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On the representational systems underlying prospection: evidence from the event-cueing paradigm

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Abstract

The ability to think about the future—prospection—is central to many aspects of human cognition and behavior, from planning and decision making, to self-control and the construction of a sense of identity. Yet, the exact nature of the representational systems underlying prospection is not fully understood. Recent findings point to the critical role of episodic memory in imagining specific future events, but it is unlikely that prospection depends solely on this system. Using an event-cueing paradigm in two studies, we here show that specific events that people imagine might happen in their personal future are commonly embedded in broader event sequences—termed event clusters—that link a set of envisioned events according to causal and thematic relations. These findings provide novel evidence that prospection relies on multiple representational systems, with general autobiographical knowledge structures providing a frame that organizes imagined events in overarching event sequences. The results further suggest that knowledge about personal goals plays an important role in structuring these event sequences, especially for the distant future.

Keywords: prospection; future thinking; autobiographical memory; goals; episodic memory

1. Introduction

One of the remarkable features of the human mind is that it allows us to transcend our immediate circumstances to envision possible futures (Buckner & Carroll, 2007; Schacter & Addis, 2007; Suddendorf & Corballis, 2007; Szpunar, 2010; Tulving, 1985). We can momentarily shift our perspective from the immediate environment and imagine ourselves in all sorts of situations that might lie ahead, consider what it would be like if these situations materialized, and explore mentally different courses of actions that could be taken to attain or avoid the imagined state of affairs. This ability to think about the future—here referred to as *prospection*—is central to many aspects of human cognition and behavior, from planning and decision making, to self-control and the construction of a sense of identity (Atance & O'Neill, 2001; Boyer, 2008; Damasio, 1999; Schacter, Addis, & Buckner, 2008; Szpunar, 2010).

In spite of the functional importance of prospection, the nature of the representational systems underlying the ability to think about the future has received relatively little attention until recently. In the past few years, however, evidence has accumulated pointing to the critical role of episodic memory in imagining future events (for review, see D'Argembeau, in press; Schacter et al., 2008; Szpunar, 2010). Most notably, investigations of various patient and subject populations have revealed that deficits in episodic memory are typically associated with parallel deficits in imagining future events (Addis, Sacchetti, Ally, Budson, & Schacter, 2009b; Addis, Wong, & Schacter, 2008; D'Argembeau, Raffard, & Van der Linden, 2008; Hassabis, Kumaran, Vann, & Maguire, 2007; Klein, Loftus, & Kihlstrom, 2002; Tulving, 1985; Williams et al., 1996), and neuroimaging studies have shown that episodic remembering and prospection recruit largely similar brain regions (Addis, Pan, Vu, Laiser, & Schacter, 2009a; Addis, Wong, & Schacter, 2007; Botzung, Denkova, & Manning, 2008; Spreng & Grady, 2010; Szpunar, Watson, & McDermott, 2007). These findings and related observations have given rise to a number of novel theoretical perspectives on the nature and

functions of episodic memory (Buckner & Carroll, 2007; Hassabis & Maguire, 2007; Schacter & Addis, 2007; Suddendorf & Corballis, 2007; Tulving, 2002). A particularly influential proposal—the *constructive episodic simulation hypothesis*—is that episodic memory provides a source of details for imagining future events (Schacter & Addis, 2007; Schacter et al., 2008). According to this view, the constructive nature of episodic memory allows the flexible recombination of details from past experiences (e.g., details about previously encountered objects, persons, and locations) into novel configurations depicting events that have not been experienced previously in the same form.

