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ABSTRACT

In randomized field experiments, we embedded one- to two-sentence anchoring, goal-setting, or savings threshold cues in emails to employees about their 401(k) savings plan. We find that anchors increase or decrease 401(k) contribution rates by up to 1.9% of income. A high savings goal example raises contribution rates by up to 2.2% of income. Highlighting a higher savings threshold in the match incentive structure raises contributions by up to 1.5% of income relative to highlighting the lower threshold. Highlighting the maximum possible contribution rate raises contribution rates by up to 2.9% of income among low savers.

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In this paper, we analyze field experiments where we randomly assigned employees at a large U.S. technology company to receive one of several versions of an email. Control emails reminded recipients of the employer matching contributions in their 401(k) retirement savings plan and how much the recipient had contributed so far in the calendar year. Treatment emails were identical to the control emails, except that they also included one of nine different one- to two-sentence cues. The cues were designed to trigger psychological phenomena previously documented in the psychology and behavioral economics literature. Specifically, we sought to use anchoring, goal setting, and savings-threshold salience to influence the recipient's subsequent savings choices. Across multiple independent experiments, we find that these small cues have large effects. High numerical cues raise 401(k) contribution rates, and low numerical cues depress 401(k) contribution rates.

The first cues we analyze are "anchors," or arbitrary numerical cues. Psychologists have long known that the presentation of anchors can shift subjects' judgments, willingness to pay for goods, and hypothetical credit card payment decisions towards those anchors in laboratory experiments (Tversky and Kahneman, 1974; Johnson and Schkade, 1989; Green et al., 1998; Kahneman and Knetsch, 1993; Ariely, Loewenstein, and Prelec, 2003; Stewart, 2009).[1] However, evidence is only beginning to emerge on the importance of anchoring for economic decisions outside the laboratory (Baker, Pan, and Wurgler, forthcoming; Beggs and Graddy, 2009; Dougal et al., 2010). Our anchoring cues are one-sentence examples of 401(k) contribution rate increases that are explicitly described as containing no informational content. Anchoring should cause employees who receive the high contribution rate increase examples to contribute more than employees who receive the low contribution rate increase examples.

The next cues we test are two-sentence savings goal examples. Locke and Latham (1990, 2002, 2006) summarize a large literature showing that setting concrete goals that are difficult to achieve enhances performance relative to setting unambitious or vague "do your best" goals. A number of laboratory studies have found that behavior changes even when the goals are subconsciously primed by environmental cues rather than consciously chosen (Chartrand and Bargh, 1996; Bargh et al., 2001; Stajkovic, Locke, and Blair, 2006). Our goal treatments lie

[1] Anchoring has traditionally been understood to arise from people beginning their thought process at the arbitrary anchor value and incompletely adjusting away from that starting point (Tversky and Kahneman, 1974; Epley and Gilovich, 2001). Other researchers have argued that anchoring occurs because information that is consistent with the anchor becomes more cognitively accessible (Mussweiler and Strack, 1999, 2001; Chapman and Johnson, 2002; Strack and Mussweiler, 1997).

between the interventions summarized by Locke and Latham, which explicitly impose goals on subjects, and the interventions that subconsciously prime goals. Although email recipients can fully perceive the goal being cued, the cues do not overtly urge them to adopt a goal. A $7,000 or an $11,000 savings goal is presented as a mere example used to illustrate the matching contribution structure. The goals literature predicts that the $11,000 savings goal example will result in higher savings rates than the $7,000 savings goal example.

Our last set of cues highlights certain savings thresholds within the 401(k). Choi et al. (2002) and Benartzi and Thaler (2007) argue that many people simplify the problem of choosing a 401(k) contribution rate by using rules of thumb tied to salient savings thresholds created by the plan's structure, such as "contribute the maximum possible amount," or "contribute the minimum necessary to earn the maximum possible employer matching contributions." Our threshold cues make salient either the maximum possible contribution rate (60% of income), the annual contribution amount necessary to earn the maximum employer match ($16,500), or the annual contribution amount after which the highest marginal matching incentives stop ($3,000). Making a certain threshold salient may make an employee more likely to use it as guidance in choosing her contribution rate; a high salient threshold would increase contributions more than a low salient threshold.

We find that in the short run, a low anchor decreases average contribution rates relative to a control email that contains no intentional anchoring cues, but high anchors have no effect on average contribution rates. The effect of a 1% anchor (the lowest anchor we test) initially becomes more negative over time, achieving its largest magnitude three months after the email, when it depresses contribution rates by 1.4% of income. This effect disappears four months after the email in the pay period when the annual bonus is paid. The 3%, 10%, and 20% anchors do not change average contribution rates at the 5% significance level for the first five months after the email, but they reduce the probability of recipients making a contribution change. In the longer run—up to a year after the email—both low and high anchors affect average contribution rates. The 1% anchor decreases contribution rates by up to 1.2% of income, the 3% anchor increases contribution rates by up to 1.5% of income, the 10% anchor increases contribution rates by up to 1.9% of income, and the 20% anchor increases contribution rates by up to 1.4% of income.

We also find that the $11,000 savings goal example raises contribution rates more than

the $7,000 savings goal example. The $11,000 goal's impact is at its apex two months after the emails were sent, raising contribution rates by 2.2% of income relative to the control email. The $7,000 goal example essentially has no impact on contribution rates relative to the control email. The fact that the high goal raises savings rates in the short run whereas the high anchors do not suggests that the high-goal effect is not merely a manifestation of an anchoring effect.

Lastly, we find that highlighting high savings thresholds raises contributions relative to highlighting low savings thresholds. Making the $16,500 savings threshold salient initially results in average contribution rates similar to making the $3,000 savings threshold salient. But four months after the email, recipients of the $3,000 threshold treatment are contributing 1.5% of income less than recipients of the $16,500 threshold treatment. Mentioning that 60% is the maximum possible contribution rate generates an even larger effect immediately after the email, but only for those who were previously contributing little. Among those on pace before the email to contribute no more than $2,500 for the calendar year, receiving the 60% threshold treatment increases contribution rates by 2.9% of income more than the control group one month after the email. Those on pace to contribute more than $2,500 are unaffected by the 60% threshold treatment on average. Further analysis suggests that low contribution *rates* (as a percent of income) at the time of the email, rather than low contribution dollar amounts, predicts high responsiveness to the 60% threshold treatment. Again, we find that the pattern of these threshold effects differs from that of the anchoring effects, suggesting that some independent mechanism lies behind them.

Because many email recipients likely ignored our emails or did not read them carefully enough to notice the cues, our estimated effect sizes are closer to zero than the true effects of seeing the cues. Nevertheless, our estimates are large compared to those estimated for a conventional economic lever, employer matching contributions to a 401(k). Kusko, Poterba, and Wilcox (1998) find, at one manufacturing firm, that increasing the match rate from 25% to 150% on the first 6% of income contributed raised average 401(k) contribution rates by only 0.2% to 0.3% of income. A decrease in the match rate from 139% to 0% was accompanied by an average contribution rate fall of only 0.3% of income. Another company studied by Choi et al. (2002) went from matching 50% of the first 5% of income contributed to matching 50% of the first 7% of income contributed for union employees, and from matching 50% of the first 6% of income contributed to matching 50% of the first 8% of income contributed for management employees.

The increase in the average contribution rate from three months prior to the change to six months after the change is 0.4% of income.[2]

Due to the constraints of our field setting, we cannot establish beyond all doubt that the psychological mechanisms that motivated our cues are in fact responsible for our treatment effects. Our cues are therefore akin to automatic enrollment in retirement savings plans (Madrian and Shea, 2001; Choi et al., 2002, 2004; Beshears et al., 2008), which has large effects on savings outcomes but whose exact psychological mechanisms are not yet precisely identified (candidates include procrastination, status quo bias, simplicity seeking, endorsement effects, and anchoring). In particular, we cannot completely exclude the possibility that our cues were effective because employees interpreted the cues as containing relevant information about their optimal savings choices.[3] For inference from subtle email cues to drive the treatment effects, employees at this firm must have extremely diffuse prior beliefs about how much they should be saving in their 401(k). Our paper's central message is that, irrespective of the exact psychological channels through which they operate, small cues of the types we have tested have large effects on savings choices. Organizations and policymakers should be cognizant of these facts when designing their communications.

Our findings are related to other research that has found that individuals' savings outcomes are strongly influenced by small changes in their decision-making environment. Many people are financially passive, so changes in the default 401(k) contribution rate and asset allocation change the contribution rates and asset allocations they end up with (Madrian and Shea, 2001; Choi et al., 2002, 2004; Beshears et al., 2008). Automatic contribution rate escalation causes many people's contribution rates to increase in lockstep with the automatic escalation schedule (Thaler and Benartzi, 2004; Benartzi, Peleg, and Thaler, forthcoming). Forcing people to stop being passive and actively make a savings choice before a deadline raises

[2] This result is not reported in Choi et al. (2002), but is reported here for the first time using that paper's data. The sample over which this average is calculated is restricted to those who had a positive contribution rate nine months prior to the match threshold change. Choi et al. (2002) show that the match threshold change had no effect on the probability of having a positive contribution rate.

[3] The most straightforward way to rule out the information channel would have been to show employees the number in the email being produced by a random number generator such as the wheel of fortune in Tversky and Kahneman (1974), making the uninformative nature of the cue irrefutable. However, such a demonstration would be extremely unnatural within the context of a corporate communication, creating a high risk of Hawthorne effects. In fact, even many laboratory anchoring experiments do not show the anchors being randomly generated to the subjects (e.g., Chapman and Johnson, 1994, 1999; Epley and Gilovich, 2001; Green et al., 1998; Jacowitz and Kahneman, 1995; Mussweiler and Strack, 2001; Stewart, 2009; Strack and Mussweiler, 1997; Wegener et al., 2001).

contribution rates relative to a regime in which the default contribution rate is zero and there is no active decision deadline (Carroll et al., 2009). Simplifying the menu of 401(k) options decreases the stickiness of the default by reducing the cognitive cost of opting out (Huberman, Iyengar, and Jiang, 2004; Choi, Laibson, and Madrian, 2009b; Beshears et al., 2010a). More investment menu complexity causes employees to allocate more of their portfolio to money market and bond funds (Iyengar and Kamenica, 2010). Unlike the above papers, we test the savings effects of interventions that subtly change the decision-making environment but do *not* rely upon passivity or the manipulation of action costs to affect behavior. Our results are thus more akin to Choi, Laibson, and Madrian (2009a), who find that making the employer match's asset allocation less salient results in 401(k) participants ignoring it when choosing an asset allocation for their other 401(k) balances.

Our paper is also related to non-experimental work in economics that identifies the effect of anchoring on decisions outside the laboratory. Baker, Pan, and Wurgler (forthcoming) show that the offer price for merger targets is biased towards the target stock's trailing 52-week high, a highly salient but normatively irrelevant number. Beggs and Graddy (2009) conclude that sales prices of auctioned paintings are anchored on the painting's previous sale price because the portion of the painting's previous sale price that was due to aggregate art market conditions at the time influences the current sale price. Using a similar econometric methodology, Dougal et al. (2010) find that a firm's borrowing cost is anchored on the nominal value of its historical borrowing costs.

The remainder of our paper proceeds as follows. Section I discusses the relevant features of the company 401(k) plan. Section II describes the experimental design, and Section III describes our data. Section IV presents our experimental results. Section V concludes.

I. 401(k) plan features

Employees at the company we study can make before-tax, after-tax, or Roth[4] contributions to their 401(k) plan. Before March 2011, employees specified three percentages: the percent of their paycheck they wanted to contribute on a before-tax, after-tax, and Roth basis. Starting in March 2011, employees had the option of specifying a dollar amount rather than a

[4] Roth contributions are made using after-tax dollars. At retirement, both principal and capital gains are not taxed upon withdrawal.

percentage to contribute from each paycheck to each contribution category. The sum of the contributions could not exceed 60% of income during any two-week pay period in 2009 and 2010. In 2011, employees could contribute 100% of their paycheck to the 401(k). Throughout our sample period, total before-tax plus Roth contributions during a calendar year were capped at $16,500 for employees under the age of 50, and at $22,000 for employees age 50 and over. Total 401(k) contributions including after-tax and employer matching contributions were limited to $49,000 in a calendar year.

Starting in 2007, new hires and employees who had never enrolled in the 401(k) were automatically enrolled at a 3% before-tax contribution rate unless they opted out. At the beginning of each subsequent calendar year until 2010, employees who had never actively chosen their 401(k) elections had their before-tax contribution rate automatically increased by 1 percentage point, and the default before-tax contribution rate for new hires also increased by 1 percentage point. In 2011, the default contribution rate for new hires did not change, and seasoned employees were not subject to automatic contribution rate increases.

The company makes contributions to the 401(k) that depend upon each employee's own cumulative contributions during the calendar year. The match amount during 2009 was the greater of (1) 100% of before-tax plus Roth contributions up to $2,500, or (2) 50% of before-tax plus Roth contributions up to $16,500, resulting in a maximum possible match of $8,250. This match structure generates a 100% marginal subsidy on contributions up to $2,500, a 0% marginal subsidy on contributions between $2,501 and $5,000, and a 50% marginal subsidy on contributions between $5,001 and $16,500. In 2010, the match structure changed to be the greater of (1) 100% of before-tax plus Roth contributions up to $3,000, or (2) 50% of before-tax plus Roth contributions up to $16,500. This new match structure shifts the 0% marginal match zone to contributions between $3,001 and $6,000. Matching contributions vest immediately.

Employees receive an annual bonus that is paid each March. In 2009 and 2010, if an employee had a 5% contribution rate in effect during the pay period in which the bonus is paid, 5% of the bonus would be contributed to the 401(k) plan. As a result, many employees changed their contribution rate shortly before or during the bonus pay period in 2009 and 2010. Starting in 2011, employees could choose a separate contribution election for their bonus, and this election could specify dollar amounts to be contributed rather than percentages of the bonus. Unless actively changed by the employee, the bonus contribution election was by default set

equal to the election for regular paychecks. Bonuses were paid on March 6, 2009, March 5, 2010, and March 11, 2011. Unlike in prior years, the 2011 bonus payment date did not coincide with a regular payday.

