Motivation Science

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Online First Publication, April 20, 2015. http://dx.doi.org/10.1037/mot0000011

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2333-8113/15/$12.00 http://dx.doi.org/10.1037/mot0000011

Avenues Down Which a Self-Reminding Mind Can Wander

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We test the mnemonic benefit of having a mind that distracts itself with unresolved matters. In 5 studies, conducted in quasi-naturalistic settings, using both self-reported and experience-sampled measures of intention-related intrusions, we establish the reminding value entailed in mindwandering. Study 1 verifies that the mind is more likely to wander toward intentions outstanding rather than intentions bygone and provides preliminary evidence that more frequent intention-related intrusions lead to greater success at realizing the intention. Studies 2–5 replicate the self-reminding effect of mindwandering. Studies 2–4 examine whether committing to an intention in a setting replete with distinctive versus banal contextual details increases the number of retrieval pathways down which the mind can wander to the intention, and thus the likelihood that the intention is retrieved in both inopportune (mindwandering) and opportune (enactment) moments. Study 5 reveals that enriched details of the commitment moment can increase the likelihood that the delayed goal will be enacted, even when the details are self-generated.

Keywords: attention, distraction, goals, mindwandering, prospective memory

Supplemental materials: http://dx.doi.org/10.1037/mot0000011.supp

People regularly catch their mind straying from where it was tasked. Minds tend to wander or generate thoughts whose content is both decoupled from the current sensory environment and unrelated to the task being carried out in that moment. By some estimates, people spend as much as one third of their waking lives entertaining these off-task thoughts (Kane et al., 2007; Killingsworth & Gilbert, 2010; Klinger & Cox, 1986; Klinger & Cox, 1987–1988). Although the colloquial term "mindwandering" implies these thoughts are completely random, scholars have noted they often involve unfulfilled intentions (Cohen, 2013; Kane et al., 2007; Klinger, 1977; Klinger & Cox, 2011; Mason, Bar, & Macrae, 2009; Stawarczyk, Majerus, Maj, Van der Linden, & D'Argembeau, 2011). People notice themselves thinking about impending dentist appointments while solving Sudoku puzzles, delinquent e-mail responses while on conference calls, and unretrieved dry cleaning while listening to lunch companions' stories. Unfulfilled intentions and chronic personal concerns appear to be a primary threat to keeping one's complete attention on an immediate experience or current activity.

Yet might it be beneficial to have a mind with a penchant for straying from an ongoing activity to other tasks outstanding? In particular, might the mind's tendency to wander from a current activity to an unrelated, unresolved intention increase the likelihood of successfully seizing future chances to realize this intention? Although it can be frustrating when one's mind

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This research was conducted and funded, in part, while the first author was Visiting Scholar and recipient of the Dean's Emerging Leader Award at the Rotman School of Management, University of Toronto. We thank Emma Hitchcock, Ashley Lynn Culver, Beth Devine, Jeff Lees, and Clarissa Cortland for assisting with data collection. We also thank Emma Hitchcock, Bobbie Goettler, and Crystal Reeck for providing comments on a previous draft of the manuscript.

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strays from an ongoing telephone conversation to the tube of toothpaste one needs to purchase, it seems far less likely to stray to the tube of toothpaste one purchased the previous day. That is, intention-related mindwandering seems oriented to outstanding needs rather than already accomplished tasks. Given evidence from the memory literature that retrieval is a powerful potentiator of subsequent retrieval (Buschke, 1974; Bjork & Whitten, 1974; Roediger & Karpicke, 2006), it follows that mindwandering episodes may serve a self-reminding function, reinforcing goal pursuits that are suspended until a more fitting future moment.

The present investigation examines this proposition by exploring the relationship between intrusive thoughts about outstanding goals and success at enacting those goals at appropriate future moments. In keeping with the view that there is a need to consider how cognitive phenomena operate when people are embedded in real-world situations (Kingstone et al., 2003; Neisser & Hyman, 1999; Rosch, 1999), we study this phenomenon in its natural context, testing the relationship between intention-related intrusions and subsequent enactment of those intentions in seminaturalistic experimental settings.

Outstanding Intentions and the Need to Self-Remind

For a variety of reasons, we cannot always enact our goals as soon as we commit to pursuing them. The world regularly presents compelling reasons for delaying goal pursuits and reinstating the efforts at more appropriate future moments. As prospective memory researchers have long noted, remembering to perform outstanding goals at the appropriate times is a daily struggle (cf., Harris, 1984; McDaniel & Einstein, 1993). Part of the problem we have with aligning our actions to our aspirations is that the temporal window for enacting many delayed intentions is ephemeral (Harris & Wilkins, 1982). If you want to call your sibling on her birthday, you are limited to a handful of hours in which doing so is both possible and appropriate or relevant. Furthermore, such enactment opportunities typically arrive when people are engrossed in an unrelated activity, making it easy to overlook the relevance of the current moment to the unfulfilled intention (Brandimonte & Passolunghi, 1994; Ellis & Nimmo-Smith, 1993; see McDaniel & Einstein, 1993 for discussion). Success at picking up your dry cleaning, for instance, requires retrieving the outstanding intention from memory in a circumscribed window of time—between leaving the office and pulling into the driveway of your home—despite its irrelevance to the task at hand of driving. An intruding thought about a starched shirt does nothing to forward one's goal of arriving home in a safe and efficient manner, yet absent such an intrusion, one is likely to forget the errand altogether. Without timely recall, many fleeting intention-fulfillment opportunities would be missed.

Complicating matters further, one cannot always precisely predict the timing of an intention-enactment opportunity. Therefore, relying entirely on external memory aids to prompt timely activation of goal pursuit is infeasible. We are limited in what we can program into the notification features of our electronic calendars or scribe on reminder notes posted exactly where we can act on our intentions. Even if we could anticipate the occurrence of enactment opportunities, noting, organizing, and updating our ever-expanding list of wants, aspirations, and needs would seem extremely time consuming. To some degree, the mind must remind itself of tasks outstanding, ideally in moments when consummation of the intention is not only permissible but also a priority.

Despite the ubiquity of delayed goals and the corresponding need to self-remind about tasks outstanding, both conventional wisdom and mindwandering research often view intruding thoughts as nuisances because they tend to impair performance on the task-at-hand (Antrobus, Singer, Goldstein, & Fortgang, 1970; Christoff et al., 2009; Smallwood, 2010; Smallwood, Fishman, & Schooler, 2007). Research has, for instance, linked mindwandering to decreased text comprehension (Schooler, Reichle, & Halpern, 2004; Smallwood, 2011; Smallwood, McSpadden, & Schooler, 2008), impaired driving (He, Becic, Lee, & McCarley, 2011), increased errors in sustained attention tasks (McVay & Kane, 2009), and decrements in performance on more traditional executive-control tasks (Mason et al., 2007; Teasdale et al., 1995). Thinking about a delayed intention in moments when it cannot be realized would seem, at least on the surface, to be highly coun-

terproductive: What good does it do to think about an outstanding need in moments when it cannot be realized?

The present investigation seeks to nuance the view that mindwandering is largely detrimental by establishing that the likelihood of seizing an emergent opportunity to act on a delayed intention increases with the frequency of mindwandering to that intention, before the opportunity for actualization. By reinforcing temporarily abandoned goal pursuits, mindwandering may be an adaptive means to harness surplus mental resources to accomplish our unresolved intentions. Consistent with previous claims by a host of other researchers (Cohen, 2013; D'argembeau et al., 2010; Klinger, 1987; Klinger & Cox, 2011; Smallwood, Nind, & O'Connor, 2009; Smallwood et al., 2011; Stawarczyk et al., 2011), we propose unfulfilled intentions tend to intrude on unrelated mental activity. We further argue that these intrusions reinforce delayed intentions by increasing their accessibility in memory (Goschke & Kuhl, 1993; Higgins, 1996; Mäntylä, 1993; Strauman & Higgins, 1987; Strahan, Spencer, & Zanna, 2002). Critically, we predict that people are more likely to recognize and act on future opportunities to realize delayed intentions as a result of this heightened accessibility. That is, we predict that having a processing system that spontaneously retrieves task-irrelevant information, or engages in what Schooler and colleagues call "attentional cycling," confers mnemonic advantages (Mooneyham & Schooler, 2013; Schooler et al., 2011).

