Everyone Believes in Redemption: Nudges and Overoptimism in Costly Task Completion

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Abstract

We elicit subjects' beliefs about the likelihood that they will redeem a mail-in form. Expected redemption rates exceed actual redemption rates by 49 percentage points, meaning that subjects are overoptimistic about their likelihood of redemption. We test the impact of three "nudges" on overoptimism: (1) informing subjects about a previous cohort's redemption rates, (2) reminding subjects about the redemption deadline, and (3) reducing transaction costs. The first two treatments reduced overoptimism by 7 and 8 percentage points respectively, but these effects were not significant. Only the third nudge had a significant effect and it reduced overoptimism by 26 percentage points. All three nudges increased redemption but had no statistically significant effect on beliefs. Our results suggest that weak cost-salience is an important mechanism for overoptimism.

Keywords: overoptimism, overconfidence, nudges, rebates, weak cost-salience
JEL Codes: D12, D14, D18

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1 Introduction

There is growing evidence that people are overoptimistic about the likelihood that they will take a future costly action: they do not exercise frequently enough to justify their gym membership (DellaVigna and Malmendier, 2006), they overestimate the likelihood that they will remember to send an email six months in the future (Ericson, 2011), and they lose money when they break a commitment to quit smoking (Giné et al., 2010). Our experiment uses a task similar to consumer mail-in rebates to study the effect of asymmetric paternalistic policies, or "nudges", on overoptimism.[1] We experiment with a rebate-like mail-in form because it is simple, familiar, and relevant to other economic decisions including completing forms to claim a tax credit, and rolling over a balance onto a credit card with a lower interest rate. Mail-in rebates for consumer products are widespread in the United States. Firms offer an estimated $4–10 billion of rebate opportunities every year and consumers redeem $3 billion (Edwards, 2007).

This internet-based experiment elicits subjects' beliefs about the probability that they will redeem a mail-in form by asking them to choose between a form they can redeem for a monetary reward and a binary lottery. The binary lottery pays either the same reward as the form or zero. For an expected-utility maximizer, the lottery payoff probability at which the subject is indifferent between the lottery and the form identifies a lower bound of the subject's beliefs that she will redeem. We will henceforth refer to this probability as the subject's elicited lower bound. We define the overoptimism of a group as the difference between the mean elicited beliefs and the actual redemption rate.[2]

This paper's main contribution is to measure the effect of nudges on overoptimism in a simple but policy-relevant domain: voluntary paperwork. Voluntary paperwork is widespread in the private sector (e.g. mail-in rebates, subscription cancellations, enrollment changes) and in the public sector (e.g. tax credits). Although many of these decisions have small stakes, they can accumulate to have substantial economic consequences. Surprisingly little work has been done measuring overoptimism in task completion, and — to our knowledge — no research has been done measuring the effect of nudges on overoptimism in this domain.[3] The first nudge, the information treatment, provides subjects with the redemption rate of a previous cohort. The second treatment sends subjects email reminders. This explores the role of overconfidence about remembering to complete the task. The third intervention reduces transaction costs by eliminating the requirement to print and save a printout from the elicitation website. This

[1] Asymmetrically paternalistic polices are designed to help those who make mistakes while imposing minimal costs on those who do not Camerer et al. (2003), while similar, libertarian paternalistic policies (Sunstein and Thaler, 2003) are designed to help biased consumers without restricting choice.

[2] We prefer the broader term "overoptimism" to "overconfidence". Whereas overconfidence is the difference between the belief in one's ability or performance and one's actual ability or performance, overoptimism is the difference between one's belief that a desirable outcome will occur and the actual probability that the outcome will occur. Under these definitions overconfidence is a special case of overoptimism. When desirable outcomes do not depend on ability or performance we suggest that overoptimism is the more accurate term. In the current context, overoptimism need not stem from a misestimation of one's ability — for example it may stem from misestimation of one's future preferences or the distribution of one's future opportunity costs.

[3] Although understanding task completion has clear scientific and policy relevance, we focus primarily on overoptimism since it is an error whereas low task completion may be optimal and rational. Increasing task completion need not be welfare enhancing whereas decreasing overoptimism generally is.

treatment tests whether non-salient redemption costs cause overoptimism.

We find large and robust overoptimism of 49 percentage points in the control group. Subjects, on average, believe that they will redeem at least 79% of the time but actually only redeem 30% of the time. Even the most pessimistic quartile of subjects are overoptimistic, and overoptimism increases as subjects get more optimistic.

The treatments have no significant effects on elicited beliefs but some affect redemption. The information treatment and the reminder treatment reduced overoptimism by about 7 and 8 percentage points respectively, but these effects are not statistically significant and, at best, offer a modest reduction in overoptimism. The third treatment, which eliminated the requirement that subjects save a piece of paper, reduced overoptimism by about 24 percentage-points.

The presence of overoptimism contradicts the rational-actor hypothesis, but there are several psychologically motivated models that predict overoptimism: present-biased preferences, overconfidence in prospective memory, and weak cost-salience. We define *weak cost-salience* to be the manifestation of a bias in cognition that causes consumers to partially ignore costs. We think of redemption costs as falling into three categories: necessary (e.g. stamp and envelope costs), opportunity (e.g. the cost of time), and prohibitive (e.g. losing the form). There is strong evidence that weak cost-salience plays an important role in generating overoptimism in this experiment. First and most strikingly, the treatment that simplified the paper work (and hence reduced necessary costs and the likelihood of prohibitive costs) increased redemption but not beliefs. This suggests that subjects did not incorporate these costs into their optimization in the first place. Second, we find that 26% of subjects had willingness to pay (WTP) of \$4.75 for a form redeemable for \$5 even though a stamp costs \$0.44, yielding a monetary payoff no greater than \$4.56.

Our results suggest that one should consider not just the magnitude of transaction costs but also how transaction costs are structured across the market. Equally sized transaction costs placed on the supply side and the demand side may have very different effects on market efficiency if one side is more prone to overoptimism than the other. If weak cost-salience affects consumers but not producers then shifting transaction costs from the supply side to the demand side may result in deadweight loss, in addition to a transfer from consumers to producers.

2 Related Literature

Mail-in rebates offer inconclusive but suggestive evidence that there is overoptimism in paperwork completion. Mail-in rebate redemption rates are quite low, between 10%–40% (Silk and Janiszewski, 2009), and consistent with our control-group redemption of 30%. Low redemption however does not imply overoptimism. There is a small, mostly theoretical literature on mail-in rebates (Narasimhan, 1984; Chen et al., 2005; Lu and Moorthy, 2007; Drago and Kadar, 2007; Gilpatric, 2009), but the only other incentivized experimental study on rebates is Silk (2004). He found 25 percentage points of overoptimism. However, even though subjects' (non-incentivized) reported confidence exceeded the actual redemption rate, subjects who opted for rebates still earned more money in expectation so it is not clear that they failed to maximize earnings. In contrast to Silk, we infer subject beliefs from incentivized choices. Without incentives there

may be an experimenter demand effect in which subjects respond in ways that they believe will please the experimenter (Zizzo, 2010). Moreover Ericson (2011) found that the un-incentivized measures differed substantially from revealed preference measures.

Indeed, perhaps the closest paper to our study is Ericson (2011) in which subjects chose between the opportunity to receive a sum for sure and the opportunity to earn a larger sum by sending an email to the author within a five-day window six months in the future. Ericson controlled for time preferences by paying all subjects on the same future date. Under the assumption of risk aversion, this method elicits a lower bound on the person's belief that they will complete the task. Ericson found that people overestimated their completion rate by 23 percentage points.

Some people who sign up for teaser-rate credit cards appear to be overoptimistic about the likelihood that they will fill out future paperwork when the teaser rate expires. Credit card companies often offer teaser-rate cards that have initial low interest rates for a limited period, and then high rates after the introductory period. Like a purchase with a mail-in rebate, using such a card may only make sense if a person expects to fill out paperwork — to transfer the balance to a lower rate card — after the introductory period ends. Shui and Ausubel (2005) find that 60% of consumers who obtain teaser-rate credit card stay with their card after the introductory period expires, even though debt remains large, about $2,000–$2,500, and despite ample opportunity to switch to lower rate alternative cards. The average consumer receives three solicitations a month from other credit card firms offering low introductory rates. Although both the transaction costs and benefits of transferring a credit card balance may be higher, a similar mechanism may drive the low switching rates.

There are several papers that have explored the effect of information on overconfidence, but to our knowledge, ours is the first to measure the effect of reminders and task simplification on overoptimism. Our first nudge gives subjects information about redemption rates — an intervention that preserves choice and is scalable to markets. Arkes et al. (1987) showed that feedback on a trivia quiz helped to reduce overconfidence. The second nudge tests the effect of reminders. It might be feasible to offer electronic reminders for certain costly future actions. Previous studies that used reminders to influence behavior yielded mixed outcomes. Karlan et al. (2010) use reminders to help subjects remember their savings goals, Apesteguia et al. (2013) show that emails reminding library patrons of due dates reduce late returns and holding times. However, Karlan et al. (2012) find that cell phone text reminders about payment deadlines have almost no effect on micro-loan borrowers' behavior. None of these studies tested the effect of reminders on overoptimism. The third nudge reduces transaction costs by simplifying the paperwork. Policymakers could potentially take action against companies that impose paperwork requirements that would be unprofitable in the absence of the consumer mistakes they induce. A classic psychology experiment directed college students to the campus health center to get a tetanus shot (Leventhal et al., 1965). Compliance rates were only 3%, but when students were handed a map with the location circled and urged to pick a specific time and route, compliance increased to 28%. Although this is highly suggestive, an increase in completion only implies a reduction in overoptimism if people do not change their beliefs as much as they change their behavior.

Although the primary purpose of this paper is to measure the efficacy of these nudges, responses to these interventions illuminates possible mechanisms for overoptimism. The first mechanism is naïve present-biased preferences (O'Donoghue and Rabin, 1999) in which decision makers believe their future selves to be unbiased time-consistent agents when they are in fact time inconsistent. As a result, naïve present-biased individuals may surprise themselves by not completing projects that they originally expected to complete (O'Donoghue and Rabin, 2008).[4] The second mechanism is overconfidence in prospective memory (Holman and Zaidi, 2010; Ericson, 2011) in which overconfidence about the probability of remembering can lead to overoptimism about redemption.