II. Experimental design

On November 17, 2009, we sent emails to employees who would contribute less than $16,500 on a before-tax plus Roth basis in 2009 if they left their contribution rate elections as of November 4, 2009 unchanged. We sent a second round of emails almost a year later to employees who were on pace to contribute less than $16,500 on a before-tax plus Roth basis in 2010 if they left their contribution elections as of October 15, 2010 unchanged.[5] Most of this second round was sent on October 19, 2010, but a randomized subset of employees received their email on October 28, 2010 instead. The 2010 study was intended as a conceptual replication and extension of the 2009 study. We present the results concurrently below for efficiency.

We randomized which email version each employee received. Figure 1 shows the template used for the 2009 emails. All 2009 emails described the matching contributions the company offered and the amount the recipient had contributed so far in 2009. Following this information was the statement, "To take greater advantage of [Company]'s 2009 match, increase your contribution rate for the remaining six weeks of 2009." The emails concluded with information on how to change one's contribution rate on the Vanguard website and was signed by the company's benefits director. The 2010 email template was identical, except that the match information was updated to reflect the new match structure, the year-to-date contribution information reflected 2010 contributions, and the statement about increasing one's contribution rate was replaced by, "To take greater advantage of [Company]'s 2010 match, increase your contribution rate soon before the year is over."

Within each year, the only difference between the control and treatment emails was that the treatment emails included one or two additional sentences right after the statement about taking greater advantage of the match (the location indicated by the "Treatment text was inserted here" box in Figure 1). Table 1 shows the additional sentences in each treatment email. We will

[5] We excluded from the first email campaign employees who had been hired in 2009, since they may have made contributions to a previous employer's 401(k) in 2009 (which are unobserved by us) and thus not be eligible to contribute $16,500 on a before-tax plus Roth basis to their current company's 401(k) in 2009. For the same reason, we excluded employees who had been hired in 2010 from the second email campaign.

discuss the treatments and randomization scheme in the below subsections.

A. Anchoring treatments

Employees in the 1% anchor treatment received the additional sentences, "For example, you could increase your contribution rate by 1% of your income and get more of the match money for which you're eligible. (1% is just an example, and shouldn't be interpreted as advice on what the right contribution increase is for you.)" Employees in the 3%, 10%, or 20% anchor treatments were shown analogous text, but 3%, 10%, or 20% replaced the two instances of 1%. The explicit denial that the treatment text contained any information about the recipient's optimal 401(k) contribution rate was designed to make this treatment as close as possible to an arbitrary numerical anchor within a framework appropriate to a corporate communication.

B. Savings-goal treatments

The savings-goal treatments made salient a savings goal that was higher than what the employee would save if his or her current 401(k) contribution rate were left unchanged. The $7,000 savings goal treatment consisted of two additional sentences added to the control email: "For example, suppose you set a goal to contribute $7,000 for the year and you attained it. You would earn $500 more in matching money this year than you're currently on pace for." The $11,000 savings goal treatment instead contained the sentences, "For example, suppose you set a goal to contribute $11,000 for the year and you attained it. You would earn $2,500 more in matching money this year than you're currently on pace for." The assignment scheme we will describe in Section II.D ensured that everybody in a goal treatment would receive the same additional match ($500 or $2,500) for attaining a $7,000 or $11,000 savings level in the 401(k).

C. Threshold-salience treatments

The three threshold-salience treatments emphasized a savings level or choice that was higher than the employee's status quo. The $3,000 threshold treatment email included the sentence, "The next $$x$ of contributions you make between now and December 31 will be matched at a 100% rate," where x was the difference between $3,000 and the employee's year-to-date before-tax plus Roth contributions. The $16,500 threshold treatment email instead included the sentence, "Contributing $$y$ more between now and December 31 would earn you the

maximum possible match," where *y* was the difference between $16,500 and the employee's year-to-date before-tax plus Roth contributions. Employees in the 60% threshold treatment had the following sentence added to their email: "You can contribute up to 60% of your income in any pay period."

D. Randomization scheme

Table 2 shows how the 4,723 email recipients in 2009 and the 4,307 email recipients in 2010 whom we analyze in this paper were allocated across experimental conditions.[6] Assignments to conditions in 2010 were independent of assignments in 2009.

Employees naturally fell into three categories based on their marginal incentives to increase their before-tax and Roth contributions in the calendar year above what they would contribute if they left their contribution rate elections unchanged: those who faced a 100% marginal match on those additional contributions, those who faced a 0% marginal match, and those who faced a 50% marginal match. Eligibility for assignment to experimental conditions depended on which category the employee was in. Within each year, employees had an equal probability of being assigned to each of the conditions for which they were eligible.

In 2009, most employees who were on pace to contribute at least $5,000—and thus faced a 50% marginal match—could be assigned to the control, the 1% anchor treatment, or the 60% threshold treatment. We do not analyze employees in this projected contribution category who were not eligible for all three treatments (and they do not appear in Table 2). Employees were eligible for all three treatments if increasing their before-tax plus Roth contribution rate by 1% of income for the remainder of 2009 would not cause their 2009 before-tax plus Roth contributions to exceed $16,500.

The anchoring statement's implication that increasing one's contribution rate by the anchor amount would increase the match earned was not necessarily true for employees whose

[6] Previous drafts of this paper also reported results from a 10% anchor treatment administered in 2009. The effects of this earlier 10% anchor treatment on average contribution rates are consistent with those of the 10% anchor treatment administered in 2010, but we exclude the earlier treatment from the current paper because we discovered that by chance, randomization had created a significant difference in the average pre-email contribution rate of the 2009 10% anchor recipients relative to their corresponding control group. There are also a small number of employees assigned to a treatment who are not in our analysis (and also excluded from Table 2) because they left the company before the first payday after the emails were sent, they had temporary Social Security numbers that made matching their 401(k) transactions to subsequent Vanguard records indexed by permanent Social Security numbers difficult, or because their employment termination date was ambiguous in the data. These exclusions cause minor imbalances in the number of employees in each cell.

marginal match on the next dollar of contribution increase was zero. And the implication could be somewhat misleading for employees whose marginal match on the next dollar of contribution increase was 100%, because much of the increase beyond the next dollar could be in the region where the marginal match was 0%. This is why we did not administer the 1% anchor to any employee on pace to contribute less than $5,000 in 2009. These employees had an equal chance of receiving only the control email or the 60% threshold email.

In 2010, most employees who were on pace to make at least $6,000 in before-tax plus Roth contributions—and thus faced a 50% marginal match—could be assigned to the control, the delayed control, the 3% anchor, the 10% anchor, or the 20% anchor. Employees in the delayed control condition received the control email on October 28 instead of October 19. We do not analyze employees in this category who were not eligible to be assigned to all five of these treatments—anybody whose before-tax plus Roth contributions in 2010 would exceed $16,500 if he or she increased his or her before-tax plus Roth contribution rate by 20% of income for just one pay period.

Employees on pace to contribute between $3,000 and $5,999 on a before-tax plus Roth basis in 2010 had an equal chance of receiving the control email, the delayed control email, the $7,000 savings goal example, or the $11,000 savings goal example. Because the marginal match on before-tax plus Roth contributions between $3,001 and $6,000 was 0%, each of these employees would earn exactly $500 or $2,500 more in matching money by raising their total 2010 before-tax plus Roth contributions to $7,000 or $11,000, respectively.

Employees who were on pace to contribute less than $3,000 on a before-tax plus Roth basis in 2010—and thus faced a 100% marginal match—were equally likely to receive the $3,000 threshold treatment or the $16,500 threshold treatment. Because there were not many employees on pace to contribute less than $3,000 in 2010, we did not assign anybody in this projected contribution category to the control group. Therefore, our analysis of these treatments will just compare the $3,000 threshold treatment effect to the $16,500 threshold treatment effect.

Untabulated randomization checks reveal that pre-email contribution rates and salaries do not differ significantly between any treatment group and its corresponding control group or between the $3,000 and $16,500 threshold treatment groups.

III. Data description

We use salary and employment termination date data from personnel records and 401(k) data provided to the company by Vanguard. Vanguard data include cross-sectional snapshots of all 401(k) contribution rate elections (before-tax, after-tax, and Roth) in effect among email recipients on January 3, 2008, November 4, 2009, October 15, 2010, and every month-end from January 2010 to August 2011. We also have a record of every 401(k) contribution rate change among this population from January 3, 2008 to August 31, 2011. Individuals in the data were assigned random identifiers; no personally identifying information was included.

We use the contribution rate data to construct a panel of 401(k) contribution rates in effect at the end of each two-week pay period.[7] Contribution rate changes submitted fewer than ten days before the next payday do not take effect until the second payday after the change, so our data allow us to identify contribution rates in effect up to the September 2, 2011 payday.

On the last payday before the 2009 email was sent, the average total contribution rate (before-tax plus after-tax plus Roth)[8] as a fraction of income was 3.6% among email recipients on pace to contribute less than $2,500 in 2009, 5.5% among email recipients on pace to contribute between $2,501 and $5,000 in 2009, and 11.0% among email recipients on pace to contribute more than $5,000 in 2009. On the last payday before the bulk of the 2010 emails was sent, the average total contribution rate was 3.4% among email recipients on pace to contribute less than $3,000 in 2010, 6.1% among email recipients on pace to contribute between $3,001 and $6,000 in 2010, and 9.6% among email recipients on pace to contribute more than $6,000 in 2010.

IV. Experimental results

A. Effect of getting a control email versus getting no email

Does simply getting a reminder email about the 401(k), without additional cues, affect

[7] If multiple contribution rate change transactions are recorded with the same effective date, we assign the latest contribution rate chosen before a payday to be the one that was effective on that payday. Up to February 19, 2010, we have both the date and time each change transaction was entered. After February 19, 2010, we only have the date each change transaction was entered. Therefore, if somebody entered multiple contribution rate changes on the same day, we cannot directly identify which rate was the last one entered. We can usually infer what the last rate was from the month-end contribution rate snapshots. In the rare cases where we cannot, we use the average of the contribution rates entered on that day.

[8] We focus on the total contribution rate because it more closely maps to total asset accumulation, which is most relevant for welfare.

savings choices? In this subsection, we assess the impact of getting a control email versus getting no email at all. Later, we will analyze how savings impact varied across email versions.

Figure 2 shows the average total contribution rate at each payday through October 15, 2010 for the subset of the 2009 control group (across all projected contribution categories) that was employed at the company on January 3, 2008.[9] The impact of the company's 1% contribution auto-escalation is visible at the beginning of 2009, but it begins to be reversed immediately. By the beginning of March 2009, when the annual bonus was paid, the average total contribution rate is similar to what it was immediately prior to the auto-escalation. This strong reversal is surprising in light of the success the auto-escalation program studied by Thaler and Benartzi (2004) had at raising long-run 401(k) contribution rates. The lack of inertia at this company may be due to the bonus payment serving as a focal deadline for action. However, the magnitude of the reversal must be interpreted with caution, since only employees who were on pace to contribute less than $16,500 on a before-tax plus Roth basis in 2009 as of November 4, 2009 were sent emails (and hence included in the graph's sample). This means that some employees who were on pace to hit the $16,500 maximum because they maintained or increased their contribution rates after the 2009 auto-escalation are excluded from the graph.

The impact of our 2009 control email appears to be large. The average total contribution rate on November 27, 2009—the first payday following the email—of control recipients employed since January 2008 is 10.7%, which is 2.3% of income higher than it was two weeks earlier. Due to the ten-day lag between when a contribution rate change request is entered and when it becomes effective, the November 27 contribution rate only reflects changes that were made in response to the November 17 email on the *same* day the email was sent. Even contribution rates entered on November 18 would not be reflected until December 11. Indeed, the average total contribution rate increases further to 11.8% on December 11, 3.4 percentage points higher than it was on November 13. The average then falls slightly to 11.5% on December 24.

By comparison, during the last three pay periods of the prior year, the sample's average total contribution rate *falls* by 0.5% of income. Alternatively, if we use as the counterfactual the 0.1% per-pay-period average contribution rate increase in the eight months prior to the experiment (March 6, 2009 to November 13, 2009), then the average contribution rate would

[9] Employees who leave the company are not included in the averages after their departure date.

have increased by only 0.3% of income over the last three pay periods of 2009 in the absence of the control email.

The 2010 auto-escalation raises the average contribution rate to 12.1% on January 8, 2010, but the average falls quickly afterwards. On the March 5, 2010 bonus payday, the average contribution rate is 9.8%, and it falls precipitously to 8.5% on the next payday. Much of this post-bonus fall is due to some employees hitting the annual before-tax plus Roth dollar contribution limit on March 5, which forces their before-tax and Roth contribution rates to be zero for the remainder of the year.[10] The average contribution rate then falls slowly afterwards through October 2010, when our second round of emails was sent.

In October 2010, we can use a contemporaneous randomized comparison to estimate the impact of the control email. Figure 3 plots the average total contribution rate each pay period minus the total contribution rate in effect on October 15, 2010—the last payday before the first 2010 emails were sent—for the delayed control group and the subset of the control group that was eligible to be assigned to the delayed control. Figure 3 does not show the total contribution rate in effect for the employee's 2011 bonus, as will be the case for all subsequent figures depicting the effects of the 2010 emails.

The average total contribution rate of the control group (the thin black line) on October 29 is 1.5% of income higher than it was on October 15, whereas the delayed control group's average total contribution rate (the thick black line) rises by only 0.1% of income during the same period. The difference is significant at the 1% level (t = 4.94). Figure 3 subsequently shows, however, that the delayed control group makes up for lost time, contributing more than the control group on November 26 and December 10. Both groups end up contributing about the same total amount. Averaging across pay periods, we find that the average total contribution rate in effect from October 29 to December 23 is 2.4% of income higher than the October 15 contribution rate for the control group and 2.1% of income higher for the delayed control group; the difference is not significant.[11] Over the longer horizon of October 29 to September 2 of the following year, the delayed control group has an insignificant 0.1% of income higher average contribution rate out of non-bonus paydays than the control group. The delay also has no

[10] These employees' contribution rates are automatically restored to their previous positive level at the beginning of the next year. A portion of the average contribution rate increase at the beginning of each year is due to such employees.

