Small Cues Change Savings Choices

James J. Choi
Yale University and NBER

Emily Haisley
Barclays Bank PLC

Jennifer Kurkoski
Google Inc.

Cade Massey
University of Pennsylvania

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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 savings 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 (Beggs and Graddy, 2009; Dougal et al., 2010; Baker, Pan, and Wurgler, 2012). 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 cues, though

[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).

consciously perceptible, do not overtly urge email recipients 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 choose their 401(k) contribution rate by using a rule of thumb based on a savings threshold 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 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 first four months after the email, our lowest anchor (a 1% increase example) decreases average contribution rates by up to 1.4% of income relative to the control email, but higher anchors (3%, 10%, and 20% increase examples) have no effect on average contribution rates. The higher anchors do decrease the likelihood of making a contribution change, suggesting that they cause temporary disengagement from the 401(k) that offsets any positive effect they might otherwise have on savings. In the longer run—up to a year after the email—our lowest anchor decreases average contribution rates by up to 1.2% of income, whereas the 3%, 10%, and 20% anchors increase contribution rates by up to 1.5%, 1.9%, and 1.4% of income, respectively.

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. The fact that the high goal raises average savings rates in the short run and does not reduce the probability of making a contribution rate change 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) increased by 2% of income the maximum amount of employee contributions matched (at a 50% match rate). The increase in the average contribution rate from three months prior to the change to six months after the change was 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

[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.

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 influenced by small changes in their decision-making environment. The effects identified in this other work can be explained by three frictions: time-inconsistent procrastination, limited memory, and mental accounting. Procrastination increases the influence of the (possibly time-varying) default outcome, the effort and cognitive cost of moving away from the default, and deadlines for making active choices (Madrian and Shea, 2001; Choi et al., 2002, 2004; Huberman, Iyengar, and Jiang, 2004; Thaler and Benartzi, 2004; Beshears et al., 2008; Carroll et al., 2009; Choi, Laibson, and Madrian, 2009b; Beshears et al., 2010a; Iyengar and Kamenica, 2010; Benartzi, Peleg, and Thaler, 2012). Limited memory causes reminders to increase savings deposits (Karlan et al., 2011). Mental accounting causes individuals to make asset allocation decisions within a salient subset of the portfolio as if it were their entire portfolio, ignoring the allocation of the remainder of their portfolio (Choi, Laibson, and Madrian, 2009a). Our cues do not rely upon these three frictions. Cues do not change the default, action costs, or deadlines. In fact, most of our cues significantly affect the average contribution rate during times when they do not significantly change their recipients' probability of having a different contribution rate than their pre-email contribution rate, indicating that cues change

[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).

choices conditional on action. In addition, it seems unlikely that employees who do not receive high savings cues contribute less because they have forgotten that higher savings choices are possible,[4] or that our cues change mental accounting boundaries.[5]

Our paper is also related to non-experimental economics research identifying the effect of anchoring on decisions outside the laboratory. Baker, Pan, and Wurgler (2012) show that the offer price for merger targets is biased towards the target stock's recent peak prices, a set of salient but normatively irrelevant numbers. 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 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 explains our econometric approach. Section IV describes our data. Section V presents our experimental results, and Section VI concludes.

I. 401(k) plan features

Employees at the company we study can make before-tax, after-tax, or Roth contributions to their 401(k) plan.[6] 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 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

[4] The cues that rule this forgetting explanation out most cleanly are the $7,000 and $11,000 savings goal cues, and the $3,000 and $16,500 savings threshold cues, since these mention a dollar savings level, and both the low and high versions of these cues are preceded by information that one can contribute $16,500 to the 401(k).

[5] There are related papers on debt choices in developing countries. Cadena and Schoar (2011) find that reminders increase microfinance loan repayments. Bertrand et al. (2010) find that take-up of a mailed loan solicitation to poor South Africans increases with attention-grabbing visuals (an attractive female photograph), lower information density (fewer example loan terms presented in a table), and not suggesting a particular use for the loan. This last finding could be interpreted as a cue effect, but it may also arise because cursory reading of the letter caused some recipients to misinterpret the suggestion as a requirement for receiving the loan.

[6] Both principal and capital gains of before-tax contributions are taxed upon withdrawal. Only capital gains of after-tax contributions are taxed upon withdrawal. Roth contributions are made using after-tax dollars, but both principal and capital gains are not taxed upon withdrawal.

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 seasoned 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, seasoned 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 matching 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.[7] 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 discuss the treatments and randomization scheme in the below subsections.

A. Anchoring treatments

[7] 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.

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.E 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. Delayed control email

In 2010, employees in the delayed control condition did not receive an email on October 19, but instead received the control email on October 28. All employees who were sent emails on October 28 were in the delayed control condition. This treatment allows us to estimate the short-run effect of the control email itself.

E. 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.[8] Assignments to conditions in 2010 were independent of assignments in 2009.

Employees naturally fell into three categories based on their marginal incentive to increase their before-tax and Roth contributions in the calendar year above what they would contribute if they left their pre-email 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 conditions (and they do not appear in Table 2). Employees were eligible for all three conditions 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

[8] Early 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.

