

# Doing what we imagine: Completion rates and frequency attributes of imagined future events one year after prospection

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Recent years have seen an explosion of studies examining behavioural and neural aspects of imagining future events. However, little is known about whether imagined future events reflect future happenings. We examined event occurrence 1 year after participants imagined highly probable future events, specific to place and time. Overall, participants did engage in most of their imagined events. Completion rates were similar to naturalistic prospective memory and implementation intention studies examining personal plan completion. Approximately 20% of events were abandoned. We found participants often imagined events that were repeated many times in the course of a year and this impacted the vividness of recollection, sense of personal importance, personal involvement in event fulfilment, and extent of positive emotionality 1 year later. Together, the results provide an important validation for prospection research and highlight novel dimensions in the temporal structure of future-thinking.

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In recent years there has been an explosion of interest in the ability to imagine the personal future, or prospection (for reviews see Atance & O'Neill, 2001; Schacter, Addis, & Buckner, 2008; Suddendorf & Corballis, 2007; Szpunar, 2010). Many studies have demonstrated shared attributes between recollecting past events (i.e., autobiographical remembering) and imagining future events in healthy participants using both behavioural (e.g., D'Argembeau & Van der Linden, 2004, 2006; Quoidbach, Hansenne, & Mottet,

2008; Rathbone, Conway, & Moulin, 2011; Spreng & Levine, 2006; Szpunar & McDermott, 2008) and neuroimaging (e.g., Addis, Wong, & Schacter, 2007; Botzung, Denkova, & Manning, 2008; Okuda et al., 2003; Spreng & Grady, 2010; Szpunar, Watson, & McDermott, 2007) techniques. Shared deficits in episodic memory and imagining future events have also been observed in older adults (Addis, Wong & Schacter, 2008), patients with amnesia (e.g., Hassabis, Kumaran, Vann, & Maguire, 2007; Klein, Loftus, & Kihlstrom,

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2002; Tulving, 1985), brain injury (Berryhill, Picasso, Arnold, Drowos, & Olson, 2010), and psychiatric disorders (D'Argembeau, Raffard, & Van der Linden, 2008; King et al., 2011; Williams et al., 1996). In spite of this growing interest in the ability to imagine events in the future there is scant evidence to suggest that what one imagines in the future reflects whether these events will actually occur at a later time.

Prospective memory research has investigated the fulfilment of delayed intentions for over 40 years (Brandimonte, Einstein, & McDaniel, 1996). In order to maintain experimental control the bulk of this work has involved participants fulfilling experimenters' intentions rather than their own. To address this issue some studies have relaxed experimental control in favour of ecological validity to examine the completion of participants' plans over the course of 1 week. Marsh, Hicks, and Landau (1998) found completion rates for participants' self-generated plans of approximately 73% and 76% in two experiments. Kim and Mayhorn (2008) restricted daily planned intentions to school and work activities and found approximately 78% of these intentions were fulfilled in 1 week. In a related line of research Gollwitzer (1999) has examined goal completion when individuals imagine and rehearse a plan with respect to the specific future context (i.e., when, where, and how) they will execute it. By forming "implementation intentions", significant improvement is made on the completion of intended actions, both within and outside the laboratory (Gollwitzer & Sheeran, 2006). In one study the impact of forming implementation intentions on personal plan completion over the winter holiday was assessed. After returning from winter break a combined 67% of all plans were completed, although there was a significant improvement in difficult plan completion with the formation of implementation intentions (62% versus 22%, Study 1: Gollwitzer & Brandstätter, 1997). Due to unknown differences between personal plans and imagined future events, however, it is unclear if these completion rates inform current investigations into whether imagined future events come to pass.

In perhaps the most relevant study to the current investigation, one neuroimaging study evaluated whether future events that were imagined in the scanner subsequently took place, when assessing brain activity associated with future event probability (Weiler, Suchan, &

Daum, 2010). Like the Gollwitzer and Brandstätter (1997) study, all imagined events were to take place over the winter holiday, and participants indicated what events actually occurred after returning from winter break. Weiler and colleagues found that 49% of events happened in full or in part, as imagined; 51% of imagined events did not occur. These completion rates are lower than one would expect from plan completion rates derived from studies of prospective memory and implementation intentions reviewed above. Imagining probable future events and personal planning both fall broadly under the umbrella of future-oriented thinking, but their relationship is undetermined (cf. Szpunar & Tulving, 2011).