Although details from past experiences are certainly essential ingredients for imagining future events, prospection might not solely depend on episodic memory (for further discussion of this issue, see D'Argembeau & Mathy, 2011; Szpunar, 2010). An important yet neglected question is whether and how representations of discrete future events are structured and organized in the cognitive system. Are future thoughts represented independently of each other or are they part of broader themes and functional units? Decades of research on autobiographical memory has led to the view that specific event memories are contextualized within higher-order autobiographical knowledge structures (e.g., knowledge about lifetime periods and general events) that locate and organize discrete past events in the individual's life story (Conway, 2001, 2009; Conway & Pleydell-Pearce, 2000). Whether or not a similar representational structure characterizes prospection is currently not known. This question raises the interesting possibility that, in addition to details sampled from episodic memory, the construction of future events might also depend on general representations of the personal future (e.g., abstract knowledge about personal goals and anticipated events) that provide a frame for organizing imagined events. Clues as to the existence of such general autobiographical knowledge structures have been offered by recent studies showing that people frequently think about their personal future in abstract ways (Anderson & Dewhurst,

2009; D'Argembeau, Renaud, & Van der Linden, 2011) and often access abstract knowledge about their future first when they attempt to imagine specific situations that might possibly happen to them (D'Argembeau & Mathy, 2011). To date, however, the evidence for these hypothetical knowledge structures is still sparse, and how they might organize representations of future events remains unknown.

In the present research, we aim to further our understanding of the representational systems underlying prospection, and in particular of the possible role of general autobiographical knowledge structures, by investigating the prevalence and nature of event clusters in prospective thought. Important insights into the organization of event memories have been gained from the use of an event-cueing method devised by Brown and Schopflocher (1998a). In this paradigm, participants first recall a set of personal events and these events (which are called the cueing events) are then used to cue other memories (called the cued events). Participants then have to answer a series of questions about various ways in which the cueing and cued events might be related (e.g., the two events might involve the same persons; one event might have caused the other) and the types of relational dimensions that characterize event pairs are used to infer the organizational principles underlying autobiographical memory. The rationale behind this approach is that the relations that hold between cueing and cued events correspond to the organizational principles that structure event memories, and that the frequency of different types of relations reflects their organizational importance (Brown & Schopflocher, 1998a, 1998b). Research using this paradigm has shown that cueing and cued events are frequently embedded in overarching event sequences—termed *event clusters*—that organize information about a set of causally and thematically related events (Brown, 2005; Brown & Schopflocher, 1998a, 1998b; Wright & Nunn, 2000).

Here, we adapted the event-cueing paradigm to investigate the extent to which prospective thoughts are organized according to higher-order knowledge structures. If general autobiographical knowledge about the personal future provides a frame that organizes prospection, the operation of these knowledge structures should be evidenced in the types of relations that characterize cueing and cued events, and prospective thoughts should therefore be frequently embedded in event clusters. For example, an imagined future event such as *visiting the tower of Pisa* might cue the related event *eating a Spaghetti Ai Frutti Di Mare on the seaside* because the two events are linked by the general goal *going on vacation in Italy next summer*, which would organize information about a set of envisioned future events. On the other hand, if prospective thoughts are not structured according to general knowledge about the personal future, then the members of the event pairs elicited by the event-cueing method should be similar in some way (e.g., the two events could involve common elements), but they should not be part of an overarching event sequence. For example, one event might involve *inviting David to eat at home on Saturday*, while a related event might be *going to visit the Magritte museum with David next week*; the two events are related because they involve the same person (i.e., David), but they constitute separate events that are not part of a broader event sequence.

We here report two studies in which we tested these hypotheses by examining the prevalence of event clusters in prospective thought. Study 1 compares to frequency of clustering for past and future events, and Study 2 further investigates whether the occurrence of event clusters in prospective thought varies as a function of the distance of the time period envisioned. In both studies, we also aimed to elucidate further the nature of the organizational principles underlying prospection. We suggest that general knowledge about personal goals plays an important role in organizing prospective thoughts in overarching event sequences (for further discussion of the contribution of personal goals to the construction of future

thoughts, see D'Argembeau & Mathy, 2011). If so, then clustering should be more likely when participants imagine events that are more relevant to their personal goals. In the present research, we tested this hypothesis by examining whether the frequency of clustering varies with the personal importance attributed to the cueing events.

2. Study 1

In Study 1, we adapted the event-cueing method to investigate the prevalence and nature of event clusters in prospective thought. We predicted that future events would be often embedded in event clusters, as is the case with past events, and that the frequency of clustering would increase with the personal importance attributed to the cueing events.