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 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 could be assigned to the control, the delayed control, the 3% anchor, the 10% anchor, or the 20% anchor. We do not analyze employees in this category who were not eligible to be assigned to all five of these conditions—those whose before-tax plus Roth contributions in 2010 would exceed $16,500 if they increased their 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 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 or delayed control group.

III. Econometric approach

We identify our treatment effects by comparing employees within a projected contribution category who were assigned to receive a cue to control email recipients in the same category. In other words, we compare each treatment group in a column within a panel of Table

2 to control email recipients within the same column in the same panel. For brevity, our analysis of the delayed control email consolidates all employees on pace to contribute more than $3,000 in 2010, rather than separately analyzing its treatment effect in each projected contribution category; that is, we compare the union of all delayed control recipients in Panel B to the union of all control email recipients in Panel B. Because we did not send control emails to employees on pace to contribute less than $3,000 in 2010, our analysis of the dollar threshold treatments will only estimate the $3,000 threshold treatment effect relative to the $16,500 threshold treatment effect.

Random assignment within contribution category makes the characteristics of employees who received each cue treatment in that category equal in expectation to those of their corresponding control group, so we can compare outcomes without additional control variables. Untabulated randomization checks show that contribution rates immediately prior to the email, year-to-date dollars contributed to the 401(k) prior to the email, projected 401(k) dollar contributions for the calendar year if the employee kept his pre-email contribution rate unchanged, 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.

Our regressions follow an event-study framework. The event date is November 17, 2009 for the 2009 cues and October 19, 2010 for the 2010 cues, the event is the sending of the cue, and the benchmark is the appropriate set of control email recipients. As is the norm in finance event studies, we estimate the effect of the event (i.e., the treatment) at multiple individual post-event periods by running a separate regression for each post-email payday. Our dependent variable is the difference in the total 401(k) contribution rate (before-tax plus after-tax plus Roth) between the payday being evaluated and the last payday prior to the email, and our explanatory variables are treatment dummies.[9]

We also estimate treatment effects averaged over multiple periods—akin to cumulative abnormal returns divided by the number of cumulating periods—by using as our dependent

[9] We focus on the total contribution rate because it more closely maps to total asset accumulation, which is most relevant for welfare. Using a first-differenced contribution rate as the dependent variable makes our cross-sectional regression equivalent to a two-period panel regression where the dependent variable is the total contribution rate and the explanatory variables are individual fixed effects, a dummy for whether the observation comes after the email date, and a treatment dummy interacted with the post-email dummy. A difference in differences regression specification, which replaces the vector of individual fixed effects with a constant and a treatment dummy, gives an identical treatment effect point estimate but has a larger standard error because it discards information from the data's panel structure.

variable the average total 401(k) contribution rate during the averaging window minus the pre-email total 401(k) contribution rate. The advantage of this approach relative to the individual payday regressions is that it concisely estimates the longer-run impact of the treatment and can have more power to detect small treatment effects that persist for many periods. The disadvantage is that when non-zero treatment effects have a duration that is shorter than the averaging period, statistical power to detect the effect is reduced because the cumulative treatment effect becomes small relative to the cumulative residual variance.[10]

IV. 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.[11] 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 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

[10] Cochrane (1999) gives the following example of the former case: "[Y]ou can predict that the temperature in Chicago will rise about one-third of a degree per day in spring. This forecast explains very little of the day to day variation in temperature, but tracks almost all of the rise in temperature from January to July." An example of the latter case is the presence today of storm clouds 100 miles to the west, which explains much of the precipitation during the next 24 hours but little of the cumulative precipitation over the next six months.

[11] 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.

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.

V. 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 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.[12] 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

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

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 after the bonus but prior to the experiment (March 6, 2009 to November 13, 2009), then the average contribution rate would 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.[13] The average contribution rate then falls slowly afterwards through October 2010, when our second round of emails was sent.

We can use a contemporaneous randomized comparison to estimate the impact of the 2010 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 all delayed control email recipients and the subset of control email recipients who were 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). But the delayed control group subsequently makes up for lost time, contributing more than the control group on

[13] 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.

November 26 and December 10, so that the average total contribution rate in effect from October 29 to December 10 is only 0.2% of income lower (p = 0.711) among the delayed control recipients than the control recipients.[14] Averaging over longer periods of time yields a similar lack of significant differences.[15]

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.[16] However, small changes in the timing of the email relative to the salient reference date has only a transient effect on 401(k) accumulation.

B. Effect of the anchors

The first cue treatment effect we examine 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 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 regression tests of whether the 1% anchor and control group series in Figure 4 differ significantly from each other. 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

[14] 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.

[15] We have tested average contributions until year-end 2010, average contributions until the bonus, the average bonus contribution by itself, and average contributions after the bonus to the end of our sample period.