In order to examine whether imagined personal future events eventually occur we contacted participants 1 year after they originally participated in a study of prospection (Spreng & Levine, 2006). In the original study we used 90 cue words to elicit 45 autobiographical memories and 45 probable future events, then examined the temporal distribution of these events. The cue word technique is the most common method used to elicit events in prospection research. Our results showed the well-known retention function of memories (i.e., the frequency of memories declines as a function of time; Rubin & Schulkind, 1997), but also showed evidence for the "intention function" whereby participants predominantly imagined events in the near future, and future event frequency declined as a function of time (Spreng & Levine, 2006). Overall, 74% of future events were imagined to occur within 1 year. On the anniversary of taking part in the test we followed up our participants to assess whether their imagined future events had occurred, been rescheduled, or abandoned. We also assessed the frequency in which imagined events occurred in the last year, along with event vividness in recollection, personal importance, personal involvement in the event occurring, and emotionality. The primary purpose of the present study was to provide novel base rates for imagined event completion 1 year after prospection, which would provide a validity check for studies of prospection, and to explore vividness of recollection, sense of personal importance, personal involvement in event fulfilment, and emotionality as a function of frequency, which had not been previously considered.

## METHOD

### Participants

Of the initial 300 undergraduate participants, 223 consented to be contacted at a later date, and 101 healthy young adults ( $M_{\text{age}} 20.1 \pm 1.5$  years, 25 males) participated online in the current study for \$10 compensation 1 year ( $M = 363.1 \pm 20.6$  days) after participating in the modified future Crovitz test (Spreng & Levine, 2006, Experiment 1). We were unable to contact by email or post the 122 additional participants who also agreed to be contacted following the original study. These participants did not differ by age, number of events, or gender distribution (all  $ps > .25$ ) from the 101 who participated in the current study. All participants gave informed consent in accordance with the Baycrest IRB.

### Procedure

Participants were invited to follow up on their future intentions from the previous year. One at a time, participants were presented with the original cue word and their imagined future event description ( $M$  number of events =  $42.3 \pm 5.8$ , maximum = 45). First, participants were asked how well they recognised the written response on a scale from 1 to 6, 1 being no recognition and 6 being strong recognition (note: In the absence of lures this was not a true test of recognition, but an assessment of confidence in the participants' familiarity with their own written response at time 1). Second, participants rated whether or not the event occurred. At this juncture participants either answered questions about their intention (A) or their memory for the imagined event (B). If the event had not occurred within the last year (3A) participants indicated whether or not they still intended for the event to occur. If not, the trial ended. For events that had not yet happened, but for which the participant still had intention (4A), a new date was provided for when the retained/rescheduled event would happen and the trial ended. If at question 2 the participant indicated that the event had occurred (3B), they then indicated how long ago, within the last year, they were first involved in the event. Participants then indicated (4B) how many times in the last year the event occurred: Once, Twice, 3–4 times, 6–12 times, 13–25 times, more than 25 times, or

Every day. Four additional questions were then rated on a scale of 1–6 and included (5B) Vividness of re-experiencing the event (1 = General memory: I know the event happened but no visual images, thoughts or feelings come to mind; 6 = Specific detailed memory: Vivid recollection with visual images, thoughts or feelings), (6B) Personal importance (1 = Not at all important; 3–4 = Moderate; 6 = Of great importance), (7B) Personal involvement (1 = Passive spectator; 6 = Active/main character), and (8B) Emotional experience related to the event (1 = Negative; 3–4 = Neutral; 6 = Positive). After completing these six questions about events that took place, the trial ended. This procedure repeated until all original future event descriptions had been presented.

## ANALYSIS AND RESULTS

After 1 year had passed, participants' self-reported recognition of their future events was moderate ( $M = 3.5 \pm 1.0$ , 6-point scale). In 78.5% ( $SD = 19.2$ ) of cases, participants had some recognition of their written descriptions, as indicated by a rating of two or more. Although participants were no longer familiar with some of their event descriptions (e.g., "*Sitting at my cottage next summer reading quietly by the lake*"; "*Tomorrow morning I'll put butter on my bagel for breakfast*"), they were capable of assessing whether or not the event had occurred and whether they maintained the intention, and retrieve details of the events that had occurred. Recognition of participant responses was examined and assessed by event occurrence with a paired-samples  $t$ -test. Recognition ratings were significantly higher for events that had happened than not. This was true for all events (occurred recognition  $M = 3.8 \pm 1.2$ ; non-occurrence recognition  $M = 3.1 \pm 1.1$ );  $t(100) = 7.7$ ,  $p < .001$ , Cohen's  $d = .48$ , and events foreseen to occur within 1 year (occurred recognition  $M = 3.8 \pm 1.2$ ; non-occurrence recognition  $M = 2.9 \pm 1.2$ );  $t(100) = 9.2$ ,  $p < .001$ , Cohen's  $d = .60$ .