The third mechanism, weak cost-salience, posits that consumers partially ignore costs. We broadly interpret costs to include both necessary costs of filling out the paper work, the opportunity cost of time, and also prohibitive costs like forgetting the task or losing the form. Thus, overconfidence in prospective memory is a special case of weak cost-salience. Weak cost-salience has manifested itself in several empirical economic studies. Hossain and Morgan (2006) find that consumers are less responsive to shipping and handling costs that are not prominently displayed relative to equivalent changes in the listed price. Finkelstein (2009) shows that people are less responsive to highway tolls if they pay electronically rather than in cash. Chetty et al. (2009) find that consumers are more sensitive to sales tax when it is incorporated into the listed price despite the fact that consumers know the sales tax rate. More generally, subjects react more strongly to explicitly stated information than known or easily inferable implicit facts (Engelmann and Strobel, 2012, for example, show this difference in games). Similarly, we posit that at the time of elicitation, subjects may not think about the specific steps required for redemption (e.g. storing the certification page, acquiring a stamp) even though they may "know" about these steps, and hence underestimate the total costs of completing the process.

3 Model and Hypotheses

3.1 Simple Model

The model shows that the beliefs that we elicit are lower bounds on the subjects' actual beliefs about the likelihood of redeeming, and should be monotonically increasing in the payoff. The timing is as follows. First, the consumer chooses between an outside option or a form. The outside option is either a certain sum of money or a binary lottery. In the next period, a consumer who chooses the form faces a stochastic cost of redemption and chooses whether to redeem. Finally, the consumer receives an automatic or form-contingent payoff.

Let r be the monetary payoff for redeeming the form and c_i be the cost of redemption for individual i. The cost is a random variable drawn from a distribution with a cumulative distribution function of $F(\cdot)$ and the consumer's perception of the distribution is $\hat{F}_i(\cdot)$. Consumer i's utility is a function of the monetary payoff minus effort costs, $u_i(r) - c_i$ with $u_i'(\cdot) > 0$ and $u_i''(\cdot) \leq 0$. Normalize $u_i(0) = 0$. The consumer may discount the future with $\beta \in (0, 1]$ in a naïve present-biased way (Laibson, 1997; O'Donoghue and Rabin, 1999). The consumer will

[4] Sophisticated agents know their future preferences and thus have rational expectations about their future behavior.

redeem whenever $\beta u_i(r) \geq c_i$, however since the consumer is naïve she believes she will redeem whenever $u_i(r) \geq c_i$. Let $\hat{c}_i(r)$ be consumer i's perceived cost conditional on redeeming a form of value r, $\hat{c}_i(r) = E_{\hat{F}}[c_i | c_i \leq u_i(r)]$. In the context of the model, the possibility of forgetting, losing the form, and other events that preclude redemption can be thought of as drawing an arbitrarily high cost $c_i \gg u_i(r)$. The perceived expected utility of choosing the form with payoff r is $EU_i(form) = \hat{F}_i(u_i(r))\beta\big(u_i(r) - \hat{c}_i(r)\big)$.

If the consumer receives a lottery that pays r with probability ρ, and 0 with probability $1-\rho$ her utility would be $\rho\beta u_i(r)$. The consumer is indifferent between choosing a lottery and a form when

$$\begin{aligned} \rho u_i(r) &= \hat{F}_i(u_i(r))\big(u_i(r) - \hat{c}_i(r)\big) \\ \hat{F}_i(u_i(r)) &= \rho \frac{u_i(r)}{u_i(r) - \hat{c}_i(r)}. \end{aligned} \tag{1}$$

Since the denominator is weakly less than $u_i(r)$,

$$\hat{F}_i(u_i(r)) \geq \rho. \tag{2}$$

Thus a ρ that makes the consumer indifferent between choosing the lottery and the mail-in form is a lower bound on the consumer's belief that she will redeem. Let $\rho_i(r)$ be the lowest value of ρ for which i will choose the lottery over the mail-in form. In short, when the consumer is indifferent, the probability that a binary lottery pays must be weakly less than the probability the subject believes that she is going to redeem because filling out forms and mailing them is costly.

When it comes to the redemption decision, time preferences may play a role and the true cost distribution affects redemption. The true probability of redemption is therefore $F(\beta u_i(r))$. Thus consumer i is overoptimistic when $\hat{F}_i(u_i(r)) > F(\beta u_i(r))$ and is observed as overoptimistic whenever $\rho_i(r) > F(\beta u_i(r))$. Notice that the consumer is perfectly accurate when $\hat{F}_i = F$ and $\beta = 1$. Notice that when $\hat{F}_i = F$, then present bias, $\beta < 1$, causes overoptimism. Likewise when $\beta = 1$ and the cost distribution is underestimated ($\hat{F}_i < F$) the consumer may be overoptimistic.

3.2 Hypotheses

Our main hypothesis is that subjects are overoptimistic about their likelihood of redeeming. The traditional economic prediction is that subjects have rational expectations about the probability of redeeming, and those who do not submit forms face submission costs that exceed the benefits.

We have only one redemption data point per subject. Hence, we can only measure overoptimism on an aggregate level. If subjects who predict redemption to be at least $\rho_i(r)$ redeem with frequency $p(r) < \rho_i(r)$, then they are overoptimistic in the aggregate. For example, if a group of subjects has an average elicited lower bound of 60% and only 53% redeem, then the group exhibits overoptimism of 7 percentage points. This metric bounds the monetary loss from the mistake. If a subsample has overoptimism $z(r) > 0$ for a form of value r then the average monetary loss from the mistake is at least $r * z(r)$.

Define s_i as an indicator variable that is 1 if i redeemed and 0 if i did not redeem.

Hypothesis 1. Systematic Overoptimism: Average elicited lower bounds will exceed actual redemption $\sum_{i=1}^{N} \frac{\rho_i(r)}{N} > \sum_{i=1}^{N} \frac{s_i}{N}$.

Hypothesis 1 says that the population is on average overoptimistic. The presence of overoptimism is the basis for the subsequent hypotheses.

A treatment can affect overoptimism through two channels: it could make beliefs more accurate, or it could bring redemption more in line with expectations. For example, the information treatment may help the subject to realize her proclivity to lose the form, lowering her beliefs. It could also motivate her to take precautions against this risk thereby increasing her redemption probability.

Hypothesis 2.a. The Information Treatment Decreases Beliefs: Information reduces overoptimism $\sum_{i=1}^{N} \frac{\rho_i(r)-s_i}{N}$ and lowers the average beliefs of redemption $\sum_{i=1}^{N} \frac{\rho_i(r)}{N}$.

Hypothesis 2.b. The Information Treatment Increases Redemption: Information reduces overoptimism $\sum_{i=1}^{N} \frac{\rho_i(r)-s_i}{N}$ and increases redemption $\sum_{i=1}^{N} \frac{s_i}{N}$.

Each of the three hypothesized mechanisms implies a testable prediction. The main observational difference between present-bias and weak-cost salience is that the former predicts that simplification will increase beliefs about redemption since future costs are lowered, but the latter does not since these future costs are ignored. Although overconfidence in prospective memory is a special case of weak cost-salience, the reminder treatment can distinguish it from other forms of weak cost-salience.

Hypothesis 3. Present-Bias is the Mechanism: Simplification reduces overoptimism $\sum_{i=1}^{N} \frac{\rho_i(r)-s_i}{N}$ and increases the average beliefs of redemption $\sum_{i=1}^{N} \frac{\rho_i(r)}{N}$.

Notice that if simplification shifts the cost distribution in a first-order stochastically dominated way $\hat{F}_i(u_i(r))$ increases and so the average beliefs should increase as well.

Hypothesis 4. Overconfidence in Prospective Memory is the Mechanism: Reminders reduce overoptimism $\sum_{i=1}^{N} \frac{\rho_i(r)-s_i}{N}$ and increase redemption $\sum_{i=1}^{N} \frac{s_i}{N}$.

Hypothesis 5. Weak Cost-Salience is the Mechanism: Simplification reduces overoptimism $\sum_{i=1}^{N} \frac{\rho_i(r)-s_i}{N}$ and has no effect on average beliefs of redemption $\sum_{i=1}^{N} \frac{\rho_i(r)}{N}$.

A strong version of weak cost-salience is specified in Hypothesis 5. The claim is that although simplification reduces redemption costs, it does not change subjects' beliefs about those costs.

Is it more desirable to use nudges to influence behavior or to influence beliefs? Ultimately this depends on the efficacy of a treatment and the costs of implementing it. On the benefit side, a treatment that only increases redemption by one percentage point is more desirable than

a treatment that only lowers beliefs by one percentage point because both improve decision making equally but the former generates the additional return from redemption. However, every policy has a cost of implementation. Choice architectures that influence behavior are less desirable than those that influence beliefs when the efficacy of the former is relatively lower and the costs of implementation are relatively higher. Furthermore, there are circumstances in which the problem is about the behavior and not overoptimism per se. For example, a person may be overoptimistic about the safety of his driving, but in a place without alternative transportation increasing the accuracy of his beliefs may have little effect on the choice to drive and welfare. In such a case, policy is best directed at influencing behavior.

In summary, we expect overoptimism, and we expect that the information treatment will affect both beliefs and redemption. We expect the reminders treatment will affect redemption only and if so, this implicates imperfect prospective memory. If the simplification treatment affects both beliefs and redemption this suggests that present-bias plays a role. However if the simplification treatment affects only redemption this implicates weak cost-salience.

4 Experimental Design

Subjects were recruited using the Claremont Graduate University, Center for Neuroeconomics Studies recruitment email list. Most subjects were students from Claremont Graduate University or one of the five Claremont Colleges (Pomona, Claremont McKenna, Scripps, Harvey Mudd, and Pitzer). Average earnings beyond the $5 participation reward were $3.07. We also ran a pilot prior to Experiment 1, described in Appendix C. The pilot procedures are different in a number of ways, so the results are not directly comparable to our main results.