[16] 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.

level during one payday and at the 1% level during the other two. 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 1% anchor effect integrated over periods of time longer than one payday. Averaged across both individually significant and insignificant paydays, the 1% anchor decreases contribution rates by 0.8% of income ($p = 0.047$) during the seven pre-bonus paydays between November 27 and February 19, has no effect on the bonus payday (+0.05% of income, $p = 0.933$), and decreases contribution rates by 0.8% of income ($p = 0.076$) during the sixteen post-bonus paydays from March 19 to October 15. Because we do not know how large each employee's bonus was, we 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 consistent with previous findings that minor psychological interventions can influence behavior after a significant delay. Research on "mere measurement" (e.g., Morwitz et al., 1993) and the "self-prophecy effect" (e.g., Spangenberg, 1997) has shown that asking people about their future intentions or asking them to predict their future behavior can change their actual behavior months later. For example, Dholakia and Morwitz (2002) find that asking customers of a financial services firm about their satisfaction with their current firm led to an increased likelihood of opening an additional account and a decreased likelihood of ending their relationship with the firm, and these effects *increased* in magnitude for 3 to 6 months after the intervention. Alternatively, our delayed effect may be due not to a single cue exposure's effect growing over time, but to the cumulative impact of multiple exposures that occurred when employees re-read 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 contribution rate 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 (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%.

The 1% anchor effect's disappearance on the bonus payday may be explained by previous laboratory evidence that even tiny discrepancies between the choice domain and the anchor domain are enough to eliminate the anchoring effect. Chapman and Johnson (1994) find that valuation of a good in dollar units responds to dollar anchors but not life expectancy anchors, and valuation of a good in life expectancy units responds to life expectancy anchors but not dollar anchors. Strack and Mussweiler (1997) report that height anchors affect height estimates much more than width estimates, and width anchors affect width estimates much more than height estimates. Our 1% anchor text referred to contribution rates on non-bonus paydays. The company's employees think quite differently about bonus payday contributions versus non-bonus payday contributions, a mindset reflected in the fact that in 2012, the company introduced a new set of 401(k) contribution rate elections so that employees could choose one set of contribution rates that applies only to the bonus payday and another set of contribution rates that applies to non-bonus paydays. The separate mental categories in which the bonus and non-bonus paydays reside may be why the 1% anchor has no effect on bonus payday contributions.

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 rates. Up through the March 11 bonus, there is no consistent ordering 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 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% anchor groups have contribution rates that are lower than the control group's by 0.2% of income (p = 0.451), 0.2% of income (p = 0.458), and 0.1% of income (p = 0.836), respectively. The anchors also have no significant effects on bonus contribution rates.[17] 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—often at the 1% level—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 fact that the anchoring effect does not increase as the anchor rises above 3% is consistent with the laboratory evidence 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.

[17] 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 2010 email recipients chose a dollar amount for their bonus contribution, so the sample loss is small.

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 some 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 the first four paydays after the email, but achieve 5% significance or greater from the fifth to eighth paydays—similar in event time to when the 1% anchor had exerted significant negative effects on average contribution rates in the prior year—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. Before the bonus, the high anchors may have had null effects on average contribution rates because they discouraged some 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, these discouraged recipients may have had enough financial slack to overcome their discouragement and increase their contribution rates.

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 testing the difference between the series in 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, has no effect on the bonus contribution (+0.1%, p = 0.893), and no average effect from the first post-bonus payday to September 2 (–0.2%, p = 0.621). The $7,000 goal has no average effect before the bonus (+0.02%, p = 0.971), no effect on the bonus contribution (–1.5%, p = 0.145), and no average effect after the bonus (+0.3%, p = 0.358).

Although the later (insignificant) 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.[18]

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.[19] 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

[18] 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.

[19] The exception is for the 5% of employees who chose a specific dollar amount to contribute out of their bonus rather than a percentage.

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 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, high 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.[20] 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$).

[20] 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.

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 rate in excess of the October 15, 2010 total contribution rate of the two groups is 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 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 treatments 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, and has large but insignificant positive effects on the bonus payday (+1.4%, $p = 0.153$) and the post-bonus paydays through October 15, 2010 (+0.4%, $p = 0.615$).

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% threshold treatment caused recipients to contribute exactly 60% of their income in any pay period between November 27, 2009 and October 15, 2010.[21] 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.[22] The regressions in Panel A show that among low contributors, those who received the 60% threshold treatment 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

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

[22] 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.

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. 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.[23]

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 is 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 (at least 5.7%) and significant through March 5. Adding the treatment and interaction coefficients together yields a

[23] 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 dummy, the 0% and 1% interactions are large and the other interactions are small or negative.

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.

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, and contrasts with the temporarily demotivating effect of more distant high anchors.

VI. Conclusion

This paper documents that small numerical cues can influence 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.

In many ways this was an unlikely setting for these kinds of 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 a relatively 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 cues. Moreover, the impact of these cues was long-lasting—in some conditions, for up to a year.

Our treatment effects are estimated on a particular sample of employees—people who are generally highly educated, technology savvy, accustomed to making changes in their 401(k), and have a good relationship with the company's management. However, we believe that 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 asset balances and income has on retirement savings plan contributions. But they did randomly vary the graphs used to deliver 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 contribution rate six months after the mailing that was on average 0.19% of income higher than that of those who received the graphs with the lower savings examples.[24]

Our findings provide both an opportunity and a warning for organizations and policy makers. The kinds of cues we investigate could be purposefully used to influence saving behavior more efficiently than through the use of more costly interventions, such as financial education or increases in matching incentives. But even unintentional cues buried in mundane communications can affect behavior. Thus, organizations and policymakers should be mindful of the cues they disseminate.