2.1 Method

2.1.1 Participants. Twenty-eight students at the University of Liège (13 females) took part in the study (mean age = 23 years; *SD* = 1.77).

2.1.2 Materials and procedure. An adaptation of the event-cueing paradigm devised by Brown and Schopflocher (1998a) was used. Participants were first asked to recall 10 specific events that happened in their personal past and to imagine 10 specific events that might reasonably happen to them in the future. On each trial, a cue word was presented on a computer screen and participants were instructed to recall or imagine a specific event (i.e., a unique event that takes place in a specific place at a specific time, and that lasts a few minutes or hours but not more than a day) in response to that cue. Once they had a specific event in mind, they pressed the space bar and typed a short description of the event; if participants failed to generate an event within 90 s, the next trial was presented. Two lists of ten cues referring to a broad range of common places, persons and feelings that can be associated with

many experiences (e.g., *friend*, *school*, *garden*, *restaurant*, *mother*, *love*, *sad*) were constructed, with words from the two lists being matched for imageability (Desrochers & Bergeron, 2000) and frequency of use (New, Pallier, Brysbaert, & Ferrand, 2004). The allocation of the two lists to the past and future conditions and the order of presentation of the two conditions were counterbalanced across participants.

The descriptions of past and future events that participants had provided were then used as cues for a second recall and imagination task. This task was identical to the first task, except that participants had to recall or imagine past and future events that were related to the events they had described earlier (rather than recalling or imagining events in response to cue words). The instructions noted that the cued and cueing events could be related in any way, but that the cued events should not simply refer to additional details about the cueing events. Again, participants pressed the space bar when they had a specific event in mind and typed a short description of the event.

Next, participants were presented with each event pair and were asked to indicate whether the cueing event and cued event involve the same person(s), whether the two events describe the same type of activity, whether they take place in the same location, whether one event causes the other, whether one event is part of the other, and whether both events are part of a single broader event. Participants responded to each question by yes or no. Finally, participants were presented again with each event description and were asked to rate the personal importance of the event using a 7-point rating scale (1 = not at all important, 7 = extremely important) and to estimate the temporal distance of the event from the present (in days, months, or years; all responses were then converted in days for analysis).

2.2 Results and discussion

The data consisted of 273 pairs of past events and 275 pairs of future events; data from 12 trials were missing because of failures to generate a specific event within the 90-s time limit. The percentages of pairs characterized by the different types of relations investigated here are shown in Table 1. As can be seen, the majority of reported events were embedded in event clusters (i.e., were causally related, members of the same broader story, or nested within one another) and this was the case for both past events and future events. Other types of relations characterizing event pairs were also well represented, and the percentages for past events are comparable to those reported by Brown and Schopflocher (1998a).

We first investigated whether pairs of past events and pairs of future events were characterized by similar types of relations. Due to the hierarchical structure of the data (i.e., the sampled events are nested within participants and thus are not independent), data were analyzed using multilevel modeling (Goldstein, 2011), with events as level 1 units and participants as level 2 units; all analyses were performed using MLwiN (Rasbash, Charlton, Browne, Healy, & Cameron, 2011). For each type of relation, we fitted a multilevel logit model to investigate differences between pairs of past events and pairs of future events in the odds of observing this relation.[1] As can be seen from Table 1, there was no significant difference between past and future events with regard to the amount of clustered pairs. However, when looking more specifically at the different types of relations that characterized clustered events, we found that the amount of event pairs that were characterized by a causal relation was higher for future events than for past events; the amount of event pairs that showed an inclusion relation or that were part of the same broader story did not differ between past and future events. There was no significant difference between past and future events regarding the other types of relations investigated in this study (i.e., the amount of

[1] For all analyses, a random coefficient model did not fit the data better than the simpler random intercept model, meaning that the difference between past and future events was similar across participants, and we thus report results from the random intercept model.

event pairs characterized by the same person(s), the same type of activity or the same location).