[11] In this and subsequent regressions where we average across paydays, we restrict the sample to employees who were still at the company at the end of the period we are averaging over.

significant effect on the contribution rate chosen for the bonus. Because we do not have information on each employee's bonus size, if an employee chose to contribute a certain dollar amount out of his bonus (rather than a percentage), we cannot translate that choice into a percentage election. We therefore do not include employees who chose a dollar amount for their bonus contribution in any of our analyses of the 2011 bonus. Only 4.5% of employees across all the 2010 mailings chose a dollar amount for their bonus contribution, so the sample loss is small. We find that the delayed control group made contributions out of the bonus that were lower than the control group's contributions by only 0.02% of the bonus amount.

Both campaigns generated positive comments from recipients. Many expressed generic thanks, such as: "Kudos and thanks to the benefits team for this very helpful and timely reminder." A few specifically mentioned the usefulness of the information included in the email, suggesting that a sizable fraction of employees have only a noisy sense of how much they are saving and the company match structure. For example, one employee noted, "I had no idea I was putting so little away!" Another said, "I had thought my % was high enough to take advantage of all of [Company]'s 401k matching but hadn't had time to double check. This e-mail is one of the examples of why I like working at [Company]."

Collectively, these results indicate that reminding employees about their 401(k) match, informing them of their year-to-date contribution amount, and making salient the year-end date had a large effect on contribution behavior.[12] However, small changes in the timing of the email relative to the salient reference date did not matter for total accumulation, as employees responded more strongly the closer the email was to the reference date.

B. Effect of the anchors

The first treatment effect we discuss is that of the 1% anchor in the 2009 emails. Figure 4 plots the average total contribution rate each pay period minus the total contribution rate the recipient had in effect on November 13, 2009, the last payday before the 2009 emails. The average contribution rate of the 1% anchor group and its control group all rise during the first two pay periods before beginning to fall, but the 1% anchor group's average is persistently below

[12] Karlan et al. (2011) and Cadena and Schoar (2011) find that reminders affect financial behaviors in developing country settings. Carroll et al. (2009) find no effect from a reminder in the U.S. One key difference may be that the Karlan et al. (2011) and Cadena and Schoar (2011) reminders were associated with a deadline, whereas the Carroll et al. (2009) reminder was not. The emails we analyze in this paper are thus closer to the reminders that have previously been found to be effective.

the control group's average until March 5, 2010, when the two converge as bonuses are paid. Surprisingly—given our prior expectation that anchoring effects would be strongest immediately after the email was sent—the gap between the 1% anchor group and the control group takes eleven weeks to reach its peak magnitude of 1.4% on February 5. The series diverge from each other after March 5, with the 1% anchor group again consistently contributing less than the control group through October 15 by as much as 1.2% of income.

Panel A of Table 3 shows tests of whether the 1% anchor and control group series in Figure 4 differ significantly from each other. We run a regression each pay period where the dependent variable is the recipient's total contribution rate minus the recipient's total contribution rate on November 13, 2009 and the explanatory variable is a 1% anchor treatment dummy.[13] We find no significant treatment effect before year-end 2009, but from January 22 to February 19, 2010, the 1% anchor decreases average total contribution rates by between 1.1% and 1.4% of income at the 5% significance level or better. Of the sixteen post-bonus paydays in Table 3, the 1% anchor effect is significant at the 5% level on June 11 and June 25, and again on October 15—eleven months after the first email date. During these three dates, the 1% anchor decreases contribution rates by between 1.0% and 1.2% of income. The 1% anchor effect is also marginally significant at the 10% level on six other post-bonus paydays.

We can examine the anchor effect integrated over periods of time longer than one payday.[14] Using as the dependent variable each employee's total contribution rate in excess of his November 13, 2009 total contribution rate averaged across paydays—including both paydays with and without significant treatment effects—the 1% anchor decreases contribution rates by 0.8% of income ($p = 0.047$) during the seven paydays between November 27 and February 19, and decreases contribution rates by 0.8% of income ($p = 0.076$) during the sixteen paydays from March 19 to October 15. It also increases contribution rates by 0.05% ($p = 0.933$) of income on the March 5 bonus payday. Because we do not know how large each employee's bonus was, we

[13] This regression specification is equivalent to a two-period panel regression where the dependent variable is the total contribution rate and the explanatory variables are individual fixed effects and a treatment group dummy interacted with whether the observation comes after the email date. A difference in differences regression specification, which replaces the vector of individual fixed effects with a constant and a treatment group dummy, gives an identical treatment effect point estimate but has a larger standard error because it discards information from the data's panel structure.

[14] The advantage of this approach relative to the individual payday regressions is that it concisely estimates the longer-run impact of the treatment. The disadvantage is that it reduces power to detect true effects whose duration is shorter than the period over which the averaging is done.

do not know how each of these three averages should be weighted to construct the 1% anchor effect on total contributions as a percent of total compensation across all 24 paydays after the email was sent.

The delayed reaction of the average contribution rate to the 1% anchor may be due to employees re-reading the email weeks after it had been sent in order to remind themselves of the instructions on how to change their contribution rate. The delayed reaction of the average is not caused by employees who react to the email with greater delay being more susceptible to anchors; the average contribution rate among employees who changed their contribution rate between the email send date and year-end 2009 also exhibits a growing divergence between the 1% anchor and control groups in January, an attenuation of the anchor effect on the bonus payday, and a re-emergence of the anchor effect after the bonus (not shown in exhibits). The fact that the 1% anchor had no significant effect on average contribution rates in 2009 does not mean it had no effect at all that year. A linear probability regression with the same controls as above (not shown in a table) reveals that 1% anchor recipients were 1.5 percentage points more likely ($p = 0.035$) to have a contribution rate exactly 1% of income higher than their November 13, 2009 contribution rate during at least one pay period between November 27 and December 24, 2009. This effect represents a doubling relative to the control group, whose corresponding probability is 1.6%.

Although the 1% anchor results in lower average contribution rate increases, does it generate more equitable outcomes by encouraging a larger fraction of recipients to make small contribution rate increases? Panel B of Table 3 replaces the dependent variable in Panel A's regressions with a dummy for a recipient's total contribution rate during a given pay period being different from her November 13, 2009 total contribution rate. In other words, these regressions model the probability of any change, regardless of size. We find no strong evidence that the 1% anchor affected the probability of action. There is one payday, January 8, where the 1% anchor has a positive 3.8 percentage point effect that is marginally significant at the 10% level. But when we instead use as the dependent variable a dummy for the total contribution rate being higher than the November 13 total contribution rate or a dummy for the total contribution rate being lower than the November 13 total contribution rate (not shown in tables), there is no marginally significant effect even on January 8.

The second email campaign tested the effect of three higher anchors: the 3% anchor, the

10% anchor, and the 20% anchor. Figure 5 shows the subsequent average total contribution rates in excess of the October 15, 2010 averages. Up through the March 11 bonus, there is no consistent relationship among the average contribution rates of the anchor groups and the control. Panel A of Table 4, which contains regressions analogous to those in Panel A of Table 3, shows that none of the anchor treatment effects on average contribution rates is significant at the 5% level during this time. We also cannot reject the equality of all the anchor treatment effects in every pay period before the bonus. Averaging across the ten pre-bonus paydays between October 29 and March 4, the 3%, 10%, and 20% anchors decreased contribution rates by 0.2% of income (p = 0.451), 0.2% of income (p = 0.458), and 0.1% of income (p = 0.836), respectively. In untabulated regressions, we find that none of the anchors in the second email campaign increased the probability that the recipient's contribution rate was exactly 3%, 10%, or 20% higher than her October 15, 2010 contribution rate in a subsequent pay period before year-end 2010.

But after the bonus, all three anchors became highly effective at raising contribution rates. The effects are statistically significant from March 18 to May 27, and their magnitudes are large: up to 1.5% of income for the 3% anchor, 1.9% of income for the 10% anchor, and 1.4% of income for the 20% anchor. However, we again cannot reject the three effects' equality in any pay period. Averaging across the thirteen post-bonus paydays from March 18 to September 2, the 3%, 10%, and 20% anchors increased contribution rates by 1.1% (p = 0.028), 1.1% (p = 0.031), and 1.0% (p = 0.019) of income, respectively.

The initial null effect of the higher anchors on average contribution rates may be tied to another effect the higher anchors had: unlike the 1% anchor, they caused recipients to disengage from their 401(k) in the short run. Panel B of Table 4 shows that the higher anchors decreased the probability of having a different contribution rate than one's October 15 contribution rate in a given pay period by as much as 8 percentage points. The decreases are insignificant or only marginally significant at the 10% level through December 10, but achieve 5% significance or greater from December 23 to February 4 for one or more anchors before losing significance for the remainder of the sample period. Untabulated regressions reveal that the higher anchors decreased both the probability of having a higher contribution rate and the probability of having a lower contribution rate. These findings suggest a possible explanation for the timing of the high anchor effects. Initially, the high anchors may have had null effects on average contribution rates because they discouraged recipients who could not afford to increase their contribution rate by an

amount close to the anchors, causing them to disengage from their 401(k). However, after the annual bonus, high anchor recipients may have had enough financial slack that they were no longer discouraged by their anchor, which resulted in their increasing their contribution rates.

The fact that the anchoring effect does not increase as the anchor rises above 3% is consistent with the experimental work of Quattrone et al. (1981) and Chapman and Johnson (1994), who find that extremely high anchors have effects that are similar to moderately high anchors. Such a result is predicted by the traditional explanation for anchoring effects: People begin their thought process at the anchor value and then adjust towards a more plausible value until they reach the nearest boundary of the plausible range (Jacowitz and Kahneman, 1995). Therefore, increasing anchors that already lie outside the range considered plausible by recipients will have no additional impact.

C. Effect of savings goal examples

Figure 6A shows how average total contribution rates in excess of the October 15, 2010 total contribution rate evolve following the dissemination of the $7,000 and $11,000 savings goal examples. Through March 4, 2011, the $11,000 goal group has persistently higher average contribution rates than the control group, with the gap peaking at 2.2% of income at year-end 2010. The ordering then reverses; the $11,000 goal group contributes less than the control group from March 18 to September 2. The $7,000 goal group oscillates above and below the control group, but is consistently below the $11,000 goal group before April 1 and above it afterwards.

Panel A of Table 5 contains the regression output analogue of Figure 6A. We see that the $11,000 goal treatment effect on the average contribution rate is increasing through year-end 2010, achieving significance at the 5% level on December 23. The treatment effect remains marginally significant at the 10% level as late as February 4. Starting on April 1 through the end of the sample period, the treatment effect point estimate is negative but insignificant. The $7,000 goal treatment effect is never significant at the 5% level. Averaging across paydays, the $11,000 goal increases contribution rates by 1.1% of income (p = 0.043) from the email send date to the last pre-bonus payday, increases the bonus contribution by 0.1% of the bonus (p = 0.893), and decreases contribution rates by 0.2% of income (p = 0.621) from the first post-bonus payday to September 2. The $7,000 goal increases contributions by 0.02% of income (p = 0.971) before the bonus, decreases the bonus contribution by 1.5% of the bonus (p = 0.145), and increases

contributions by 0.3% of income ($p = 0.358$) after the bonus.

Although the later negative point estimates of the $11,000 goal treatment effect might indicate that the $11,000 goal's positive effect on contributions reverses in the long run, we show below that the reversal is probably an artifact of the annual dollar cap on before-tax plus Roth contributions. Because the $11,000 goal group contributed more early in 2011, they were more likely to hit the cap midway through the year, forcing their before-tax and Roth contribution rates to be zero for the remainder of 2011.[15]

We cannot identify precisely which employees were constrained by the cap because we have no information on the size of each employee's 2011 bonus, so we do not know the dollars contributed out of the bonus for the 95% of employees who had a percentage contribution election for their bonus. However, an employee who reduces his contribution rate to zero for the remainder of 2011 is likely to have done so because he hit the cap. We therefore construct an alternative contribution rate series that replaces any unbroken string of 0% total contribution rates that begins after the first payday of 2011 and ends on September 2, 2011 (the end of our sample period) with the last total contribution rate the employee had in effect before this string. The difference between this alternative series and the actual series shows how much of the drop in each group's contribution rate is likely to be driven by the contribution cap.

Figure 6B plots the resulting average contribution rates in excess of the October 15, 2010 contribution rate. In this graph, the $11,000 goal group never contributes less than the control or $7,000 goal groups, suggesting that the reversal in Figure 6A is due to the contribution cap. Consistent with our assumption that permanent moves to a 0% contribution rate are due to the cap, the three contribution rate series in Figure 6B are indistinguishable from those in Figure 6A early in the year—when people are less likely to have hit the cap—and begin to deviate only after the March 11 bonus is paid.

Heath, Larrick, and Wu (1999) argue that goals very far from the status quo create a "starting problem," where individuals find it difficult to motivate themselves to start a task. The linear probability regressions in Panel B of Table 5 show no evidence that our seemingly ambitious $11,000 goal generated a starting problem. The probability of having a contribution rate different than one's October 15, 2010 contribution rate is between 1.5 and 5.9 percentage

[15] They would still be able to contribute on an after-tax basis, but after-tax contributions are not matched and have a less favorable tax treatment.

points higher among $11,000 goal recipients than control email recipients, depending on the pay period, although this difference is never significant at the 5% level. The $7,000 goal group is also more likely to act than the control group, with the difference in probabilities being significant at the 5% level on January 7, when the $7,000 goal group has a 9% higher probability of having a different contribution rate. There is no evidence that the probability of action is lower for the $11,000 goal group than for the $7,000 goal group. The absolute value of the *t*-statistic in a test of the difference between the two groups never exceeds the 1.39 (p = 0.165) it attains on December 23, when the $11,000 goal group is *more* likely to have acted than the $7,000 goal group. Therefore, unlike high anchors, goal examples raise contribution rates without decreasing engagement with the 401(k).