4.1 Experiment 1: Control Group

All Experiment 1 subjects followed the control procedure. The experiment had three phases: elicitation, form redemption, and payoff. First, we conducted a web-based elicitation. A week later, we mailed forms and a $5 participation reward as a personal check to subjects. Forms were due about six weeks after elicitation leaving subjects approximately 5 weeks to redeem. We mailed payoffs a week after the deadline.

The online elicitation first thoroughly disclosed the steps necessary to redeem a form. The website then used two methods to elicit subjects' beliefs about the likelihood they would redeem. The WTP elicitation had subjects choose between a form redeemable for $\$r$, where r may be 5, 10, 15, and 20, and a (weakly) smaller automatic payment $\$x$ that required no further action. We repeated this question 21 times keeping the form value fixed while progressively increasing the automatic payment. We varied the automatic payment in increments of $\frac{r}{20}$ (e.g. 25-cent increments for the $5 form and 50-cent increments for the $10 form). For example, the website asked subjects, "Would you prefer: A. $7 automatically or B. $10 if you file." This elicitation approach uses the multiple-price-list format, a variant of the Becker-DeGroot-Marschack (BDM) procedure (Andersen et al., 2006). If subjects are weakly risk averse, then the lower bound on the subject's belief about the likelihood of redemption is $\rho_i(r) = \frac{WTP}{r}$.

The second method, "lottery elicitation," had subjects choose between the form and a lottery that would pay r with probability ρ and 0 with probability $1-\rho$. Each line increased ρ by five percentage points so that ρ ranged from 0% to 100% over 21 questions. Since both the form and its alternatives are binary lotteries, a maximizing subject will simply choose the dominant lottery. The point at which a subject is indifferent between the two choices reveals a lower bound of the subject's belief that she will redeem the form. This is a lower bound because the elicitation does not control for the cost of redemption. All subjects made both WTP and lottery choices for all four form values. Figure 1 shows a screen shot of the choice structure.

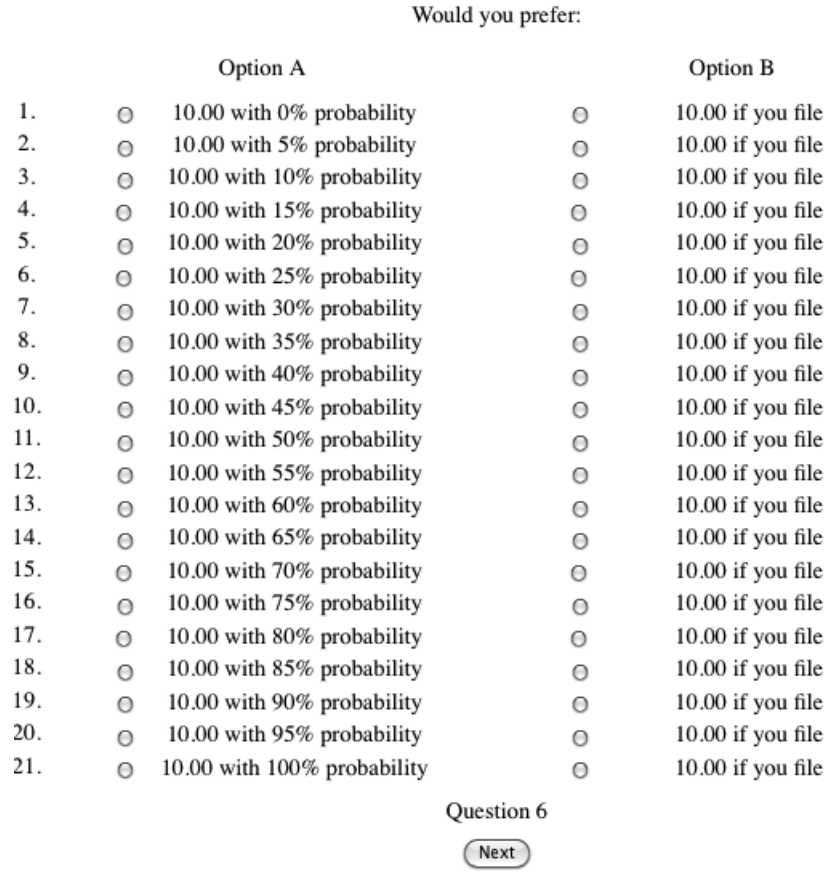

Figure 1: Lottery elicitation presented this screen to subjects four times, varying only the payoff.

The WTP method is slightly simpler while the lottery method controls for risk preferences. We controlled for order effects by randomizing whether the WTP or lottery elicitation came first. Similarly, we randomized the assignment of the form column and the automatic payment column to the left and right positions.

We use a methodology that is incentive compatible and formally equivalent to the BDM with undisclosed probabilities. The BDM with undisclosed probabilities has been used in the experimental literature before; see for instance Bohm et al. (1997); Noussair et al. (2004). The instructions read "We will randomly select one of your choices and implement it," and

probabilities were not explicitly stated. Our methodology addresses a significant challenge. Only subjects who preferred the form to the automatic payment generate redemption data. If each line of the multiple-price-list were implemented with equal probability this would generate redemption data that over-represents subjects who believed they were likely to redeem, creating a selection effect.[5] To control for this, we use data only from subjects for which the first line of the \$5-rebate and \$10-rebate screens were randomly selected. The first line offered a choice between (A) a mail-in form and (B) a \$0 automatic payment. Since all but two of our 343 subjects chose the form when they were given this \$0 outside option, there is almost no selection effect because there is almost no heterogeneity in preference. This line was selected with a $\geq 95\%$ probability, and with a 2-5% probability all other lines were selected with equal chance. This 2-5% of the sample exhibit selection effects and are thus dropped from the analysis.[6]

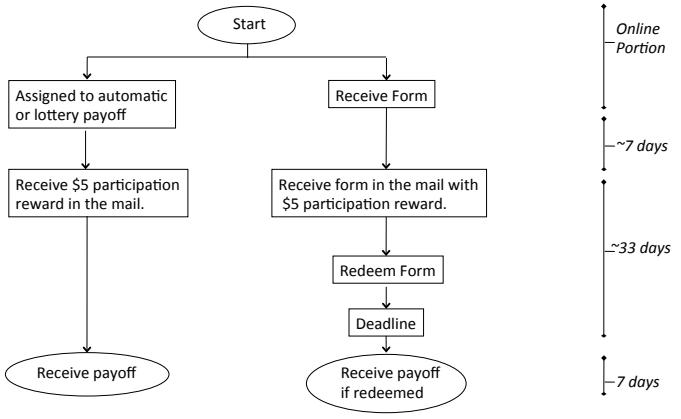

Figure 2: Experiment flow and timing

Subjects had to do only two things to redeem the form. First they had to print out and save the certification page shown at the end of the online experiment. This is analogous to saving a receipt to include with a rebate form. Subjects then had to write their name, shipping address, and email address on the form, enclose the certification page, and send in the form. We mailed subjects the form one week after the elicitation along with their \$5 participation reward. This delay required subjects to predict their future actions. The delay is analogous to waiting for an online purchase to arrive or waiting until spring to file taxes. We showed subjects

[5] For example, suppose 10 people state a threshold of 80% and 10 people state a threshold of 30% (so the unconditional fraction of the population that have an 80% threshold is one half). If each line is selected with equal probability there will be about 11 people assigned forms, and 9 people who get automatic payments. Of the 11 people assigned forms, about 8/11 would have stated a threshold of 80%. Thus the fraction of the group receiving a form who have an 80% threshold is different than the sample population.

[6] Due to an error in the data collection about one or two subjects in this 2-5% group may have remained in our analysis.

a sample form and a sample certification page and made these steps clear prior to elicitation. We used neutral language, always referring to the form as a "mail-in form." Any earnings from redemption, automatic payments, or lottery payoffs were sent by check seven weeks after the elicitation. Figure 2 depicts the experiment timeline.

Table 1: Experiment implementation: session dates and number of analysis sample subjects in each treatment.

Session	Elicitation	Forms mailed	Email reminders	Deadline	Payment mailed	Subjects	Subjects assigned to each treatment							
							Control		Information		Reminder		Simplification	
							$5	$10	$5	$10	$5	$10	$5	$10
1a	5/15-5/16	5/23		6/25	7/2	51	35	16						
1b	5/19-5/20	5/27		6/29	7/6	10	4	6						
1c	5/31-6/1	6/8		7/12	7/19	19	8	11						
2a	9/16-9/17	9/24	10/10	10/27	11/3	36	4	4	5	5	5	3	5	5
2b	9/23-9/24	10/1	10/17	11/3	11/10	115	15	15	14	15	11	16	14	15
2c	9/30-10/1	10/8	10/24	11/10	11/17	34	5	5	2	4	5	5	4	4
2d	10/7-10/8	10/15	10/31	11/17	11/24	20	3	2	2	2	3	3	3	2
2e	10/21-10/22	10/29	11/14	12/1	12/8	25	4	2	3	2	3	4	4	3
Total						310	78	61	26	28	27	31	30	29

4.2 Experiment 2: Treatment Groups

Each session of Experiment 2 had subjects randomly assigned equally between the control procedure, described above, and three treatment procedures described below. In addition, Experiment 2 subjects were invited to respond to an online post-experiment survey. Experiment 1 took place in summer 2011 while Experiment 2 took place in Fall 2011. Each treatment made one substantive change to the control design. Table 1 shows the dates and numbers of subjects in each session and treatment.

The information treatment disclosed the $5 and $10 redemption rates from Experiment 1 to Experiment 2 subjects before their belief elicitation. The treatment added the text, "In a previous experiment, 22.9% (41.9%) of Claremont College participants who received the $5 ($10) form successfully redeemed it for payment. The two experiments use identical questions and forms, but the previous experiment did not inform participants about other subjects' redemption rates."

The reminder treatment informed subjects prior to elicitation, "If you have not sent in the form by [24 days from now] we will send you an email reminder that restates the deadline." Then, 24 days later we sent subjects who had not returned their form the following email, "Dear Participant: The deadline to submit your mail-in form with the certification page is (deadline). Kind Regards, Experiment Staff"

The simplification treatment eliminated the certification page requirement, as well as all mention and display of that page.