Percent of completed, rescheduled, and abandoned events within and beyond 1 year are reported in Table 1; 11 participants had no events extending past 1 year. Confidence intervals (CI) reported are 95% and were determined from 10,000 bootstrap resamplings with replacement to better estimate the population parameter from our sample (Efron & Tibshirani, 1985). Of the events imagined to occur within 1 year, 61.4% of

TABLE 1

Percent of imagined future events, and their rates of occurrence, retention, and abandonment within and beyond 1 year

Time interval	Events Imagined				Event Occurrence				Events Retained/ Rescheduled				Events Abandoned			
	M	SD	95% CI		M	SD	95% CI		M	SD	95% CI		M	SD	95% CI	
			Lower	Upper			Lower	Upper			Lower	Upper			Lower	Upper
Within 1 yr	78.0	21.8	73.7	82.2	61.4	14.5	58.5	64.2	16.7	11.2	14.6	19.0	22.0	13.8	19.3	24.7
Exceeding 1 yr	22.0	21.8	20.7	29.5	14.7	20.5	10.7	19.2	63.3	28.7	57.2	69.1	22.0	24.0	17.2	27.1
Total	100	n/a	n/a	n/a	51.7	17.2	48.4	55.2	26.9	15.5	23.9	29.9	21.4	12.5	19.1	24.0

Event occurrence, events retained/rescheduled, and events abandoned are conditionalised (i.e., the means for event occurrence, events retained/rescheduled, and events abandoned within 1 year sum to 100%, etc.).

events happened. Additionally, 14.7% of events imagined to occur in more than a year's time had happened. In total 51.7% of all imagined events had occurred within 1 year. Events that happened ranged from day-to-day occurrences ("I am listening music in my room and lying on my bed."), to non-routine events happening earlier than expected ("Going to Scotland to climb the Eildon Hills.").

When participants did not engage in the imagined event, the intention was either (A) retained and rescheduled in some form, or (B) abandoned. For those events that were imagined to occur within 1 year but did not happen, 16.7% were recast to a later time ("Sitting at the cottage, and watching a butterfly slowly land beside me."). A total of 63.3% of future events imagined to occur in more than 1 year were retained and/or rescheduled. Thematically many rescheduled events beyond 1 year could be classified as life scripts relating to career, children, relationships, and vacation/travel (Bernsten & Bohn, 2010; Bernsten & Rubin, 2004; deVries & Watt, 1996). Examples of future events involving these life scripts are career, "Working in a business in the city, being part of all the hustle."; children, "I will have the facts-of-life talk with my son/daughter when he/she is about 9 yrs old."; vacation/travel, "I see myself on a cruise boat, basking in the afternoon sun, sipping tropical drinks, reading the latest novels. Dancing and partying by night, swimming and relaxing by day."; relationships, "One day, when I'm old and grey (hopefully), I'll go and walk in a prairie with my husband; holding hands.". Not all such unfulfilled distant events can be easily categorised. The following examples touch on themes of family, but are also specific in their detail: "Next summer, I'll be out in the yard planting flowers with my mom." and "I will

have to tell my sister the truth, that it was me who broke her favorite glass horse."

A number of events were no longer intended and had been abandoned. For the events expected to happen within 1 year, 22% of them did not occur, and the intention was abandoned. Similarly, 22% of events expected to happen beyond 1 year were also abandoned. For example, "I decide that I want to spend my week's allowance of food money on a single meal, to celebrate my amazing marks on the next round of tests, and go to Le Papillion. I order a crepe with sausage and cheese, just like I used to with my parents."

Next we examined the vividness of recollection, sense of personal importance, personal involvement in event fulfilment, and emotionality of events that had occurred. Comparisons of these qualities of imagined future events by event frequency were conducted with repeated-measures ANOVA and pairwise comparisons were Bonferroni corrected for multiple comparisons ( $\alpha < .05$ ). In order to reduce exclusion of cases due to listwise deletion, frequency categories were collapsed into three bins: Rare (Once or Twice), Infrequent (3–4 times or 6–12 times), and Routine (13–25 times, 25+ times, or Every day).