Antecedents of Intention-Related Intrusions

Assuming this role of mindwandering is indeed beneficial, it warrants consideration of the antecedent factors that increase the frequency with which unfulfilled intentions intrude on unrelated mental activity. We propose that when it comes to intrusions, not all delayed intentions are created equal: The likelihood that a delayed intention intrudes on unrelated mental activity depends on its representation in memory. Intentions connected more diversely (i.e., linked to a broader array of items) or potently (i.e., associated with certain items to a greater degree) should be more accessible and, consequently, more likely to invade conscious thought. Therefore, one could increase the intrusion potential of a delayed intention by facilitating richer associations for that intention in memory. We propose that one method for doing so is to add distinctive and unique features to the moment in which one commits to the intention's pursuit.[1]

In making this prediction regarding the antecedents of intention-related intrusions, we draw on research suggesting that salient, idiosyncratic features of an encoding context effectively provide retrieval avenues through which people can subsequently access any material they encountered in this context (Chu, Handley, & Cooper, 2003; Howard & Kahana, 1999, 2002; Lesgold & Goldman, 1973; Smith & Vela, 2001). The ease with which people recall previously encountered information increases with the number and distinctiveness of potential retrieval pathways present at the encoding moment (Moscovitch & Craik, 1976; Tulving & Pearlstone, 1966; Watkins & Watkins, 1976; see also Parker & Gellatly, 1997). Distinctive information present when one commits to pursuing a goal might similarly increase the likelihood that the individual spontaneously recollects that outstanding goal in moments when it cannot be actualized.

In sum, assuming intention-related intrusions promote successful intention enactment as we assert herein, knowing what, in turn, predicts intention-related intrusions would be valuable. Our argument is that one factor that may account for the frequency with which the mind wanders to an outstanding intention is the number of unique retrieval pathways established to the intention at encoding, which would in turn be influenced by the elaborateness of the commitment event. Whereas past research has primarily focused on how salient features of the *enactment context* effectively cue *timely* retrieval of a delayed intention (e.g., Brandimonte & Passolunghi, 1994; McDaniel & Einstein, 1993), here we consider how salient features of the *commitment context* increase *untimely* retrieval of a delayed intention and the possible

[1] Although outside the scope of the present research, evidence from the prospective memory literature linking the motivational strength of an intention to the rate of enactment success suggests that the rate of intention-related intrusions may also increase with an intention's personal importance, the potential benefits of realizing it, and the consequences of failing to satisfy it (Kvavilashvili & Ellis, 1996).

mnemonic benefit of this intention-related mindwandering.

Beyond having prescriptive value, this research addresses the outstanding question of whether having a mind that wanders from where it is tasked is beneficial (Dane, Baer, Pratt, & Oldham, 2011; Mason et al., 2007; Mooneyham & Schooler, 2013; Smallwood & Andrews-Hanna, 2013; Stawarczyk et al., 2011). Existing evidence suggests mindwandering enables patience (Smallwood, Ruby, & Singer, 2013), emotion and pain regulation (Franklin et al., 2013; Kucyi, Salomons, & Davis, 2013), and self-entertainment in mundane settings (Antrobus et al., 1970; Gold & Cundiff, 1980; Klinger, 1999; Singer, 1966). Evidence also suggests that creative problem-solving improves after periods of mindwandering (Baird et al., 2012). However, to our knowledge, research has yet to find *direct* empirical evidence that performance on a topic or activity to which the mind wanders in off-task moments improves subsequent to the occurrence of intrusive thoughts about the topic or activity. Obtaining this evidence is a critical next step toward answering the question of why the mind *distracts itself* with information *it produces*.

Study Overview

We present evidence that the likelihood that a delayed intention will be implemented at the appropriate future moment increases with intrusive thoughts about the delayed intention in the period leading up to the enactment window. In all of our studies, we use a paradigm in which we ask participants to complete a task at a specific time in the future (e.g., send us an e-mail in three days, between 3:00 p.m. and 4:00 p.m.). After participants commit to pursuing the intention, we explicitly and firmly request they refrain from using external memory aids (e.g., a calendar notification) and instead try to enact the intention using only their "natural memory." We measure successful enactment of the delayed intention by directly observing participants' behavior (e.g., whether they send us the e-mail during the target timeframe) and relate this behavior to features of the encoding context (i.e., the commitment moment), as well as the frequency of intention-related intrusions participants experience in the period leading up to the enactment window. We measure intention-related intrusions using a combination of self-reports and electronic event-tracking applications. Importantly, this paradigm is intended to be naturalistic: Successful participants must maintain the intention for multiple days—much longer than could be examined in purely lab-based studies—while going about their everyday activities.

Study 1 reveals that intention-related mindwandering is oriented toward outstanding needs rather than already accomplished tasks and provides preliminary evidence that the frequency of intention-related intrusions predicts goal attainment. Study 2 replicates the effect of frequent goal intrusions on goal attainment and provides preliminary evidence that salient contextual features of the commitment event are associated with more frequent intention-related intrusions and greater enactment success. Study 3 replicates the effect of frequent intrusions on goal attainment and compares the impact of increasing potential retrieval pathways (via distinctive features of the encoding moment) with another mnemonic strategy: associating the intention with a feature in the enactment moment. Study 4 shows that people who recollect details of the commitment moment are more likely to recall the intention in both inopportune (mindwandering) and opportune (enactment) moments. Finally, Study 5 reveals that the commitment context need not be physically enriched to yield the observed effect: People who merely self-generate distinctive versus banal retrieval pathways to the commitment event are more likely to recall and act on the intention in the opportune moment.

Study 1

Study 1 provides evidence in support of our assertion that intention-related mindwandering is oriented toward outstanding needs rather than already accomplished tasks. We asked participants to complete a task—send the experimenter a text message—during a specific time window in the future using only their "natural memory" (i.e., without the aid of external notification devices, e.g., an electronic calendar). Participants used an iPhone application (app) to track their intention-related mindwandering across the pre- and postenactment period.

Method

Participants and design. Forty-two participants from the Columbia University community (80% female; average age = 23 years) completed the study in exchange for $19.01. To be included in the study participants had to (a) have lived in the United States or an English-speaking country for at least 10 years, (b) be at least 18 years of age, (c) own an iPhone, and (d) be capable of sending one text message in the week after the study. Four additional participants attended the initial session but failed to respond to the postenactment survey and therefore cannot be included in the analysis.

The experiment used a single between-subjects manipulation (enactment delay: short or long), which allows us to test an alternative explanation for our predicted result. In both conditions, participants visited the lab on a Monday and were asked to adopt a goal: send the experimenter a text message at a certain time in the future. Participants in the short-delay condition were asked to enact the goal (i.e., to send us a text message) on Wednesday between 3:00 p.m. and 4:00 p.m., or after an approximately 50-hr delay. Likewise, participants in the long-delay condition were asked to enact the goal on Friday between 3:00 p.m. and 4:00 p.m., or after an approximately 98-hr delay. Critically, participants in both conditions were asked to track intention-related thoughts for an entire week (i.e., until the following Monday), using the required iPhone app, across both the pre- and postenactment periods.

Procedure.