Table 1. Types of relations characterizing pairs of past and future events

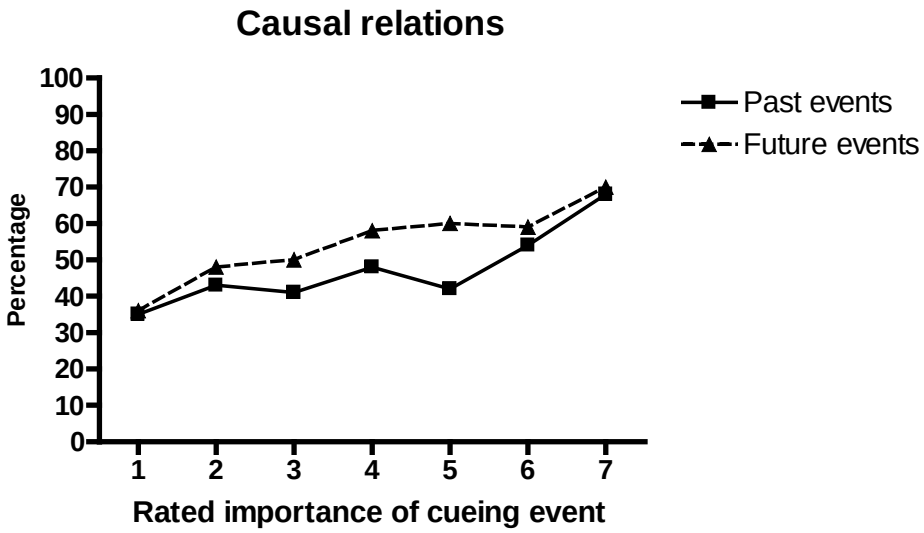
	Past (%)	Future (%)	Coefficient	*SE*	*Z*	*p*
Clustered events	76	80	0.301	0.233	1.29	0.20
Causal relation	49	58	0.402	0.181	2.22	0.03
Same broader event	50	54	0.192	0.188	1.02	0.30
Inclusion	33	36	0.129	0.199	0.65	0.51
Same person(s)	69	71	0.082	0.192	0.43	0.66
Same activity	42	36	-0.266	0.179	1.49	0.14
Same location	52	47	-0.254	0.176	1.36	0.17

Note: Following Brown and Schopflocher (1998a), events were considered to be members of the same cluster if the participant indicated that pair members were causally related, member of the same broader event, or nested within one another.

In accordance with our main hypothesis, the preceding analyses indicated that future events were often embedded in event clusters, and the results showed that the occurrence of causal relations was even more frequent for future events than for past events. Next, we examined whether clustering was related to the personal importance attributed to the cueing events and whether this relation was similar for past and future events. A multilevel logit model showed that the occurrence of clustering increased with the personal importance of the cueing events (coefficient = 0.214, $SE = 0.069$, $Z = 3.10$, $p = 0.002$); this effect did not interact with the temporal direction of the events (i.e., past versus future; coefficient = 0.049, $SE = 0.051$, $Z = 0.96$, $p = 0.34$). Looking more specifically at the different types of relations

that characterized clustered events, we found that the personal importance of the cueing events predicted the occurrence of causal relations (coefficient = 0.235, *SE* = 0.055, *Z* = 4.27, $p < 0.001$) and inclusion relations (coefficient = 0.254, *SE* = 0.063, *Z* = 4.03, $p < 0.001$), but not the occurrence of event pairs that were part of the same broader event (coefficient = 0.056, *SE* = 0.055, *Z* = 1.02, $p = 0.31$); none of these effects interacted with the temporal direction of the events (see Figure 1). The occurrence of pairs sharing common person(s), activity or location was unrelated to the importance of the cueing events.

Figure 1. Clustering and the personal importance of the cueing events in Study 1.