5 Results

5.1 Beliefs

Subjects' elicited lower bounds are quite high: the average bound elicited using the lottery method ranged from 73% to 84% depending on the treatment and payoff. Roughly 25–40% of subjects believed they would redeem the form at least 95% of the time. The modal elicited lower bound is 95%. Only about one in eight subjects had an elicited lower bound less than or equal to 50% for a $5 form.

The vast majority of subjects, 322 of 333 (97%), had only a single switch point for each of the eight elicitations and thus made choices consistent with preferences that are strictly increasing in money. The WTP and lottery elicitation methodologies yielded qualitatively similar elicited lower bounds. The correlation between the two methods ranges from 0.52 to 0.6 depending on the form value. The mean absolute difference between the beliefs from the two methods, $\sum_i \left| \frac{WTP_i(r)}{r} - \rho_i(r) \right|$ ranges from 12 percentage points to 15 percentage points depending on the form value. The WTP method yields elicited lower bounds that are on average 2.3 percentage points lower than the lottery elicitation method. This is what one would expect from risk aversion. In the main text we report only the lottery elicitation for ease of exposition. We believe the lottery elicitation is the superior method due to the fact that it controls for risk preferences. All of our statistical tests with both methods yield very similar numerical results with identical signs and conventional significance levels (i.e. $p<0.1$, $p<0.05$, $p<0.01$) using WTP beliefs. Appendix B.2 reports our results using the WTP measures.

Table 2 displays results from regressions of elicited lower bounds on subject characteristics, payoff, and treatment. Columns 1 and 2 use a Tobit specification because elicited lower bounds can range from 0 to 1. Specification 1 reports results from a one-observation-per-subject regression that includes each subject's beliefs only for their form's payoff. This specification computes beliefs from the overoptimism analysis sample discussed at length below. Specification 2 uses an observation per form value and clusters standard errors by subject. Elicited lower bounds are strikingly consistent across treatments, payoffs, and subject characteristics. Specification 3 uses subject fixed effects to generate a within-subject estimate of the change in beliefs as a function of form value. Each $5 increase in form payoff raises subjects' elicited lower bounds 2-3 percentage points. The coefficients on the treatment dummies in Table 2 reveal no statistically significant differences in mean belief among the treatments. A Kolmogorov-Smirnov test of the equality of probability distributions cannot reject the null that beliefs are the same across treatments. The p-values for the information, reminder, and simplification treatments were 0.99, 0.86, and 0.39 respectively.

Table 3 reports elicited lower bounds by treatment. None of our treatments had a substantively or statistically significant impact on beliefs. This rejects Hypothesis 2.a, that the information treatment decreases beliefs and Hypothesis 3, that present bias is the main mechanism.

Table 2: Dependent variable: elicited lower bound

	(1)	(2)	(3)
\$10	0.04**	0.03***	0.03***
	(0.02)	(0.01)	(0.01)
	[-0.00, 0.09]	[0.02, 0.04]	[0.01, 0.04]
\$15		0.05***	0.05***
		(0.01)	(0.01)
		[0.04, 0.07]	[0.03, 0.07]
\$20		0.07***	0.07***
		(0.01)	(0.01)
		[0.05, 0.09]	[0.05, 0.09]
Information	-0.04	-0.02	
	(0.03)	(0.03)	
	[-0.11, 0.02]	[-0.08, 0.05]	
Reminder	-0.02	0.00	
	(0.03)	(0.03)	
	[-0.08, 0.04]	[-0.05, 0.06]	
Simplification	-0.04	-0.03	
	(0.03)	(0.03)	
	[-0.10, 0.03]	[-0.08, 0.03]	
Constant	0.79***	0.78***	0.96***
	(0.02)	(0.02)	(0.01)
	[0.75, 0.83]	[0.76, 0.81]	[0.95, 0.97]
Clustered standard errors	No	Yes	Yes
Individual fixed effects	No	No	Yes
N	310	1240	1240

Notes: Omitted categories are the \$5 form and the control group. Robust standard errors in parentheses. 95% confidence intervals in brackets. Columns (1) and (2) are Tobit models and column (3) is OLS.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5.2 Redemption and Overoptimism

Table 3 also reports redemption, and overoptimism by treatment. The table shows that overoptimism is consistently positive and that redemption rates are far more sensitive to the payoff than are beliefs.[7] Table 3 compares mean beliefs to mean redemption.[8] We find robust and substantial overoptimism that ranges from 23 to 49 percentage points across our control and three treatments confirming Hypothesis 1. We reiterate that our measure is a lower bound on the true level of overoptimism. Foregone earnings from overoptimism increase from $2.56 for the $5 payoff to $3.06 for the $10 payoff (the difference is not statistically significant).

Only the simplification treatment had a statistically significant impact on redemption and overoptimism. This rejects Hypothesis 2.b, that information would increase redemption, and Hypothesis 4, that prospective memory was the main mechanism. This confirms Hypothesis 5, that weak cost-salience is the main mechanism. Our 311 subject sample allows us to identify treatment effects of about 12 percentage points at the 10% significance level. We cannot reject the null hypothesis that the information and reminder treatments had no effect on beliefs, redemption, or overoptimism. We can reject the hypothesis that they eliminated overoptimism.

The simplification treatment increased redemption by about 26 percentage points. This effectively cut overoptimism in half. The simplification treatment reduced the monetary loss from overoptimism by about $1.15 for the $5 payoff and $2.30 for the $10 payoff. The treatment effects are listed in Table 3 and the mean treatment effects are displayed in Figure 4. An unpaired t-test comparing overoptimism between the control group and the simplification treatment using only the $5 form finds that the difference of 19 percentage points is significant at $p<0.07$ (control N=78, simplification treatment N=30). Using only the $10 form, the difference is significant at $p<0.01$ (difference =0.27, control N=61, simplification treatment N=29).

5.3 Correlates of Overoptimism

Table 4 reports the results of Tobit models of overoptimism. Overoptimism is increasing in elicited lower bounds. The coefficient on the elicited lower bound in column 2 of Table 4 is 0.66. This implies that those who value forms the most are also making the largest monetary mistake; a 10 percentage-point increase in the lower bound is associated with a 6.7 percentage-point increase in overoptimism. The finding that overoptimism is increasing in beliefs is consistent with findings in psychology that overconfidence is increasing in confidence (Dunning et al., 1990). But since the coefficient value is less than 1, this also implies that redemption is increasing in beliefs. This implies that beliefs are not meaningless noise but do indeed correlate with behavior.

We further explore this result in Table 5 which reports average elicited lower bounds and redemption by quartile for the full sample including both control and treatment subjects. The lowest quartile of elicited lower bounds exhibits statistically significant overoptimism of 23 per-

[7] Of the 132 subjects who returned the form, seventeen subjects (13%) made an error which invalidated their redemption. Five subjects (4%) did not include the certification page. Nine subjects (7%) used the sample form from the elicitation website's instructions rather than the actual mailed form.

[8] By chance, subjects in the control received $5 forms more frequently than subjects in the three treatment groups. This affects the reported treatment effect in Table 3 by no more than 1 percentage point. The regressions in Table 4 control for this.

Table 3: Results by treatment

Treatment	Elicited lower bound	Redeemed	Overoptimism[a]	Proportion receiving $10 forms	N
Control	0.80	0.31	0.49***	0.44	139
	(0.21)	(0.46)	(0.04)	(0.50)	
Information	0.76	0.35	0.41***	0.52	54
	(0.23)	(0.48)	(0.07)	(0.50)	
Reminder	0.79	0.38	0.41***	0.53	58
	(0.20)	(0.49)	(0.07)	(0.50)	
Simplification	0.77	0.54	0.23***	0.49	59
	(0.16)	(0.50)	(0.07)	(0.50)	

Notes:

[a] Unpaired one-sided t-test, H_0 : elicited lower bound $\leq$ redemption rate

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Standard deviations in parentheses in columns 1, 2, and 4.

Standard errors in parentheses in column 3

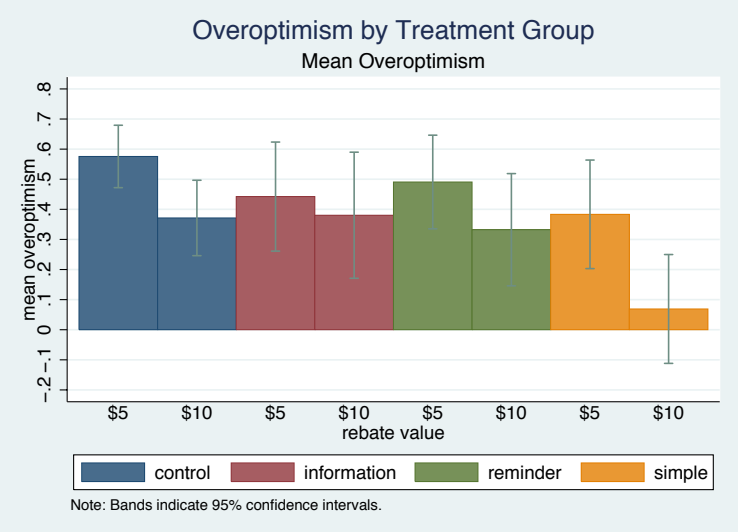

Figure 3: Treatment effects on overoptimism

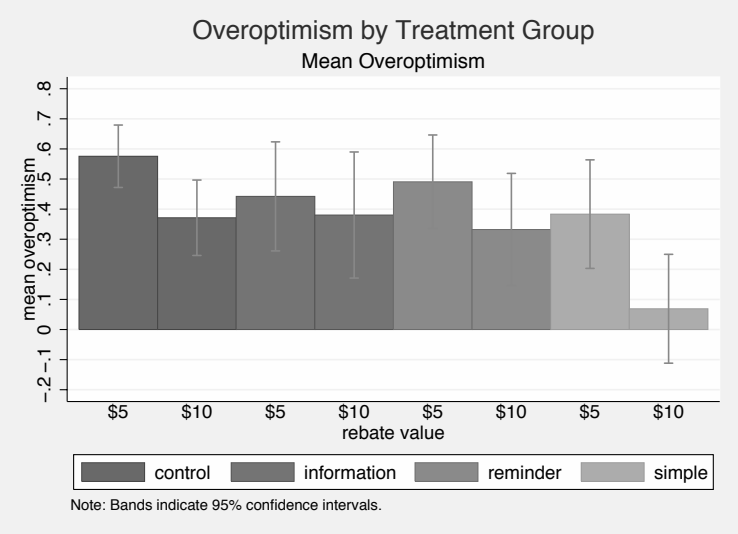

Figure 4: Treatment effects on overoptimism. **GRAYSCALE VERSION**

Table 4: Tobit model of overoptimism

	(1)	(2)
$10	-0.19***	-0.22***
	(0.06)	(0.05)
	[-0.30, -0.08]	[-0.32, -0.11]
Information	-0.07	-0.04
	(0.08)	(0.08)
	[-0.22, 0.09]	[-0.19, 0.10]
Reminder	-0.08	-0.07
	(0.08)	(0.07)
	[-0.23, 0.07]	[-0.21, 0.08]
Simplification	-0.26***	-0.25***
	(0.08)	(0.07)
	[-0.41, -0.11]	[-0.39, -0.10]
Elicited lower bound		0.66***
		(0.13)
		[0.39,0.92]
Constant	0.58***	0.08
	(0.05)	(0.11)
	[0.49, 0.68]	[-0.15, 0.30]
N	310	310

Notes: Omitted categories are the $5 form and the control group. The coefficients are extremely close to OLS coefficients since only the upper bound on overoptimism of 1 binds only 3% of the time. Simple algebra can transform the OLS version of Column 2 into a regression predicting redemption as a function of beliefs and observables.

