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Reminders through Association

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ABSTRACT

We often fail to follow through on our good intentions. While limited self-control is frequently the culprit, another cause is simply forgetting to enact intentions when opportunities arise. We introduce a novel, potent approach to facilitating follow through: *reminders-through-association*. This approach involves associating intentions (e.g., to mail a letter on your desk tomorrow) with distinctive cues you will encounter when you have opportunities to act on those intentions (e.g., Valentine's Day flowers that arrived late yesterday, which are sitting on your desk). We show that cue-based reminders are more potent when the cues they employ are distinctive relative to (a) other regularly-encountered stimuli and (b) other stimuli encountered concurrently. Further, they can be more effective than written or electronic reminder messages, and they are undervalued and underused. *Reminders-through-association* are a new tool for policymakers and individuals, developed by integrating and expanding on past research on self-control, reminders, and prospective memory.

Imagine that just before drifting off to sleep one night, you suddenly remember that an important application is buried under a stack of papers on your desk at work, and you need to mail it tomorrow. How will you ensure that you remember? Forming an intention is easy; following through is hard. This paper introduces and tests a novel approach to bridging memory gaps and facilitating follow through. The approach relies on (1) identifying distinctive cues that will be present when intentions (e.g., to mail the application) can be enacted, and (2) cognitively associating those cues with the intentions. For instance, when lying awake worrying about the important application buried on your desk, you might deliberately contemplate what distinctive cues near your desk are likely to catch your eye tomorrow when you arrive at work. You may recall that a bouquet of Valentine's Day flowers arrived late yesterday afternoon, which are now decorating your desk – and that they are especially distinctive since flowers rarely grace your desk. The "reminders-through-association" approach to remembering that we introduce here involves cognitively associating mailing the application (buried on your desk) with the sight of the distinctive roses (also on your desk). This association deliberately turns the flowers into a reminder to mail in the application.

Six laboratory and field experiments show that *reminders-through-association* can dramatically increase people's success following-through on their intentions. *Reminders-through-association* are: 1) more potent when they are distinctive relative to other cues encountered concurrently; 2) more potent when they are distinctive relative to other cues encountered in the recent past; 3) more potent than written reminders when encountered in environments with other written signage; and, 4) under-valued and under-used. This last finding suggests that while some people are sophisticated about the value of *reminders-through-association*, many others are naïve about the benefits of this approach to overcoming remembering challenges. This work introduces and evaluates a new tool for facilitating follow-through with clear applications for individuals and policy makers (Thaler and Sunstein, 2003). It also highlights two dimensions of cue distinctiveness that increase the impact of reminders, offers new insights into the workings of prospective memory, and extends knowledge about actors' self-awareness of their own limits and willingness to act on that self-awareness (O'Donoghue and Rabin, 1999).

FOLLOW-THROUGH FAILURES

Many of our most important problems can be attributed, at least in part, to failures to enact our intentions. For instance, despite our good intentions, we often eat poorly; fail to exercise or vote in elections; and neglect to complete and return tax forms, savings forms, and homework assignments. Unanticipated obstacles sometimes contribute to follow-through failures, and self-control failures can also prevent success (e.g., see Ariely and Wertenbroch, 2002; Read et al., 1999; Milkman et al., 2009; Read and Van Leeuwen, 1998; Soman and Cheema, 2011; Rogers and Bazerman, 2008). However, most pertinent to *reminders-through-association* is the fact that people sometimes simply fail to *remember* to enact their intentions (e.g., get a flu shot) at opportune moments (e.g., on the day when flu shots are offered at work).

Self-control research provides a useful framework for understanding people's sophistication (or lack thereof) about the psychological frailties that can produce follow-through failures. Some people are sophisticated (while others are naïve) about the struggles they will face successfully exerting self-control in the future (O'Donoghue and Rabin, 2001).

Sophisticated individuals can, and often do, take steps to overcome limited self-control. Anticipating that they may not follow through on their intentions, they value and adopt commitment devices, which increase the future costs of failing to follow-through (e.g., taking the medication Antabuse in the morning to induce vomiting if alcohol is consumed later in the day; Ashraf et al., 2006; Schwartz et al., 2014; Milkman et al., 2014; Rogers et al., 2014).

Notably, people can also be sophisticated about the risk that future memory failures will undermine their efforts to follow-through on good intentions (Ericson, 2011). One strategy sophisticates can deploy to solve this problem is to set up reminders, or strategic tools that direct their attention in the future to their previously formed intentions. Traditional reminders deploy messages shortly before intentions can be enacted and have been shown to effectively facilitate follow through in a wide range of contexts, from medical care (Shea, DuMouchel and Bahamonde, 1996) to savings (Karlan et al, 2014). However, to be highly effective reminders must have at least two features that are often challenging to achieve. First, they must be "delivered" at precisely the relevant future moment when a previously formed intention can be enacted, as arriving even a few minutes before action is possible can render reminders ineffective (Austin, Sigurdsson & Rubin, 2006). Second, they must capture people's limited attention in that future moment (Bazerman, 2014; Simons and Chabris, 1999). In light of these challenges, traditional reminder messages are sometimes not effective (e.g., Nickerson, 2007; Austin et al, 2006).

We introduce a new tool that should be valued by "memory sophisticates" or those who recognize that memory failures may obstruct their ability to follow-through on some intentions. *Reminders-through-association* build on the success of traditional reminders but differ as the only technology they require is human memory. They are "delivered" precisely at the relevant future moment by design: notable cues encountered in the moment when intentions can be enacted are repurposed to serve as reminders with associative memory serving as the delivery technology. Examples of *reminders-through-association* include telling yourself you will (a) get a flu shot on the day when you first see Halloween candy on sale at your local pharmacy or (b) remember to pay your utility bill online when you change the month on the calendar in your kitchen or (c) get your running shorts out of the dryer in the morning to bring to work when you see the kitchen stool placed in front of the door to your garage.

