypothesis (233 obs; without date controls: OLS on average donation p=0.053; OLS on probability of donation p=0.024; with date controls: OLS on average donation p=0.030; OLS on probability of donation p=0.008).

Discussion
What can we learn by comparing an original study to its failed replications? When another researcher fails to replicate a study, the lack of a result might arise from differences in methods, subject pool, environment, or some other factor. When a researcher fails to replicate a result using the same instructions, subject pool, and laboratory environment, one must look for subtle differences between the replication attempt and the original study.

Whether our study is first or later in a session affects the *sign* of the effect of cognitive load on charitable giving. One possible explanation is that the efficacy of our cognitive load manipulation is sensitive to session order. For example, the cognitive load task might more completely occupy the deliberative system if subjects have suffered mental fatigue from participating in studies earlier in the session. Similarly, subjects might be differently inclined to spend mental energy remembering the long string of letters in the high load treatment depending on mental fatigue. Our manipulation check questions provide some evidence that cognitive load is differently effective early and late in a session (see SOM4). Another possible explanation is that load is equally effective early and late in a session but that its effect on giving may be heavily moderated by the context of the request — even context as subtle as when in a session of studies the subject is asked to donate.

Both of these possible explanations are worthy of future study. The former explanation tells a very cautious tale about cognitive load manipulations and suggests further replication attempts of results established using cognitive load manipulations. Both

explanations suggest that role of the deliberative system in charitable giving is far from resolved and that one should be cautious in relying on cognitive load manipulations to establish that result. A similar debate has arisen about the effectiveness of time-pressure tests on the role of the deliberative system in charitable giving (Rand et al., 2012; Tinghog et al., 2013).

A natural next step for future research would be to randomize when in a session a load manipulation is run (rather than relying on between-session data) to investigate whether the treatment effect changes monotonically with session order and to investigate whether the types of other tasks subjects complete in a session moderate the effect of load on giving.

Overall, these results demonstrate an important value of replication. Even when a replication fails, it may be able to teach something about the original effect.

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Supplemental Online Material

for

Learning from (Failed) Replications: Cognitive Load Manipulations and Charitable Giving

In this online appendix, we first present protocols and results from all of our studies (SOM1).

We then present regression results supporting the claims in the paper focusing on the charity request to give to the Red Cross, both for all the data and focusing on the period after we developed our session order hypothesis (SOM2).

In the SOM we also present the following additional results:

Results from the general request, a request to give money back to the experimenter in some studies or to the Wharton Fund in other studies, and results from the opt-in studies (SOM3).

Regression results from Cognitive Reflection Test (CRT) (Frederick, 2005) questions that were an attempted manipulation check (SOM4).

Finally we present the instructions for the study (SOM5) and the text of our original paper (SOM6).

SOM1. Protocols of all Studies

In all studies participants were…

- Given a string of either 3 (low load) or 9 (high load) letters to memorize.
- *Put through the steps listed in the Protocol column*
- Asked to recall the letter sequence.
- Asked to indicate which CRT questions they had seen before.

Study	**Run Date**	**Session Order**	**# of Ss**	**Design**	**Protocol**
Original	4/10/12-4/16/12	4th	205	2 (load: high vs. low) x 2 (request type: experimenter vs. Red Cross) x 2 (request order: charity first vs. second) with request order as a within-subject factor. Analysis ignores the second decision, treating the experiment as a 2 (load) x 2 (request type) between-subjects design.	• Asked the first CRT question (bat & ball). • Endowed with $3 and asked how much they wanted to give to the Red Cross [experimenter]. • Asked the second CRT question (widget). • Endowed with an additional $3 and asked if they wanted to give to the other request. • Asked the third CRT question (lake).
Opt 1	7/12/12-7/18/12	3rd	192	2 (load: high vs. low) x 2 (request type: experimenter vs. Red Cross) with request as opt in to donate and donation request made once load was removed	• Asked the first CRT question (bat & ball). • Endowed with $3, given a chance to opt-in to see a request to give to the Red Cross [experimenter] at the end of the study. • Asked the remaining two CRT questions.
Opt 2	9/4/12-9/5/12	1st	86	Identical to Opt 1	Identical to Opt 1
Rep 1	9/6/12-9/7/12	1st	139	2 (load: low vs. high) x 2 (request type: Wharton Fund vs. Red Cross) between subjects design.	• Asked the first CRT question (bat & ball). • Endowed with $3 and asked how much they wanted to give to the Red Cross [Wharton Fund]. • Asked the remaining two original CRT questions plus three additional new CRT questions.
Rep 2	10/25/12-	1st	194	2 (load: low vs. high) x 3 (request	• Asked the first CRT question (bat & ball).