[24] The magnitude of this treatment effect, a 0.19% of income increase, cannot be directly compared to ours because Goda, Manchester, and Sojourner's graphs were distributed in a paper mailing and were not prominently featured, but appeared on the second page of a four-page brochure. Seventy-six percent of recipients were not enrolled in the savings plan before the mailing; if these recipients wanted to start contributing, they had to mail in a request for an enrollment kit, at which point they would receive the enrollment forms in a few weeks. They would then have to complete these enrollment forms and physically mail them back. Recipients who were already enrolled in the plan had to physically mail in a form to change their contribution rate.

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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 on November 4, 2009 or October 15, 2010 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

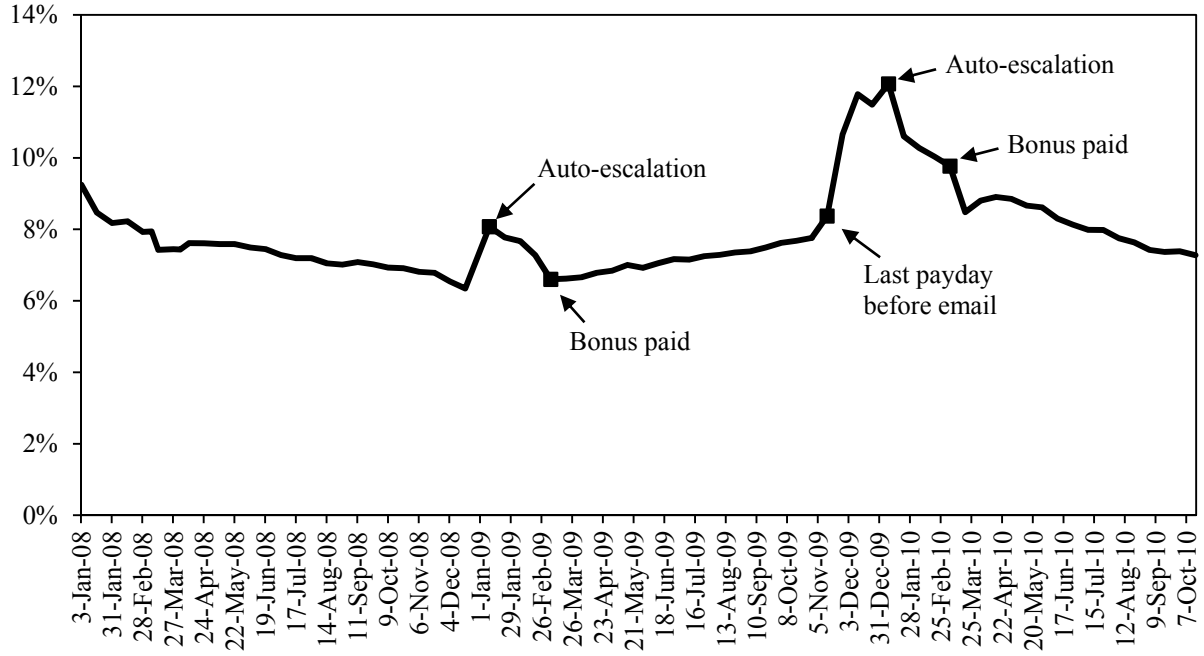


Figure 3. Average total contribution rate in excess of October 15, 2010 total contribution rate, email recipients on pace to contribute $3,000 or more in 2010