Past memory research suggests *reminders-through-association* should reduce follow-through failures. First, cues linked with a memory induce recall of that memory; many argue that there can be no recall without cues (James, 1890; Jones, 1979; Tulving, 1974). A cue is any prompt that triggers memory recall. Cues can be as explicit as verbal reminders – "Remember to click 'YES' on the next page" – or they can be nonverbal (e.g., the smell of cookies baking may remind you of childhood). *Reminders-through-association* involve deliberately associating your intentions – which can be thought of as a memory to be recalled in a specific future moment – with a cue that will be situated in the future moment when your intentions can be enacted.

The *reminders-through-association* approach builds on past research examining how the distinctiveness of cues that are noticed affects recall of associated memories. Past research suggests that cue distinctiveness is a function of how rarely a cue has been encountered historically, and how noticeable a cue is when it is encountered. Cues that have rarely been encountered before are more likely to trigger accurate recall of an associated memory than more common cues. This is because rarer cues will have relatively fewer other associations that might be triggered when they are noticed (Anderson, 1983). However, even relatively common cues

can be made more or less distinctive based on the contexts in which they are encountered. Cues that are relatively dissimilar from other stimuli that are encountered concurrently, or that have been encountered in the recent past, are more likely to trigger the recall of associated memories (McDaniel & Einstein, 1993; Brandimonte & Passolunghi, 1994).

Six experiments explore the benefits, limitations and demand for *reminders-through-association* (Studies 1-5). We show that cue distinctiveness moderates the effectiveness of *reminders-through-association* (Studies 2a and 2b), *reminders-through-association* can be more effective than written reminder messages in environments cluttered with other written signage (Study 3), *reminders-through-association* can meaningfully increase follow-through in the field (Study 4), and, in at least some settings, people under-value and under-use *reminders-through-association* (Study 5).

Study 1: Can *Reminders-Through-Association* Facilitate Follow-Through?

Study 1 examines whether *reminders-through-association* successfully facilitate follow through on intentions in a laboratory setting.

Participants.

This study was embedded within a series of other laboratory studies conducted by other researchers. That series of studies recruited eighty-seven people through advertisements in campus newspapers at several large Northeastern universities to participate in a paid hour-long series of studies. The sample size was determined based on the needs of the researchers coordinating the laboratory session.

Method.

Participants completed an hour-long series of studies in a computer laboratory; our experiment was embedded within this larger study session. All participants were randomly assigned by the survey platform to one of two experimental conditions: the *reminders-through-association* condition or the *control* condition. All participants first viewed a page on their computer terminal that read:

> *As you collect your payment at the end of this [Name of Research Laboratory Here] session you will have an opportunity to have additional $1 donated to Greater Boston Food Bank on your behalf. This will be extra and will not affect your direct cash compensation. There will be a small stack of paperclips on the counter as you are leaving. In order for $1 to be donated you will need to silently pickup one of these paperclips and take it with you.*
>
> *Do you intend to do this action when you leave in order for Greater Boston Food Bank to receive the $1 donation?*

All participants then advanced to a second screen. The message on the second screen varied by condition. In subsequent analyses we include only participants who reported intending to take the action needed to have the money donated to the Greater Boston Food Bank (89% reported having the intention). Results are unaffected by including those who did not have this intention. We exclude those who did not have the intention because our primary research question examines the use of *reminders-through-association* specifically to help people follow through on their intentions. Since experimental conditions were assigned independent of

responses to the intention question, unsurprisingly the proportion of participants having that intention did not differ by condition, $t(85)=1.23$, $p=.22$. Participants in the *reminders-through-association* condition read:

> *Thank you! To remind you to pick up a paperclip, an elephant statuette will be sitting on the counter as you collect your payment. Here is an image of it:*

Those in the *control* condition simply read: "*Thank you!*"[1]

Participants collected their payment at the end of the session from a lab manager who stood behind a counter on which both the paper clips and the elephant statuette were displayed. The lab manager recorded which participants picked up a paper clip.

Results.

As described above, only those 77 participants who reported intending to perform the behavior required to make the donation were included in our study. Those in the *reminders-through-association* condition performed the intended behavior at a significantly higher rate (74%, 29 out of 39) than did those in the *control* condition (42%, 16 out of 38), χ^2 (77) = 8.2, p = .004.

Discussion.

Study 1 confirms that *reminders-through-association* can reduce follow-through failures.

Study 2: Cue Distinctiveness Moderates the Effectiveness of *Reminders-Through-Association*

Studies 2a and 2b examine whether more distinctive cues produce more effective *reminders-through-association*, as hypothesized based on past prospective memory research (Anderson, 1983; McDaniel & Einstein, 1993; Dismukes, 2012). Study 2a examines how what

[1] A superior design would have included the statement *"Thank you, please remember to pick up your paper clip."* in the *control* condition to be more parallel with the *reminders-through-association* condition. This imperfection in Study 1's design is addressed by the subsequent studies, which maintain more perfectly parallel instructions across conditions.

we call "sequential distinctiveness" impacts the effectiveness of cues used as *reminders-through-association*. We define a cue as sequentially distinctive when it differs from other cues encountered in the recent past. Study 2b examines how what we call "concurrent distinctiveness" affects the effectiveness of cues used as *reminders-through-association*. We define a cue as concurrently distinctive when it differs meaningfully from other stimuli encountered simultaneously (e.g., in the same environment). Together these studies make two points. First, they show that distinctive cues are more effective than other cues when used as *reminders-through-association*. Second, they show that what makes a cue distinctive is affected by at least two aspects of the cue's context: what is encountered before it, and what is encountered simultaneously.

Study 2a: Sequentially Distinctive *Reminders-Through-Association*

Participants.

Participants were recruited through MTurk to complete a ten-minute online survey for which they were paid $0.75. Only MTurk workers located in the US who had not participated in previous similar studies were eligible. The aim was to recruit nine hundred participants, a sample size chosen ex ante based on expected effect sizes from a pilot study. A total of nine hundred and twenty participants (53% male, M_{age}=33) completed the study before it was closed.

Method.