	10/31/12, 11/5/12-11/9/12			type: charity forced vs. charity opt-in vs. experimenter) between subjects design	• Endowed with $3 and asked how much they wanted to give to the Red Cross [experimenter] OR (opt-in) given a chance to opt-in to see a request to give to the Red Cross. • Asked the remaining two original CRT questions plus three additional new CRT questions.
Rep 3	11/15/12-11/21/12	4th	202	Identical to Rep 1	Identical to Rep 1
Rep 4	1/22/13-1/28/13	1st	206	2 (load: low vs. high) x 3 (request type: Experimenter vs. Wharton Fund vs. Red Cross) between subjects design.	• Asked the first CRT question (bat & ball). • Endowed with $3 and asked how much they wanted to give to the Red Cross [Wharton Fund; experimenter]. • Asked the remaining two original CRT questions plus three additional new CRT questions.

SOM2. Regression Results of Donation to Red Cross

	Donation Decisions to Red Cross by Load and Late in Session							
	Average Donation				Probability of Donation			
	All Red Cross Data		Post-Hypothesis Data		All Red Cross Data		Post-Hypothesis Data	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
High Load* Late in Session	0.633 (0.219)***	0.709 (0.217)***	0.589 (0.303)*	0.677 (0.309)**	0.229 (0.098)**	0.273 (0.099)***	0.284 (0.125)**	0.342 (0.128)***
High Load	-0.193 (0.153)	-0.198 (0.155)	-0.270 (0.199)	-0.300 (0.206)	-0.051 (0.071)	-0.067 (0.073)	-0.097 (0.087)	-0.132 (0.091)
Late in Session	-0.188 (0.153)		-0.083 (0.213)		-0.046 (0.070)		0.007 (0.090)	
Constant	0.974 (0.118)***		1.113 (0.151)***		0.546 (0.051)***		0.597 (0.063)***	
Date Dummies	No	Yes	No	Yes	No	Yes	No	Yes
Observations	405	405	233	233	405	405	233	233

This table reports OLS regression results on the average amount donated and a linear probability model (OLS) of whether the subject donated a positive amount. Date Dummies include a dummy variable for each calendar date on which the study was run to allow for different average levels of donation on each date. Post-Hypothesis Data looks only at the Red Cross Charity request for Replications 2, 3, and 4 after we developed our session order hypothesis. Robust standard errors are used for all tests and significance is donated: * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

SOM3. Results of all Studies

Study	Session Order	# of Ss	Red Cross				Experimenter				Wharton Fund			
			Low Load		High Load		Low Load		High Load		Low Load		High Load	
			Avg $	% Don	Avg $	% Don	Avg $	% Don	Avg $	% Don	Avg $	% Don	Avg $	% Don
Original (1st ask)	4th	205	$0.51	38.4%	$1.12**	58.0%*	$0.29	25.5%	$0.21	19.2%				
Rep 1	1st	139	$0.73	45.7%	$0.66	48.6%					$0.24	20.0%	$0.22	23.5%
Rep 2 (no opt)	1st	125	$1.02	59.3%	$0.79	44.4%	$0.52	33.3%	$0.29	25.0%				
Rep 3	4th	202	$1.03	60.3%	$1.35	79.1%*					$0.38	37.2%	$0.15*	15.5%*
Rep 4	1st	206	$1.19	60.0%	$0.90	55.9%	$0.37	28.9%	$0.30	25.8%	$0.22	17.2%	$0.25	30.8%
			Red Cross				Experimenter							
			Low Load		High Load		Low Load		High Load					
			% Opt In		% Opt In		% Opt In		% Opt In					
Opt 1	3rd	192	50.0%		52.0%		34.0%		54.3%*					
Opt 2	1st	86	45.5%		59.1%		40.9%		25.0%					
Rep 2 (opt)	1st	67	40.0%		50.0%									