Standard errors in parentheses. 95% confidence intervals in brackets.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Results by elicited lower-bound quartile

Quartile	Elicited lower bound			Redeemed	Overoptimism[a]	Proportion receiving $10 forms	N
	Min	Max	Mean				
1	0.00	0.65	0.49	0.25	0.23***	0.38	71
			(0.17)	(0.44)	(0.43)	(0.49)	
2	0.70	0.80	0.74	0.35	0.39***	0.49	65
			(0.04)	(0.48)	(0.48)	(0.50)	
3	0.85	0.90	0.87	0.44	0.43***	0.56	75
			(0.02)	(0.50)	(0.50)	(0.50)	
4	0.95	1.00	0.96	0.42	0.53***	0.48	99
			(0.02)	(0.50)	(0.50)	(0.50)	

[a] Unpaired one-sided t-test: H_0 : elicited lower bound $\leq$ redemption rate

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Standard deviations in parentheses

centage points and all of the higher quartiles exhibit greater overoptimism. We find overoptimism even on the left-hand tail. The 43 subjects with elicited lower bounds of 55% or lower were overoptimistic. Even the 30 subjects in the lowest decile of elicited lower bounds (all with elicited lower bounds under 50%) were still overoptimistic by 5 percentage points (NS).

One can see this visually in Figure 5, which plots redemption over elicited lower bound quartiles. Each curve represents one of the treatments and each point represents a quartile within a treatment. The 45° line in Figure 5 indicates where the elicited lower bound equals the redemption rate. The distance between the curve and the 45° line is the magnitude of overoptimism, and one can see that overoptimism is increasing in the elicited lower bound. This implies that there will be a pathological selection in the marketplace in which those who value the redemption-contingent alternatives the most are also the same individuals who make the largest financial errors. Population overoptimism will tend to understate the deadweight loss since those who self-select have greater overoptimism.[9]

5.4 Redemption Timing

About 47% of redemption occurs in the first week in which redemption is possible (the ninth through the sixteenth day). Figure 6 is a histogram of redemption by day. Since we mailed forms to subjects seven days after elicitation ends, and it takes usually a day for the mail to travel in each direction, day nine is about the earliest that a person can redeem. The fastest subject redeemed in eight days (a few subjects hand delivered their forms to the address). Hazard rate regressions confirm that there is no evidence of a deadline spike.[10] The week that began with email reminders is the least popular week for subjects in the reminder treatment to redeem.

[9] It is worth noting that the positive relationship between the elicited lower bounds and overoptimism is not tautological. It is possible for these two measures to be orthogonal or even negatively associated. For instance, suppose the whole population falls into two groups with elicited lower bounds of either 80% or 50%. If the 80% group redeems at 60% and the 50% group redeems at 10%, then overoptimism would be twice as high for the 50% group, and overoptimism would then be negatively associated with beliefs.

[10] The hazard rate regression results are available upon request

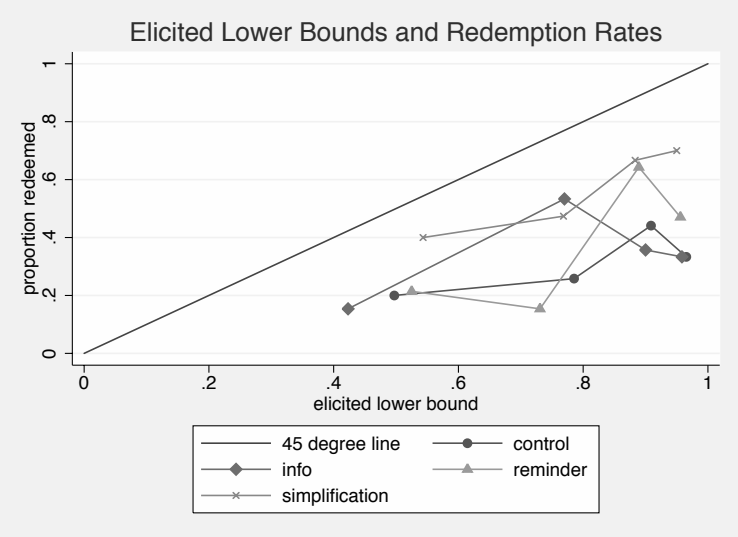

Figure 5: Overoptimism over elicited lower bounds. Elicited lower bounds on or above the 45 degree line are consistent with rational expectations

5.5 Post-Experiment Survey

About 45% of the subjects in Experiment 2 participated in the post-experiment survey. Tables 6, 7, and 8 present its results. We advise caution in interpreting this survey, which took place six weeks after the first subjects redeemed their forms. Subjects may have forgotten aspects of their experience. Further, we offered no incentives. Respondents redeemed at 57% compared to the mean population redemption rate of 39%. Respondents' elicited lower bounds were slightly higher than the population's. Overoptimism averaged 25 percentage points compared to the mean population overoptimism of 38 percentage points.

Subjects repeated the lottery elicitation for the $10 form but did so hypothetically. The newly elicited lower bounds did not change on average for those who redeemed, but they decreased by 25 percentage points for those who did not redeem. Subjects who did not redeem may have learned of their overoptimism. Nonetheless, the elicited lower bound of 55% is still substantially above the previous redemption rates. The results are presented in Table 6.

Table 7 shows that subjects who redeemed also planned to take action sooner and experienced fewer challenges finding stamps, envelopes, and their confirmation pages. Subjects who redeemed were far more likely to report that they planned to submit the form the day it arrived (56%) than those who did not redeem (27%). About a third (32%) of subjects who redeemed reported having a stamp, envelope, and certification page ready when the form arrived, while only about 11% of non-redeeming subjects did. Sixty percent of subjects who did not redeem reported that getting a stamp, envelope, and certification page was "hard" or "impossible" while only 20% of subjects who redeemed reported that they found it "hard" to obtain a stamp, envelope, and certification page.

Table 8 shows that most subjects believed it was quite unlikely that an error would prevent them from being paid for a proper submission. It also shows that subjects report actual

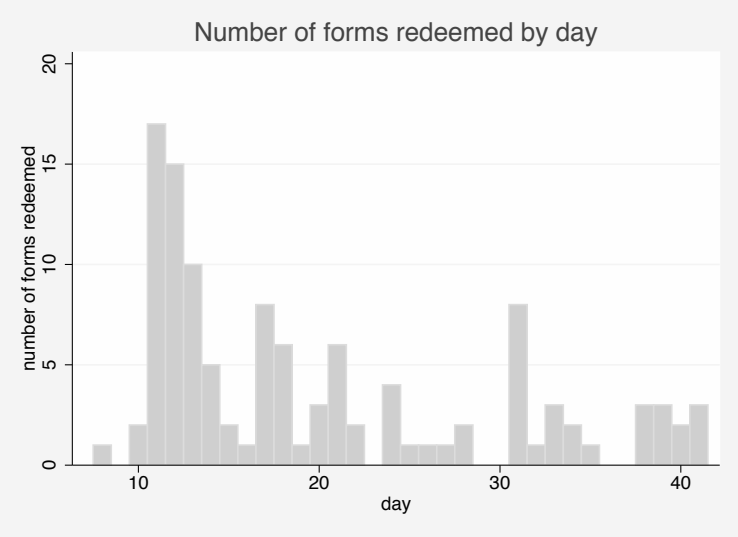

Figure 6: Redemption over time

Notes: Day 1 is the elicitation day. The deadline for most sessions is day 42, and the email reminder is day 25.

completion times very close to their anticipated completion times.

Table 6: Mean elicited lower bounds and post-experiment hypothetical elicited lower bounds for the $10 form

	Subjects who redeemed	Subjects who did not redeem	Difference[a]
Initial elicitation	0.85	0.79	0.06*
	(0.018)	(0.03)	(0.051)
Post-experiment elicitation	0.86	0.55	0.31***
	(0.018)	(0.055)	(0.051)
Pre-post change	0.00	-0.25	0.25***
	(0.02)	(0.05)	(0.05)
N	52	42	

Notes: Standard errors in parentheses.

[a] T-test with unequal variance: H_0 : beliefs of subjects who redeemed = beliefs of subjects who did not redeem

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5.6 Check Deposits

All payoffs for the subjects were given in the form of checks. Consequently, we observe the proportion of payments that subjects deposited. Unlike checks for commercial rebates, these checks have no expiration date so it is possible that the ultimate deposit rate will be higher than reported here. Since both the automatic, lottery, and form payments were all distributed via check, we cannot identify overoptimism in check depositing. As of February 11, 2013, we found that the $5 participation reward that everyone received was deposited only 79% of the

Table 7: Post-experiment survey questions about the process of redeeming forms.