All participants were randomly assigned by the survey platform to one of two experimental conditions: the *distinctive reminder-through-association* condition or the *indistinctive reminder-through-association* condition. All participants first encountered a page that displayed the following message:

> *In this survey you will have an opportunity to support to a charitable organization called Gardens for Health that provides lasting agricultural solutions to address the problem of chronic childhood malnutrition.*
>
> *Do you plan to follow the directions to support the charity? You will not lose any compensation for doing so.*

All participants then advanced to a second screen. As with Study 1, we include in subsequent analyses only participants who reported intending to take the action needed to have the money donated to Gardens for Health (72% reported having the intention). Results are unaffected by including those who did not have this intention. Since experimental conditions were assigned independent of responses to the intention question, unsurprisingly the proportion of participants having that intention did not differ by condition, $t(918)=1.05$, $p=.29$. The second page contained the following information:

> *In this survey you will have an opportunity to support a charitable organization called Gardens for Health that provides lasting agricultural solutions to address the problem of chronic childhood malnutrition.*
>
> *On the 12th page of this survey, please choose answer "A" for the last question on that page, no matter your opinion. The previous page is Page 1. You are now on Page 2. The*

next page is Page 3.

The picture below will be on top of the NEXT button on the 12th page. You are now on Page 2. The next page is Page 3. This is intended to remind you to select answer "A" for the last question on that page.

If you follow these directions, we will donate $0.30 to Gardens for Health.

Participants then went on to answer ten pages of survey questions that were copied from another study as a filler task. In order to retain participant attention in the filler survey, participants were told that "Some of the questions in this survey have correct answers. You will earn a $.03 bonus for each correct answer. These questions will be marked with a "$$" before the question." Five of these questions were included in the ten page survey. For those assigned to the *distinctive reminder-through-association* condition, the "next" button on the first nine of these pages was covered by one of a set of cartoonish animals, none of which were elephants. The specific cartoon elephant associated with the intention to donate replaced the "next" button on the tenth page of the filler survey (12th page overall). For those assigned to the *indistinctive reminder-through-association* condition, the "next" button on the first nine of filler survey pages was covered by one of a set of cartoonish elephants, each of which differed from the specific elephant image associated with the donation intention. The specific cartoon elephant associated with the intention to donate replaced the "next" button on the tenth page of the filler survey (12th page overall). In this way, animals overlaid the "next" button for the first nine pages of the filler survey in both conditions. The animals in the *indistinctive reminder-through-association* condition were all different variations of cartoonish elephants, thus rendering the specific elephant image associated with the intention to donate relatively indistinctive. The animals in the *distinctive reminder-through-association* condition were all non-elephants, therefore rendering the specific elephant image associated with the intention to donate relatively distinctive (sequentially distinctive, to be precise). See Figure 1 for the actual images.

FIGURE 1. Sequentially Distinctive and Indistinctive Cues

Indistinctive.

Distinctive.

Results.

Seventy-four percent of those in the *distinctive reminder-through-association* condition (252 out of 342) performed the intended behavior, whereas 53% of those in the *indistinctive reminder-through-association* condition followed through (170 out of 319), χ^2 (1, N=661) = 29.73, p<.001.

Study 2b: Concurrently Distinctive *Reminders-Through-Association*

Participants.

Participants were recruited through MTurk to complete a five-minute online survey for which they were paid $0.50. Only MTurk workers located in the US, who had not participated in previous similar studies, had a standard HIT approval rating of 95%, and had 1,000 or more approved HITs were eligible. The goal was to recruit four hundred participants, a sample size chosen ex ante based on expected effect sizes from a pilot study. Four hundred and twelve participants (48% male, M_{age}=31) completed the study.

Method.

All participants first encountered a screen that displayed the following message:

> *In this survey you will have an opportunity to support to a charitable organization called Gardens for Health that provides lasting agricultural solutions to address the problem of chronic childhood malnutrition.*
>
> *Do you plan to follow the directions to support the charity? You will not lose any compensation for doing so.*

Only participants who reported intending to take the action needed to have the money donated to Gardens for Health advanced to the next screen (80% reported having the intention). Those who did not report having the intention were not permitted to continue with the survey. Participants were then randomly assigned by the survey platform to one of two conditions: the *distinctive reminder-through-association* condition or the *indistinctive reminder-through-association* condition. The next screen presented the following information to participants in both conditions:

> *In this survey you will have an opportunity to support a charitable organization called Gardens for Health that provides lasting agricultural solutions to address the problem of chronic childhood malnutrition.*
>
> *After this page you will begin a survey composed of 10 pages. The pages are not numbered. Each page contains one image and one question about that image.*

We will donate $0.30 to Gardens for Health if you select the response option "None of the above" on the 10th page. To help you remember to click "None of the above" on the 10th page, the following stuffed animal will be part of the image.

Participants then answered nine pages of survey questions that were copied from another study as a filler task. The filler task included one image per page, and one question about that image on the same page. A variety of stuffed animals were included in images on four of the nine filler pages. None of the stuffed animals appeared more than once on the filler pages.

In both experimental conditions, on the 10th page where the *reminder-through-association* cue (the stuffed bear) was included, participants viewed an image of a cash register at a coffee shop adorned by the stuffed bear. The images in both experimental conditions also included a sign that read: *"Cash Only/For all purchases under/$10"*as well as another, blurry sign. Participants were asked: *Which of the following can you most likely order at this cashier?* Participants could choose from *coffee, beer, smoothie,* or *none of the above.* If participants remembered the directions from their intention to donate, they would choose *none of the above.*

The difference between conditions in this experiment was whether or not additional stuffed animal stimuli surrounded the cash register besides the stuffed bear (see Figure 2 for the actual images). In the *indistinctive reminder-through-association* condition, four other stuffed animals that had appeared in images supplied on previous filler pages also adorned the cash register, thus rendering the specific stuffed animal associated with the intention to donate relatively indistinctive from other simultaneously occurring stimuli. In the *distinctive reminder-through-association* condition, the stuffed bear cue was the only stuffed animal in the 10th page image, rendering the specific stuffed animal associated with the intention to donate relatively distinctive from other simultaneously occurring stimuli.

FIGURE 2. Distinctive and Indistinctive Cues

Indistinctive.

Distinctive.

Results.