This table reports results from each study and indicates whether the high load and low load conditions are statistically significantly different using t-tests (for average donation) and pr-tests (for probability of donation and probability of opting in): * $p<0.05$, ** $p<0.01$.

SOM4. Cognitive Reflection Tests

	Cognitive Reflection Test Questions Answered Correctly by High Load and Late in Session											
	Subjects Analyzed in this Paper						All Subjects					
	Bat (0 or 1)		Bat and Widget (0 to 2)		Bat, Widget and Lake (0 to 3)		Bat (0 or 1)		Bat and Widget (0 to 2)		Bat, Widget and Lake (0 to 3)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
High Load* Late in Session	-0.193 (0.099)*	-0.184 (0.102)	-0.409 (0.165)**	-0.425 (0.169)**	-0.481 (0.226)**	-0.505 (0.229)**	-0.056 (0.057)	-0.056 (0.057)	-0.001 (0.065)	-0.097 (0.093)	-0.131 (0.126)	-0.127 (0.126)
High Load	0.116 (0.070)*	0.109 (0.072)	0.202 (0.118)*	0.208 (0.122)*	0.279 (0.161)*	0.295 (0.166)*	0.037 (0.040)	0.036 (0.040)	0.076 (0.066)	-0.002 (0.065)	0.002 (0.088)	0.001 (0.088)
Late in Session	0.108 (0.069)		-0.200 (0.115)*		0.254 (0.158)		0.047 (0.040)		-0.010 (0.093)		0.074 (0.090)	
Constant	0.474 (0.051)***		0.845 (0.085)***		1.464 (0.115)***		0.503 (0.028)***		0.917 (0.046)***		1.589 (0.062)***	
Date Dummies	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	405	405	405	405	405	405	1224	1224	1224	1224	1224	1224

This table reports OLS regression results on the number of questions answered correctly in the cognitive reflection test for the first question (Bat), the first two questions (Bat and Widget) and all three questions that were asked to all subjects (Bat, Widget, and Lake). The first six regressions analyze subjects who answered the Red Cross donation question and are analyzed in this paper. The second six regressions analyze all subjects who answered Cognitive Reflection Test questions in any of the studies listed in SOM 1. Robust standard errors are used for all tests and significance is donated: * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

Reference

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SOM5. Instructions shown to Participants

(i) Introduction and Cognitive Load Screen

In this study, you are going to memorize a sequence of letters and answer several questions.

People are often busy or distracted while trying to remember things in the real world. We are going to have you make a series of judgments and decisions while you try to remember a sequence of letters.

Below is a sequence of three letters to memorize and keep in your mind throughout this study. You will be asked to recall this sequence at the end of the study.

Letter Sequence:
[low load condition] G X N [high load condition] G X N T D P L R W

Take a moment to memorize these letters. When you are ready to continue, click the "Next" button.

(ii) Request Screen

We have given you an additional $3 for participating in this study. As of now, this money is yours and you may use it however you like.

If you'd like, you may choose to donate a portion of your $3 endowment to the American Red Cross [return a portion of your $3 endowment to the experimenter for use in future studies]. You can donate [return] any amount, including $0.00, in increments of 25 cents.

How much would you like to donate to the American Red Cross [return to the experimenter]?

$ _____

SOM6. Original Study

Deliberative Reasoning Constrains Charitable Giving

Humans are willing to incur a cost to help others, including genetically unrelated strangers, as evidenced by widespread charitable giving (Andreoni, 2006; Gneezy, Gneezy, Nelson, & Brown, 2010). A crucial question about the nature of human generosity is whether people are innately selfish but capable of generosity or innately charitable but capable of selfishness. We investigate this question by considering the role of the deliberative system — characterized by careful analytic reasoning — in anonymous charitable giving.