TABLE 2

Percent of events that happened by frequency of occurrence in the last year

	M	SD	95% CI	
			Lower	Upper
Once	25.5	16.1	22.3	28.7
Twice	7.7	7.2	6.3	9.1
3–5 times	14.7	9.2	12.9	16.5
6–12 times	12.6	8.1	11.0	14.2
13–25 times	10.0	7.5	8.5	11.5
More than 25 times	21.3	12.4	18.9	23.8
Everyday	8.2	6.9	6.8	9.6

The number of repetitions for events carried out in the last year are reported in Table 2.

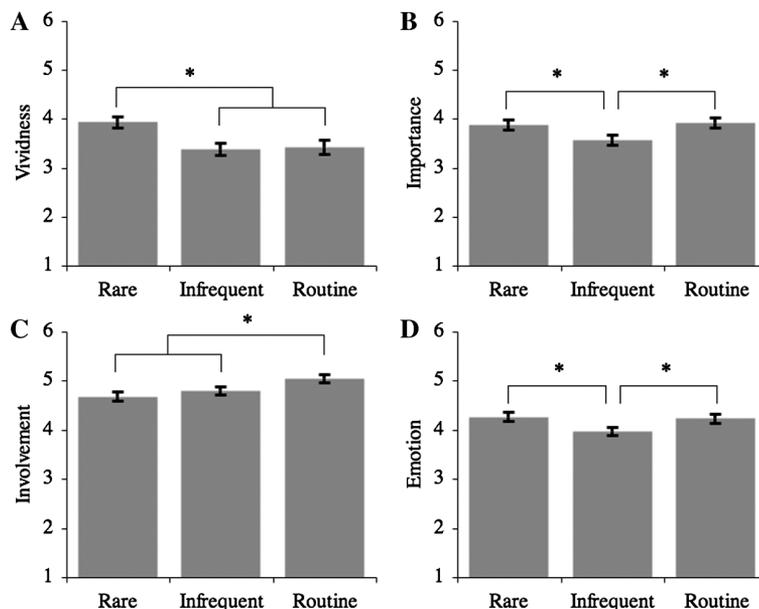
Events that occurred could be vividly recalled ( $M=3.6\pm 1.0$ , CI: 3.4–3.8) and significantly differed by event frequency in the last year, Wilk's  $F(2, 93)=8.94$ ,  $p<.001$  (Figure 1A). Rare events were recollected with more vividness than infrequent (Cohen's  $d=.42$ ) and routine (Cohen's  $d=.32$ ) events, which did not differ. An example of a rare and vividly remembered event was "When I go to the dentist next week, I'll be told I have a cavity." An example of a routine low vividness event was "After I shower I'll change my clothes into something more suitable for the day."

Participants rated completed future events as personally important ( $M=3.8\pm 0.7$ , CI: 3.6–3.9) and importance significantly differed by event frequency, Wilk's  $F(2, 93)=7.02$ ,  $p<.001$  (Figure 1B). Infrequent events were rated as less important than both rare (Cohen's  $d=.26$ ) and routine (Cohen's  $d=.31$ ) ones, which did not differ. For example, a low importance, infrequent event was "I will water the plants in my house." A highly important event that was rare would be, "Entering through the door of my first apartment." In contrast, important but routine event examples are "Locking the door when I leave my house for school." and "My boyfriend will give me a kiss when he comes over this evening."

Participants felt as though they were actively involved in future events occurrence ( $M=4.8\pm 0.7$ , CI: 4.7–5.0) and personal involvement significantly differed by event frequency, Wilk's  $F(2, 93)=6.64$ ,  $p<.01$  (Figure 1C). Personal involvement was higher for routine events than rare (Cohen's  $d=.33$ ) or infrequent (Cohen's  $d=.24$ ) ones, which did not differ. An example of a routine event with high personal involvement was "Tomorrow morning, as soon as I step out of the house, I am going to walk along a street." A rare event with low personal involvement was, "The first flower my boyfriend buys me."