Eight-two percent of those in the *distinctive reminder-through-association* condition (133 out of 163) performed the intended behavior, whereas 70% of those in the *indistinctive reminder-through-association* condition followed through (116 out of 165), χ^2 (1, N=328) = 5.72, p<.017.

Discussion.

Which cues are associated with intentions to follow-through impacts the effectiveness of *reminders-through-association.* Studies 2a and 2b examine two types of cue distinctiveness, and show that more distinctive cues make more effective *reminders-through-association.* We

propose that distinctiveness increases cues' likelihoods of being noticed, which increases the effectiveness of those cues when used as *reminders-through-association.* These studies also shed light on whether *reminders-through-association* work entirely because of what occurs when intentions are associated with cues (e.g., the encoding process). Each study associated an intention with a cue in exactly the same way across experimental conditions. Each study's experimental conditions only differed in how distinctive the cue ended up being when participants later encountered it. This shows that the effectiveness of *reminders-through-association* is not entirely driven by the encoding process, but rather it is at least in part a result of improving people's recall of their intentions.

Study 3: *Reminders-Through-Association* Can Dominate Written Reminders

Traditional written reminder messages can sometimes effectively promote follow-through (e.g., Karlan et al, 2014), but not always (e.g., Nickerson, 2007). While in some cases, written reminders may render *reminders-through-association* unnecessary, one context in which traditional written reminders may be less valuable than *reminders-through-association* is when they are posted in environments with many other similar, written signs that compete for attention. That is, when they are not concurrently distinctive. Study 3 compares *reminders-through-association* with traditional, written reminder messages in a visual context concurrently crowded with many other written messages.

Participants.

Participants were recruited through MTurk to complete a five minute online survey for which they were paid $0.50. Only MTurk workers located in the United States who had not participated in previous similar studies were eligible. The study was opened to 250 participants, a sample size that was pre-determined based on pilot testing. Two hundred and forty-nine participants completed the study before it was closed (59% male, M_{age}=32).

Method.

All participants first read the following message on their screen:

> *In this survey you will have an opportunity to support a charitable organization called Gardens for Health that provides lasting agricultural solutions to address the problem of chronic childhood malnutrition.*
>
> *Do you plan to follow the directions to support the charity? You will not lose any compensation for doing so.*

Only participants who reported intending to take the action needed to donate to Gardens for Health were included in the study (76% reported having the intention). Those who did not report having the intention were not permitted to continue with the survey. Participants were then randomly assigned by the survey platform to one of three experimental conditions before the next screen: the *reminder-through-association* condition, the *written-reminder-message* condition or the *control* condition. The next screen for participants in the *control* condition read:

> *In this survey you will have an opportunity to support a charitable organization called Gardens for Health that provides lasting agricultural solutions to address the problem of chronic childhood malnutrition.*

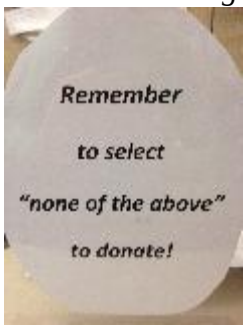
After this page you will begin a survey of 10 questions.

On the 10th question, please choose the answer "none of the above," no matter your opinion.

If you follow these directions, we will donate $0.30 to Gardens for Health.

Participants in the two treatment conditions read the same text as those in the *control* condition, except that above the final line of text was an additional line of text and an image. In the *written-reminder-message* condition, this additional line of text and image were as follows:

There will be a sign with this instruction to remind you:



In the *reminder-through-association* condition, the additional line of text and image were as follows:

There will be a picture of this alien to remind you:

All participants then viewed the same nine pages, each with a picture of a store check-out counter and a single survey question about the picture. Six of these pictures of store check-out counters included visible written signs. The picture on the tenth page was the same across conditions except for a single feature (see Figure 3 for exact images). Those in the *control* condition viewed a picture of a store counter with a cash register and no reminder message and no other flyers or promotional signs. Those in the *written-reminder-message* condition viewed the same picture of a store counter with a cash register, but it also contained a written reminder message as well as other flyers and promotional signs. Those in the *reminder-through-association* condition viewed the same picture of a store counter with a cash register and flyers and promotional signs as those in the *written-reminder* condition, except in place of the written reminder message it contained the distinctive cue image that had been associated with the intention to click the "None of the Above" option (e.g., the alien). The question asked on this page was "Can you pay with a credit card at this store?" and the response options were "Yes," "No," and "None of the Above."

Figure 3. Tenth Page in Study 3.

A. Cash register image displayed in the *control* condition

B. Cash register image displayed in the *written-reminder-message* condition

C. Cash register image displayed in the *reminder-through-association* condition

The alien cue in the *reminder-through-association* condition was more sequentially and concurrently distinctive than the written reminder posted in the *written-reminder-messages* condition. Six of the preceding nine pages of images included written messages posted, whereas none of the nine preceding images included aliens or stuffed animals. This rendered the alien cue shown in the *reminder-through-association* condition more sequentially distinctive than the written reminder shown in the *written-reminder-message* condition. Additionally, since the tenth image included several irrelevant written messages across treatment conditions, the alien cue in the *reminder-through-association* condition was more concurrently distinctive than the written reminder posted in the *written-reminder-message* condition.

Results.

Participants in the *reminder-through-association* condition performed the intended behavior at a higher rate (92%) than those in both the *written-reminder-message* condition (78%), χ^2 (1, N=126) = 5.02, p=.025 and those in the *control* condition (71%), χ^2 (1, N=126) = 8.99, p=0.003. There was no significant difference in the rate of follow-through between participants in the *control* condition and the *written-reminder-message* condition, χ^2 (1, N=126)=.670, p=.413.

Discussion.

While written reminders can sometimes be highly effective (e.g., Karlan et al, 2014), in environments with many stimuli competing for attention, *reminders-through-association* can be more effective than written reminder messages.

Study 4: *Reminders-Through-Association* in a Field Setting

Study 4 is a field experiment examining the efficacy of *reminders-through-association* in a stimulus-rich environment: a coffee shop.

Participants.