	Subjects who redeemed	Subjects who did not redeem	H_0: Responses are independent of redemption
When the form arrived, did you intend to deal with it:			
Immediately	0.34	0.14	
Same day	0.22	0.14	
By weekend	0.10	0.16	
Before deadline	0.34	0.57	Pearson χ^2 p=0.03
Were a stamp, an envelope, and the confirmation page available when the form arrived:			
Yes	0.32	0.11	
No but easy to obtain	0.47	0.29	
No and hard to obtain	0.20	0.51	
No and impossible to obtain[a]		0.09	Pearson χ^2 p=0.00
N	59	45	

Notes: [a]Subjects who redeemed did not see the option indicating that redemption was impossible. We treated the missing cell as containing zero responses in the significance calculations.

Table 8: Post-experiment survey: mean responses about the costs and benefits of redemption.

	Subjects who redeemed	Subjects who did not redeem	Difference[b]
Hourly wage required to fill out forms	\$16.94	\$17.87	-0.93
	(2.15)	(1.77)	(2.90)
Expected completion time (minutes)	7.63	13.40	-5.78**
	(1.04)	(2.19)	(2.26)
Actual completion time (minutes)	8.42	8.38[a]	0.05
	(1.17)	(2.71)	(3.32)
Wage * actual form completion time	\$1.89	\$1.74	0.15
	(0.67)	(0.27)	(0.73)
Subjective probability of error	0.03	0.06	-0.02
	(0.01)	(0.02)	(0.02)
N	59	46	

Notes:

[a]The survey only asked the actual completion time question of subjects who indicated that they filed. Eight subjects who did not redeem nonetheless indicated that they filed and answered this question. Four of these eight failed to redeem because they submitted incorrect paperwork. The other four anomalous answers could come from errors on the part of subjects, the Postal Service, or the experimenters.

[b] T-test with unequal variance: H_0 : subjects who redeemed have the same average response as subjects who did not redeem.

Standard errors in parentheses.

time. Those who redeemed are substantially more likely to deposit, at 93% relative to 68% for those who do not redeem.

6 Discussion

6.1 Explanations

Returning to our hypotheses from Section 3.2, we find strong evidence for Hypothesis 1 (overoptimism), evidence consistent with Hypothesis 5 (weak-cost salience), and some limited evidence for Hypothesis 2 (efficacy of information), Hypothesis 3 (present bias), or Hypothesis 4 (prospective memory).

There are three main reasons to believe that at least some of the overoptimism is driven by weak cost-salience. First, quite dramatically, the simplification treatment reduces the costs of redemption, leading to a 26 percentage-point increase in redemption, while having no detectable effect on beliefs.

Second, some subjects seem not to factor the \$0.44 cost of the stamp into their decisions: 26% of subjects preferred the \$5 form to an automatic payment of \$4.75 (using the WTP elicitation). Even if these subjects believed that they would redeem with certainty, the value of the form could not exceed \$4.56 due to the cost of a \$0.44 stamp. From this observation alone, it would appear that at least a quarter of all the subjects do not expect to spend \$0.44 on a stamp. Of those who redeemed the \$5 form and used a stamp, 30% preferred a \$5 form to a \$4.75 automatic payment.

Third, elicited lower bounds are much less sensitive to payoff than redemption.

We now ask an additional question. Suppose costs can be broken down into two categories: (1) routine costs of submission such as the necessary costs of redemption (e.g. the stamp and the envelope) and the routine opportunity cost of time (e.g. the time it takes multiplied by one's wage), and (2) cost shocks that make redemption suboptimal (e.g. "getting too busy") or prohibitive (e.g. losing the form). For the three reasons above it seems that people are underestimating the routine costs. Can we measure by how much subjects underestimate routine costs? We address this point by answering a similar question: by how much do subjects underestimate the costs incurred conditional on redeeming?

We proceed with a simple exercise to find an upper bound on subjects' perceived costs conditional on redeeming. Let the mean perceived cost conditional on redeeming be $\hat{c}(r) = \frac{1}{N}\sum_{i=1}^{N}\hat{c}_i(r)$. Let $w_i(r)$ be i's WTP for a form of value r, and so $u(w_i(r)) = \hat{F}_i(u_i(r))(u_i(r) - \hat{c}_i(r))$. Then $\hat{c}_i(r) = u_i(r) - \frac{u(w_i(r))}{\hat{F}_i(u_i(r))}$. To approximate an upper bound, set $\hat{F}_i(u_i(r)) = 1$, and assume risk neutrality. Then $\hat{c}_i(r) \leq r - w_i(r)$. Using this method we find that $\hat{c}(5) \leq \$1.31$, $\hat{c}(10) \leq \$2.22$, $\hat{c}(15) \leq \$3.20$, and $\hat{c}(20) \leq \$4.30$. To summarize, we infer that subjects believe they will incur costs on average less than \$1.31 when they redeem a \$5 form and costs less than \$2.22 when they redeem a \$10 form. These costs must be weakly increasing since a subject is willing to bear larger costs when the form value is higher.

The second step is to infer the actual redemption costs conditional on redeeming from post-experiment survey responses. Responders reported the actual time required for redemption and their willingness-to-accept for filling out forms for an hour. Table 8 reports population averages

of subjects' expected and experienced cost of redemption. Multiplying the amount of time subject i needs to complete the form by the hourly wage she reported yields the shadow wage she would require to fill out the form. The total cost for redeeming a \$5 form should be the shadow wage plus the expected stamp cost. The average post-experiment survey respondent reported a shadow wage of \$1.87 for one form.[11] Stamps cost \$0.44 at the time of the study and 89% of subjects who redeemed a \$5 form used them. A few subjects hand delivered the form. We infer the average cost is \$2.26, which is greater than $\hat{c}(r)$ for both the \$5 and \$10 form. We interpret this as the average routine cost as described above. With no additional cost shocks, it will require an average of at least \$2.26 to redeem a form.

Let $c(r)$ be the cost conditional on redeeming a form of value r. We will now show that $c(r) > \hat{c}(r)$. Maintain the assumption that subjects are risk neutral. Observe that given the average cost conditional on redeeming the \$5 rebate, $c(5)$, the smallest possible $c(10)$ would be $c(5)$ plus all of the additional probability mass of reedeming the \$10 form, $p(10) - p(5)$, placed on the lowest possible cost realization for which redemption will still occur with the \$10 form but not with the \$5 form. This lowest possible cost realization is \$5. More generally, for $r > 5$ we must have $c(r) \geq c(r-5) + (r-5)[p(r) - p(r-5)]$. Using $c(5) = \$2.26$ as derived above, then $c(10) \geq 3.51$, which exceeds $\hat{c}(r)$ for all r except $r = 20$. Thus it seems that subjects underestimate the average costs conditional on redeeming a \$5 form by at least $2.26 - 1.31 = \$0.95$, and underestimate the average costs conditional on redeeming a \$10 form by at least $3.51 - 2.22 = \$1.29$. This method demonstrates that perceived costs conditional on redeeming a form fall substantially below actual costs conditional on redeeming the form. It is not just that subjects "get too busy" or lose the form more frequently than they expect, but also that they seem to systematically underestimate the routine costs by at least a third.

A second possible mechanism is that people are overoptimistic because they are naïve about their present-biased preferences (O'Donoghue and Rabin, 1999). However, this is inconsistent with the finding that subjects' elicited lower bounds did not increase in the simplification treatment (see Hypothesis 3).

Additionally, if present bias is the only mechanism it implies an unlikely discount parameter β. We can infer β from elicitation and redemption data by making a set of standard assumptions.[12] For simplicity we assume that $\delta = 1$. Under these assumptions, subjects will fail to redeem if the present cost c_i is greater than the future reward $u_i(r)$ discounted by β, so when $\beta \leq \frac{c_i}{u_i(r)}$. This inequality allows one to bound β.

We can approximate β using the actual cost inference above. Using the data from the post-experiment survey our mean shadow-wage of completing the form plus the cost of stamp is

[11] We drop one outlying, \$75 per-form, response from all of the shadow-wage-per-form discussions in this paper. That subject's redemption of a \$10 form casts doubt on the credibility of her answer. Including her answer increases the average shadow wage by more than 50% to \$2.89. Of course including this outlier only strengthens the finding that subjects underestimated conditional costs.

[12] We follow the experimental literature (see e.g. Andreoni and Sprenger (2012); Ifcher and Zarghamee (2011)) and must make the following assumptions so income can be interpreted as the object being discounted. First, income is entirely consumed in the period in which it is earned (i.e. individuals cannot borrow or save). Otherwise, the individual could smooth her consumption over time by saving and borrowing at unobservable interest rates. Second, one must assume that consumption is relatively constant over time so that the marginal utility of a dollar is constant over time. Otherwise there are motives to shift costs and benefits over time that have nothing to do with time preferences. Third, price levels are approximately constant over time.

$2.26. A person who did not redeem a $5 payoff has a β of at most $\frac{2.26}{5} \approx 0.45$. A person who did not redeem a $10 payoff has a β of at most $\frac{2.26}{10} \approx 0.23$. DellaVigna (2009) reports that estimates of β fall between 0.40 to 0.89. So if we invoke naïve present-biased preferences as our sole mechanism, this rough approximation suggests an exceptionally low discount factor for someone who did not redeem a $10 form.

The data seem somewhat incongruous with another prediction of the naïve present-biased preference model. The model predicts that naïfs who find it rational to redeem will often procrastinate, implying that redemption should spike just before the deadline. We observe no such deadline spike. The hazard rate is at its highest during the first ten days in which redemption is possible, and then sharply drops for the remainder of the redemption period. Although naïve present-biased preferences may play a role in overoptimism, this mechanism alone cannot explain the pattern of results.

The third mechanism, overconfidence in prospective memory, is unable to explain all of the findings. If forgetting about the task were the sole cause of non-redemption for a significant number of subjects, then email reminders would have helped. Furthermore, overconfidence in prospective memory cannot explain the efficacy of the simplification treatment. Although losing the certification page may be related to prospective memory, we interpret this as a separate type of error. It seems more related to retrospective memory and one's organizational skills than one's prospective memory.

Additional mechanisms come from interacting the previous three mechanisms. The interaction between naïve present-biased preferences and imperfect prospective memory can lead to greater procrastination which leads to an unexpected increase in forgetting (Holman and Zaidi, 2010; Ericson, 2010). In addition, weak cost-salience may enable unexpected procrastination: when a consumer draws an unexpectedly high redemption cost, she may choose to delay unrealistically hoping to draw a lower cost in the next period. Although we suspect that these interaction effects may play a role in our subjects' behavior, our design is unable to identify such interaction effects.