Precommitment session. Before the encoding session, we e-mailed prospective participants instructions for downloading the required iPhone app (participants were reimbursed for the app's $.99 cost). The required app ("countedApp," available at countedapp.com) allowed participants to actively tally the number of times they thought about the assigned goal. It displays a number (zero initially or after a reset) that is incremented by one with the tap of a button. Although not automatically displayed, the app also records the exact time of each incrementation and can export this data as an e-mail report.

Commitment (encoding) session. On arriving at the laboratory, participants were directed to a small testing room. Participants then learned that the study involved trying to remember to do something at a particular moment in the future. Specifically, participants were asked to try to remember to send the experimenter a text message during a time window determined by their condition (short-enactment delay: between 3:00 p.m. and 4:00 p.m. on Wednesday; long-enactment-delay: between 3:00 p.m. and 4:00 p.m. on Friday). Importantly, participants were informed they should attempt this task without using external memory aids (e.g., calendars, reminders, notes to self, friends, etc.).

Participants were then remunerated $19.01 in exchange for four things: (a) trying to remember to send the text message during the target timeframe, (b) using the counter app to track each time they thought about this goal over the next seven days (the experimenter stressed that they should continue to count such thoughts even *after* the target enactment timeframe and should continue recording thoughts regardless of whether they successfully remembered), (c) responding to a short follow-up survey after the seven days, and (d) sending the log file from the counter app after the seven days. The experimenter emphasized that the payment was not conditional on actually remembering to send the text message: the participant would be paid regardless, and honesty regarding the rules was the predominant concern.

At this point, the experimenter asked participants to launch the counter app, and made sure they understood its operation (including how to send the log file). Participants received more explicit instructions about what to record with the counter app. Specifically, the experimenter told them to increment the counter whenever they had a spontaneous thought intrusion related to the delayed goal (i.e., sending the text message). These intrusions could be any thought that reminded participants of the goal. Back-to-back thoughts about the goal—those that occurred within 5 minutes of each other—were to be recorded as a single thought episode. The experimenter stressed the importance of providing an accurate measure of the frequency with which thoughts about the goal intruded: Not experiencing any intrusions at all during the seven days was fine, but they should capture any spontaneous, intention-related thoughts that did happen to occur. If thoughts about the goal occurred at a time in which they could not increment the counter (e.g., in class), they

should increment the counter as soon as they were in a situation that permitted doing so.

To minimize the chance that participants would inadvertently encounter the experimenter's telephone number during the experimental period, participants were told to embed the number in the middle of their electronic telephone contact list. The experimenter encouraged participants to save the telephone number under the name "Memory Study." They were told that they could erase the contact (and delete the downloaded app) at the end of the experiment (the subsequent Monday).

Before dismissing participants, the experimenter provided a summary of the rules in bullet-point format and reemphasized that the participant would receive an e-mail with the survey in a week's time and should track intention-related intrusions until Monday afternoon when they received this survey by e-mail. The experimenter asked participants to acknowledge that they understood the rules and to commit to the task by initialing beside each rule and signing at the bottom of the document.

Postenactment survey. We e-mailed participants a link to the electronic, postenactment survey at approximately 2:00 p.m. on the Monday after the initial session. The survey asked participants to report whether they remembered to send the text, whether they experienced any issues, the number of intention-related intrusions they experienced (i.e., the number on the app counter), more details about the type of intrusion they experienced, and a few questions about their remembering strategy (see supplemental online material [hereafter, SOM], Table S1).

Results and Discussion

Intention-related intrusions. Consistent with the view that intention-related mindwandering is a common occurrence, participants, on average, reported thinking about the texting goal 22.2 times ($SD = 27.0$, median = 14) over the course of the entire week. Confirming our prediction that these intrusions tend to be oriented toward outstanding concerns rather than already accomplished tasks, the within-participant occurrence of intrusions about the texting intention was significantly more frequent in the pre- compared with postenactment period, ($M_{before} = 5.57$ intrusions/day ($SD = 5.66$), $M_{after} = 1.27$ intrusions/day ($SD = 1.69$), within-subject test: $t(41) = 6.34$, $p < .001$, Cohen's $d = .98$). Further, intrusions were more common in the 24 hours preceding compared with the 24 hours after the deadline ($M_{before} = 4.19$ intrusions ($SD = 4.42$), $M_{after} = 2.17$ intrusions ($SD = 2.74$), within-subject test: $t(41) = 3.04$, $p = .004$, Cohen's $d = .47$).

Both of the previous tests, however, suffer from a critical confound: the preenactment period is always closer to the commitment moment, so simple memory decay could explain both results. To examine this alternative explanation, we can compare the frequency of intention intrusions on Thursday experienced by people for whom the enactment window had passed (short-delay participants) with those for whom the enactment window was forthcoming (long-delay participants). Supporting our predictions, the participants for whom the enactment window had passed had marginally fewer thoughts on Thursday than those for whom the enactment window was forthcoming ($M_{short} = .90$ ($SD = 1.09$), $M_{long} = 2.95$ ($SD = 5.14$), $t(40) = 1.78$, $p = .08$, Cohen's $d = .55$).[2]

Intention enactment. We can further break down the analysis by examining the intrusion behavior for participants who did and did not successfully enact the goal. Seventy-six percent of participants in the short-delay condition (16 of 21) and 48% of participants in the long-delay condition (10 of 21) successfully retrieved and acted on the intention during the enactment window. Looking only at participants who successfully enacted the goal, we find that the differences in pre- versus postenactment thought intrusions become more pronounced. Successful enacters averaged 4.83 more intrusions per day before (vs. after) they enacted the goal, $t(25) = 4.81$, $p < .001$, $SD_{difference} = 5.12$, Cohen's $d = .94$. The 24 hours before the deadline featured an average of 2.65 more intrusions than the 24 hours after, $t(25) = 2.63$, $p = .015$, $SD_{difference} = 5.15$, Cohen's $d = .52$. Additionally, we can again look at the between-condition differences in

[2] Unfortunately, our design does not permit us to examine a possible remaining confound regarding the interaction between our manipulation and day of the week (e.g., could something have occurred on Thursday that differentially reminded participants of outstanding versus lapsed intentions?).

intrusions on Thursday to alleviate concerns regarding simple memory decay. Successful enactors in the long-enactment-delay condition had significantly more intrusions on Thursday ($M_{difference} = 5.40$, $SD = 6.72$), the day before their enactment opportunity, compared with those in the short-enactment-delay condition ($M_{difference} = .69$, $SD = .87$), the day after their enactment opportunity, $t(24) = 2.80$, $p = .010$, Cohen's $d = 1.13$.

We then looked for preliminary evidence linking frequent intrusions to successful enactment. As predicted, the number of intrusions in the 24 hours before the deadline (logged for better normality) was a significant predictor of successful enactment when entered into a logistic regression as the only predictor variable ($\beta_{ln(thoughts)} = .33$, $SE(\beta) = .15$, $z = 2.30$, $p = .021$): Those participants who had more intention-related intrusions in the day leading up to the enactment window were more likely to successfully enact the intention when the appropriate opportunity arose.

In sum, this study provides evidence that the mind is more likely to wander toward concerns outstanding rather than concerns bygone. This assertion complements evidence that people have an easier time recalling to-be-performed compared with performed tasks *when instructed to do so by an experimenter* (Goschke & Kuhl, 1993; Koriat, Ben-Zur, & Nussbaum, 1990; Lewin, 1926; Marsh, Hicks, & Bink, 1998; Zeigarnik, 1927). Here we show that self-originated thoughts show the same disparity: Tomorrow's concerns are more intrusive than yesterday's concerns, even though both are only 24 hours away. Finally, in this study, we provide preliminary evidence that spontaneously revisiting outstanding intentions increases one's likelihood of enacting them in the appropriate moment. We further explore this purported self-reminding function of mindwandering in the following studies.