Participants were five hundred customers of Crema Café (a coffee shop located in Cambridge, Massachusetts) who exited the cafe between the hours of 7 a.m. and 2 p.m. on Tuesday, May 14, 2014. In coordination with the café's owner, participants were recruited by two research assistants who stood outside of the cafe handing out coupons attached with a paper clip to a flyer that contained condition-specific information. Five hundred was the pre-determined number of materials printed before the study began based on estimates of how many patrons visit the coffee shop on a typical day before mid-afternoon. Administrative records show that the café had 807 total checks during the time window when the coupons were distributed.

Method.

When a customer walked out of the café, a research assistant asked, "Would you like $1 off your purchase on Thursday?" If the customer agreed, he or she received a $1-off coupon paper-clipped to a flyer. The vast majority of customers approached accepted the coupon. Among those who declined, the most common explanations provided to the research assistants were that they would not be coming to the cafe on the following Thursday or that they did not want to stop as they were exiting the cafe. Importantly, customers were not exposed to experimental materials until after they agreed to accept a coupon.

Every customer received the same coupon, which explained that they would receive $1 off their purchase on Thursday (see Figure 4), which was two days in the future. The flyer to which the coupon was affixed varied by experimental condition. Participants received one of two flyers that were randomly sorted. Both flyers reminded participants: "When you see the cash register on Thursday, remember to use this coupon." Both flyers also thanked participants for being a customer and reminded them to recycle their flyer. The *reminder-through-association* flyer (see Figure 5a, N=246) differed from the *control* flyer (see Figure 5b, N=254) in that it also featured a picture of a stuffed alien and the text "To remind you Thursday, this will be on the cash register." Thus, those who received the *reminder-through-association* flyer were thus instructed to cognitively associate the stuffed alien with their intention to use the coupon, whereas those who received the *control* flyer were not.

Two days later, on the Thursday when coupons could be redeemed, a stuffed alien, as pictured on the *reminder-through-association* flyer, was positioned on both of the cash registers in the café. This made the stuffed alien visible to all customers as they paid for their purchases, regardless of condition (see Figure 6). Thus, the cue was visible to everyone, but it only served as a reminder to use the coupon for those who received the *reminder-through-association* flyer. The two conditions differed only in whether the stuffed alien cue was linked with the intention to redeem the coupon. Customers who presented a coupon to the cashier received $1 off their purchase.

Figure 4. Coupons presented to Study 4 participants.

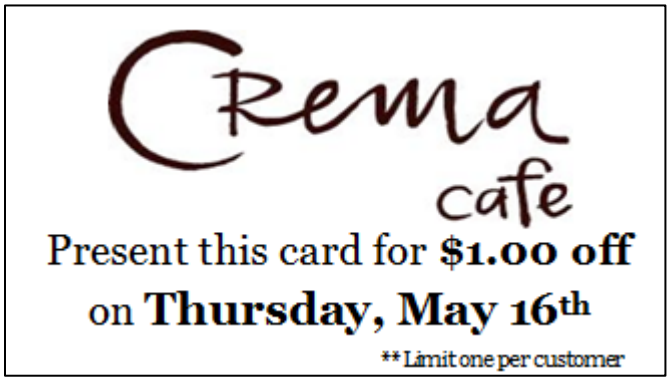


Figure 5. Flyers to which coupons were affixed in Study 4, which varied by experimental condition.

A. *Reminder-through-association*

When you see the cash register on Thursday, remember to use this coupon.

Please Recycle this piece of paper.

To remind you Thursday, this will be on the cash register:

Thanks for being a Crema Customer!

B. Control

When you see the cash register on Thursday, remember to use this coupon.

Please Recycle this piece of paper.

Thanks for being a Crema Customer!

Figure 6. Stuffed alien displayed in front of Crema Café's cash register on the date when coupons could be redeemed (Study 4).

Results.

Twenty-four percent of customers who received a *reminder-through-association* flyer redeemed the coupon for $1 off their purchase on the following Thursday as compared to just 17% of customers who received the *control* flyer $\chi^2(1, N=500)= 3.01$, $p=.083$. This 36% increase in coupon use is marginally significant using a two-tailed test, and reaches standard levels of significance using a one-tailed hypothesis test. While a one-tailed test may be most appropriate given that theory and previous experiments informed a directional hypothesis, we report the more conservative test here.

Discussion.

This study shows how *reminders-through-association* can be harnessed by firms (or policymakers) to help people follow through on their intentions in the field. By ensuring that distinctive cues are appropriately placed, informing people in advance about the cues, and creating an association between the cues and intentions, follow-through failures can be reduced.

Study 5: Are People Sophisticated about the Value of *Reminders-Through-Association*?

Study 5 seeks to understand people's sophistication (or lack thereof) about their limited memory, building on work showing that many people are sophisticated about another psychological failing: their limited self-control (Rabin & O'Donague, 1999). Those who are sophisticated about their limited memory should value *reminders-through-association* while naïfs should not.

Participants.

Six-hundred-and-five participants were recruited through MTurk to complete a fifteen-minute survey online (56% male, M_{age}=34) for which they were paid $1.00. Only MTurk workers located in the United States who had not participated in previous similar studies were eligible. The unique design of this study (involving participants paying for *reminders-through-association*) meant that the other studies in this manuscript were of little help in estimating the sample size needed for this study. Pilot tests were used to determine the study's sample size, suggesting that at least six hundred participants were needed.

Method.

All participants were given a $0.06 bonus at the beginning of the study. They then completed two pages of filler questions in a single, lengthy survey. One of these questions explained that *"Some of the questions in this survey have correct answers. You will earn a $.03 bonus for each correct answer. These questions will be marked with a "$$" before the question."* There were four such bonus questions included to ensure that participants paid attention to the questions they were asked on the survey and put effort into answering them. All participants were then told that they could earn a $0.60 bonus if they selected Choice "E" on the last question of page 11 of the survey.