6.2 Implications

Overoptimism can lead to market failure. Consider a risk-neutral consumer who perceives her probability of redemption to be higher than her actual redemption rate by $z \in (0, 1]$. We simplify the notation by ignoring transaction costs. Define r as the value of redemption, and define p as the price less the expected benefit of redemption at the decision maker's actual redemption rate. The consumer's misperception will shift her demand curve up from $x(p)$ to $x(p - z * r)$. Consequently the consumer will overconsume the good, creating the deadweight loss triangle illustrated in Figure 7. The key issue here is that consumers may purchase goods at prices that exceed the consumers' valuation. The first fundamental theorem of welfare economics implies that a perfectly competitive market assigns transaction costs efficiently. However, with overoptimistic consumers, firms may have incentives to impose transaction costs that induce consumer error. Thus transaction costs may be larger than predicted by the perfectly-competitive rational model. Even when the magnitude of transaction costs has been minimized, the question of who incurs these costs will still have implications for efficiency. Whereas the normative Coase

theorem prescribes property rights be assigned to minimize transaction costs (Cooter and Ulen, 1999), policy makers should additionally tradeoff the deadweight loss of overoptimism in their analysis.

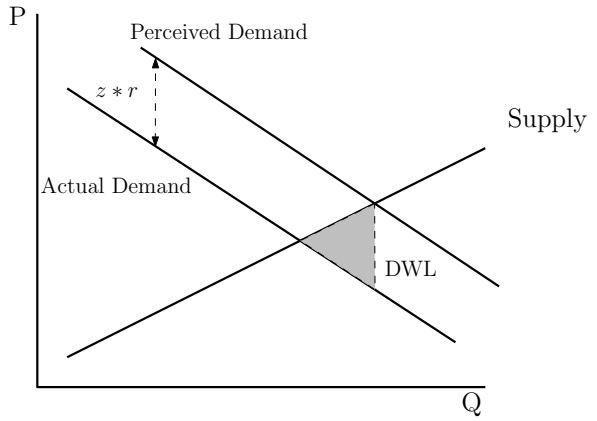

Figure 7: The difference between consumer-perceived price and actual price creates deadweight loss.

The Federal Trade Commission and the Consumer Financial Protection Bureau of the United States both have the authority to prohibit unfair trade practices that cause "injury to consumers" that "cannot be reasonably avoided" and are "not outweighed by countervailing benefits to consumers or to competition."[13] The results of our experiment suggest that stealthy costs may indeed cause injury to consumers potentially without countervailing benefits. Our experiment makes it easy for consumers to maximize their earnings but despite this and despite clear disclosures about average behavior, most of our participants forwent substantial payment. If our results generalize, they suggest careful reassessment of what can "be reasonably avoided."

7 Conclusion

We interpret our results as evidence for the existence of overoptimism as opposed to evidence of its magnitude. Given the sensitivity of overoptimism to the rebate level and small changes in the redemption process, it is quite likely that small institutional and contextual differences in the market have a large effect on overoptimism levels. Although our experiment controls for time preferences, in the market present bias and high discount rates may make future rebates and tax credits less attractive thereby reducing errors from overoptimism. In contrast, present bias could exacerbate overoptimism when rewards are *immediate* and transaction costs are delayed. Thus, the results in this paper give us an incomplete portrait of decision making in specific markets but can contribute to rigorous policy making that draws appropriately on a variety of evidence.

[13]Federal Trade Commission Act, 15 USC §41 and Dodd-Frank 12 USC 5301 sec 1031.

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For Online Publication

B Online Appendix: Additional Results

B.1 Additional Tables and Figures on Beliefs and Overoptimism

Table 9: Mean elicited lower bounds by payoff and treatment.

Form payoff	All groups	Control	Information	Reminder	Simplification
$5	0.76	0.78	0.74	0.78	0.73
	(0.21)	(0.22)	(0.23)	(0.20)	(0.21)
$10	0.79	0.79	0.79	0.80	0.78
	(0.19)	(0.20)	(0.19)	(0.17)	(0.16)
$15	0.82	0.81	0.81	0.83	0.81
	(0.18)	(0.20)	(0.20)	(0.17)	(0.15)
$20	0.84	0.83	0.84	0.84	0.84
	(0.18)	(0.20)	(0.19)	(0.17)	(0.15)
N	310	139	54	58	59

Standard deviations in parentheses

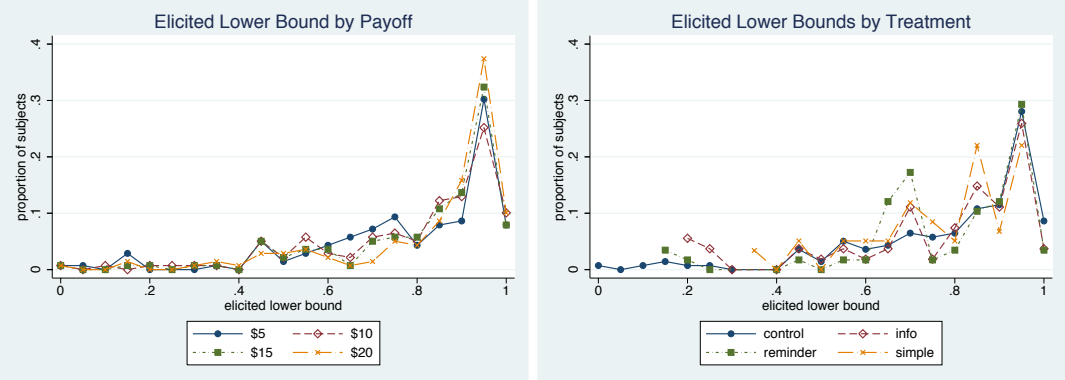

Figure 8: Elicited lower bounds by payoff and treatment

Table 10: $5 forms

Treatment	Elicited lower bound	Redeemed	Overoptimism[a]	Expected monetary loss	N
Control	0.81	0.23	0.58***	$2.88	78
	(0.19)	(0.42)	(0.46)	(2.30)	
Information	0.71	0.27	0.44***	$2.21	26
	(0.26)	(0.45)	(0.45)	(2.24)	
Reminder	0.71	0.22	0.49***	$2.45	27
	(0.23)	(0.42)	(0.39)	(1.97)	
Simplification	0.75	0.37	0.38***	$1.92	30
	(0.17)	(0.49)	(0.48)	(2.41)	

Notes:[a] Unpaired one-sided t-test: H_0 : elicited lower bound $\leq$ redemption rate

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Standard deviations in parentheses.

Table 11: $10 forms

Treatment	Elicited lower bound	Redeemed	Overoptimism[a]	Expected monetary loss	N
Control	0.78	0.41	0.37***	$3.71	61
	(0.22)	(0.50)	(0.49)	(4.89)	
Information	0.81	0.43	0.38***	$3.80	28
	(0.18)	(0.50)	(0.54)	(5.40)	
Reminder	0.85	0.52	0.33***	$3.32	31
	(0.14)	(0.51)	(0.51)	(5.08)	
Simplification	0.79	0.72	0.07	$0.69	29
	(0.16)	(0.45)	(0.48)	(4.75)	

Notes:[a] Unpaired one-sided t-test: H_0 : elicited lower bound $\leq$ redemption rate

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Standard deviations in parentheses.

B.2 Comparing WTP and Lottery Elicitation

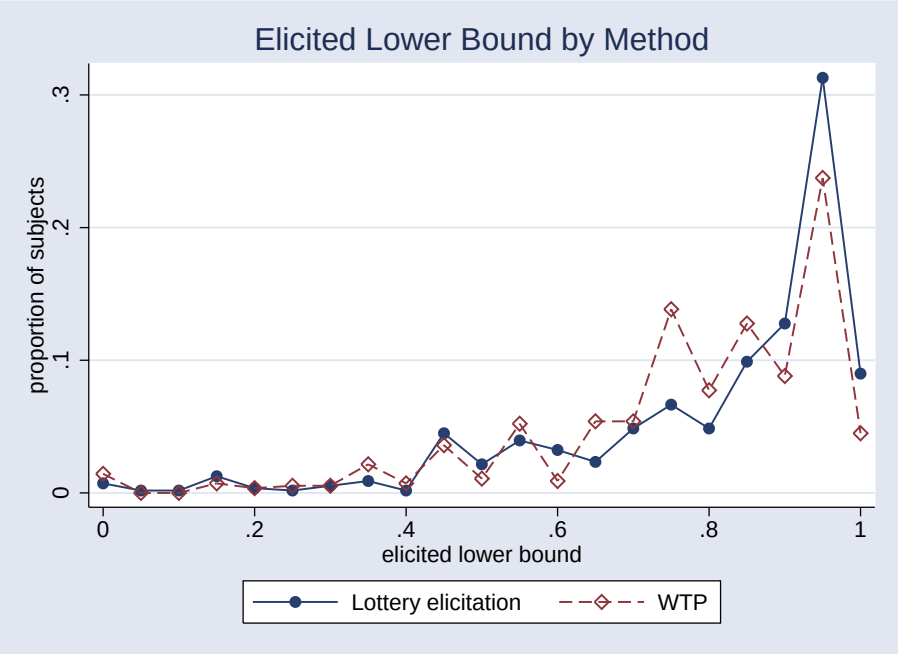

Figure 9: Elicited lower bounds by methodology. This graph aggregates across all form values

Comparing WTP and lottery elicitation yields evidence of risk aversion. The WTP method implies elicited lower bounds that are 2.3 percentage points lower on average than the lottery elicitation method. Considering each subject's four choices separately, 71% percent of all decisions were either risk neutral or risk averse, and 51% of subjects revealed consistent weak risk aversion for all four rebate levels.

Table 12 replicates the results from Table 2, Table 13 replicates the results from 3, and Table 14 replicates the results from Table 4. In summary, the results are nearly identical.