Study 2

Study 2 provides evidence that frequent mindwandering to an unfulfilled intention predicts success in recalling that intention at the appropriate future moment. It also provides preliminary evidence that the presence of salient contextual cues at encoding may be associated with more frequent intention intrusions and greater enactment success.

Method

Participants and design. Ninety individuals from the Columbia University community participated in exchange for $20 (65% female; average age = 23 years). Study 2 used the same inclusionary criteria as Study 1, with the exception that individuals who owned an Android phone were also encouraged to participate. Four additional participants attended the initial session but failed to respond to the postenactment survey and therefore cannot be included in the analysis.

We assigned 55 participants to a treatment condition that incorporated many unique and salient features in the intention-commitment moment. We assigned an additional 35 participants to a control condition in which the intention-commitment moment was comparatively banal. Because of study logistics, the participants in the treatment and control conditions participated on separate days. As a result of this lack of random assignment, selection or time effects could confound the results. We therefore perform the analyses of interest separately on each group and offer caution when we make between-condition comparisons.

Procedure.

Precommitment session. Study 2 used the same precommitment session procedures as Study 1, with the exception that participants were required to install one of two freely available counter apps onto their smartphone: "Tally Counter" (iOS) or "Simple Counter" (Android). These particular counter apps allowed participants to keep a running tally of their intrusions. However, unlike the purchased counter app used in Study 1, these free apps did not log the exact times at which the tallies occurred.

Commitment (encoding) session: Treatment participants. Each person participated in a small group session of eight people or fewer, held on a Sunday. On arrival at the lab, each participant was directed to a room that had been contextually enriched with odd features. More specifically, (a) the experimenter donned neon clothing (a shirt and scarf), (b) a video with flying cat heads and electronic music played on a large screen behind the experimenter (see bringinthecats.com), (c) a Superman poster

hung on the wall behind the experimenter, (d) a stuffed baby penguin was sitting on a table in the middle of the room, and (e) participants used green felt pens to sign forms.

Participants were told that the study involved adopting a goal: trying to remember to send a text message to the experimenter in seven days' time at 3:00 p.m. As with Study 1, participants were informed that they needed to attempt this task without relying on external memory aids. The experimenter explained to participants that they should try to send the text exactly at 3:00 p.m.—not before or after.

Participants were informed that they would receive the $20 remuneration now and that this payment was in exchange for three things: (a) trying to remember to send the text message in one week, (b) noting when they experienced intention-related intrusions using the counter app, and (c) responding to a 10-min online survey that they would receive by e-mail three hours after the target enactment time. Participants were then instructed to embed the experimenter's phone number in the middle of their electronic telephone contact list (under "Memory Study").

The experimenter then provided the same instructions as in Study 1 concerning what to record with the counter app (e.g., they were told they should not increment the counter more than once in a 5-min interval, etc.). Consistent with the procedures used in Study 1, before leaving the laboratory, participants were asked to initial each item on a checklist to confirm their understanding of the goal (sending the text message), the rules of the task (e.g., *don't tell people*), and the intrusion counting procedures.

Commitment (encoding) session: Control participants. We also sought to compare participants who underwent the previously described treatment (the enriched context) with a second sample of participants who did not. The experimental procedure was identical for these participants, with the critical exception that we removed the salient contextual cues (i.e., the researcher wore normal clothes and nothing out of the ordinary was present in the lab room). These control sessions were conducted on a different week than the treatment sessions, so assignment between the conditions could be confounded with nonexperimental factors.

Postenactment survey. We e-mailed participants a link to the electronic, postenactment survey approximately three hours after the goal-enactment deadline. As with Study 1, the survey asked participants to report on their success, any issues, the number of texting-intention intrusions they experienced (the number on the counter), more details about the nature of the texting intrusion, and a few questions about their remembering strategy (see SOM, Table S2).

Results and Discussion

For participants in the treatment condition ($n = 55$), we tested the prediction that success at recalling and acting on the delayed goal would be associated with more frequent intention-related intrusions in the intervening period. The data supported this prediction: the number of recorded intrusions (logged for better normality) was a strong predictor of remembering when entered as the only independent variable in a logistic regression ($\beta_{\ln(\text{thoughts})} = 1.51$, $SE(\beta) = .49$, $z = 3.09$, $p = .002$). Twenty-five of 55 treatment participants remembered to text, and they averaged 27.8 intrusions in the intervening week ($SD = 13.5$, median = 27) versus 16.5 intrusions for the 30 participants who forgot ($SD = 12.5$, median = 10).[3]

As expected, we observed the same basic pattern of findings among participants in the control condition ($n = 35$). Of the 11 participants who remembered to send the text, the average number of thoughts over the 7-day delay was 31.3 ($SD = 31.8$, median = 20) compared with 16.0 thoughts for the 24 participants who forgot ($SD = 13.5$, median = 11). For this sample, the number of thoughts (again, logged) was a marginally significant predictor of remembering ($\beta_{\ln(\text{thoughts})} = .75$, $SE(\beta) = .46$, $z = 1.62$, $p = .10$). Aggregating over both conditions, the result becomes even stronger ($\beta_{\ln(\text{thoughts})} = 1.17$, $SE(\beta) = .34$, $z = 3.48$, $p < .001$; see Figure 1).

The predictive power of number of thoughts was similar across the two samples. In both samples, participants who remembered to send the text message reported approximately twice as many intention-related intrusions during the

[3] Because the free counter apps used in Study 2 did not log the times at which the tallies occurred, we could not distinguish intrusions that occurred before and after the enactment window.

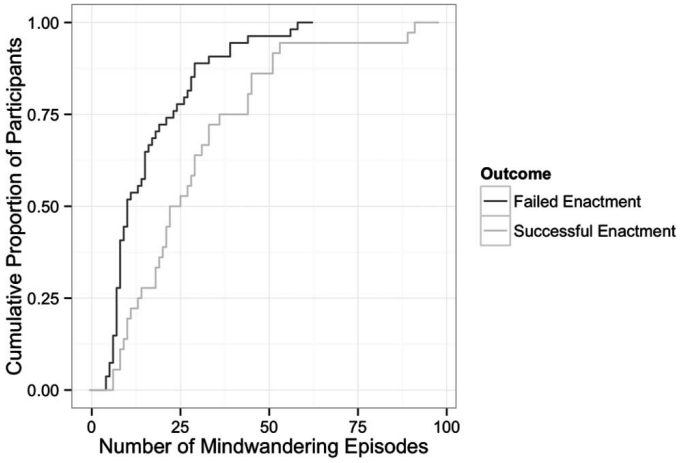

Figure 1. The relationship between intention-related intrusions experienced over the course of the week and enactment success (across both treatment and control conditions in Study 2).

period between committing to the intention and enacting (or failing to enact) the goal.

Consistent with the prediction that salient contextual cues at encoding create potent retrieval avenues down which the mind wanders to the intention in both inopportune and opportune future moments, a greater proportion of participants successfully enacted the goal in the enriched context condition compared to the control condition (45% vs. 31%), and this difference corresponded with a greater median number of intrusions (19 vs. 13). Although these results are directionally consistent with our hypothesis, neither reached statistical significance ($\beta_{treatment} = .60$, $SE(\beta) = .45$, $z = 1.32$, $p = .19$ and $t(88) = 1.22$, $p = .23$, Cohen's $d = .26$, respectively, using a logistic regression to predict success and a *t*-test to measure differences in logged thoughts).

In sum, Study 2 builds on the results of Study 1 with evidence that frequent intention-related mindwandering in inopportune moments predicts success at recalling the intention at the opportune future moment. It also provides preliminary evidence that salient features of the commitment moment are associated with increased intention-related mindwandering, as well as greater enactment success.