Participants were then randomly assigned by the survey platform to one of four experimental conditions to assess the extent to which they valued and benefitted from *reminders-through-association*. The first two experimental conditions resemble the experimental conditions in the previous studies. Participants in the *all-reminders-through-association* condition saw a page on which they were told that an image of an elephant (which was displayed to them on the page) would appear at the bottom of page 11 of their survey to remind them to select Choice "E" on that page. Participants assigned to the *none* condition were not told about, offered, or provided with any opportunity to use an elephant as a reminder on page 11. This *none* condition provided a baseline assessment of what proportion of the sample would follow through without any reminders available. Contrasting the *none* condition with the *all-reminders-through-association* condition allowed us to replicate the basic design of the previous studies where *reminders-through-association* were either made available to no one or to everyone.

There were two "new" conditions in this study. Participants in the *costly-reminders-through-association* condition saw a page on which they were offered the opportunity to pay $0.03 to have the image of the elephant (which was displayed to them on the page) replace the "next" button at the bottom of page 11 of their survey in order to remind them to select Choice "E" on that page. This condition assessed the proportion of participants who were sophisticated about the value of *reminders-through-association*. Finally, participants in the *free-reminders-through-association* condition saw a page on which they were offered the opportunity, at no cost,

to opt into having the image of the elephant (which was displayed to them on the page) at the bottom of page 11 of their survey in order to remind them to select Choice "E" on that page. This condition assessed how many participants would proactively use a reminder-through-association if it were provided free-of-charge. *Free-reminders-through-association* and *all-reminders-through-association* differed in that those assigned to *free-reminders-through-association* had to actively choose to use the reminder-through-association, whereas participants assigned to *all-reminders-through-association* were universally exposed to the reminder-through-association. Contrasting takeup of *reminders-through-association* in the *free-reminder-through-association* condition with takeup in the *costly-reminder-through-association* condition allowed us to compare demand for *reminders-through-association* at two prices ($.03 and $0.00).

All participants proceeded through the questionnaire after being exposed to information about what to expect on page 11.

Results.

Table 1 shows the percentage of participants in each condition who elected to use the elephant cue and the percentage of participants in each condition who earned the bonus on the survey's 11th page.

Table 1. Study 5 Choices and Outcomes.

Experimental Condition	Distinctive Cue Take-up	Earned $0.60 Bonus	Avg. Earnings Per Participant
All-reminders-through-association (N=152)	100% N=152	87% N=132	$0.52 (SE=.02)
None (N=153)	N/A N=153	59% N=90	$0.35 (SE=.02)
Costly-reminders-through-association (N=144)	53% N=77	74% N=106	$0.43 (SE=.02)
Free-reminders-through-association (N=156)	92% N=143	90% N=141	$0.54 (SE=.02)

Study 5 first replicates the results of the previous studies, finding that participants are more likely to follow through when they are assigned a reminder-through-association (in the *all-reminders-through-association* condition, 87%) than when no reminder-through-association is available (*none* condition, 59%; $\chi^2(1, N=305)=30.22$, $p<.001$).

This study also shows that some participants valued reminders created through associations with distinctive cues enough that they were willing to pay for them: 53% of participants in the *costly-reminders-through-association* condition paid for the elephant cue (a significantly higher fraction than zero; one sample z-test of proportion, $z=2x10^9$; $p < 0.001$; $B = 0.53$, $p<.001$). This shows that some people are sophisticated about the value of the reminders created through associations.

Third, enough participants were sophisticated about the value of reminders created through associations that the availability of those (costly) cues increased follow-through and created value. That is, those in the *costly-reminders-through-association* condition were not only more likely to earn the bonus (74%) than those in the *none* condition (59%; $\chi^2(1, N=297)= 7.23$, $p=.007$), but they also earned more profit: participants earned \$0.43 on average in the *costly-reminders-through-association* condition (SE=.022) as compared to \$0.35 on average in the *none* condition (SE=.024), $t(295)= -2.22$, $p=.027$.

Finally, we found that at least some of the 47% of participants in the *costly-reminders-through-association* condition who did not elect to pay for the reminder created through association made a mistake. We can infer this by comparing earnings in this condition to the earnings of participants in the *free-reminders-through-association* condition (92% of whom elected to use the distinctive cue) if they had each paid \$0.03 for the cue. In that case, the average participant in the *free-reminders-through-association* condition would have earned \$0.51 (SE=.014) as compared to the average of \$0.43 in the *costly-reminders-through-association* condition (SE=.022), $t(298)= 3.36$, $p=.001$. This means that participants in the *costly-reminders-through-association* condition would have earned 20% more money had they been fully sophisticated and only opted out of receiving the distinctive reminder-through-association for reasons other than its cost.

Discussion.

People under-anticipated the costliness of their limited memory. Just as a lack of sophistication about limited self-control means people under-value potentially helpful commitment devices, a lack of sophistication about limited prospective memory means people under-value potentially helpful *reminders-through-association.*

General Discussion

This manuscript describes and tests a new approach to increasing follow-through: creating reminders by associating intentions (e.g., get a flu shot) with distinctive cues that will be present when and where those intentions can be enacted (e.g., when you first notice Halloween candy on sale at your local pharmacy). This *reminders-through-association* approach dramatically increases follow-through on intentions (Studies 1-5), is more potent when intentions are associated with more distinctive cues (Studies 2a and 2b), and can be more effective than traditional written reminder messages in environments with other written signage (Study 3). Moreover, some people are sophisticated about their limited prospective memory, leading them

to value *reminders-through-association*; but many are naïve and so under-value and under-use *reminders-through-association* (Study 5).

Policymakers can use *reminders-through-association* as a welfare-enhancing tool (Thaler and Sunstein, 2003), similar to strategic defaults (Madrian and Shea, 2000; Chapman et al., 2010) or social norms (Schultz et al, 2007; Gerber and Rogers, 2009). As Study 4 demonstrated, policymakers can harness *reminders-through-association* by ensuring that (a) distinctive cues (visual, auditory, olfactory, taste-based or tactile) are present in environments where good intentions can be enacted, and (b) people associate these cues with their good intentions. For example, many airports require travelers to pay their parking fees before returning to the parking facility. When issuing parking cards as people arrive at the airport, travelers could be shown a rare, distinctive cue – a large statue of an alien, perhaps – and told that it will be visible next to the location of the payment carrels when they later return to the facility. This cue would be sequentially distinctive since statues of aliens will likely not have been encountered in the travelers' recent past (Study 2a), and concurrently distinctive since there would not be other strange statues visible in the area where it is encountered (Study 2b). This distinctive cue would likely be noticed (presumably with higher likelihood than a written reminder message), triggering travelers to remember that they must pay for parking before re-entering the parking facility. Since this cue would be located at the payments carrels, travelers would remember to pay for their parking at the exact moment when they could act.