Within the dual processes framework of decision making (Kahneman, 2003; Sanfey, Loewenstein, McClure, & Cohen, 2006; Sloman, 1996), one hypothesis is that people are innately selfish (Dawkins, 1989; Moore & Loewenstein, 2004) and the deliberative system must determine whether a situation is worthy of personal sacrifice before an individual will engage in charitable behavior. An alternative hypothesis is that people are inherently altruistic (Bowles, 2006; de Waal, 2008) and the deliberative system must inhibit charitable impulses in order to prioritize personal welfare. These two hypotheses paint very different pictures of the human generosity and the extent to which we are programmed to be generous.

We experimentally test the importance of the deliberative system in the non-strategic setting of anonymous charitable giving by occupying cognitive resources crucial to deliberative processing with a working memory task (Baddeley, 1992; Gilbert & Osborne, 1989; Miller, 1956).[1] Charitable giving more than doubles when we impinge the deliberative system by placing subjects under high cognitive load. The effect of load on giving is specific to charitable donation; cognitive load does not affect giving to a general (i.e. non-charitable) request. Our findings suggest that humans are instinctively generous and that deliberative reasoning constrains charitable giving.

Method

This study was a 2 (charity request or general request) x 2 (low or high cognitive load) between-subjects design.

Subjects

Subjects were 205 University of Pennsylvania undergraduates (mean age=20, SD=1.5; 63% female) who participated in this study as the first of several unrelated studies in an hour-long session at the Wharton Behavioral Lab. Subjects received $10 payment for the entire session and whatever they chose to keep in this study.

Charity Request vs. General Request

[1] Prior research based on disrupting the right dorsolateral prefontal cortex can be interpreted as showing the importance of the deliberate system in *strategic* interactions (Knoch, Pascual-Leone, Meyer, Treyer, & Fehr, 2006).

While subjects were under high or low cognitive load, they were given an endowment of $3 and exposed to a request. Half of the subjects (n=102) were asked how much they wanted to give to the American Red Cross ("Charity Request"). The other half (n=103) were asked how much they wanted to give to the experimenter for use in future studies ("General Request"). Subjects could give up to their $3 endowment in increments of $0.25. The amount given in response to either request was deducted from the subject's earnings.

The variation in the type of request allows us to determine whether occupying the deliberative system affects giving to charitable requests only, or whether it affects giving to requests in general (Langer, Blank, & Chanowitz, 1978). If cognitive load only affects charitable giving, we can make inferences about the human charitable instinct; if it affects behavior towards both requests, we can only infer the role of the deliberative system in compliance more generally. In addition, the general request has the same structure as the charitable request, so it acts as a control for other effects cognitive load might have on behavior. For example, if high cognitive load makes subjects give randomly or give without reading the question carefully, we should observe those behaviors in response to both requests.

Cognitive load manipulation

Cognitive load manipulations often involve asking participants to memorize a sequence (Gilbert, Giesler, & Morris, 1995; Gilbert & Osborne, 1989; Shiv & Fedorikhin, 1999). Since subjects in our experiment were making numeric giving decisions, we asked subjects to memorize a sequence of letters — rather than numbers — to avoid anchoring effects (Tversky, 1974). Subjects were randomly assigned to memorize either a 3-letter sequence ("GXN") (low cognitive load, n=103), or a 9-letter sequence ("GXNTDPLRW") (high cognitive load n=102). We did not incentivize the cognitive load manipulation to avoid income effects.

Results

Figure 1 shows that giving to charity more than doubles when we occupy participants' deliberative systems by placing them under high cognitive load (*t*-test, t=2.986 *p*=0.004, see *SOM* for robustness tests). Individuals under high cognitive load are not only more likely to give nonzero amounts (t=1.993 *p*=0.049), but they also make larger donations conditional on giving (n=49, t=2.289 *p*=0.027). Furthermore, individuals under high cognitive load are significantly more likely to give their entire endowment to charity (t=2.663 *p*=0.009). These results suggest that individuals are inclined to give to charity when asked and require cognitive resources to withhold donations.