Causal relations
Percentage
100
90
80
70
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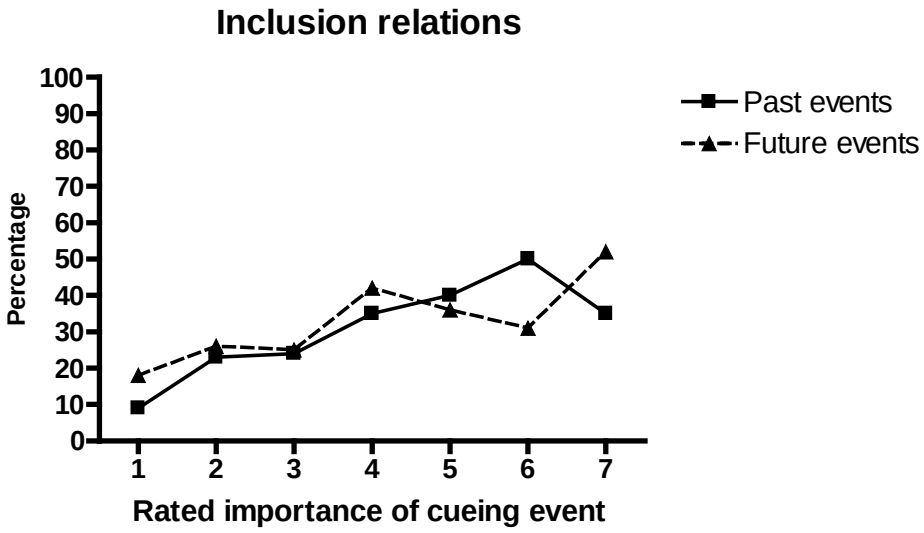
7
Rated importance of cueing event
Past events
Future events


Inclusion relations
Percentage
100
90
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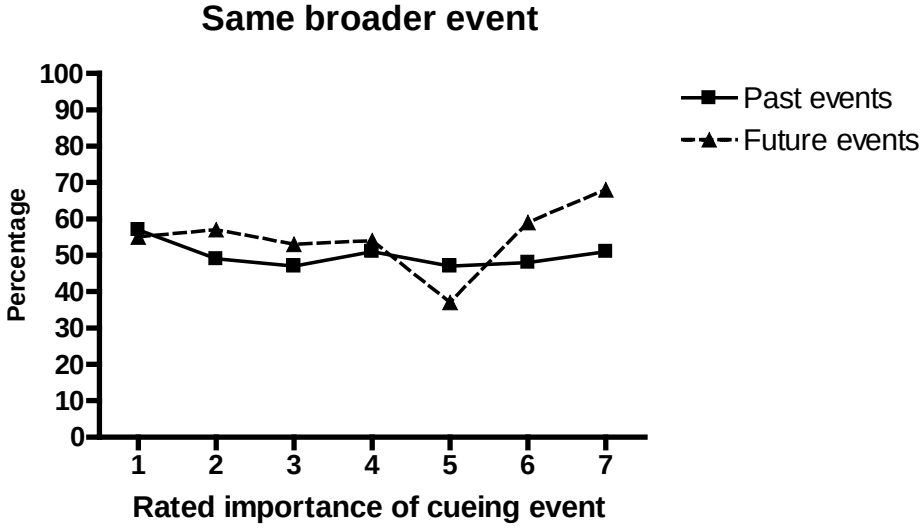
Rated importance of cueing event
Past events
Future events


Same broader event
Percentage
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Rated importance of cueing event
Past events
Future events

Comparable analyses were performed in order to investigate whether the occurrence of each type of relation was predicted by the temporal distance of the cueing events from the present (note that this variable was right-skewed and therefore was log-transformed for modeling purposes). None of the relations between event pairs that were assessed here significantly varied with temporal distance.

In summary, this study replicates previous findings that event memories are commonly embedded in event clusters (Brown, 2005; Brown & Schopflocher, 1998a, 1998b) and further shows that clustering is as frequent for prospective thoughts as it is for memories. By demonstrating that prospective thoughts are commonly embedded in overarching event sequences, these data provide novel evidence for the existence of general autobiographical knowledge structures which organize imagined future events. We also found that clustering increased with the personal importance attributed to the cueing events, both for past events (in keeping with previous studies; Brown, 2005; Brown & Schopflocher, 1998a) and for future events. Assuming that important events are mostly events that are relevant to one's goals, this finding lends support to the view that personal goals play an important role in organizing event memories (Brown & Schopflocher, 1998a; Conway & Pleydell-Pearce, 2000) and in guiding the imagination of future events (D'Argembeau & Mathy, 2011).