Reminders-through-association are one of several reminder strategies that sophisticated individuals can employ to remember to follow-through on their intentions. Well-placed written reminders (like those examined in Study 3) and scheduled digital reminders are other examples. We posit that *reminders-through-association* are especially well-suited for remembering challenges with particular characteristics. For example, they may be more useful than scheduled digital reminders when digital technology is not available in the moment (a) when it is necessary to create the reminder or (b) when follow-through can occur (e.g., when mindfully working or socializing, in meetings or at meals, preparing for bed or exercising, etc.). *Reminders-through-association* are also well-suited for remembering to opportunistically perform a behavior when follow-through can only occur at an unknown future time. For example, you might want to remember to buy diapers the next time you happen to be in CVS, or ask a friend about how a medical appointment went the next time she calls. Study S1 in the SOM reports an experiment illustrating this point. It shows that *reminders-through-association* can be more effective than scheduled, digital reminders for following through on intentions that are to be performed when people encounter a specific context at an unknown future time. However, given the cognitive effort that may be needed to create and use *reminders-through-association*, digital reminders may be a superior technology in some contexts.

The research presented in this paper complements past work on implementation intentions, which has shown the power of forming concrete "if…then" plans for fulfilling intentions. Forming implementation plans increases people's likelihoods of following through on their intentions (Gollwitzer and Sheeran, 2006; Rogers et al, in press; Nickerson & Rogers, 2010; Milkman et al, 2011, 2013). The current research extends this literature by demonstrating that *what* features of performance environments intentions are linked to affects the likelihood of intentions being enacted – distinctive cues are more likely to trigger follow-through (Studies 2a and 2b). The current research also extends work on prospective memory by integrating research and theory on reminders, memory and self-control.

In introducing and testing a novel strategy to facilitate follow-through, this research builds on past work on sophistication and naiveté, showing that these concepts apply not only to limited self-control but also to limited memory. A similar sophistication-naiveté framework could extend to people's vulnerabilities to other cognitive biases. While bias blindspot research shows that people tend to under-estimate their own biases (Pronin, Lin, & Ross, 2002), some subsets of people may be especially sophisticated about bias. Sophistication about overconfidence, the planning fallacy or loss aversion, for example, may help people proactively circumvent consequences of these biases without eliminating the biases themselves. This could be a rich vein for further basic and interventional research. Future research could also disentangle how the processes of encoding and recall of intentions contribute to the effectiveness of the *reminders-through-association* approach. Studies 2a and 2b show that *reminders-through-association* work, in part, because of improved timely intention recall. Future research could further explore this, as well as other mechanisms like whether associating intentions with distinctive cues (the encoding process) strengthens people's commitments to their intentions.

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SUPPORTING ONLINE MATERIALS

Study S1: The Effectiveness of Different Types of Reminders to Perform Behaviors That Are to be Enacted at Unknown Future Times

Technologies like digital calendars that produce reminders for scheduled events and scheduled short message service (SMS) reminders have made it easier to remember to follow through at the right time on many intentions. This is particularly true for intentions that are to be executed at a known future time when a digital device will be in hand and the focus of attention. However, many intentions require remembering to opportunistically perform a behavior when encountering a specific situation at an unknowable future time. For example, you might want to remember to buy diapers the next time you happens to be at CVS, or ask a friend about how a medical appointment went the next time she calls. Study S1 shows that *reminders-through-association* can be more effective than scheduled digital reminders for following through on this class of intentions.

Participants.

Participants were recruited through MTurk to complete a 45-minute online survey for which they were paid $4.80. Only MTurk workers located in the United States who had not participated in previous similar studies were eligible. We aimed to recruit around 700 participants based on power estimates from pilot tests. Six hundred and ninety-seven participants completed the study (42% male, M_{age}=37). All participants reported intending to complete the survey in one continuous visit.

Method.

All participants were first asked if they intended to follow directions in the study that would lead the researchers to make $0.30 donation to Gardens for Health, a charitable organization that provides lasting agricultural solutions to address the problem of chronic childhood malnutrition. Nearly all participants reported intending to follow the directions that would produce this donation (96% reported having the intention; N=669). Only participants who reported having the intention were included in the study. Those who did not report having the intention were not permitted to continue with the survey. Next, participants were reminded that they intended to support Gardens for Health, and they were told for the first time that the researchers would make the donation if they selected choice "E" on the last question of Page 11 of the survey. Participants were then randomly assigned by the survey platform to one of four conditions: the *reminder-through-association* condition, the *known-time, scheduled-reminder* condition, the *unknown-time, scheduled-reminder* condition, or the *no-reminder* condition.

In the *reminder-through-association* condition, participants were told that there would be an image of an elephant (see Figure S1) on Page 11 to remind them to select choice "E".

Figure S1. Elephant Cue for Reminders-Through-Association Condition

In the *known-time, scheduled-reminder* condition, participants were instructed to schedule a digital reminder using a specific program that would deliver a pop-up reminder on top of their internet browser. They were told that they would be on page 11 around 33-minutes into the survey. They were instructed to have the reminder pop up at that time and were provided with a button they could click to receive a reminder exactly 33 minutes into the survey. For technical reasons, this program was not able to record the exact fraction of participants in this condition who actually followed the instructions and scheduled the digital reminder. In the *unknown-time, scheduled-reminder* condition participants were instructed to schedule a digital reminder using the same program. They were told that they would be on page 11 sometime between 3 minutes and 40 minutes into the survey. They were advised to schedule the reminder to pop up at the time they thought would be most useful. In the *no-reminder* condition, participants received no additional information.