D. Effect of $3,000 and $16,500 savings threshold salience

We begin our analysis of the effect of making the $3,000 and $16,500 savings thresholds salient by examining a histogram of total 2010 before-tax plus Roth contribution amounts by treatment group.[16] Figure 7 shows that those who received the $3,000 threshold treatment appear more likely than those who received the $16,500 threshold treatment to end up with 2010 before-tax plus Roth contributions clustered around $3,000. Specifically, the $3,000 threshold treatment recipients were 5.0 percentage points more likely to end up with 2010 contributions between $2,700 and $2,999, 0.8 percentage points more likely to end up with 2010 contributions between $3,000 and $3,299, and 0.4 percentage points more likely to end up with 2010 contributions between $3,300 and $3,599. The 6.2 percentage point increase in the probability of having 2010 contributions totaling between $2,700 and $3,599 is not statistically significant, however (p = 0.113).

Despite there being hints that the $3,000 threshold treatment affected 2010 contributions relative to the $16,500 threshold treatment, this effect does not appear in average total contribution rates. Figure 8 shows that the average total contribution rates in excess of the October 15, 2010 total contribution rate of the two groups are quite similar through year-end 2010. But a large gap opens up in 2011, as $3,000 threshold treatment recipients drop their contribution rate much more than $16,500 threshold treatment recipients. Seeing the lower

[16] We examine before-tax plus Roth contributions instead of total contributions in the histogram because the thresholds in the treatments were linked to the match, which was only earned on before-tax and Roth contributions.

threshold appears to have made recipients satisfied with achieving a lower savings level, causing them to contribute less afterwards. Panel A of Table 6 shows that the difference between the two groups' average total contribution rates peaks at 1.5% of income on February 18, when it also achieves statistical significance at the 5% level. The difference is also marginally significant at the 10% level on January 21, March 4, and April 1 through May 13, and completely disappears by July 22. Averaging across the January 7 through July 8 non-bonus paydays, the $16,500 threshold group on average contributed 1.0% of income (p = 0.045) more than the $3,000 threshold group. The $16,500 threshold group also contributed 0.7% more of its bonus (p = 0.359). Panel B of Table 6 indicates that the threshold highlights did not have significant differential effects on the probability of action.

E. Effect of 60% contribution rate threshold salience

We analyze the effect of making the 60% contribution rate threshold salient separately for recipients who were on pace to contribute less than $2,500, between $2,500 and $4,999, and between $5,000 and $16,499 in 2009, since each of these groups faced different marginal matching incentives.

Figure 9 plots over time the average total contribution rate in excess of the November 13, 2009 total contribution rate. Recipients of the 60% threshold treatment who were projected to contribute less than $2,500 in 2009 immediately raise their contribution rate by 2.5% of income more than the control group, and this gap grows to 2.9% of income on December 24 before attenuating to less than 1% of income from January 22 to October 15. Table 7 shows the corresponding regression results through the March 5 bonus payday only for the sake of brevity. Panel A indicates that the treatment effects are statistically significant at the 5% level or better through January 8, 2010 and insignificant afterwards. Averaging across paydays, the 60% threshold treatment increases contribution rates by 1.8% of income (p = 0.011) from the email send date to the last pre-bonus payday, 1.4% of income (p = 0.153) on the bonus payday, and 0.4% of income (p = 0.615) after the bonus through October 15, 2010.

On the other hand, the bottom two graphs in Figure 9 and Panels B and C of Table 7 indicate that there is no significant 60% threshold treatment effect for recipients who were on pace to contribute at least $2,500 in 2009.

In untabulated regressions, we examine whether the 60% highlight caused recipients to

contribute exactly 60% of their income in any pay period between November 27, 2009 and October 15, 2010.[17] These regressions show that the 60% threshold treatment made contributing at 60% more likely only for recipients who were previously on pace to contribute less than $2,500 in 2009. The effect for these recipients is a 5.7 percentage point increase (p = 0.020) in the probability of contributing 60%, up from a baseline probability of 5.4% in the control group. The effect's point estimate declines to an insignificant 1.1% (p = 0.411) for recipients on pace to contribute between $2,500 and $4,999 in 2009, and declines even further to an insignificant –1.0% (p = 0.461) effect for recipients on pace to contribute between $5,000 and $16,499 in 2009.

Is the 60% threshold treatment effect on low contributors due to their learning from it that the plan's maximum contribution rate is 60%? According to this explanation, employees in the control group chose smaller contribution increases than they otherwise would have because they falsely believed they were not allowed to contribute more. Table 8 presents evidence against this explanation. The coefficients are from a regression where the dependent variable is a dummy for having a higher total contribution rate than one had in effect on November 13, 2009, and the explanatory variable is a dummy for receiving the 60% threshold treatment.[18] The regressions in Panel A show that among low contributors, those who received a 60% highlight were between 5.7 and 13.5 percentage points more likely to make an increase of any size between November 27 and March 5, whereas the information story would predict that both groups would be equally likely to make a contribution increase (albeit of different sizes). These results also indicate that making salient the very high maximum possible contribution rate did not induce inertia due to demotivation among low savers.

Panels B and C show that among those on pace to contribute more than $2,500, there is no effect of the 60% threshold treatment on the probability of increasing contributions, consistent with the previous null effects within these projected contribution categories on average contribution rates and the probability of contributing exactly 60%.

Table 9 explores further a theme that emerges from the analysis so far: The 60% threshold treatment has a larger effect on people contributing little at the time the email was sent.

[17] The results are qualitatively similar if we only consider the period from November 27, 2009 to December 24, 2009.

[18] Untabulated regressions where the dependent variable is a dummy for having a contribution rate that is *either* higher or lower than the November 13, 2009 value yield similar results.

The table shows that low contribution *rates*, not low contribution dollar amounts, predict susceptibility to the 60% threshold treatment, even within the population on pace to contribute less than $2,500 in 2009. The dependent variable in the regressions, which are run separately for each projected contribution category, is the difference between that pay period's total contribution rate and the November 13, 2009 total contribution rate. The explanatory variables are a 60% threshold treatment dummy, a dummy for the November 13, 2009 total contribution rate being 0% or 1%, and an interaction between these two dummies.[19]

For those projected to contribute less than $2,500 (Panel A), the interaction is 3.9% and significant at the 5% level on November 27. In contrast, the coefficient on the uninteracted treatment dummy is only 1.0% and insignificant, indicating that almost all of the 60% threshold treatment effect in this contribution category is concentrated among employees with contribution rates of 0 to 1%. The interaction loses significance by the next payday and attenuates, but the point estimate remains sizable, never falling below 1.3%.

Even though the 60% threshold treatment's average effect on employees projected to contribute at least $2,500 was small and insignificant in Table 7, Panels B and C of Table 9 show that there is a strong positive treatment effect among employees in these projected contribution categories who were contributing 0 to 1% at the time of the email. The treatment interaction among recipients projected to contribute $2,500 to $4,999 is significant and much more persistent than the interaction among those projected to contribute less than $2,500. The interaction starts at 3.5% but grows to 9.1% by January 8 and remains large ($\geq$ 5.7%) and significant through March 5. Adding the treatment and interaction coefficients together yields a treatment effect for 0 to 1% contributors in this projected contribution category of 3.2% to 8.9% of income. The treatment interaction pattern for recipients projected to contribute more than $5,000 lies between that of the first and second projected contribution categories; the interaction is large (6.3%) and significant on the first payday after the email, loses statistical significance immediately afterwards, but regains significance on January 22 and February 5 with large point estimates of between 6.0% and 6.6%. In that first payday, the treatment effect for 0 to 1% contributors is 6.1% of income.

[19] We have chosen a dummy for the total November 13 contribution rate being 0% or 1% because in untabulated regressions of November 27 contribution rates minus November 13 contribution rates that control for dummies for each November 13 contribution rate from 0% to 5% and interactions of those dummies with the treatment effect, the 0% and 1% interactions are large and the other interactions are small or negative.

Beshears et al. (2010b) present evidence that low-income employees are more strongly influenced by the default contribution rate in retirement savings plans. However, the strength of the 60% threshold treatment effect among 0 to 1% contributors does not seem to be explained by a general negative correlation between income and susceptibility to "nudges." The average salary of those contributing 0 to 1% immediately prior to the email is 41% higher than that of those contributing at a higher rate among employees on pace to contribute less than $2,500, 61% higher among employees on pace to contribute between $2,500 and $4,999, and 7% lower among employees on pace to contribute more than $5,000.

Our leading hypothesis is that employees with low contribution rates were particularly motivated by the 60% threshold cue because of the especially large gap between their current contribution rate and the threshold. This would be consistent with the higher contribution responses we find among employees who were randomly assigned to a more distant goal or a more distant dollar contribution threshold.

V. Conclusion

This paper makes three main contributions. First, we demonstrate via multiple independent large-scale field experiments that a variety of subtle numerical cues influence, in ways predicted by psychology and behavioral economics, decisions as economically significant and familiar as retirement savings plan contributions. Low cues decrease contribution rates by up to 1.4% of income, and high cues increase contribution rates by up to 2.9% of income. Cues have large effects even when the surrounding communication explicitly denies that the cue has informational content, implying that even incidental numbers contained in a communication can have large unintended consequences on subsequent choices. Second, we show that the impact of cues can be surprisingly long-lasting—in some conditions, for up to a year. To our knowledge, there is little previous research on the time course of cue effects, especially outside the laboratory. Finally, we document that reminders have substantial effects on savings choices, consistent with recent research on the importance of attention in economic decisions.

In many ways this was an unlikely setting for these cues to wield much influence. The communication was the kind of administrative email many employees ignore. For those who did read it, the cues were only a very small part of an information-rich note. Finally, acting on the cue required multiple steps beyond reading the email (logging into the 401(k) administrator's

site, etc.). Finding an economically meaningful influence on decisions in this setting underscores the potential importance of these kinds of cues.

Our treatment effects are estimated on a particular sample of employees who are generally well educated, technologically savvy, comfortable making changes in their 401(k), and on amicable terms with the company management. However, we believe that savings cues can be effective in populations that are quite different from our study company's population. In a paper released after the first working paper draft of our own study, Goda, Manchester, and Sojourner (2011) describe a field experiment they ran using hard-copy mailings to University of Minnesota employees. Cues are not the main focus of their experiment; they are primarily interested in the effect that providing projections of future asset balances and income to employees has on retirement savings plan contributions. But they did randomly vary the graphs used to communicate these projections. One set of graphs showed asset and income projections for the cases where the employees increased their savings by $0, $50, $100, or $250 per pay period. The other set of graphs showed these projections for the cases where the employees increased their savings by $0, $100, $200, or $500 per pay period. Employees receiving the graphs with the higher savings examples had a higher contribution rate six months after the mailing than that of those who received the graphs with the lower savings examples.[20]

Our findings provide both an opportunity and a warning for organizations and policy makers. The kinds of cues we investigate could be used intentionally to influence saving behavior more efficiently than more costly interventions, such as financial education or higher matches. But unintentional cues, even those buried in mundane communications, can also affect behavior. Organizations and policymakers should wield them mindfully.

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Table 1. Cue text

This table lists the text that was inserted into the emails in each cue treatment at the point indicated in Figure 1.

Cue type	Treatment	Additional email text
Anchor	1% anchor	For example, you could increase your contribution rate by 1% of your income and get more of the match money for which you're eligible. (1% is just an example, and shouldn't be interpreted as advice on what the right contribution increase is for you.)
	3% anchor	For example, you could increase your contribution rate by 3% of your income and get more of the match money for which you're eligible. (3% is just an example, and shouldn't be interpreted as advice on what the right contribution increase is for you.)
	10% anchor	For example, you could increase your contribution rate by 10% of your income and get more of the match money for which you're eligible. (10% is just an example, and shouldn't be interpreted as advice on what the right contribution increase is for you.)
	20% anchor	For example, you could increase your contribution rate by 20% of your income and get more of the match money for which you're eligible. (20% is just an example, and shouldn't be interpreted as advice on what the right contribution increase is for you.)
Savings goal	$7,000 goal	For example, suppose you set a goal to contribute $7,000 for the year and you attained it. You would earn $500 more in matching money this year than you're currently on pace for.
	$11,000 goal	For example, suppose you set a goal to contribute $11,000 for the year and you attained it. You would earn $2,500 more in matching money this year than you're currently on pace for.
Savings threshold	$3,000 threshold	The next $*x* of contributions you make between now and December 31 will be matched at a 100% rate. *[x is the difference between $3,000 and the recipient's year-to-date match-eligible contributions]*
	$16,500 threshold	Contributing $*y* more between now and December 31 would earn you the maximum possible match. *[y is the difference between $16,500 and the recipient's year-to-date match-eligible contributions]*
	60% threshold	You can contribute up to 60% of your income in any pay period.

Table 2. Subjects per experimental cell

This table shows the number of employees who received each version of the 401(k) email in 2009 and 2010. The numbers are reported separately by projected contribution category. Projected contributions are the total before-tax plus Roth contributions to the 401(k) an employee would have ended up with in 2009 or 2010 if the contribution rates effective immediately prior to email receipt remained unchanged for the remainder of the calendar year.