Overall, participants felt positive emotion related to completed events ( $M=4.1\pm 0.6$ , CI: 4.0–4.2), which differed by event frequency, Wilk's  $F(2, 93)=4.89$ ,  $p<.01$  (Figure 1D). Infrequent events were rated as less positive than both rare (Cohen's  $d=.26$ ) and routine (Cohen's  $d=.26$ ) ones, which did not differ. An infrequent neutral event example is, "Watching people trying to get on the streetcar which is already at maximum capacity." An example of a rare positive event is "A trip to Niagara-on-the-Lake," A routine positive event example is, "Going out tonight with my girlfriends for coffee."

Events were completed earlier than originally anticipated ( $M=-191.9$  days  $\pm 568.3$ , CI: -311.6 to -95.0), with no difference by event frequency,



**Figure 1.** Qualities of imagined future events by frequency of occurrence within the last year for (A) vividness, (B) personal importance, (C) personal involvement, and (C) emotion. All qualities were rated on a scale of 1 to 6. Vividness, importance and involvement ratings indicate increasing degree of endorsement. For emotion, 1 = Negative; 3–4 = Neutral; 6 = Positive emotional experience related to the event.

Wilk's  $F(2, 93) = 0.56$ ,  $p > .55$ . However, the timeliness of event completion was biased by distant events occurring early and does not necessarily reflect early execution of near term prospective events.

## DISCUSSION

An ever-growing number of studies are examining the ability to imagine personal future events. While prospective memory research emphasises intention execution, there is a paucity of research examining whether imagined future events eventually happen. In our initial study (Spreng & Levine, 2006), we used a cue word technique to elicit highly probable personal future events that were specific in place and time. We found that 74% of imagined future events were foreseen to occur within 1 year. After 1 year had passed we followed up with 101 of the original participants. We found that participants were capable of recognising their written descriptions after 1 year and that recognition was better for events that had occurred. Below we discuss occurrence rates for imagined events, rescheduled, and abandoned events, and the quality of events depending on how frequently they occurred in the last year.

Of the imagined future events foreseen to occur within 1 year, we found that 59–64% happened after a year had passed (see Table 1 for full results). We also found that 11–19% of events foreseen to occur after more than a year, occurred earlier. These results provide an important validation for prospection studies. While a majority of events foreseen to occur within 1 year are actually realised, a substantial minority is not. The range of imagined events completed within 1 year is consistent with an implementation intentions study that broadly sampled personal goals and found completion rates of 67% over the course of one month (Gollwitzer & Brandstätter, 1997). Three naturalistic studies of prospective memory found higher completion rates from 73–78% for personal intentions over the course of one week (Kim & Mayhorn, 2008; Marsh et al., 1998). Naturalistic prospective memory completion rates were higher than the range we observed. However, one would expect a decline in completion rates as the interval of time increases between intention formation and execution. A systematic assessment of imagined events on different time scales would be necessary to clarify the pattern of completion over time. Weiler et al. (2010) examined whether imagined

future events later happened over the winter holiday and found that 49% of events did occur in full or in part. This proportion is much lower than the present findings. Although both paradigms used cue words to elicit events, Weiler et al. (2010) constrained the interval of time to 1 month and only used cue words that were thematically linked to the Christmas and New Year's holidays (e.g., Christmas shopping, New Year dinner). The present study used cue words that were construed broadly to elicit probable future events over the lifespan (e.g., Clothing, Kindness, Home; Rubin, 1980), which is likely to account for the difference. Factors such as time period, cueing methods, and task instructions will affect the nature of imagined events, with implications for studies comparing correlates of imagined events with those of other tasks, such as memory for past events.

Even though not all prospective events had happened, participants viewed many of their imagined future events as still likely to occur. Between 15–19% of events foreseen to occur within the last year, and which had not happened, were still seen as probable; 57–69% of events foreseen to occur in more than one year, and which had not yet happened, were also still seen as probable. Thematically many of the events forecast to occur in the more distant future could be classified as cultural life scripts (Bernsten & Bohn, 2010; Bernsten & Rubin, 2004; deVries & Watt, 1996). Overall, 24–30% of imagined events retained their viability after 1 year.