Table 12: Dependent variable: elicited lower bound using WTP data

	(1)	(2)	(3)
$10	0.02	0.03***	0.03***
	(0.02)	(0.01)	(0.01)
	[-0.02, 0.07]	[0.01, 0.04]	[0.01, 0.04]
$15		0.04***	0.04***
		(0.01)	(0.01)
		[0.02, 0.06]	[0.02, 0.06]
$20		0.05***	0.04***
		(0.01)	(0.01)
		[0.02, 0.08]	[0.03, 0.06]
Information	-0.02	-0.02	
	(0.03)	(0.03)	
	[-0.08, 0.04]	[-0.09, 0.05]	
Reminder	-0.02	-0.03	
	(0.03)	(0.04)	
	[-0.08, 0.04]	[-0.09, 0.04]	
Simplification	-0.02	0.00	
	(0.03)	(0.03)	
	[-0.03, 0.07]	[-0.06, 0.07]	
Constant	0.76***	0.83***	0.02*
	(0.02)	(0.02)	(0.01)
	[0.71, 0.80]	[0.79, 0.88]	[0.00, 0.04]
Clustered standard errors	No	Yes	Yes
Individual fixed effects	No	No	Yes
N	310	1231	1231

Notes: This table conducts the same analysis as in Table 2 using WTP data. Omitted categories are the $5 form and the control group. Robust standard errors in parentheses. 95% confidence intervals in brackets. Columns (1) and (2) are Tobit models and column (3) is OLS.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 13: Results by treatment using WTP data

Treatment	Elicited lower bound	Redeemed	Overoptimism[a]	Proportion receiving $10 forms	N
Control	0.76	0.31	0.45***	0.44	137
	(0.19)	(0.46)	(0.04)	(0.50)	
Information	0.75	0.35	0.40***	0.52	54
	(0.19)	(0.48)	(0.07)	(0.50)	
Reminder	0.75	0.38	0.37***	0.53	56
	(0.20)	(0.49)	(0.06)	(0.50)	
Simplification	0.79	0.54	0.25***	0.49	59
	(0.15)	(0.50)	(0.06)	(0.50)	

Notes:

[a] Unpaired one-sided t-test, H_0 : elicited lower bound $\leq$ redemption rate

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Standard deviations in parentheses in columns 1, 2, and 4.

Standard errors in parentheses in column 3

Table 14: Tobit model of overoptimism using WTP data

	(1)	(2)
$10	-0.22***	-0.24***
	(0.05)	(0.05)
	[-0.33, -0.11]	[-0.34, -0.13]
Information	-0.05	-0.04
	(0.08)	(0.08)
	[-0.20, 0.11]	[-0.19, 0.11]
Reminder	-0.07	-0.06
	(0.07)	(0.07)
	[-0.21, 0.08]	[-0.20, 0.08]
Simplification	-0.20***	-0.22***
	(0.07)	(0.07)
	[-0.35, -0.06]	[-0.36, -0.07]
Elicited lower bound		0.58***
		(0.12)
		[0.34,0.82]
Constant	0.56***	0.12
	(0.05)	(0.09)
	[0.47, 0.65]	[-0.6, 0.30]
N	306	310

Notes: This table conducts the same analysis as in Table 4 using WTP data. Omitted categories are the $5 form and the control group. The coefficients are extremely close to OLS coefficients since only the upper bound on overoptimism binds only 3% of the time. Simple algebra can transform the OLS version of column 2 into a regression predicting redemption as a function of beliefs and observables.

Standard errors in parentheses. 95% confidence intervals in brackets.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

B.3 Post Experiment Survey: The Single Most Important Reason Subjects Did not Redeem

Table 15 reports subjects' answers to a question that asked for "the single most important reason" they did not return the form. The survey asked this question only of subjects who did not redeem. The most popular reported reason for nonredemption, at 25%, was that "the payoff was insufficient." This is consistent both with time-consistent and present-biased preferences. Only 23% of those who did not redeem reported that they did so primarily because they lost the certification page.

Table 15: Post-experiment survey: single most important reasons subjects did not redeem.

Reason for non-redemption	
Insufficient payoff	0.25
Did not save certification	0.23
Busy at deadline	0.16
Forgot deadline	0.14
Form did not arrive	0.07
Too busy	0.05
Misplaced form	0.02
Other	0.09
N	44

B.4 Subject Demographics and Correlations Between Demographics, Beliefs and Overoptimism

At the end of the elicitation, subjects answered twenty GRE-style analogy questions and asked each subject how many she thought she answered correctly. These data allow us to correlate overconfidence on the GRE questions with overoptimism on the form redemption. There were no incentives for getting the correct answers. An exit survey asked subjects their gender, race, student status, major, and grade point average (GPA). The survey also asked height and weight, which we used to compute body-mass index (BMI). We speculated that if present bias plays a substantial role in overoptimism and healthy eating habits, high BMI may be positively correlated with overoptimism. Additionally subjects reported which organizational tools they used by selecting from the following list, "I try to remember them", "I list tasks on paper", "I use a calendar", "I use a non-electronic personal organizer", "I use a personal digital assistant or smartphone", and "None of the above" (which was mutually exclusive with all the others).

We were unable to find robust, statistically significant relationships between subject characteristics and beliefs or overoptimism, which is unsurprising given our small sample size and limited measures. Table 16 present illustrative regressions that add demographic characteristics to our main regression specification. Body mass index, calculated from self-reported height and weight, was not a significant predictor of overoptimism. We hypothesized that overoptimism may correlate with overconfidence in other domains. We hypothesized that subjects would be overconfident about their scores on our analogy questions, but they were in fact 3.5 percentage points underconfident on average. Other scholars report underconfidence on difficult tasks

(Moore and Healy, 2008). Experiments 1 and 2 had one different analogy question. Performance on one Experiment 1 analogy was negatively correlated with performance on the rest of the test because it had an ambiguous answer. We replaced that question for experiment 2. Nonetheless, we correlated the overconfidence on analogies with overoptimism about redemption and find that it is not significantly correlated (pairwise correlation, $p>0.3$).

People who use a non-electronic organizer are 20.8 percentage points less overoptimistic. None of the other organization tools came up as significant. We also observed no statistically significant association with race, sex, grade point average, and major.

Table 16: Tobit Model of the Effects of Subject Characteristics on Elicited Lower Bounds and Overoptimism

	Elicited lower bounds	Overoptimism
$10	0.03***	-0.21***
	(0.01)	(0.06)
$15	0.05***	
	(0.01)	
$20	0.07***	
	(0.01)	
Information	-0.02	-0.02
	(0.03)	(0.08)
Reminder	0.00	-0.03
	(0.03)	(0.07)
Simplification	-0.02	-0.21***
	(0.03)	(0.08)
Elicited lower bound		0.69***
		(0.12)
Economics major	-0.01	-0.12
	(0.06)	(0.15)
Science/engineering major	0.01	-0.11
	(0.07)	(0.15)
Undecided major	0.03	-0.22
	(0.07)	(0.17)
Humanities-only major	0.03	-0.14
	(0.07)	(0.14)
BMI	0.00	0.01
	(0.00)	(0.01)
Analogy overconfidence	0.02	0.23
	(0.08)	(0.19)
Analogies correct	0.07	-0.01
	(0.06)	(0.16)
Non-electronic organizer	0.03	-0.13**
	(0.02)	(0.06)
Remember	0.03	-0.03
	(0.03)	(0.07)
List on paper	0.04	-0.04
	(0.03)	(0.06)
Calendar	0.04*	-0.06
	(0.02)	(0.06)
Smartphone	-0.03	0.02
	(0.02)	(0.06)
Male	0.02	-0.07
	(0.02)	(0.07)
White	0.04	-0.02
	(0.02)	(0.06)
Monotonic preferences	0.07***	0.05
	(0.03)	(0.06)
Constant	0.51***	0.07
	(0.11)	(0.27)
Clustered standard errors	Yes	No
N	1200	300

Notes: Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

We did not include "No Organizational Tools" in these models since only one subject reported this. We did not include GPA since about a third of the data is missing. It does not come out significant if included.

C Pilot

We ran a 55-subject pilot study starting February 17th, 2011. The task was a version of the simplification treatment from the final study. The elicitation was for the same four form payoffs ($5, $10, $15, and $20) but we implemented the first line of the $10 and $20 rebate multiple-price lists with high probability. We dropped subjects for which the first line was not chosen. There were several major differences between the pilot design and the eventual design:

- There was no participation reward.
- The pilot had forms mailed three days after elicitation with a four week deadline, while the main experiment used a seven day delay and a six week deadline.
- Differences in Elicitation
  - The order of questions and columns was not randomized.
  - The WTP multiple-price list used a constant increment of 50 cents and ran from $0 to $20 regardless of the form payoff, meaning that subjects could report preferring a form to a larger automatic payment.
  - The lottery elicitation question used 10% increments rather than 5% increments.

Perhaps because of the broadly gradated 10% increments in the lottery elicitation, preferences on average were slightly risk seeking. In fact there is a small but statistically significant overoptimism in the pilot using WTP but not lottery elicitation.

The pilot results are quite compatible with our overall finding. Beliefs in the pilot were quite similar to beliefs in the final experiment. The pilot's beliefs, redemption rate, and overoptimism are statistically and substantively indistinguishable from the simplification treatment results with the $10 payoff, reported in Table 11. The redemption rates in the $20 cell were, unsurprisingly, higher and sufficient to reduce overoptimism to near zero. Although it is tempting to conclude that high stakes eliminate overoptimism, we are unable to make this claim because the sample size is small (N=26). A fairly large sample size would be needed to detect the welfare loss of overoptimism, since errors are fewer but larger (e.g. an overoptimism of 3.5 percentage points for $20 payoffs is equivalent to an overoptimism of 7 percentage points for the $10 payoffs, but detecting the former requires a larger sample ceteris paribus).

Table 17: Pilot results

Form Payoff	Elicited lower bound	Redeemed	Overoptimism[a]	Expected monetary loss	N
$10	0.79	0.71	0.07	0.75	28
	(0.12)	(0.46)	(0.47)	(4.74)	
$20	0.85	0.85	0.00	0.08	26
	(0.11)	(0.37)	(0.42)	(8.30)	

Notes: [a] Unpaired one-sided t-test: H_0 : elicited lower bound $\leq$ redemption rate
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Standard deviations in parentheses.