Study 3

The primary aim of Study 3 is to provide stronger evidence that augmenting the intention-encoding environment with distinctive features can increase mindwandering to the delayed intention and—further—can increase the likelihood that the intention will be successfully enacted at the appropriate future moment. A secondary aim of Study 3 is to compare the impact of increasing potential retrieval pathways (via distinctive features of the encoding environment) with a more traditional strategy for retrieving delayed intentions: generating associations between the delayed intention and an anticipated contextual feature of the enactment moment.

Evidence suggests that timely retrieval of an outstanding intention is facilitated when people identify a salient contextual feature of the enactment moment that can serve as reminder of the action outstanding (cf., Breneiser & McDaniel, 2006; Brandimonte & Passolunghi, 1994; Gollwitzer, 1993; McDaniel & Einstein, 1993; McDaniel et al., 2004). Because this strategy is explicitly designed to help people bind the desired action to a specific feature of the enactment context, it should increase the likelihood that people retrieve the delayed intention at the *appropriate* future moment, but not in advance of the cue's appearance.

We test whether people who commit to the intention in a setting replete with potent retrieval pathways experience more frequent intention-related intrusions (in the interim period) than people who identify a salient feature of the enactment context to remind them of the goal

outstanding. Further, we test whether the intensified rate of intrusions in inopportune moments leads to greater enactment success among participants in the former compared with the latter condition.

Method

Participants and design. One hundred thirty-three members of the Columbia University community completed the study in exchange for monetary remuneration. Twenty-seven additional people participated in the initial session, but failed to respond to the postenactment survey and are thus excluded from the analysis. Two more participants are removed from the analysis for admitting to use memory aids.[4] The study had a single between-participants manipulation (suggested strategy: commitment-focused, enactment-focused, no treatment) designed to compare the efficacy of intention-retrieval strategies. Unlike the previous studies, participants were not asked to track their thoughts during the intervening period. However, the current design allowed us to properly randomize participants (in contrast to Study 2) so that cohort effects should not bias our results.

Procedure.

Commitment (encoding) session. As with the previous studies, participants were told they would be given a goal: attempt to send us an e-mail at a specific time in the future. The experimenter explained that they should rely only on their "natural memory" to perform this task (i.e., not use external memory aids) and that honesty regarding this rule was paramount—failing to remember to send the e-mail would not result in any ill consequences.

The experimenter then proceeded to explain the details of the task. Participants were asked to send an e-mail to a provided e-mail address in five days' time (e.g., on Tuesday if it was a Thursday). More specifically, they were to send the e-mail before they brushed their teeth for the first time that day. The e-mail would prompt an automatic response that contained a link to a brief, 2-min survey they should complete. If participants forgot to send the e-mail, they would receive the link to the survey at the end of the day and should complete it at that time. Participants were told that if they remembered the intention at the appropriate time, but forgot the e-mail address, they should report in the survey that they succeeded at recalling the intention but failed to retain the e-mail address.

After explaining the rules of the task to the participant, the experimenter suggested a strategy to the participants that might help them successfully complete the goal. The suggested strategy depended on condition: commitment-focused participants were asked to attend to salient contextual details that were incorporated into the laboratory environment for them only, namely, a bright yellow carpet and a print depicting conjoined twins (rendition of Gemini). The purpose of this manipulation was to increase the number of distinctive retrieval pathways to the delayed intention down which the mind might wander in inopportune moments (i.e., the intervening period).

Enactment-focused participants were, alternatively, asked to identify a contextual feature of the anticipated *enactment moment* that they could use to remind themselves to send the e-mail (i.e., a stimulus they would encounter while implementing their tooth-brushing routine on the target morning). The purpose of this manipulation was to establish a retrieval cue from the enactment context that could remind them of the desired action.

Finally, no-treatment participants were given no explicit strategy to help them successfully complete the goal and, like the enactment-focused participants, committed to the intention in the absence of salient contextual details (i.e., without the carpet or the conjoined twins print). After the manipulation-based instructions (or lack thereof in the case of no-treatment participants), the experimenter reiterated the e-mail goal and the rules to the participant. Participants were then paid and dismissed.

Postenactment survey. As with Studies 1 and 2, the survey asked participants to report on their success, whether they followed the rules, had any issues, the frequency of intention-related intrusions, and their remembering strategies (see SOM, Table S3).

Critically, participants were asked to indicate the frequency with which they experienced intrusive thoughts about the commitment moment

[4] The exclusion rate did not differ significantly across the three conditions (commitment focused: 22%, enactment focused: 18%, and no treatment: 14%, $\chi^2(2) = 1.07$, $p = .58$).

during the delay. We expected participants in the commitment-focused condition (those who were provided with enriched potential retrieval pathways during the experimental session) to experience a higher rate of "commitment-moment" intrusions. Further, we expected that an increase in the rate of intrusions would be associated with greater enactment success. To replicate the finding that goal intrusions in the 24 hours preceding the enactment window are particularly likely to bolster enactment success, participants were asked to indicate whether they experienced an intrusion the evening before the enactment window (*yes*/*no*).

Results and Discussion

As predicted, commitment-focused participants reported more intrusions about the moment in which they committed to the intention (i.e., the lab session; $M = 2.95$, $SD = .79$) than did enactment-focused participants ($M = 2.57$, $SD = .94$; $t(130) = 2.03$, $p = .044$, Cohen's $d = .44$). Further, these commitment-moment intrusions were a significant predictor of successful intention enactment (logistic regression: $\beta_{\text{commitment-moment intrusions}} = .67$, $SE(\beta) = .23$, $z = 2.93$, $p = .004$). Indeed, 47% of commitment-focused participants successfully completed the goal (sending the e-mail), whereas only 21% of enactment-focused participants succeeded (logistic regression dummy coded so that commitment-focused = 1 and enactment-focused = 0: $\beta_{\text{commitment-focused}} = 1.16$, $SE(\beta) = .48$, $z = 2.39$, $p = .017$). Thus, contextual details of the commitment moment might provide avenues down which the wandering mind may revisit the intention in the delay period. And, more importantly, this spontaneous revisiting seems to confer a mnemonic benefit, enhancing the likelihood the intention is retrieved at the appropriate future moment.

We also explored whether, across the three conditions, goal-related intrusions that occurred within 24 hours of the enactment window are a strong predictor of performance (as in Study 1). Results of a logistic regression confirm that the probability of enacting the goal increased significantly among participants who experienced a goal-related intrusion the night before the enactment window (dummy coded so that predictor = 1 if the participant thought about it the previous night and = 0 otherwise: $\beta_{\text{previous night}} = 2.39$, $SE(\beta) = .43$, $z = 5.38$, $p < .001$). A full 67% of participants who enacted the goal reported experiencing such an intrusion. By contrast, only 15% of people who failed to enact the goal reported having this experience.

As a final point of discussion, an examination of the behavior of no-treatment participants independently is worthwhile. Both the mean rate of commitment-moment intrusions ($M = 2.81$, $SD = .87$) and the enactment success rate (40%) of participants in this condition fell above the means of the enactment-focused participants and below the means of the commitment-focused participants. This finding suggests participants in the no-treatment condition formed retrieval pathways to the intention independently of the experimenter's instruction to do so. Indeed, those who reported more thoughts about the commitment moment were significantly more likely to be successful (logistic regression only for control condition: $\beta_{\text{commitment-moment intrusions}} = 1.44$, $SE(\beta) = .48$, $z = 2.97$, $p = .003$). The lab session might have been sufficiently bizarre *in the absence of explicit instructions* to generate distinct retrieval cues down which the mind could wander to the intention.[5]

In sum, Study 3 provides evidence that distinctive features of the commitment moment lead to increased mindwandering to the goal during the intervening period between commitment and potential enactment. Further, it supports the idea (much like Studies 1 and 2) that this frequent revisiting of the intention during *inopportune* (mindwandering) moments increases the likelihood that it is retrieved at the *opportune* (enactment) moment.