Panel A: 2009 email campaign			
	Projected 2009 before-tax + Roth contributions		
	$0 - $2,499	$2,500 - $4,999	$5,000 - $16,499
Control	257	651	973
1% anchor	0	0	968
60% threshold	252	651	971
Panel B: 2010 email campaign			
	Projected 2010 before-tax + Roth contributions		
	$0 - $2,999	$3,000 - $5,999	$6,000 - $16,499
Control	0	263	560
Delayed control	0	260	560
3% anchor	0	0	561
10% anchor	0	0	562
20% anchor	0	0	565
$7,000 savings goal	0	263	0
$11,000 savings goal	0	262	0
$3,000 threshold	226	0	0
$16,500 threshold	225	0	0

Table 3. Effect of 1% anchor in 2009 emails

Within each panel, a separate regression is run for each column. The sample is employees who were on pace to contribute at least $5,000 in before-tax plus Roth contributions in 2009 if they left the contribution rates in effect on November 4, 2009 unchanged for the remainder of 2009. In Panel A, the dependent variable is the difference between the total (before-tax plus after-tax plus Roth) 401(k) contribution rate effective on the column's payday and the total contribution rate effective on November 13, 2009. In Panel B, the dependent variable is a dummy for whether the total contribution rate on the column's payday differs from the total contribution rate on November 13, 2009. The control variable is a dummy for whether the employee received the 1% anchor. Standard errors are in parentheses below the point estimates. $^{+}$ Significant at the 10% level. * Significant at the 5% level. ** Significant at the 1% level.

Panel A: Contribution rate relative to 11/13/2009 contribution rate

	11/27/09	12/11/09	12/24/09	1/8/10	1/22/10	2/5/10	2/19/10	3/5/10	3/19/10	4/2/10	4/16/10	4/30/10
1% anchor	-0.572	-0.173	-0.322	-0.960^{+}	-1.304**	-1.393**	-1.103*	0.055	-0.486	-0.750	-0.724	-0.782
	(0.450)	(0.559)	(0.611)	(0.574)	(0.504)	(0.492)	(0.508)	(0.656)	(0.498)	(0.499)	(0.484)	(0.487)
Constant	2.996**	3.960**	3.310**	4.419**	2.621**	2.209**	1.809**	1.937**	-0.657^{+}	-0.356	-0.379	-0.577^{+}
	(0.318)	(0.395)	(0.432)	(0.406)	(0.357)	(0.348)	(0.360)	(0.464)	(0.353)	(0.353)	(0.342)	(0.344)
	5/14/10	5/28/10	6/11/10	6/25/10	7/9/10	7/23/10	8/6/10	8/20/10	9/3/10	9/17/10	10/1/10	10/15/10
1% anchor	-0.906^{+}	-0.953^{+}	-1.186*	-1.024*	-0.922^{+}	-0.957^{+}	-0.756	-0.695	-0.613	-0.885^{+}	-1.035^{+}	-1.146*
	(0.490)	(0.488)	(0.490)	(0.499)	(0.491)	(0.496)	(0.511)	(0.518)	(0.518)	(0.529)	(0.544)	(0.547)
Constant	-0.702*	-0.660^{+}	-0.903**	-1.091**	-1.426**	-1.564**	-1.987**	-2.172**	-2.569**	-2.693**	-2.698**	-2.828**
	(0.346)	(0.346)	(0.347)	(0.354)	(0.348)	(0.351)	(0.362)	(0.366)	(0.367)	(0.374)	(0.384)	(0.387)

Panel B: Probability of contribution rate different than 11/13/2009 contribution rate

	11/27/09	12/11/09	12/24/09	1/8/10	1/22/10	2/5/10	2/19/10	3/5/10	3/19/10	4/2/10	4/16/10	4/30/10
1% anchor	0.012	0.018	0.017	0.038^{+}	0.031	0.036	0.032	0.002	0.025	0.025	0.021	0.020
	(0.017)	(0.020)	(0.021)	(0.022)	(0.022)	(0.022)	(0.022)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Constant	0.159**	0.248**	0.284**	0.590**	0.695**	0.610**	0.624**	0.713**	0.684**	0.684**	0.684**	0.691**
	(0.012)	(0.014)	(0.015)	(0.016)	(0.016)	(0.016)	(0.016)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
	5/14/10	5/28/10	6/11/10	6/25/10	7/9/10	7/23/10	8/6/10	8/20/10	9/3/10	9/17/10	10/1/10	10/15/10
1% anchor	0.025	0.021	0.019	0.016	0.009	0.011	0.008	0.010	0.012	0.010	0.008	0.007
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Constant	0.690**	0.692**	0.697**	0.703**	0.710**	0.714**	0.722**	0.726**	0.730**	0.738**	0.742**	0.748**
	(0.015)	(0.015)	(0.019)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)

Table 4. Effect of 3%, 10%, and 20% anchors in 2010 emails

Within each panel, a separate regression is run for each column. The sample is employees who were not assigned to the delayed control group and were on pace to contribute at least $6,000 in before-tax plus Roth contributions in 2010 if they left the contribution rates in effect on October 15, 2010 unchanged for the remainder of 2010. In Panel A, the dependent variable is the difference between the total (before-tax plus after-tax plus Roth) 401(k) contribution rate effective on the column's payday and the total contribution rate effective on October 15, 2010. In Panel B, the dependent variable is a dummy for whether the total contribution rate on the column's payday differs from the total contribution rate on October 15, 2010. The columns labeled "Bonus" use the contribution rate elections in effect for the annual bonus to construct the dependent variable. The control variables are dummies for whether the employee received the 3% anchor, 10% anchor, or 20% anchor. Standard errors are in parentheses below the point estimates. $^{+}$ Significant at the 10% level. * Significant at the 5% level. ** Significant at the 1% level.

Panel A: Contribution rate relative to 10/15/2010 contribution rate

	10/29/10	11/12/10	11/26/10	12/10/10	12/23/10	1/7/11	1/21/11	2/4/11	2/18/11	3/4/11	Bonus	3/18/11
3% anchor	-0.710^{+}	-0.682	-0.630	-0.292	-0.713	-0.320	-0.080	-0.092	0.347	0.718	0.466	0.979^{+}
	(0.420)	(0.545)	(0.646)	(0.642)	(0.656)	(0.625)	(0.554)	(0.521)	(0.588)	(0.536)	(0.861)	(0.512)
10% anchor	-0.580	-0.453	-0.199	0.005	-0.775	-0.820	-0.335	-0.407	0.303	0.574	0.693	1.174*
	(0.420)	(0.545)	(0.645)	(0.641)	(0.656)	(0.625)	(0.554)	(0.521)	(0.588)	(0.536)	(0.862)	(0.513)
20% anchor	-0.433	-0.305	-0.189	0.156	0.133	0.001	-0.031	-0.312	-0.207	0.168	0.553	0.732
	(0.419)	(0.544)	(0.644)	(0.640)	(0.654)	(0.624)	(0.552)	(0.519)	(0.586)	(0.534)	(0.862)	(0.512)
Constant	2.082**	3.036**	3.673**	3.060**	2.913**	3.461**	2.292**	2.049**	1.095**	0.732^{+}	1.479*	0.063
	(0.297)	(0.386)	(0.457)	(0.454)	(0.464)	(0.442)	(0.392)	(0.368)	(0.416)	(0.379)	(0.610)	(0.363)
	4/1/11	4/15/11	4/29/11	5/13/11	5/27/11	6/10/11	6/24/11	7/8/11	7/22/11	8/5/11	8/19/11	9/2/11
3% anchor	1.549**	1.549**	1.455**	1.531**	1.231**	0.921^{+}	0.850^{+}	0.852	0.722	0.767	0.772	0.669
	(0.486)	(0.491)	(0.474)	(0.483)	(0.476)	(0.486)	(0.511)	(0.522)	(0.499)	(0.495)	(0.521)	(0.534)
10% anchor	1.712**	1.867**	1.542**	1.517**	1.130*	0.719	0.495	0.326	0.225	0.400	0.687	0.577
	(0.487)	(0.492)	(0.476)	(0.484)	(0.476)	(0.487)	(0.512)	(0.522)	(0.499)	(0.496)	(0.522)	(0.535)
20% anchor	1.206*	1.420**	1.342**	1.340**	1.114*	0.914^{+}	0.862^{+}	0.850	0.918^{+}	0.915^{+}	0.851	0.618
	(0.486)	(0.491)	(0.475)	(0.483)	(0.476)	(0.486)	(0.512)	(0.522)	(0.499)	(0.495)	(0.521)	(0.534)
Constant	-1.302**	-1.502**	-1.594**	-1.588**	-1.691**	-1.615**	-1.708**	-1.808**	-2.035**	-2.132**	-2.335**	-2.610**
	(0.344)	(0.348)	(0.336)	(0.342)	(0.337)	(0.344)	(0.362)	(0.369)	(0.353)	(0.350)	(0.369)	(0.379)

Panel B: Probability of contribution rate different than rate effective 10/15/2010

	10/29/10	11/12/10	11/26/10	12/10/10	12/23/10	1/7/11	1/21/11	2/4/11	2/18/11	3/4/11	Bonus	3/18/11
3% anchor	-0.032^{+}	-0.038	-0.036	-0.049^{+}	-0.064*	-0.068*	-0.062*	-0.044	-0.023	-0.021	-0.012	-0.016
	(0.019)	(0.024)	(0.025)	(0.026)	(0.027)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)
10% anchor	-0.022	-0.022	-0.022	-0.030	-0.053^{+}	-0.079**	-0.063*	-0.059^{+}	-0.043	-0.043	-0.033	-0.036
	(0.019)	(0.024)	(0.025)	(0.026)	(0.027)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)
20% anchor	-0.033^{+}	-0.045^{+}	-0.049^{+}	-0.048^{+}	-0.059*	-0.076*	-0.072*	-0.072*	-0.044	-0.042	-0.036	-0.040
	(0.019)	(0.023)	(0.025)	(0.026)	(0.027)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)
Constant	0.143**	0.217**	0.264**	0.292**	0.325**	0.530**	0.551**	0.557**	0.580**	0.580**	0.594**	0.584**
	(0.014)	(0.017)	(0.018)	(0.019)	(0.019)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)

	4/1/11	4/15/11	4/29/11	5/13/11	5/27/11	6/10/11	6/24/11	7/8/11	7/22/11	8/5/11	8/19/11	9/2/11
3% anchor	-0.022	-0.015	-0.014	-0.018	-0.014	-0.018	-0.016	-0.019	-0.020	-0.025	-0.016	-0.009
	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)
10% anchor	-0.032	-0.042	-0.039	-0.045	-0.044	-0.046	-0.037	-0.041	-0.036	-0.029	-0.022	-0.015
	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)
20% anchor	-0.044	-0.047	-0.041	-0.045	-0.048	-0.050^{+}	-0.049	-0.048	-0.042	-0.039	-0.032	-0.026
	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)
Constant	0.600**	0.604**	0.606**	0.613**	0.617**	0.618**	0.619**	0.625**	0.626**	0.627**	0.625**	0.628**
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)

Table 5. Effect of goal examples in 2010 emails

Within each panel, a separate regression is run for each column. The sample is employees who were not assigned to the delayed control group and were on pace to contribute between $3,000 and $5,999 in before-tax plus Roth contributions in 2010 if they left the contribution rates in effect on October 15, 2010 unchanged for the remainder of 2010. In Panel A, the dependent variable is the difference between the total (before-tax plus after-tax plus Roth) 401(k) contribution rate effective on the column's payday and the total contribution rate effective on October 15, 2010. In Panel B, the dependent variable is a dummy for whether the total contribution rate on the column's payday differs from the total contribution rate on October 15, 2010. The columns labeled "Bonus" use the contribution rate elections in effect for the annual bonus to construct the dependent variable. The control variables are dummies for whether the employee received the $7,000 savings goal example or the $11,000 savings goal example. Standard errors are in parentheses below the point estimates. + Significant at the 10% level. * Significant at the 5% level. ** Significant at the 1% level.

Panel A: Contribution rate relative to 10/15/2010 contribution rate

	10/29/10	11/12/10	11/26/10	12/10/10	12/23/10	1/7/11	1/21/11	2/4/11	2/18/11	3/4/11	Bonus	3/18/11
$7,000 goal	-0.437	0.783	0.761	0.699	0.100	0.046	-0.403	-0.194	-0.624	-0.671	-1.482	-0.654
	(0.476)	(0.656)	(0.876)	(0.953)	(0.932)	(0.775)	(0.647)	(0.604)	(0.711)	(0.711)	(1.017)	(0.680)
$11,000 goal	0.678	0.835	1.505+	1.762+	2.234*	1.388+	0.570	1.102+	0.560	0.536	0.137	0.038
	(0.477)	(0.656)	(0.878)	(0.956)	(0.935)	(0.777)	(0.649)	(0.606)	(0.712)	(0.712)	(1.021)	(0.682)
Constant	0.608+	0.726	1.414*	1.736*	1.704**	1.784**	1.996**	1.709**	1.808**	1.831**	2.736**	1.935**
	(0.337)	(0.464)	(0.620)	(0.674)	(0.659)	(0.548)	(0.457)	(0.427)	(0.502)	(0.502)	(0.717)	(0.481)
	4/1/11	4/15/11	4/29/11	5/13/11	5/27/11	6/10/11	6/24/11	7/8/11	7/22/11	8/5/11	8/19/11	9/2/11
$7,000 goal	-0.135	-0.178	0.008	0.139	0.758+	0.658	0.460	0.274	0.221	0.250	-0.015	0.010
	(0.592)	(0.579)	(0.612)	(0.617)	(0.308)	(0.430)	(0.361)	(0.363)	(0.364)	(0.371)	(0.392)	(0.392)
$11,000 goal	-0.358	-0.589	-0.720	-0.637	-0.002	-0.090	-0.249	-0.333	-0.393	-0.159	-0.360	-0.287
	(0.595)	(0.582)	(0.615)	(0.619)	(0.437)	(0.431)	(0.612)	(0.364)	(0.365)	(0.371)	(0.393)	(0.393)
Constant	1.500**	1.600**	1.675**	1.563**	0.738*	0.733*	0.662**	0.748**	0.780**	0.638*	0.564*	0.495+
	(0.419)	(0.409)	(0.432)	(0.435)	(0.308)	(0.304)	(0.255)	(0.257)	(0.257)	(0.262)	(0.278)	(0.279)

Panel B: Probability of contribution rate different than rate effective 10/15/2010