On the other hand, the prevalence of event clusters in prospective thought was unrelated to the temporal distance of imagined events. However, it should be noted that few future events referred to a distant time period in this study (73% of reported events were estimated to occur within the next year), and therefore the results regarding the effect of temporal distance should be taken with caution. In Study 2, we sought to replicate the general finding that prospective thoughts are commonly embedded in event clusters, and we

investigated further the effect of temporal distance by manipulating this variable experimentally.

3. Study 2

There are reasons to suspect that the organizational principles underlying prospection might vary to some extent with the distance of the envisaged time period. Growing evidence shows that people tend to mentally represent distant future events in terms of abstract features that convey the perceived essence of the events, whereas near future events tend to be represented in terms of more concrete and incidental details (for review, see Trope & Liberman, 2003). These differences in the way near and distant future events are typically construed might have organizational consequences, such that the role of general autobiographical knowledge structures in organizing prospective thoughts might be relatively more important for the distant future. On the other hand, concrete features of imagined events (e.g., the persons or location involved) might play a greater role in organizing near future thoughts. We here tested this hypothesis by examining the prevalence of event clusters and other types of relations for prospective thoughts that pertain to the close future (i.e., the next month) or the distant future (i.e., the next one to five years).

3.1 Method

3.1.1 Participants. Twenty-eight students at the University of Liège (12 females) took part in the study (mean age = 22 years; *SD* = 1.79).

3.1.2 Materials and procedure. The task was identical as in Study 1, except that participants were asked to imagine 10 specific events that might reasonably happen to them in the near future (i.e., within the next month) and 10 specific events that might reasonably happen to

them in the distant future (i.e., in 1 to 5 years from now) in response to the cue words; no past event condition was included in this study. The order of presentation of the two time periods was counterbalanced across participants.

3.2 Results and discussion

Data were missing for 28 trials because of failures to generate a specific event within the 90-s time limit and data from 57 other trials were discarded because the temporal distance of the cueing event fell outside the required time period (e.g., for the distant future, the participant reported a future event that would happen in less than a year). Thus, in total, the data consisted of 244 pairs of events for the close future and 213 pairs of events for the distant future. As can be seen in Table 2, the prevalence of the different types of relations characterizing event pairs was comparable to Study 1, with event clusters being common for both the close future and the distant future.

To examine whether the relations characterizing event pairs varied as a function of temporal distance, we fitted, for each type of relation, a multilevel logit model to investigate differences between close and distant future events in the odds of observing this relation. Although clustering tended to be more frequent for the distant future, the effect failed to reach statistical significance (see Table 2). However, when looking more specifically at the different types of relations that characterized clustered events, we found that the amount of event pairs that were characterized by a causal relation was significantly higher for the distant future than for the near future. On the other hand, pairs of events involving the same location were more frequent for the near future than for the distant future. For the other types of relations, the effect of temporal distance was not significant.

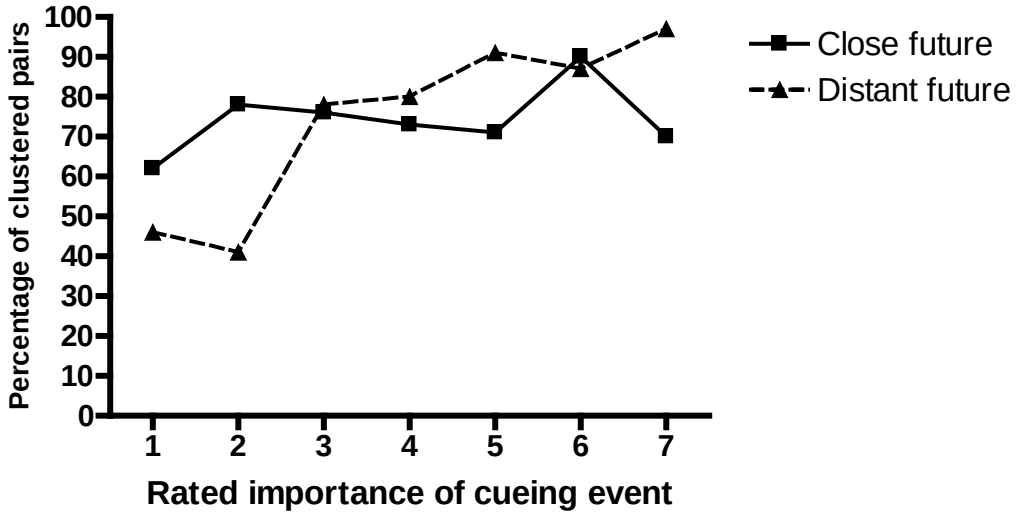
Table 2. Types of relations characterizing event pairs for the close and distant future