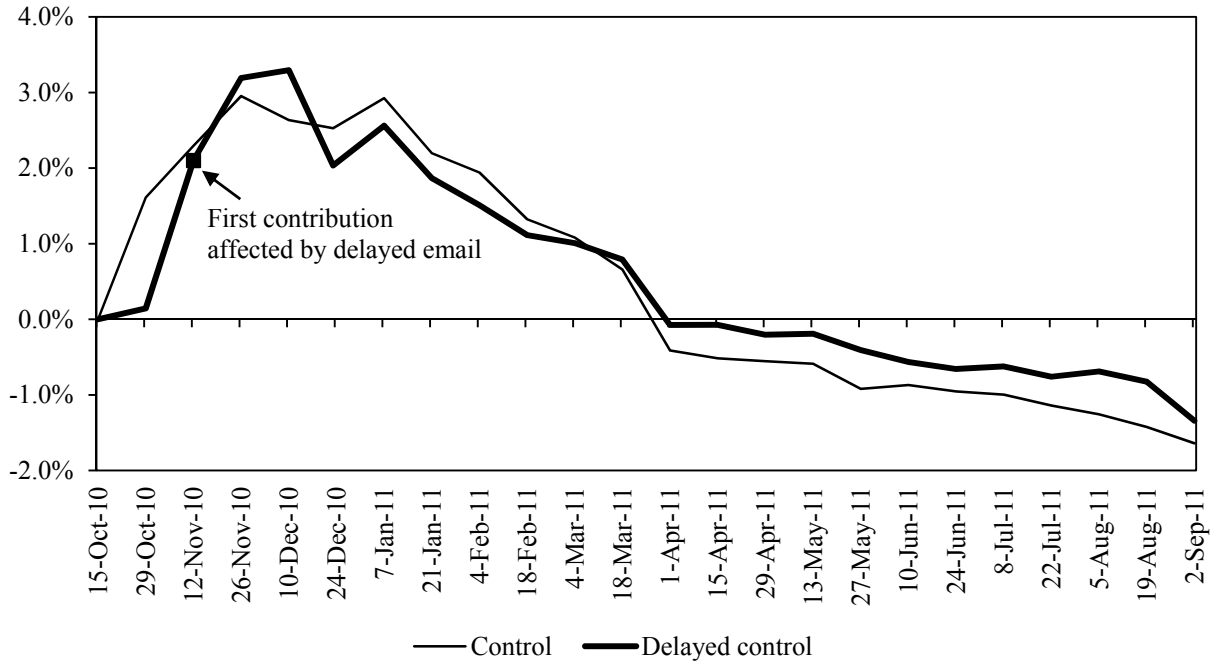


Figure 4. Average total contribution rate in excess of November 13, 2009 total contribution rate, email recipients projected to contribute $5,000 to $16,499 in 2009

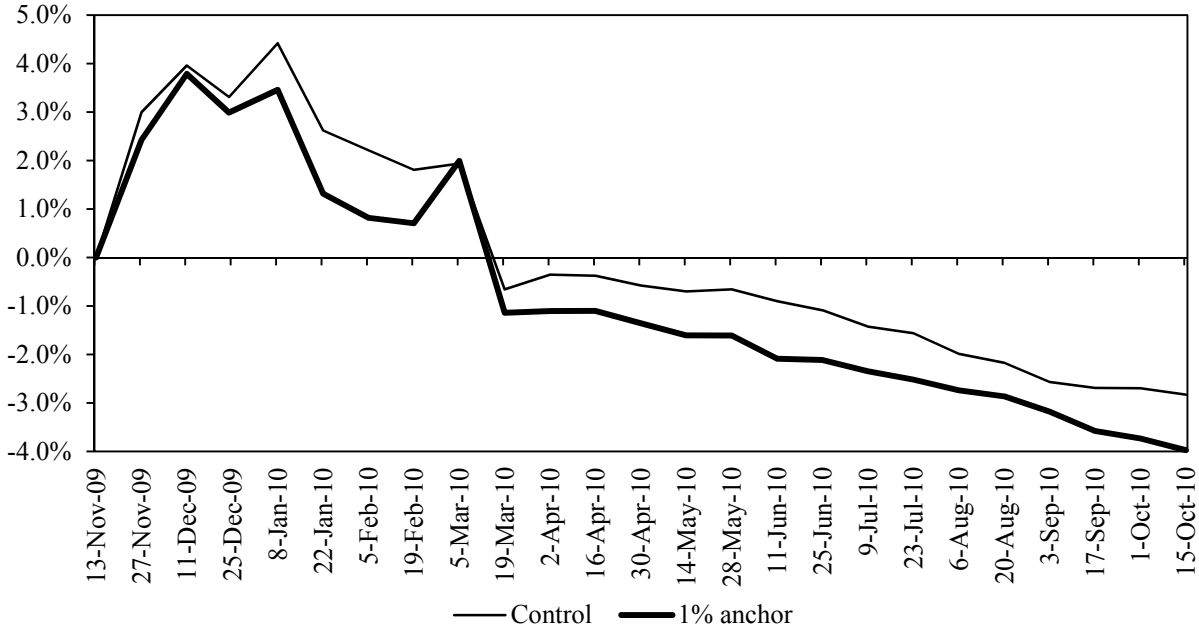


Figure 5. Average total contribution rate in excess of October 15, 2010 total contribution rate, email recipients projected to contribute $6,000 to $16,499 in 2010