	10/29/10	11/12/10	11/26/10	12/10/10	12/23/10	1/7/11	1/21/11	2/4/11	2/18/11	3/4/11	Bonus	3/18/11
$7,000 goal	0.008	0.023	0.033	0.024	0.012	0.090*	0.062	0.068	0.078^{+}	0.078^{+}	0.077^{+}	0.055
	(0.020)	(0.025)	(0.029)	(0.031)	(0.033)	(0.043)	(0.044)	(0.044)	(0.044)	(0.044)	(0.045)	(0.044)
$11,000 goal	0.015	0.019	0.035	0.041	0.057^{+}	0.059	0.034	0.034	0.035	0.031	0.037	0.022
	(0.020)	(0.025)	(0.030)	(0.032)	(0.033)	(0.043)	(0.044)	(0.044)	(0.044)	(0.044)	(0.045)	(0.044)
Constant	0.046**	0.076**	0.107**	0.130**	0.142**	0.347**	0.403**	0.415**	0.469**	0.473**	0.488**	0.492**
	(0.014)	(0.018)	(0.021)	(0.022)	(0.023)	(0.030)	(0.031)	(0.031)	(0.031)	(0.031)	(0.032)	(0.031)

	4/1/11	4/15/11	4/29/11	5/13/11	5/27/11	6/10/11	6/24/11	7/8/11	7/22/11	8/5/11	8/19/11	9/2/11
$7,000 goal	0.047	0.038	0.044	0.050	0.046	0.052	0.049	0.039	0.035	0.045	0.038	0.048
	(0.044)	(0.044)	(0.044)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)
$11,000 goal	0.022	0.024	0.035	0.041	0.033	0.041	0.037	0.029	0.033	0.037	0.029	0.024
	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)
Constant	0.498**	0.504**	0.508**	0.502**	0.510**	0.508**	0.516**	0.528**	0.534**	0.529**	0.539**	0.540**
	(0.031)	(0.031)	(0.031)	(0.031)	(0.032)	(0.032)	(0.032)	(0.032)	(0.032)	(0.032)	(0.032)	(0.032)

Table 6. Effect of highlighting $3,000 and $16,500 thresholds in 2010 emails

Within each panel, a separate regression is run for each column. The sample is employees who were on pace to contribute less than $3,000 in before-tax plus Roth contributions in 2010 if they left the contribution rates in effect on October 15, 2010 unchanged for the remainder of 2010. In Panel A, the dependent variable is the difference between the total (before-tax plus after-tax plus Roth) 401(k) contribution rate effective on the column's payday and the total contribution rate effective on October 15, 2010. In Panel B, the dependent variable is a dummy for whether the total contribution rate on the column's payday differs from the total contribution rate on October 15, 2010. The columns labeled "Bonus" use the contribution rate elections in effect for the annual bonus to construct the dependent variable. The control variable is a dummy for whether the employee received the $16,500 contribution threshold treatment. Standard errors are in parentheses below the point estimates. + Significant at the 10% level. * Significant at the 5% level. ** Significant at the 1% level.

Panel A: Contribution rate relative to 10/15/2010 contribution rate

	10/29/10	11/12/10	11/26/10	12/10/10	12/23/10	1/7/11	1/21/11	2/4/11	2/18/11	3/4/11	Bonus	3/18/11
$16,500 threshold	0.218	0.231	0.106	0.223	0.031	0.312	1.440+	1.070	1.536*	1.041+	0.690	0.841
	(0.686)	(1.005)	(1.199)	(1.297)	(1.274)	(1.052)	(0.793)	(0.698)	(0.755)	(0.600)	(0.752)	(0.545)
Constant	1.066*	2.597**	3.658**	4.209**	4.280**	3.284**	1.665**	1.815**	1.480**	1.386**	1.511**	1.330**
	(0.484)	(0.707)	(0.843)	(0.912)	(0.895)	(0.738)	(0.557)	(0.490)	(0.527)	(0.420)	(0.524)	(0.382)
	4/1/11	4/15/11	4/29/11	5/13/11	5/27/11	6/10/11	6/24/11	7/8/11	7/22/11	8/5/11	8/19/11	9/2/11
$16,500 threshold	1.350+	1.374+	1.184+	1.122+	0.499	0.501	0.447	0.257	-0.002	-0.357	0.104	0.212
	(0.702)	(0.710)	(0.669)	(0.669)	(0.441)	(0.451)	(0.453)	(0.472)	(0.643)	(0.617)	(0.435)	(0.440)
Constant	1.270**	1.284*	1.201*	1.220**	1.010**	1.079**	1.119**	1.302**	1.614**	1.762**	1.185**	0.990**
	(0.493)	(0.498)	(0.469)	(0.469)	(0.309)	(0.317)	(0.319)	(0.330)	(0.450)	(0.433)	(0.306)	(0.310)

Panel B: Probability of contribution rate different than rate effective 10/15/2010

	10/29/10	11/12/10	11/26/10	12/10/10	12/23/10	1/7/11	1/21/11	2/4/11	2/18/11	3/4/11	Bonus	3/18/11
$16,500 threshold	-0.004	-0.005	-0.036	-0.053	-0.052	-0.060	-0.048	-0.066	-0.024	-0.021	-0.024	-0.025
	(0.028)	(0.035)	(0.038)	(0.040)	(0.040)	(0.046)	(0.046)	(0.047)	(0.048)	(0.048)	(0.048)	(0.048)
Constant	0.102**	0.164**	0.222**	0.258**	0.265**	0.404**	0.411**	0.438**	0.453**	0.450**	0.433**	0.468**
	(0.020)	(0.025)	(0.027)	(0.028)	(0.029)	(0.032)	(0.033)	(0.033)	(0.033)	(0.033)	(0.034)	(0.034)
	4/1/11	4/15/11	4/29/11	5/13/11	5/27/11	6/10/11	6/24/11	7/8/11	7/22/11	8/5/11	8/19/11	9/2/11
$16,500 threshold	-0.033	-0.022	-0.011	-0.020	-0.031	-0.017	-0.012	-0.009	-0.005	0.012	0.005	0.005
	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)	(0.049)	(0.049)	(0.049)	(0.049)	(0.049)	(0.049)	(0.049)
Constant	0.486**	0.477**	0.472**	0.477**	0.493**	0.493**	0.502**	0.512**	0.507**	0.509**	0.512**	0.517**
	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)

Table 7. Effect of 60% contribution rate threshold treatment in 2009 emails on average contribution rate change

Each panel contains a different sample of employees, divided according to how much they would contribute on a before-tax plus Roth basis to the 401(k) in 2009 if they left the contribution rates in effect on November 13, 2009 unchanged for the remainder of 2009. We exclude employees assigned to the 1% anchor. Within each panel, a separate regression is run for each column. The dependent variable is the difference between the total (before-tax plus after-tax plus Roth) 401(k) contribution rate effective on the column's payday and the total contribution rate effective on November 13, 2009. The control variable is a dummy for whether the employee received the 60% contribution rate threshold treatment. Standard errors are in parentheses below the point estimates. $^{+}$ Significant at the 10% level. * Significant at the 5% level. ** Significant at the 1% level.

Panel A: $0 - $2,499 projected 2009 contributions								
	11/27/09	12/11/09	12/24/09	1/8/10	1/22/10	2/5/10	2/19/10	3/5/10
60% threshold	2.484**	2.749**	2.867*	2.536*	0.563	0.812	0.648	1.353
	(0.877)	(1.010)	(1.160)	(1.058)	(0.811)	(0.728)	(0.731)	(0.946)
Constant	1.004	1.763*	2.512**	2.424**	1.437*	0.680	0.779	0.631
	(0.617)	(0.710)	(0.816)	(0.743)	(0.569)	(0.511)	(0.513)	(0.665)
Panel B: $2,500 - $4,999 projected 2009 contributions								
	11/27/09	12/11/09	12/24/09	1/8/10	1/22/10	2/5/10	2/19/10	3/5/10
60% threshold	-0.084	-0.288	-0.093	0.252	0.565	0.186	0.237	0.696
	(0.408)	(0.511)	(0.524)	(0.445)	(0.383)	(0.355)	(0.344)	(0.578)
Constant	1.363**	2.278**	2.295**	2.289**	1.805**	1.934**	1.814**	2.344**
	(0.288)	(0.361)	(0.371)	(0.316)	(0.271)	(0.251)	(0.244)	(0.409)
Panel C: $5,000 - $16,499 projected 2009 contributions								
	11/27/09	12/11/09	12/24/09	1/8/10	1/22/10	2/5/10	2/19/10	3/5/10
60% threshold	-0.075	0.378	0.285	-0.322	-0.097	-0.272	-0.163	-0.698
	(0.476)	(0.569)	(0.607)	(0.564)	(0.491)	(0.470)	(0.460)	(0.593)
Constant	2.996**	3.960**	3.310**	4.419**	2.621**	2.209**	1.809**	1.937**
	(0.336)	(0.402)	(0.430)	(0.400)	(0.348)	(0.333)	(0.326)	(0.420)

Table 8. Effect of 60% contribution rate threshold treatment in 2009 emails on probability of a contribution rate increase

Each panel contains a different sample of employees, divided according to how many dollars they would contribute on a before-tax plus Roth basis to the 401(k) in 2009 if they left the contribution rates in effect on November 13, 2009 unchanged for the remainder of 2009. We exclude employees assigned to the 1% anchor. Within each panel, a separate regression is run for each column. The dependent variable is a dummy for whether the total contribution rate on the column's payday is higher than the total contribution rate on November 13, 2009. The control variable is a dummy for whether the employee received the 60% contribution rate threshold treatment. Standard errors are in parentheses below the point estimates. $^{+}$ Significant at the 10% level. * Significant at the 5% level. ** Significant at the 1% level.

Panel A: $0 - $2,499 projected 2009 contributions								
	11/27/09	12/11/09	12/24/09	1/8/10	1/22/10	2/5/10	2/19/10	3/5/10
60% threshold	0.057*	0.066*	0.071*	0.115**	0.123**	0.123**	0.119**	0.135**
	(0.027)	(0.033)	(0.036)	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)
Constant	0.078**	0.128**	0.164**	0.490**	0.476**	0.470**	0.470**	0.377**
	(0.019)	(0.022)	(0.025)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
Panel B: $2,500 - $4,999 projected 2009 contributions								
	11/27/09	12/11/09	12/24/09	1/8/10	1/22/10	2/5/10	2/19/10	3/5/10
60% threshold	-0.003	-0.009	-0.009	-0.032	-0.033	-0.034	-0.044	-0.006
	(0.015)	(0.019)	(0.020)	(0.026)	(0.026)	(0.026)	(0.026)	(0.027)
Constant	0.081**	0.135**	0.156**	0.688**	0.686**	0.693**	0.697**	0.621**
	(0.011)	(0.013)	(0.014)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
Panel C: $5,000 - $16,499 projected 2009 contributions								
	11/27/09	12/11/09	12/24/09	1/8/10	1/22/10	2/5/10	2/19/10	3/5/10
60% threshold	0.002	0.014	0.015	0.033	0.022	0.018	0.012	-0.002
	(0.017)	(0.020)	(0.021)	(0.022)	(0.022)	(0.022)	(0.022)	(0.021)
Constant	0.159**	0.248**	0.284**	0.590**	0.605**	0.610**	0.624**	0.713**
	(0.012)	(0.014)	(0.015)	(0.016)	(0.016)	(0.016)	(0.016)	(0.015)

Table 9. Interaction of pre-email contribution rate with 60% contribution rate threshold treatment effect on subsequent contribution rate change

Each panel contains a different sample of employees, divided according to how many dollars they would contribute to the 401(k) in 2009 if they left the contribution rates in effect on November 13, 2009 unchanged for the remainder of 2009. We exclude employees assigned to the 1% anchor. Within each panel, a separate regression is run for each column. The dependent variable is the difference between the total (before-tax plus after-tax plus Roth) 401(k) contribution rate effective on the column's payday and the total contribution rate effective on November 13, 2009. The control variables are dummies for whether the employee received the 60% contribution rate threshold treatment and whether her total contribution rate on November 13, 2009 was 0% or 1%, and the interaction of these two dummies. Standard errors are in parentheses below the point estimates. $^{+}$ Significant at the 10% level. * Significant at the 5% level. ** Significant at the 1% level.

Panel A: $0 - $2,499 projected 2009 contributions								
	11/27/09	12/11/09	12/24/09	1/8/10	1/22/10	2/5/10	2/19/10	3/5/10
60% threshold	0.956	1.400	1.715	1.523	0.127	0.420	0.312	0.821
	(1.172)	(1.344)	(1.541)	(1.408)	(1.080)	(0.972)	(0.975)	(1.267)
60% threshold ×	3.929*	3.748^{+}	3.460	3.099	1.577	1.390	1.300	1.843
0-1% rate	(1.747)	(2.003)	(2.297)	(2.106)	(1.615)	(1.451)	(1.455)	(1.888)
0-1% rate	0.911	2.135	3.275*	2.599^{+}	2.321*	1.977^{+}	2.193*	2.431^{+}
	(1.219)	(1.397)	(1.603)	(1.464)	(1.124)	(1.010)	(1.012)	(1.315)
Constant	0.554	0.708	0.900	1.140	0.295	-0.297	-0.305	-0.575
	(0.857)	(0.982)	(1.125)	(1.029)	(0.788)	(0.710)	(0.712)	(0.926)
Panel B: $2,500 - $4,999 projected 2009 contributions								
	11/27/09	12/11/09	12/24/09	1/8/10	1/22/10	2/5/10	2/19/10	3/5/10
60% threshold	-0.275	-0.568	-0.371	-0.178	0.151	-0.163	-0.046	0.354
	(0.415)	(0.520)	(0.533)	(0.450)	(0.384)	(0.357)	(0.348)	(0.587)
60% threshold ×	3.519^{+}	5.656*	5.615*	9.083**	8.320**	7.032**	5.665**	6.840*
0-1% rate	(2.099)	(2.630)	(2.694)	(2.263)	(1.931)	(1.819)	(1.770)	(2.988)
0-1% rate	1.052	-0.568	0.089	-1.234	0.005	-0.087	0.037	0.057
	(1.626)	(0.520)	(2.086)	(1.752)	(1.495)	(1.422)	(1.384)	(2.335)
Constant	1.329**	2.275**	2.292**	2.330**	1.805**	1.937**	1.813**	2.343**
	(0.292)	(0.366)	(0.376)	(0.317)	(0.271)	(0.252)	(0.245)	(0.414)

Panel C: $5,000 - $16,499 projected 2009 contributions								
	11/27/09	12/11/09	12/24/09	1/8/10	1/22/10	2/5/10	2/19/10	3/5/10
60% threshold	-0.167	0.340	0.204	-0.304	-0.177	-0.304	-0.103	-0.494
	(0.476)	(0.574)	(0.614)	(0.568)	(0.489)	(0.465)	(0.453)	(0.587)
60% threshold ×	6.305*	3.386	4.984	2.024	6.624*	5.959*	2.724	-2.283
0-1% rate	(2.968)	(3.575)	(3.816)	(3.526)	(3.029)	(2.917)	(2.841)	(3.684)
0-1% rate	7.077**	5.338*	4.267^{+}	8.528**	9.352**	11.484**	13.995**	18.200**
	(1.953)	(2.353)	(2.512)	(2.321)	(1.994)	(1.896)	(1.846)	(2.394)
Constant	2.785**	3.800**	3.182**	4.162**	2.337**	1.861**	1.385**	1.386**
	(0.337)	(0.407)	(0.435)	(0.403)	(0.347)	(0.330)	(0.321)	(0.417)

Figure 1. 2009 email text

Dear [Employee],

We want to remind you that [Company] matches your qualified contributions (pre-tax and Roth) to the [Company] 401(k) Plan. In other words, [Company] will give you free money for saving in your 401(k).