	Close (%)	Distant (%)	Coefficient	*SE*	Z	*p*
Clustered events	74	81	0.471	0.267	1.76	0.078
Causal relation	48	58	0.572	0.210	2.72	0.006
Same broader event	49	50	-0.063	0.221	0.29	0.77
Inclusion	41	40	0.056	0.202	0.28	0.78
Same person(s)	69	69	0.015	0.211	0.07	0.94
Same activity	38	32	-0.364	0.206	1.77	0.08
Same location	42	33	-0.458	0.202	2.27	0.02

Note: Following Brown and Schopflocher (1998a), events were considered to be members of the same cluster if the participant indicated that pair members were causally related, member of the same broader event, or nested within one another.

Next, we examined whether the occurrence of event clusters is influenced by the personal importance of the cueing events and whether this effect is similar for the close and distant future. In keeping with the results of Study 1, we found that the frequency of event clusters increased with the personal importance attributed to the cueing events (coefficient = 0.317, $SE = 0.085$, $Z = 3.73$, $p < 0.001$). Interestingly, however, this effect interacted with temporal distance (coefficient = 0.162, $SE = 0.065$, $Z = 2.49$, $p = 0.01$). As shown in Figure 2, the percentage of event clusters increased with increasing personal importance for the distant future, whereas for the close future the percentage of event clusters remained relatively constant across levels of personal importance. This was confirmed by fitting a model separately for the close and distant future, which showed a significant effect of personal importance for distant events (coefficient = 0.684, $SE = 0.148$, $Z = 4.62$, $p < 0.001$) but not for close events (coefficient = 0.083, $SE = 0.115$, $Z = 0.72$, $p = 0.47$).

Figure 2. Clustering and the personal importance of the cueing events in Study 2.



In summary, Study 2 replicates the finding that prospective thoughts are often embedded in event clusters and further shows that although clustering is frequent regardless of temporal distance, participants are more likely to produce pairs of causally related events for the distant future than for the near future. The results also demonstrate that the occurrence of clustering increases with the personal importance of the cueing events when participants envision the distant future, whereas for the near future, clustering is unrelated to personal importance. Together, these findings suggest that, although prospective thoughts are frequently organized in overarching event sequences for both the near future and the distant future, the underlying organizational principles vary somewhat with the distance of the envisaged time period: prospective thoughts seem to be organized in terms of goal-related knowledge to a greater extent for the distant future than for the near future. On the other hand, the present results suggest that information about concrete details, in particular the imagined location, plays a greater role in organizing near future thoughts. Interestingly, recent findings indicate that location is imagined more vividly when events are envisioned to occur in the

near future (Arnold, McDermott, & Szpunar, 2011); this might in part explain the greater reliance on this feature for organizing near future thoughts.

4. Does clustering reflect the operation of preexisting knowledge structures? Evidence from response times

The results of Studies 1 and 2 converge to demonstrate that prospective thoughts are frequently embedded in event clusters. An important issue that remains to be addressed is whether the occurrence of clustering in prospective thought reflects the operation of preexisting autobiographical knowledge structures (e.g., abstract knowledge about personal goals) or whether event clusters are constructed online during the experiment (e.g., on the basis of information derived from the cueing event and schematic knowledge about typical event sequences). One way to address this issue is to examine whether the time needed for generating the cued events varies depending on whether or not the cueing and cued events are part of the same cluster (Brown, 2005). If the occurrence of clustering reflects the operation of preexisting knowledge structures that organize prospective thought, the cued events should be produced faster for clustered pairs than for unclustered pairs because these knowledge structures should facilitate the generation of causally or thematically related events. On the other hand, if event clusters are constructed online during the experiment, response times for generating the cued events should not be shorter for clustered pairs; they might even be longer, reflecting the time needed to elaborate the causal or thematic relations that link the cueing and cued events.