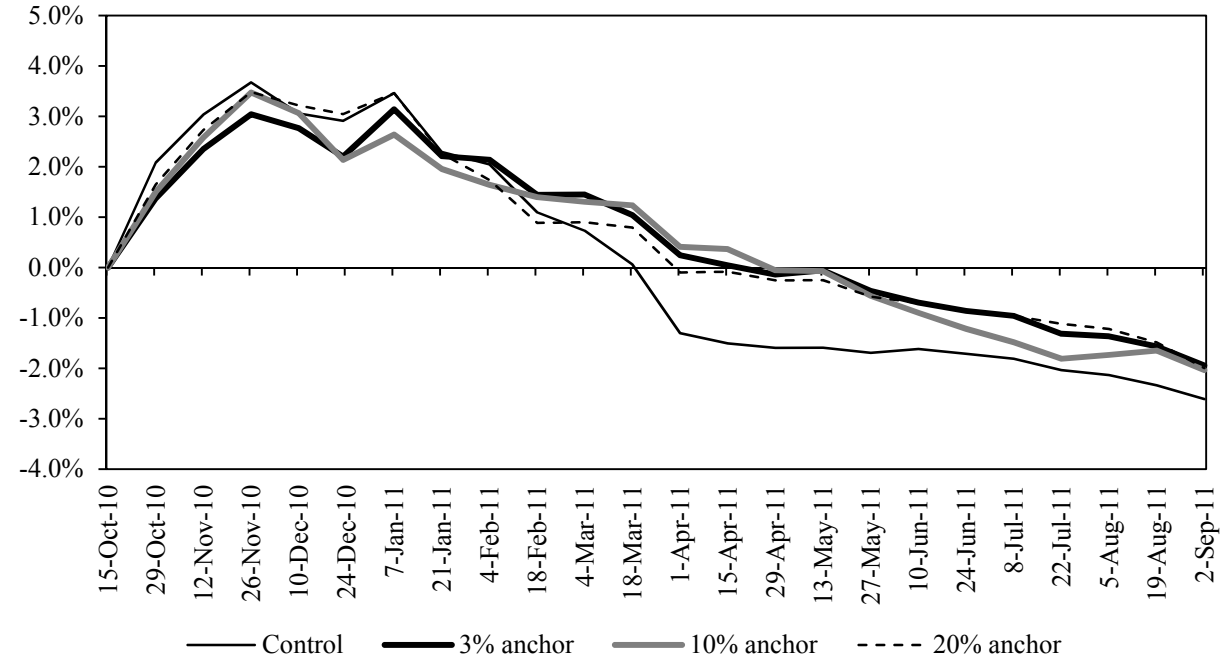


Figure 6A. Average total contribution rate in excess of October 15, 2010 total contribution rate, email recipients projected to contribute $3,000 to $5,999 in 2010

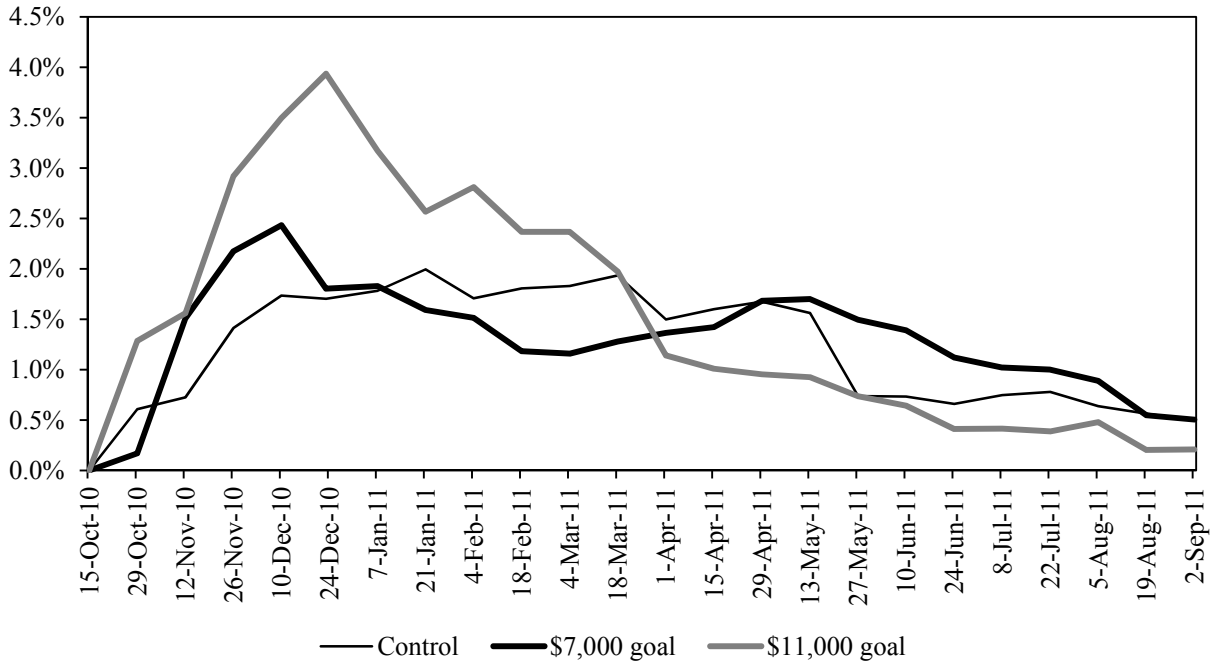


Figure 6B. Adjusted average total contribution rate in excess of October 15, 2010 total contribution rate, email recipients projected to contribute $3,000 to $5,999 in 2010

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.