Study 4

Study 3 provided evidence that committing to a goal in the presence of distinctive, idiosyncratic cues increases the likelihood that it will be retrieved at the appropriate future moment, presumably because doing so creates more potential retrieval pathways to the delayed intention. Study 4 measures this link more directly. By incorporating several potential retrieval cues

[5] Providing anecdotal evidence for this possibility, one participant in the no-treatment condition explicitly remarked on her way out of the lab how "weird" this study was.

into the commitment session and then testing the relationship between recollection of these contextual details and timely retrieval of the delayed intention, we assess whether the likelihood of enacting a delayed goal increases with the number of retrieval pathways.

Method

Participants. Fifty individuals (62% female; average age = 22) from the Columbia University community participated in the experiment in exchange for monetary compensation ($5). Five additional participants admitted to using memory aids and three participants did not respond to the follow-up survey and are thus removed from the following analyses.[6]

Procedure.

Commitment (encoding) session. Participants entered the lab room on a Sunday, one at a time, and were directed to a room in which the experimenter was waiting. The experimenter described the study to the participant as examining how people remember to act on future goals. Participants were told they would be given a goal they would need to try to enact in the future. As with the previous studies, the experimenter explained they should rely only on their "natural memory" and that being honest about following this rule was important—their payment was not contingent on successful enactment.

The experimenter then proceeded to explain the details of the goal. More specifically, the participants were asked to try to remember to send the experimenter a text message the following Sunday at 3:00 p.m. (i.e., exactly one week from the first session). Participants were then given the target phone number and asked to embed it in their phone under "Memory Study." Finally, participants were told they would receive an e-mail Sunday night at 6:00 p.m. with a link to an online survey that queried their experience of trying to enact the goal.

To examine whether having more distinctive retrieval pathways to the commitment moment in memory increases the likelihood that the intention will be retrieved at the appropriate future moment, we incorporated several potential retrieval cues into the experimental session. Specifically, (a) the song "Jingle Bells" played in the background during the entire session, (b) a metallic French Bulldog piggybank was placed prominently on the desk in front of the participant, (c) the experimenter wore a bright-colored shirt (yellow or purple), and (d) participants filled out all forms using a pen with bright red ink. These unique contextual cues, if retained, should provide routes through which the participant's mind might wander to the commitment moment and, importantly, the intention (see Table 1).

As with previous studies, the session concluded with participants going through and initialing a checklist, confirming they understood the rules of the study.

Postenactment survey. At approximately 6:00 p.m. on the Sunday after the initial session, all participants received a link to the postenactment survey via e-mail. The survey asked participants whether they successfully completed the task, whether they followed the stated rules, about the number of intrusions they experienced, about their strategies for completing the goal, their experience attempting the task, and about their memory for the encoding event (see SOM, Table S4).

To test whether salient features of the commitment setting act as retrieval avenues down which the mind can wander to the delayed intention, participants were asked the following free recall-format questions: (a) *When the experimenter told you about the task, what song was playing in the background?*, (b) *What color shirt was the experimenter wearing?*, (c) *What was sitting on the desk where you were directed to sit?*, and (d) *The experimenter provided you with a pen. What color was the pen that you used to check the boxes and sign your name?* In addition to providing an answer for each of these items, participants were asked to rate their confidence in their responses. Finally, participants were asked to categorize their responses as either (a) a guess, (b) something they "knew" (i.e., they believed it was correct, but could not necessarily "see it in their mind"), or (c) something they could "recollect" (i.e., they were able to reexperience the information or "bring it back to mind"; Tulving, 1999). We suspected that contextual details the participants recollected

[6] Including the participants who admitted to using memory aids does not change the results in a substantial manner (e.g., the relationship between correctly recalled details and successful enactment remains significant: $\beta_{\text{correctly recalled details}} = .57, SE(\beta) = .28, z = 2.05, p = .040$).

Table 1
Correctly Recalled Contextual Details in Study 4

Detail	Successful enactment	Failed enactment
Number of participants	13	37
Sum of correctly recalled contextual details (4 total)	2.39_b	1.41_a
(*I can recollect this*)	1.54_b (65%)	$.68_a$ (48%)
(*I know this*)	$.23_a$ (10%)	$.46_a$ (33%)
1. The song playing	77%	54%
Song confidence (of 5)	3.69	3.35
2. Experimenter shirt color	38%	22%
Shirt-color confidence (of 5)	2.62	2.27
3. Item on the desk (bulldog piggy-bank)	62%	41%
Bulldog confidence (of 5)	3.62	3.00
4. Color of pen ink	62%	24%
Pen-color confidence (of 5)	3.00	2.54

Note. Scores in rows that share a subscript letter do not differ by $p < .05$ in a two-tailed *t*-test. The sum of correctly recalled details does not equal the sum of recollected and known details, because some participants indicated that they were guessing.

(vs. simply knew) were more likely to be revisited, because these details should be associated with a greater number of potential retrieval avenues.

Participants were also asked to retrospectively report the frequency with which they experienced intrusions about the commitment moment (like Study 3, participants did not record their thoughts using a counter app). Specifically, they were asked to respond to the following question on a 5-point scale (1 = *zero*, 5 = *more than 6*)[7]: *Leading up to the 3:00 p.m. text deadline, on how many occasions did you spontaneously remember or think about the moment in which you were given the goal? In other words, on how many occasions did you reflect back on the initial session in the behavioral lab when you were given the task by the experimenter?* A similar question was asked regarding intrusive thoughts about the enactment moment (see SOM for exact wording).

Results and Discussion

Results support our core prediction that the likelihood an intention is recalled and enacted at the appropriate future moment increases with the number of contextual retrieval cues that have been encoded from the intention-commitment moment. Results of a logistic regression revealed the sum of correctly recalled details of the intention-commitment setting predicted successful enactment of the goal ($\beta_{\text{correctly recalled details}} = .76$, $SE(\beta) = .31$, $z = 2.41$, $p = .016$). That is, people who encoded and retained a greater number of retrieval pathways to the delayed intention during the commitment moment were more likely to retrieve the intention at the appropriate moment.

Furthermore, contextual details that could be recollected—in essence, those that the wandering mind could revisit—were a stronger predictor of enactment than were contextual details that participants "knew" but could not necessarily relive. The number of details that were correctly "recollected" predicted successful enactment ($\beta_{\text{recollected details}} = .72$, $SE(\beta) = .33$, $z = 2.16$, $p = .031$), whereas the number of details that were correctly "known" did not ($\beta_{\text{known details}} = -.33$, $SE(\beta) = .67$, $z = -.33$, $p = .62$) when entered simultaneously into a logistic regression.[8]

Finally, consistent with the view that salient, idiosyncratic contextual cues present at the commitment moment may increase future en-

[7] Scale points: 1 = *zero occasions*, 2 = *one or two occasions*, 3 = *three or four occasions*, 4 = *five or six occasions*, 5 = *more than six occasions*.

[8] It should be noted there was a marginally significant negative correlation between the number of details correctly "recollected" and the number of details correctly "known" ($r = -.26$, $t(48) = -1.86$, $p = .07$). Although this is not surprising, as a correctly remembered detail could either be "known" or "recollected" but not both, it indicates the result should be interpreted with caution.

actment because they provide more avenues down which the mind can wander to the intention in inopportune moments (i.e., before the enactment window), people who retained more retrieval paths to the outstanding intention—those who recollected a greater number of contextual details—had marginally more intrusive thoughts during the delay period about the moment in which they committed to the texting goal or about the impending enactment moment (summation of the two measures: $\beta = .45$, $SE(\beta) = .27$, $t(48) = 1.66$, $p = .10$).