Approximately 20% of all imagined events did not occur, and would not be rescheduled. This rate of abandoned events was equivalent for events imagined to occur within 1 year, those extending past 1 year, and all events. In a naturalistic prospective memory study (Marsh et al., 1998), reprioritising and changing plans, not forgetting, was the primary reason why participants did not fulfil intentions that were monitored over 1 week. Rates of rescheduled and abandoned events likely reflect changing priorities and fluid contingencies that normally occur within a naturalistic context. The proportion of events that would never occur illustrates a key dissociation of prospection from autobiographical memory. Autobiographical retrieval is a reconstruction of prior experience (Bartlett, 1932; Schacter & Addis, 2007). Although memory retrieval is subject to distortions (Schacter, Coyle, Fischbach, Mesulam, & Sullivan, 1995; Schacter, Guerin, & St Jacques, 2011), autobiographical recall is considered to correspond to true prior

occurrences (when the events have been verified, e.g., Addis, Sacchetti, Ally, Budson, & Schacter, 2009). Prospection, on the other hand, is more purely an act of construction and imagination, which may draw upon past events (Hassabis & Maguire, 2007; Schacter & Addis, 2007). Occurrence probabilities for the future are far lower than the occurrence probability of remembered events. Indeed, there might even be an optimism bias, whereby we imagine far more in the future than can actually be accomplished within 1 year. Evidence from New Year's resolutions and other personal goals suggests that people can be overly ambitious in their goal formation (cf. Koestner, 2008).

Participants were instructed to imagine highly probable future events specific in place and time. When we examined how often these events occurred in the last year, we found that most had only occurred once, as expected. Next in frequency, however, participants imagined events that occurred with regularity. Surprisingly, two-thirds of imagined future events had occurred more than twice in the last year (Table 2). These data underscore the inherent difficulty in projecting oneself forward to a specific time and place. For many events, participants appeared to project themselves into a framework of routine and repetition.

An important consideration for the study of prospection is that the frequency of engaging in an event impacts other qualities. Rarely occurring events are recalled with the more vividness. This is consistent with the observation that repeated events lead to a "semanticised" memory or gist-based recollection where details become blurred across repeated episodes (e.g., Neisser, 1981). Events that are both rare and routine were evaluated as more important than infrequent events. Overall, participants felt as though they were actively involved in future events occurring. This active role may account for similarities between occurrence rates and intention completion rates from naturalistic prospective memory (Kim & Mayhorn, 2008; Marsh et al., 1998) and implementation intention (Gollwitzer & Brandstätter, 1997) studies. We also found that our participants felt more in control of (i.e., actively involved in) events that were routine. What we have most control over in our life may be our day-to-day activities. Rare and infrequent events are felt less inside our control, and more as something that happens to us. All future events had a bias towards positive emotions. However, rare and

routine events were seen as more positive. This positivity bias is likely due to the greater incidence of positive future thoughts in healthy young adults (D'Argembeau, Renaud, & Van der Linden, 2011) rather than our participants fulfilling more positive events. The effect sizes of frequency on vividness, importance, personal involvement, and emotionality were small to medium. Future research examining the qualities of prospection may be interested in controlling for the frequency with which the participant might engage in a future event. Although our ratings were captured at time two, it is likely that frequently occurring events happened many times prior to the initial sampling at time one. The contextual specificity of imagined events will likely be a determining factor in its frequency. One could imagine going to dinner, going to dinner with Karen, or going to Oleana for dinner with Karen; these events would vary from a routine activity to a single event.

Currently there is no taxonomy of future-oriented thinking, as with memory (e.g., Squire, 1987). The distinction between imagined probable future events and personal goals is murky. While some imagined future events clearly reflect desired goal states, it is not necessary that they do. One may imagine, and have the goal of, writing a letter over the winter holiday. Imagining sitting at a family dinner while one's aunt spills cranberry sauce on her blouse, while a highly probable future event, is unlikely to be in the repertoire of one's goals (although this event may be embedded within the goal of assembling the entire family for dinner). It will be important to tease apart goals from incidental happenings to dissociate these forms of future-oriented thinking. It would be worthwhile to examine the emotionality of imagined future events and the rate of occurrence to assess individual differences in outlook (optimists, realists, pessimists) and in clinical populations, such as depression (e.g., Strunk, Lopez, & DeRubeis, 2006). Finally, the current results suggest that a better understanding of cyclical time, and its framework of repetitions, would enrich our understanding of prospection. In the study of autobiographical episodic memory, emphasis is placed on memories that happen only once (e.g., Levine, Svoboda, Hay, Winocur & Moscovitch, 2002). Cast into the future, prospective events fall into a framework of regularity and established life scripts (Bohn & Berntsen, 2011), which may play as

large a role in framing our future self as the contents of our memories.

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