Importantly, the effect of cognitive load is unique to the charity request. Individuals under high cognitive load do not give more to a general request than individuals under low cognitive load (t-test, t=0.773 *p*=0.441); in fact, they give directionally less. Occupying the deliberative system does not lead individuals to comply with requests more generally; rather, the effect of occupying the deliberative system is specific to charitable giving.

Discussion

Occupying the deliberative system with cognitive load increases donation to the American Red Cross, a charitable request, but does not affect the amount of money returned to the experimenter. That cognitive load does not increase giving back to the experimenter demonstrates that the effect of occupying the deliberative system is specific to charitable request and that cognitive load is not generating an increase in giving as a result of random actions or subjects failing to read the question carefully.

That the average charitable donation more than doubles when subjects are put under high cognitive load is consistent with the interpretation that generosity is somewhat automatic or instinctual and that cognitive resources are needed for individuals to inhibit charitable impulses and act selfishly. The results inform theories about the origin of human generosity and has practical implication for charitable fundraising.

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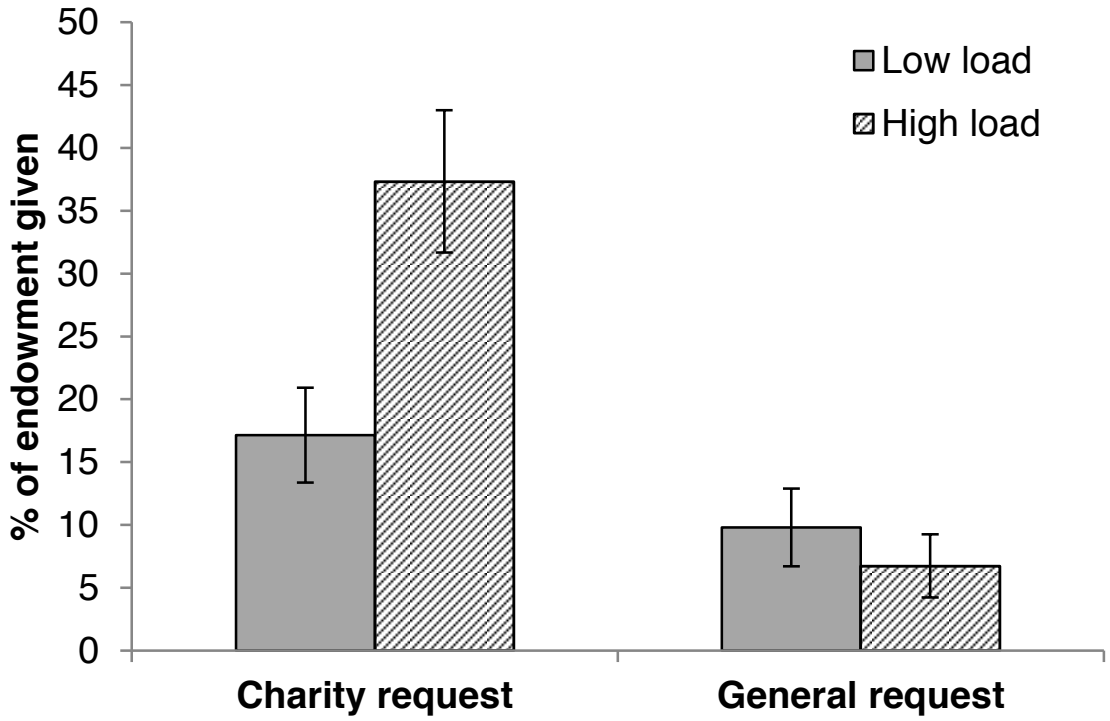

Fig. 1. Average percentage of the $3 endowment given to either the American Red Cross ("Charity Request") or to the experimenter ("General Request") (means ± SEM). Participants were independently randomized across the Charity Request or General Request and across being put under high or low cognitive load.