In sum, Study 4 provides evidence that salient, idiosyncratic details present in the intention-commitment moment, if retained in memory by the goal striver, can increase the likelihood that a future intention is realized in the appropriate moment. We propose that memories of the commitment moment act as avenues down which the mind can wander to the outstanding intention during the intervening period between commitment and potential enactment. This periodic revisiting, as the data from Studies 1 through 3 suggest, should reinforce the accessibility of the delayed intention. In accordance with this idea, people who established more retrieval pathways to the outstanding intention, especially those who could "recollect" them as opposed to simply "knew" them, were more likely to recall and act on the delayed goal at a befitting time.

Study 5

In Studies 2 through 4, participants committed to an intention during concomitant exposure to stimuli (objects and sounds) with the potential to serve as retrieval pathways down which the mind could wander to the intention in inopportune moments. In Study 5, rather than expose participants in a treatment condition to salient contextual details in the commitment moment, we ask them to simulate such details. We predict that a participant who generates a unique and distinctive experience will be more likely to spontaneously revisit this episode—to mind-wander to it—during the intervening period between intention commitment and potential enactment. In so doing, the participant should increase the accessibility of the outstanding intention in memory, thus increasing the likelihood of recalling the intention when the opportune moment finally arrives.

We test this prediction by giving participants a goal that, to successfully complete, they must enact after a 92-hr delay (sending us an e-mail). Before receiving the goal, half the participants constructed a narrative story around a set of unusual, idiosyncratic details (potent retrieval cues) while the other half constructed a narrative story around a set of comparatively prosaic details (banal retrieval cues; Bower & Clark, 1969). We then test whether this manipulation predicts subsequent enactment success.

Method

Participants and design. Participants were 792 individuals recruited through Amazon's Mechanical Turk (AMT). Participants were paid $1 for completing the approximately 12-min task. Seven participants were not included in the analysis because, although they accepted the task in AMT, we found no record of them having completed the encoding phase of the online survey (responses were recorded using Qualtrics). Another participant indicated that completing the goal during the required time was impossible, and was thus dropped from the analysis. The study used a single between-subjects manipulation (retrieval cues at encoding: potent or banal).

Procedure. Study 5 consisted of two phases. In the first phase of the study, participants were asked to write a short story about a fictional character. They were told that "the story should be short (maybe a paragraph or two), but longer than one or two sentences" and that it should take "approximately 8 minutes to complete." The participants who were randomly assigned to the potent-retrieval-cues condition were provided a distinctive—arguably absurd—set of details to incorporate into their story:

> Write a story involving a child who grows up and turns into a dolphin (she is born a human). At some point she realizes that she must live in water, although she dreams of living on land and being a professional ballerina. She does not like to eat fish, which is a problem because most dolphins eat nothing but fish.

Participants in the banal-retrieval-cues condition were provided a comparatively dull set of details to incorporate in their story:

> Write a story involving a child who grows up and becomes a construction worker. At some point, she realizes that she would rather have a desk job and dreams of being an architect. She is afraid of heights,

which is a problem because most construction jobs require work to be done on ladders and scaffolding.

After participants finished generating their story (phase one), we gave every participant the goal of sending us an e-mail in four days' time (phase two). Specifically, participants were told they should try to remember to send us an e-mail with their Participant ID in the subject line, on Monday afternoon (the experiment was always offered on a Thursday), between 1:00 p.m. and 5:00 p.m. (in their time zone). We provided participants with an e-mail address and, for individuals concerned with privacy, we provided a method for sending an anonymous e-mail.

As with previous studies, we told participants the study was concerned with how people remember naturally, so (a) they should copy the e-mail address and their participation number into a text/word file and save it in a folder on their computer, preferably somewhere out of sight, and (b) external memory aids were forbidden because of our interest in whether people can remember naturally (i.e., remember to send the e-mail without external reminders, e.g., calendar notifications). We emphasized that participants would receive payment regardless of whether they successfully sent the message.

Finally, participants were asked to (a) confirm their availability during the target time period—four days later, between 1:00 p.m. and 5:00 p.m., (b) indicate the time zone in which they resided, and (c) rate how effective they are at remembering to enact delayed goals (1 = *very bad*) and (7 = *very good*).[9]

Results and Discussion

The dependent measure of interest was successful enactment of the delayed e-mail intention during the specified time interval—between 1:00 p.m. and 5:00 p.m., four days after participants committed to the goal. We decided a priori to allow for a 5-min grace period on either side of the specified interval, although post hoc analysis shows the following result is robust to more strict and more lenient cutoffs. Results provide support for our hypothesis: 88 of 391 participants (22.5%) in the potent-retrieval-cues condition remembered to e-mail, whereas only 63 of 401 participants (15.7%) remembered in the banal-retrieval-cues condition (logistic regression: $\beta_{\text{treatment}} = .44$, $SE(\beta) = .18$, $z = 2.42$, $p = .015$).[10] In other words, participants who created a more enriched experimental experience for themselves at encoding, and thus who were likely to have more potent retrieval pathways through which a wandering mind might revisit the goal, were 43% more likely to self-initiate retrieval of the intention at the appropriate future moment. Interestingly, the proportional increase is almost identical to that in Study 2, in which the treatment condition was associated with a 45% increase in enactment success compared to the control condition.[11]

As a second level of analysis, we looked at the stories the participants wrote. A research assistant (RA; blind to the hypothesis) rated a random subset of stories for quality (described to the RA as "general goodness") and unusualness/bizarreness (using 1 to 9 scales). Confirming that our manipulation was effective, the RA indeed rated the stories in the potent-retrieval-cues condition as more unusual ($M_{\text{potent}} = 3.98$, $M_{\text{banal}} = 1.09$, $t(195) = 16.18$, $p < .001$, Cohen's $d = 2.31$), but not higher in quality ($M_{\text{potent}} = 3.86$, $M_{\text{banal}} = 3.94$, $t(195) = -.25$, $p = .80$, Cohen's $d = .04$). Participants in the potent-retrieval-cues condition also wrote longer stories ($\text{median}_{\text{potent}} = 864$ characters, $\text{median}_{\text{banal}} = 760$ characters, t test on log-transformed character count: $t(790) = 4.85$, $p < .001$, Cohen's $d = .32$), which raised a concern that the manipulation may have led to differences in participants' elaboration of the material at encoding—a long history of research reveals that memory retention increases with the amount of elaboration of the material at encoding (cf., Craik & Lockhart, 1972).

To assuage concerns that our potency manipulation increased enactment because it encour-

[9] This measure was a significant predictor of successful enactment (logistic regression: $\beta = .27$, $SE(\beta) = .06$, $z = 4.31$, $p < .001$) but did not interact with the manipulation ($\beta_{\text{interaction}} = .11$, $SE(\beta) = .13$, $z = .88$, $p = .38$).

[10] Six participants failed to include their participant ID in their e-mail, which is necessary to link them to an experimental condition. Through communication, we were able to resolve this issue for five of the participants, leaving one participant who succeeded but was recorded as failing in an unknown condition. Another participant admitted to cheating and was also marked as failing.