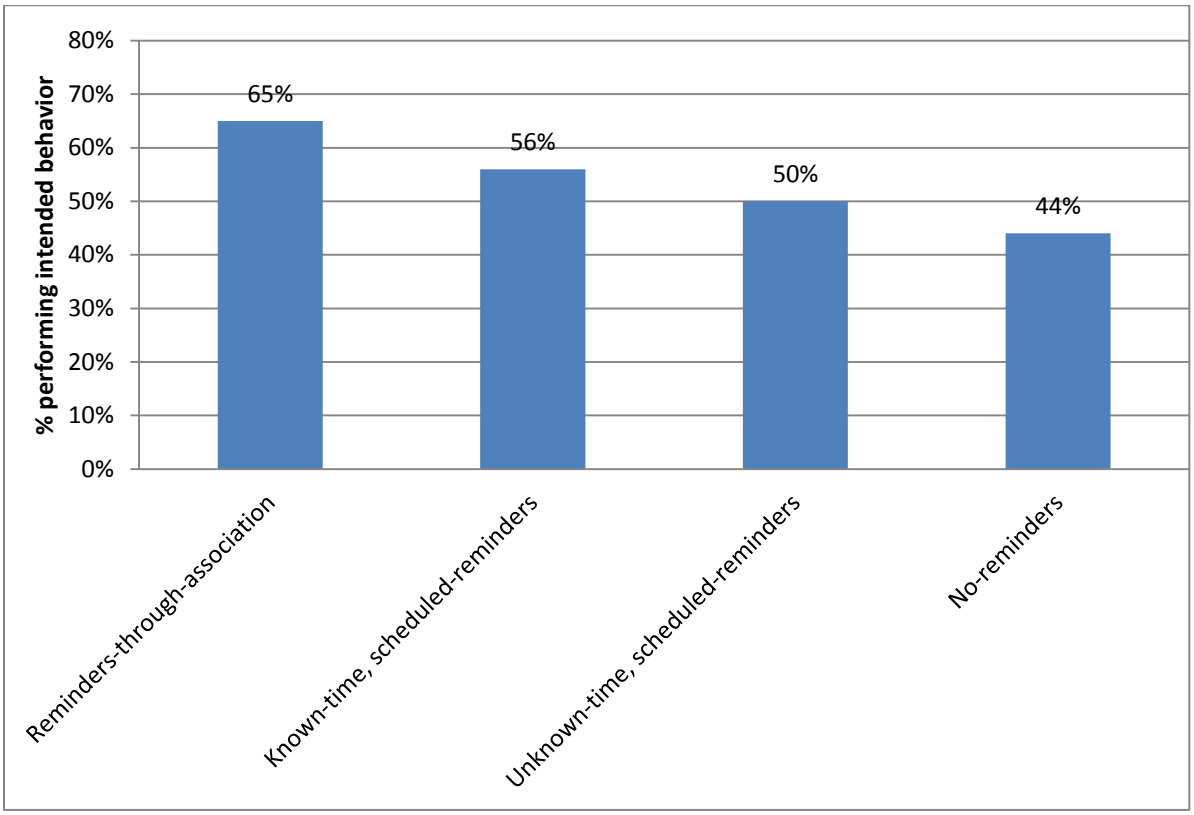
All participants proceeded to watch thirteen different movie trailers, and answered two questions about each trailer. Some pages included more than one trailer. Participants were kept on each page for exactly three minutes and twelve seconds and were auto-advanced to the next page when the time expired. These timing parameters were set so that all participants were on page 11 exactly thirty-two minutes after the beginning of the survey, and such that they would remain on that page for three minutes and twelve seconds. In the *reminder-through-association* condition, individuals were presented with a cartoon elephant (as shown in Figure S1) that replaced the "next" button on the 11th page. In the *known-time, scheduled-reminder* and *unknown-time reminder* conditions a pop-up reminder reading *"Remember to click E on the last question!"* appeared at the time participants had scheduled. Participants knew to expect this reminder. In the *no-reminder* condition, participants received no cue or reminder.

Results.

The average time at which participants in the *unknown-time, scheduled-reminder* condition elected to schedule their reminders to pop-up was 11.2 minutes into the study with a standard deviation of 8.8 minutes (SE=0.70).

Sixty-five percent of those in the *reminder-through-association* condition (112 out of 173) performed the intended behavior, 44% of participants in the *no-reminder* condition (72 out of 165) performed the intended behavior, 56% in the *known-time, scheduled-reminder* condition (96 out of 170) performed the intended behavior, and 50% in the *unknown-time, scheduled-reminder* condition (81 out of 161) performed the intended behavior. Figure S2 visually displays these results.

Figure S2. For at Least Some Follow-through Problems, Relying on a Reminder-through-Association Is More Effective than a Scheduled Digital Reminder



The primary hypothesis in this study was that reminders-through-association can be more effective than scheduled digital reminders when follow-through is required at an unknown future time. Consistent with our prediction, those in the *reminder-through-association* condition were more likely to perform the intended behavior than those in the *unknown-time, scheduled-reminder* condition, χ^2 (1, N=334) =7.1176, p=.008. Those in the *reminder-through-association* condition were also, surprisingly, directionally (though insignificantly) more likely to perform the intended behavior than those in the *known-time, scheduled-reminder* condition, χ^2 (1, N=343) =2.46, p=.117. As mentioned above, it is possible that some participants in the *known-time, scheduled-reminder* condition chose not to schedule a reminder at all.

This study also addressed several secondary questions. Those in the *known-time, scheduled-reminder* condition were more likely to perform the intended behavior than those in the *no-reminders* condition, χ^2 (1, N=335) =5.52, p=.019. This indicates that, as expected, digital reminders, when timely, can help people follow-through on their intentions. Those in the *unknown-time, scheduled-reminder* condition were no more likely to perform the intended behavior than those in the *no-reminders* condition, χ^2 (1, N=326) =1.46, p=.23, however. This is consistent with past research showing that for reminders to be effective, it is critical for them to occur when a follow-through opportunity is present (see Austin et al., 2006).

Discussion.

Study S1 illustrates that scheduled digital reminders can be less effective than *reminders-through-association* for at least one class of follow-through problem: those involving behaviors that are to be performed opportunistically in the future at an unknown time.