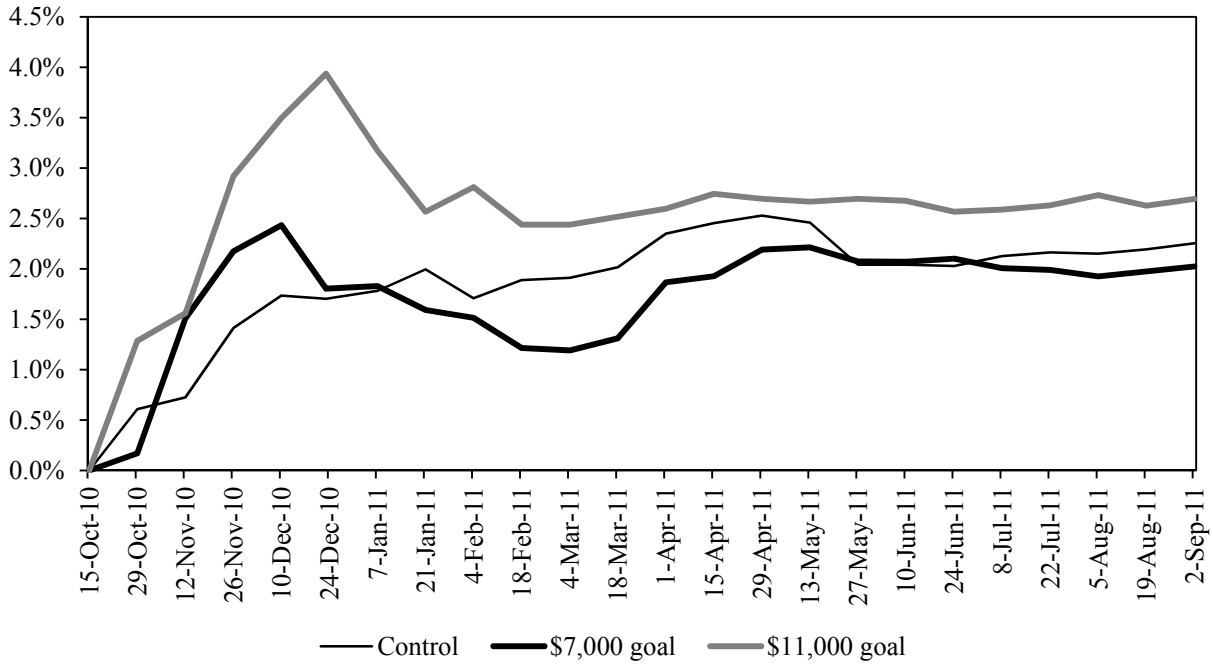


Figure 7. Histogram of total before-tax plus Roth 2010 contributions, email recipients projected to contribute less than $3,000 in 2010

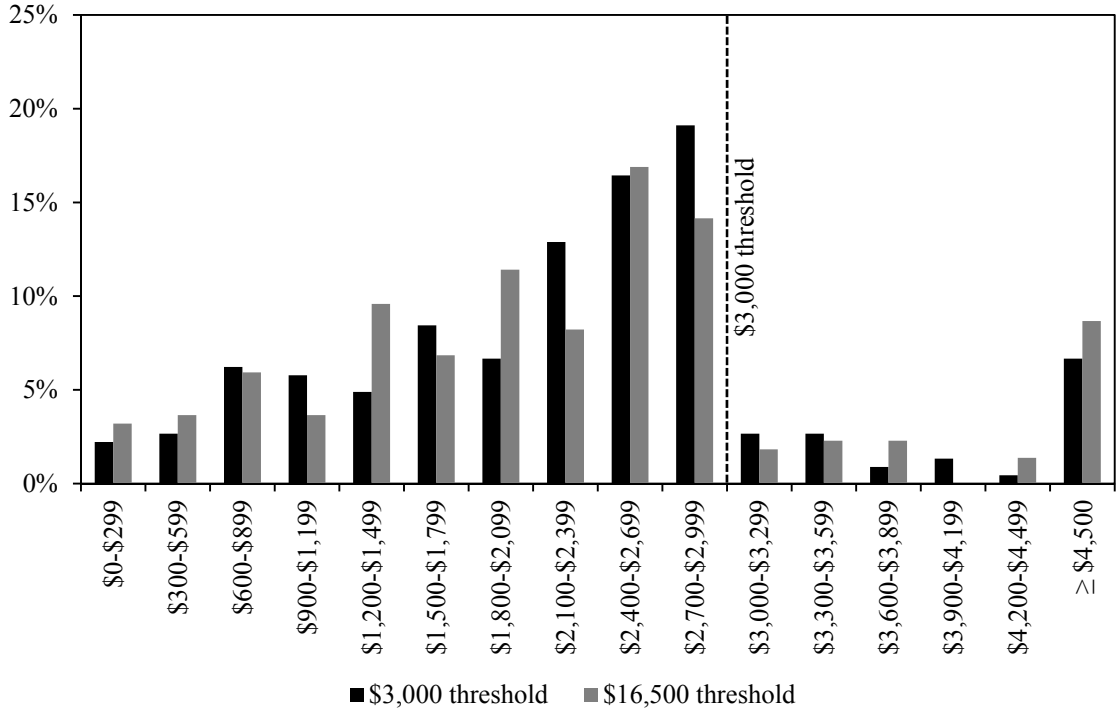


Figure 8. Average total contribution rate in excess of October 15, 2010 total contribution rate, email recipients projected to contribute less than $3,000 in 2010