What is the [Company] match?
[Company]'s matching contribution is the greater of: (a) 100% of your qualified 2009 401(k) contributions up to $2,500; or (b) 50% of your qualified 2009 contributions up to $16,500 for a total possible match of $8,250.*

Where am I at right now?
You've made $X,XXX in qualified payroll contributions to the [Company] 401(k) Plan as of November 1, 2009.

To take greater advantage of [Company]'s 2009 match, increase your contribution rate for the remaining six weeks of 2009. **Treatment text was inserted here.**

See this calendar for deadlines for making contribution changes. **

How do I increase my contribution?
To change your contribution rate, follow these steps:
1. Log in to Vanguard, our 401(k) vendor. (If you've never logged in before, you will need the [Company] Plan number, [######].)

2. Click on "Change paycheck deductions" under the "I want to. . ." menu

3. Adjust your percentages in the boxes.

4. Click "continue" and follow directions until you see the confirmation page. A confirmation will also be emailed or mailed to you.

Happy saving!
- [Director of Benefits]

** Must be employed at last day of the plan year in order to receive the maximum match. See URL for more details.*

*** The actual amount you can contribute is subject to other IRS limits. See Plan Specific Limitations for details.*

Figure 2. Average total contribution rate among November 2009 control email recipients employed at company as of January 3, 2008

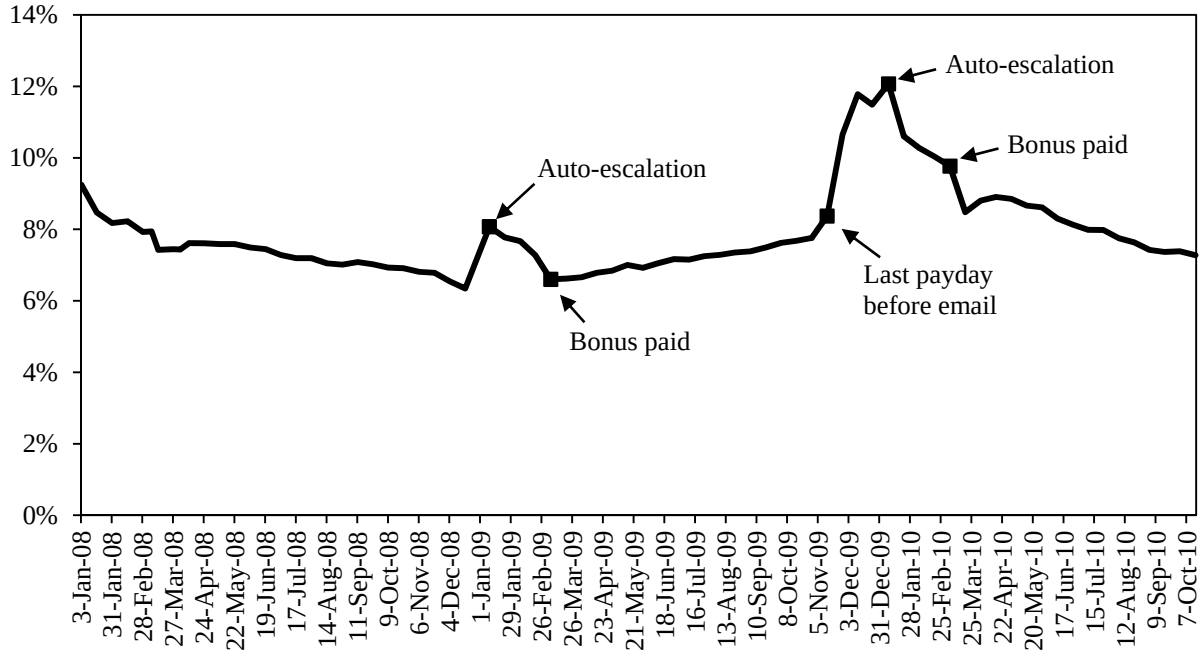


Figure 3. Average total contribution rate in excess of October 15, 2010 total contribution rate, email recipients on pace to contribute $3,000 or more in 2010

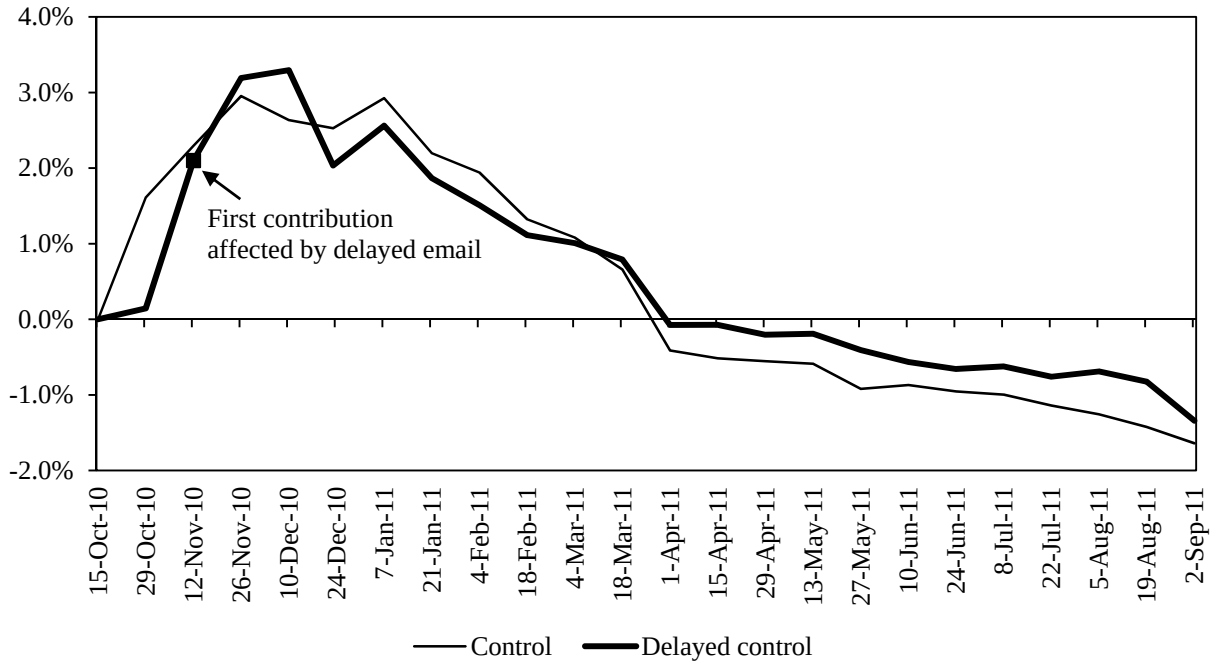


Figure 4. Average total contribution rate in excess of November 13, 2009 total contribution rate, email recipients projected to contribute $5,000 to $16,499 in 2009

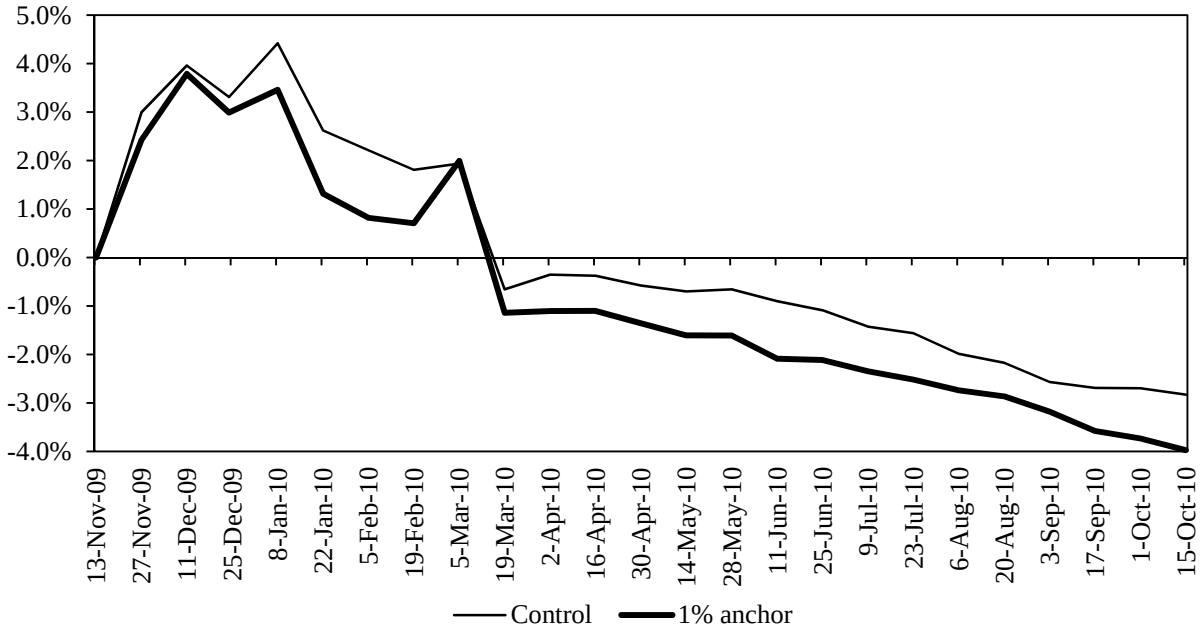


Figure 5. Average total contribution rate in excess of October 15, 2010 total contribution rate, email recipients projected to contribute $6,000 to $16,499 in 2010

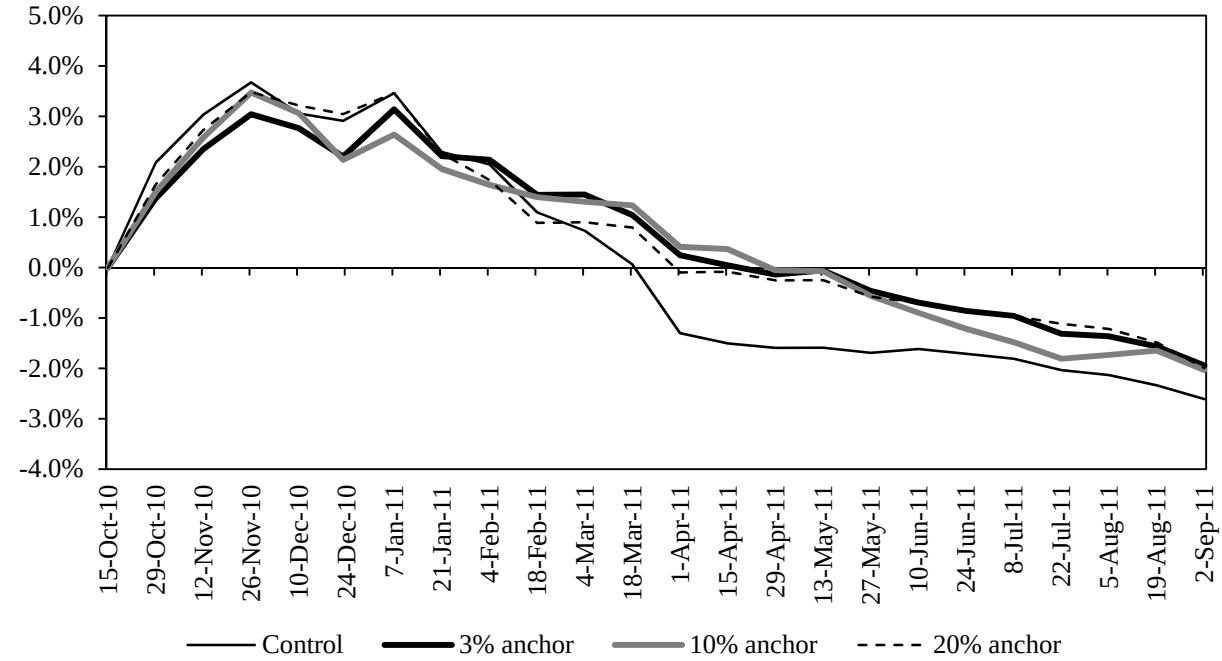


Figure 6A. Average total contribution rate in excess of October 15, 2010 total contribution rate, email recipients projected to contribute $3,000 to $5,999 in 2010