[11] The average enactment rate in Study 2 was higher than in Study 5 (control conditions: 30% vs. 16%), which could be due to methodological (e.g., online vs. in-person study) or population differences (participants recruited from AMT vs. lab pool).

aged more lengthy elaboration, we conducted a logistic regression with story length (log-transformed and standardized) and condition (effect coded: potent = 1 and banal = −1) as separate predictors of enactment success. The log-transformed length of the story (and thus, perhaps, degree of elaboration) was a significant predictor of timely enactment ($\beta_{length} = .25$, $SE(\beta) = .09$, $z = 2.63$, $p = .009$). But, importantly, the potency manipulation was also still significant ($\beta_{treatment} = .18$, $SE(\beta) = .09$, $z = 1.98$, $p = .048$). To further explore potential differences in stimulus elaboration, we conducted another logistic regression that included the interaction between the length of the story and the potency manipulation. Both main effects remained significant ($\beta_{length} = .29$, $SE(\beta) = .10$, $z_{length} = 2.95$, $p = .003$; $\beta_{treatment} = .21$, $SE(\beta) = .09$, $z_{potency} = 2.27$, $p = .027$) and were qualified by a marginally significant interaction ($\beta_{interaction} = -.18$, $SE(\beta) = .10$, $z_{interaction} = 1.80$, $p = .072$). Story length was a significant predictor of enactment for individuals in the banal condition (simple effect: $\beta_{length} = .46$, $SE(\beta) = .16$, $z = 2.99$, $p = .003$), but not for those in the potent condition (simple effect: $\beta_{length} = .11$, $SE(\beta) = .12$, $z = .94$, $p = .35$). The potency manipulation had the largest effect on participants who, for whatever reason, were the least motivated to construct lengthy stories.[12]

To summarize, Study 5 results indicate that the likelihood that people recall and enact an intention at the appropriate future moment increases with the distinctiveness of potential retrieval cues participants self-generated in the intention-commitment moment.

General Discussion

Notwithstanding existing evidence that tasks outstanding are a source of distraction, research has thus far overlooked whether intention-related mindwandering has mnemonic benefits. Confirming our predictions, the present investigation reveals that the mind's tendency to wander from a current activity to other unresolved intentions increases the likelihood of successfully seizing future chances to realize these aspirations. Across a series of studies conducted in seminaturalistic settings, using both self-reported and experience-sampled measures of intention-related intrusions, we consistently find that the more frequently a mind wanders to an outstanding intention in inappropriate moments (i.e., before the enactment window), the greater the likelihood of it doing so when a more opportune moment presents itself. As far as we know, this article is the first empirical demonstration of this mnemonic value produced by mindwandering.

Beyond establishing the self-reminding function of mindwandering, we further examined the types of unfulfilled intentions most likely to intrude on unrelated thought. Drawing from research on contextual retrieval pathways (e.g., Howard & Kahana, 1999, 2002), we proposed that committing to an intention in a setting replete with distinctive versus typical contextual details increases the number and potency of retrieval routes to the delayed intention, thereby making unintentional recollection more likely and frequent during the interim between goal commitment and potential enactment. Results suggest that increasing the number and the potency of potential retrieval pathways down which the mind can wander to the delayed goal leads to an increase in both the likelihood that an unfulfilled intention intrudes on unrelated mental activity and the likelihood that it is retrieved when the enactment window finally arrives. Future research might consider other factors that facilitate timely retrieval of delayed intentions by increasing intention-related intrusions. The prospective memory literature provides a number of likely candidates (e.g., the personal importance of an intention, see Kvavilashvili & Ellis, 1996).

To be sure, research has already made a compelling argument in support of the view that the ability to decouple attention from the current sensory environment and simulate future happenings is one of the cardinal cognitive capacities distinguishing primates from other species, enabling our capacity to act with foresight (Andrews-Hanna et al., 2007; Buckner & Carroll, 2007; Spreng & Grady, 2010; Spreng, Mar, & Kim, 2009; Suddendorf & Corballis, 2007; Suddendorf & Redshaw, 2013). Although we do not question the advantages conferred on species

[12] If elaboration also increases retrieval pathways (e.g., Bradshaw & Anderson, 1982) it is possible that elaboration has a non-additive effect when combined with the potent-retrieval-cues manipulation because of diminishing returns on additional retrieval pathways.

that possess the ability to prudently prepare for future opportunities via mental simulation, and although we are sympathetic to the assertion that the mind is drawn to reflect on impending future events (Andrews-Hanna, 2012; Bar, 2009; Bar, Aminoff, Mason, & Fenske, 2007; Binder et al., 1999; Cohen, 2013; Mason et al., 2007; Mason, Bar, & Macrae, 2009; Smallwood & Schooler, 2006), we believe the distinction between volitionally simulating possible future happenings (i.e., planning) and having thoughts of an outstanding need intrude on one's ongoing mental activity is important. During an important meeting, an intrusive thought about a blouse that needs to be retrieved from the dry cleaner would seem to confer little advantage in terms of planning (because the process of picking up dry cleaning is straightforward). Moreover, whereas previous research has considered whether mindwandering affects *how effectively a future task is implemented*, we consider whether it affects the likelihood of a future task being *implemented at all*. We believe examining the possible reminding value entailed in these off-task moments is worthwhile, if only because these intention-related intrusions speckle so much of our waking activity.

We should acknowledge the present investigation has limitations. The present investigation found goal enactment increased with *recollected* intention-related mindwandering (Studies 3 and 4) and with "*self-caught*" mindwandering (Studies 1 and 2; Schooler et al., 2011). Thus, one limitation of the research methodology used herein is that having mindwandering episodes was confounded with remembering their occurrence in the former set of studies and with noticing them in the latter. As is true of any research that uses self-report measures, we have an imperfect measure of mindwandering frequency and thus our conclusions should be interpreted with some caution.

Second, although the naturalistic approach we adopt permits examining the self-reminding function of mindwandering in an ecologically valid context, it also introduces problems when attempting to draw strong inferences about causality. As with any field study, we are poorly positioned to account for the effect of "third variables" (i.e., omitted variables; Clarke, 2005). For instance, it is possible that an unmeasured variable increases both one's awareness of intention-related mindwandering and retrieval of delayed intentions in opportune moment. If this is the case, the relationship we find between mindwandering and timely recall of delayed goals would be spurious. Although we cannot think of an omitted variable that might have such an effect, we acknowledge that we are poorly positioned to make definitive claims about causality. Future research might consider manipulating opportunities for mindwandering (cf., Baird et al., 2012; Mason et al., 2007; Teasdale et al., 1995) instead of simply measuring its occurrence as we did here. Doing so would provide stronger evidence for the mnemonic benefits of a wandering mind. Still, we believe that the benefits afforded by studying this particular phenomenon as it occurs in the real world are worth the drawbacks.

We think it is also important to note that although having participants commit to the intention in a setting replete with idiosyncratic details augmented the intrusion rate (Studies 3 and 4), participants appear to establish retrieval cues at encoding even in the absence of our intervention (see control participants, Study 3). Doing so led to a greater likelihood of intrusions by these intentions in both opportune and inopportune moments; however, our embellishment manipulation was not strictly necessary for a rise in the rate of intention-related intrusions. Indeed, the results of Study 5 confirm that mentally embellishing the commitment moment has a similar effect on enactment as physically embellishing the commitment moment.

Although the primary aim of this investigation was to examine the upsides of a ubiquitous but often maligned mental behavior, reflecting on the implications of our intention-related mindwandering for the attainment of "mindful" work is worthwhile. In particular, our results would seem to add empirical credibility to the long-standing view that one should act on tasks that can be implemented quickly (cf., Allen, 2002). Doing so obviously ensures the task gets acted on, but it also prevents the task from being a source of distraction if it is delayed.

Conclusion

The view that people have better memories for intentions that are incomplete versus complete has a longstanding history in psychology (Lewin, 1926; Zeigarnik, 1927). Here, we offer an important extension of that axiom: Not only

does the mind have an easier time retrieving unfulfilled versus fulfilled intentions when *prompted by an experimenter* to do so, it also tends to retrieve this information in the *absence of direct prodding by others*. Whereas a narrow perspective on this behavior would lead one to emphasize the perils of having an information-processing system that is prone to distraction, a broader perspective leads one to consider that having a mind that wanders in this way offers mnemonic upsides.

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Received October 7, 2014
Revision received January 13, 2015
Accepted January 18, 2015 ■