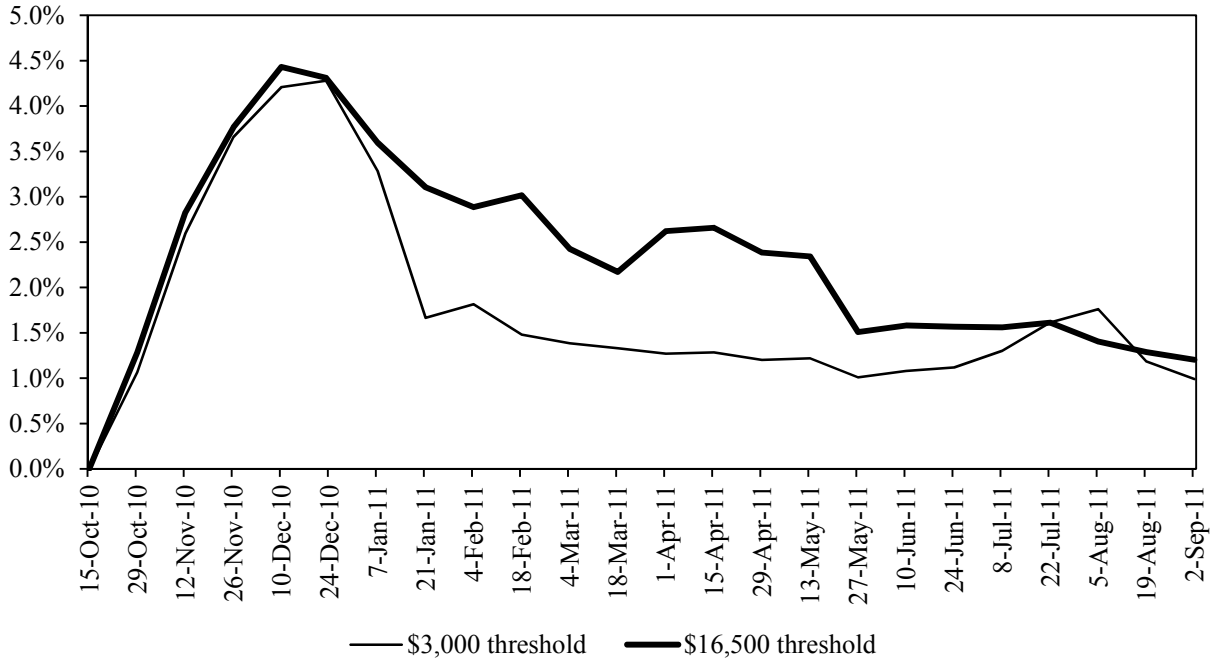
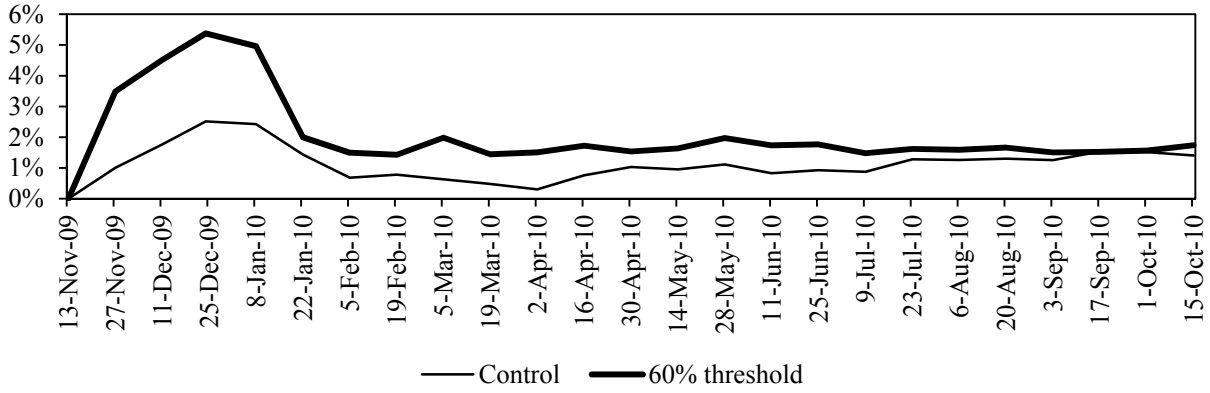
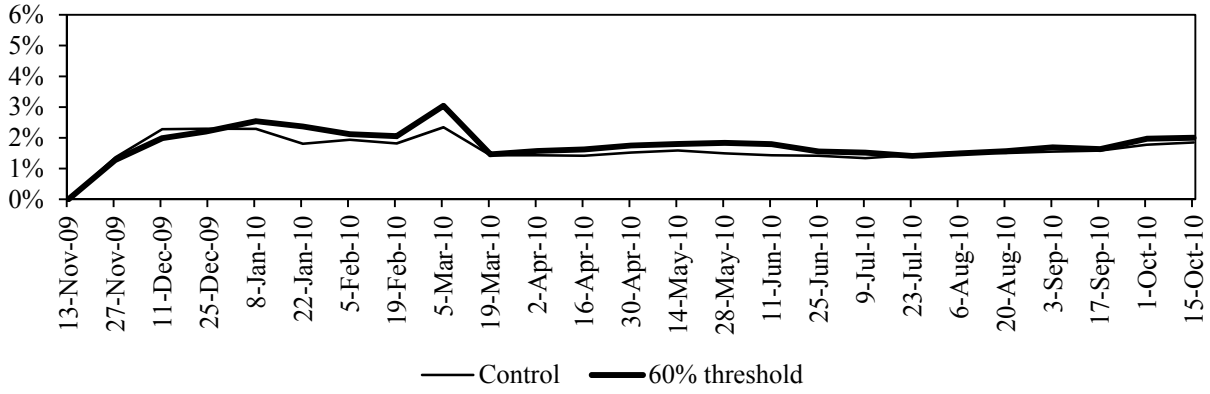


Figure 9. Average total contribution rate in excess of November 13, 2009 total contribution rate

Projected 2009 contributions: $0 - $2,499



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



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