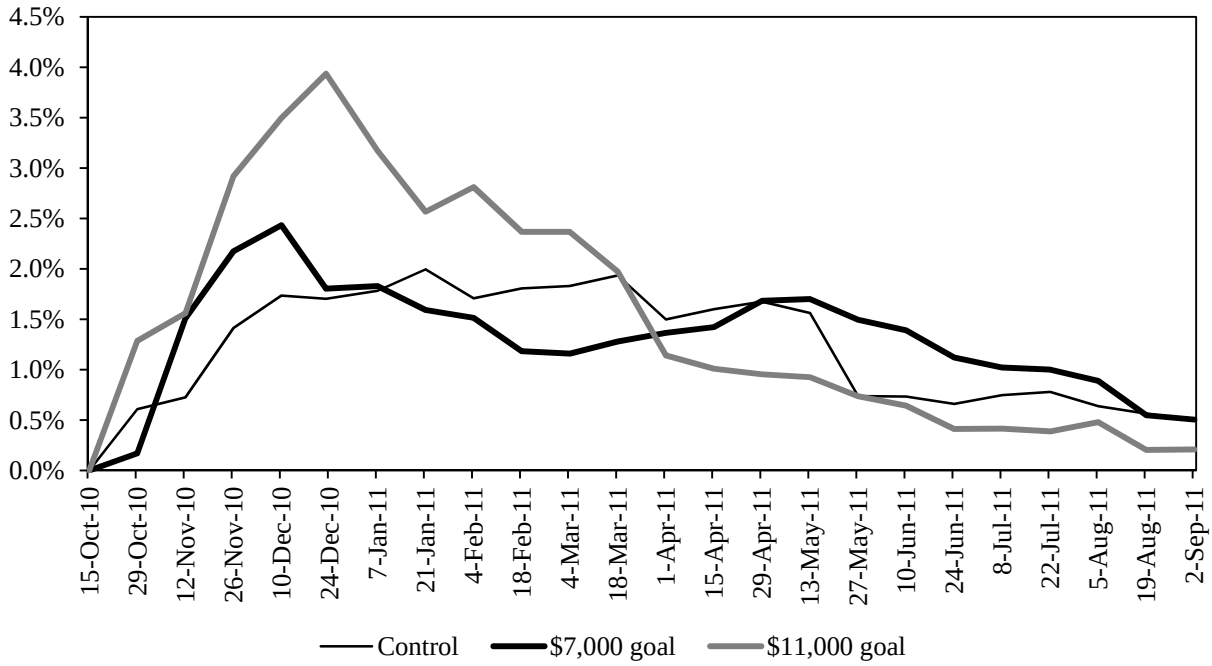


Figure 6B. Adjusted average total contribution rate in excess of October 15, 2010 total contribution rate, email recipients projected to contribute $3,000 to $5,999 in 2010

Any contiguous sequence of 0% contribution rates that begins after January 7, 2011 and ends on September 2, 2011 is replaced by the last positive contribution rate in 2011 observed for the employee.

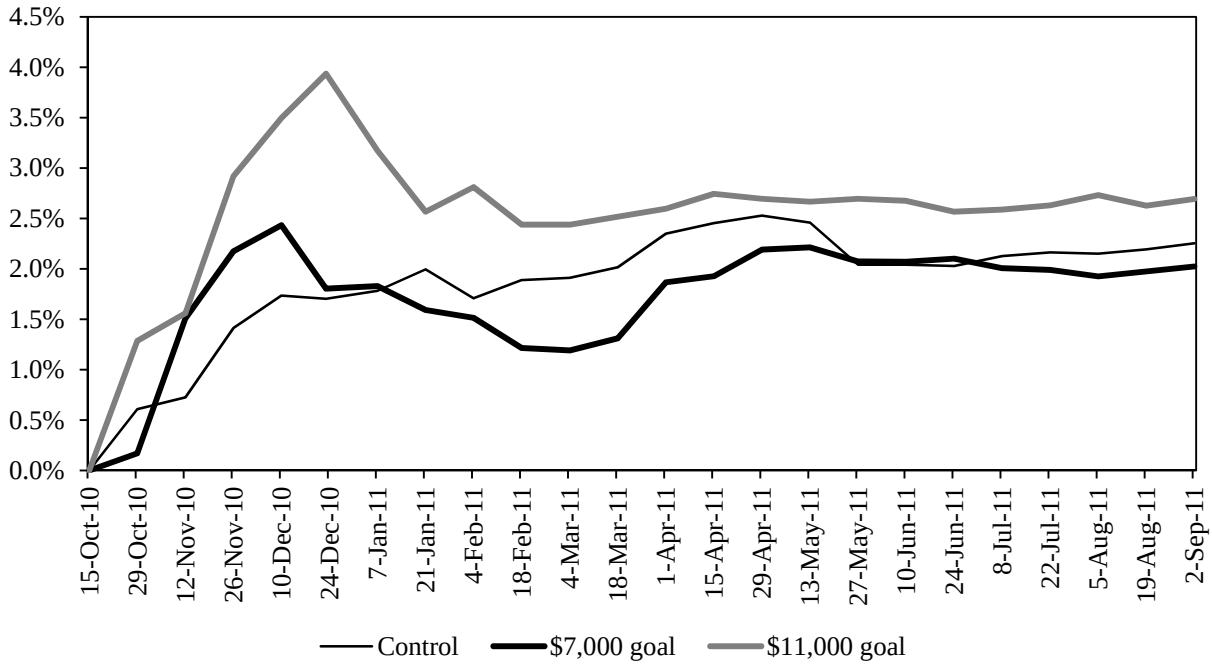


Figure 7. Histogram of total before-tax plus Roth 2010 contributions, email recipients projected to contribute less than $3,000 in 2010

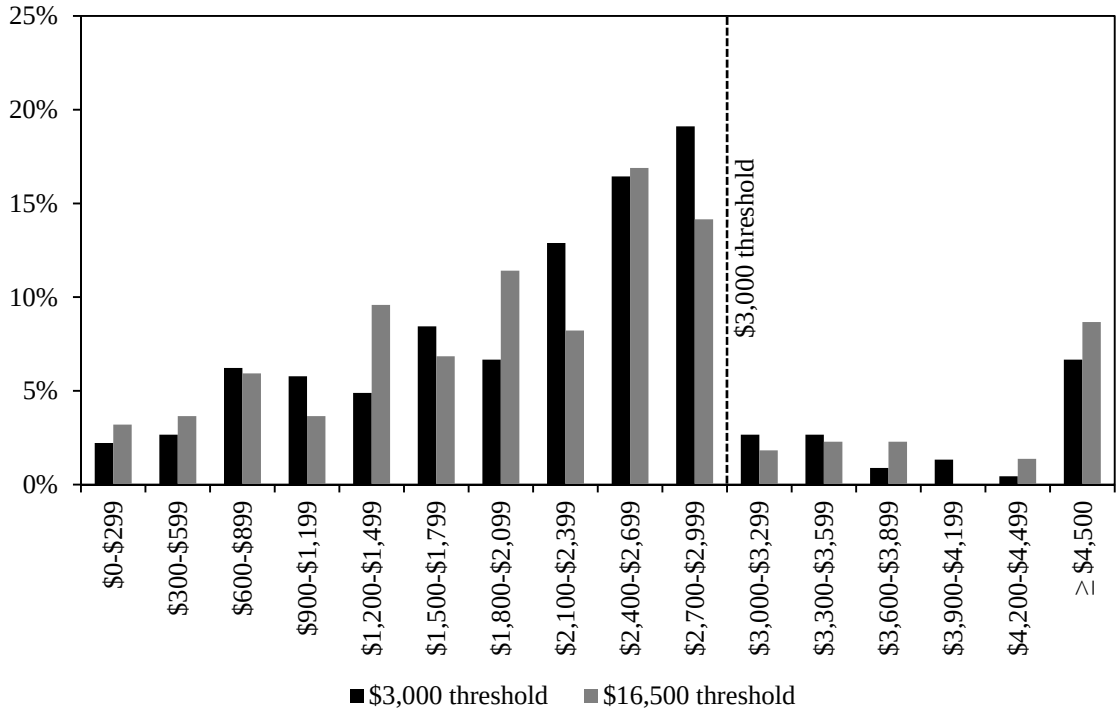


Figure 8. Average total contribution rate in excess of October 15, 2010 total contribution rate, email recipients projected to contribute less than $3,000 in 2010

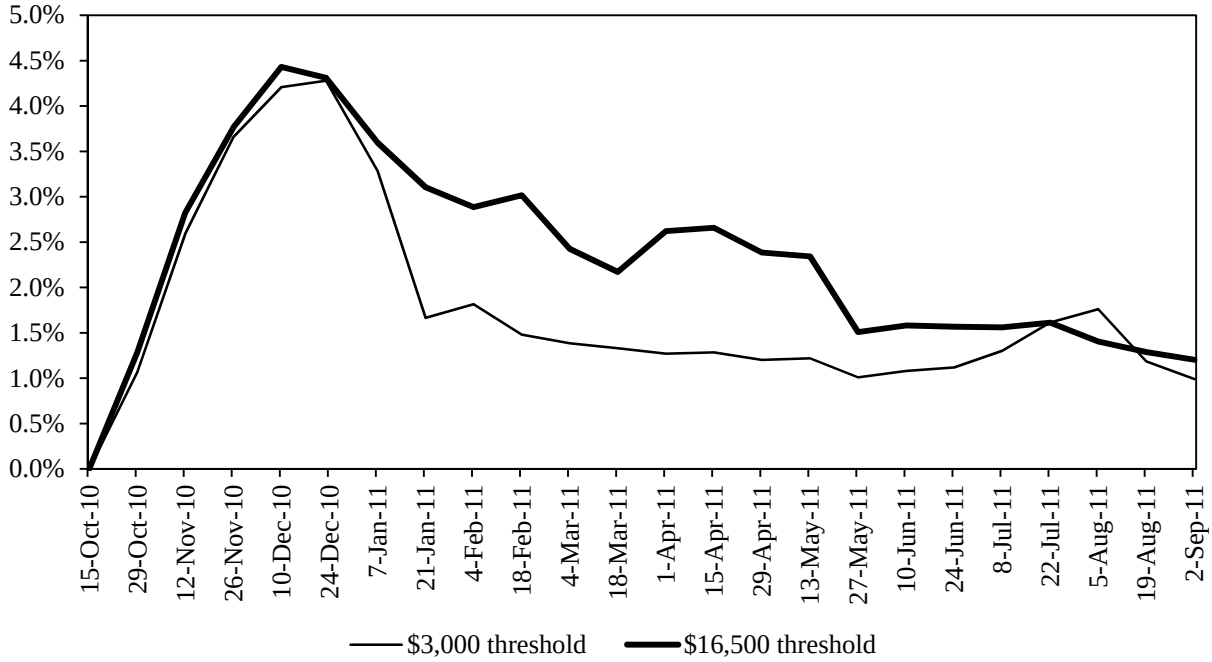
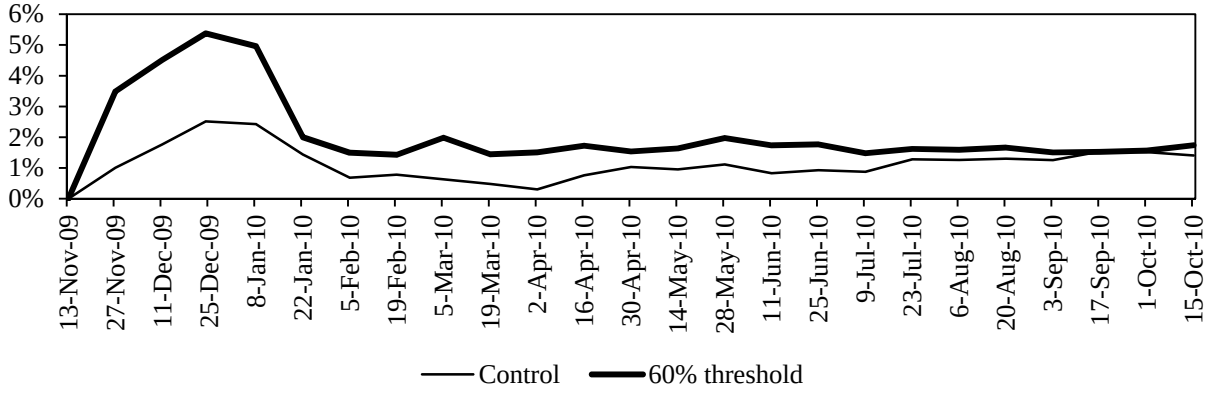
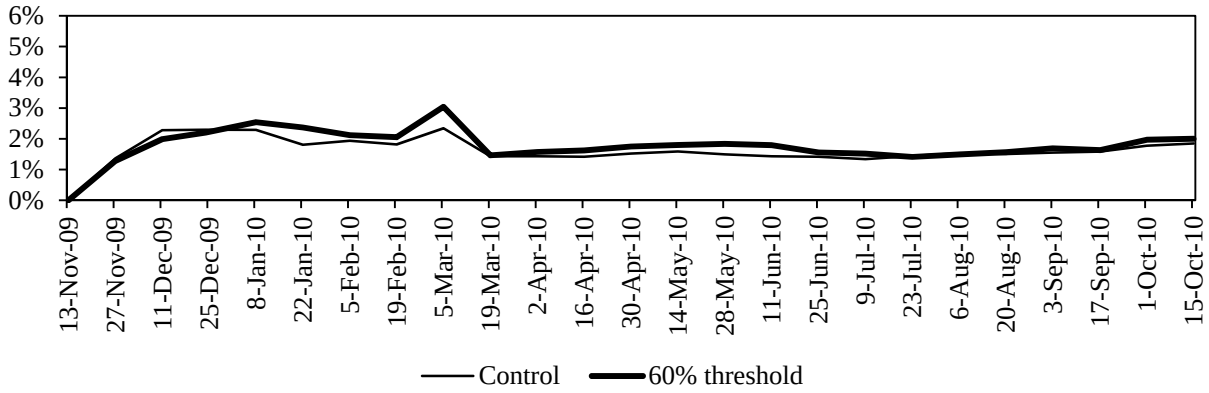


Figure 9. Average total contribution rate in excess of November 13, 2009 total contribution rate

Projected 2009 contributions: $0 - $2,499



Projected 2009 contributions: $2,500 - $4,999



Projected 2009 contributions: $5,000 - $16,499