To decide between these two possibilities, we examined whether response times (RTs) for generating the cued events differed as a function of whether or not these events were part of an event cluster. For this analysis, data from Studies 1 and 2 were combined, resulting in 732 pairs of future events. The median RT for generating the cued events was 9.94 s for

clustered pairs and 14.30 s for unclustered pairs. To investigate whether RTs were significantly different between the two types of pairs, we fitted a random intercept multilevel model that included clustering as predictor variable and RT as outcome variable (this latter variable was right-skewed and thus was log-transformed for modeling purposes). This analysis revealed that the time needed for generating the cued events was significantly faster for clustered pairs than for unclustered pairs (coefficient = -0.30, *SE* = 0.09, *Z* = 3.33, $p < 0.001$). We also performed a similar analysis for past events (using the 273 pairs of past events reported in Study 1) and replicated the previous finding (Brown, 2005; Brown & Schopflocher, 1998a) that cued events are retrieved faster when they are part of clustered pairs (coefficient = -0.26, *SE* = 0.12, *Z* = 2.17, $p = 0.03$; median RT = 8.46 s for clustered pairs and 12.40 s for unclustered pairs). These findings thus provide support for the view that clustering results from the operation of preexisting knowledge structures.

5. General discussion

The present research provides new insights into the nature of the representational systems underlying prospection. Recent findings and theoretical developments have emphasized the critical role of episodic memory in imagining future events (Schacter et al., 2008; Suddendorf & Corballis, 2007; Szpunar, 2010; Tulving, 2002). While not downplaying the contribution of episodic memory, the present findings demonstrate that prospection also depends on higher-order knowledge structures. In two studies, we found that discrete events that people imagine might happen in their personal future are commonly embedded in broader event sequences that link a set of envisioned events according to causal and thematic relations. Further, the analysis of event generation times suggests that these event sequences result from the intervention of preexisting knowledge structures during the construction process. Together, these data suggest that prospection involves multiple representational

systems: not only episodic memory, which provides the source of details for imagining specific events, but also more general autobiographical knowledge structures that link and organize imagined events according to broader themes and sequences.

Our findings also contribute to elucidating further the nature of these general autobiographical knowledge structures. In our previous work, we proposed and provided some evidence that general knowledge about personal goals plays an important role in guiding the imagination of future events; we found, in particular, that providing people with cues referring to their personal goals facilitates the construction of episodic future thoughts (D'Argembeau & Mathy, 2011). Interestingly, the present findings further suggest that general knowledge about personal goals contributes to linking and organizing a set of imagined future events in overarching event sequences. It has been proposed that goal processing plays a key role in the formation of event clusters in autobiographical memory (Brown, 2005; Brown & Schopflocher, 1998a, 1998b). In a similar vein, knowledge about personal goals may play an important role in structuring and organizing prospective thoughts: imagined events may be linked together and integrated in broader event sequences on the basis of their causal roles in achieving personal goals. If one assumes that important events are mostly events that are relevant to personal goals, the present finding that clustering increased with the personal importance attributed to the cueing events lends support to this idea.

It is noteworthy, however, that even when the personal importance attributed to the cueing events was low, the percentage of imagined events that were part of an event cluster was still quite substantial (see Figure 2). This finding suggests that personal goals are not the only basis for organizing prospective thoughts. Moreover, the results of Study 2 suggest that the extent to which personal goals contribute to organizing imagined events depends on the distance of the time period envisioned, with personal goals being less relevant for organizing

representations of near future events. It will be important for future research to identify the various organizational principles (other than personal goals) that contribute to structure prospective thoughts and to investigate which principles are differentially involved depending on the temporal distance of envisioned events.

The present findings also raise a number of interesting questions as to what differentiates prospective thoughts from other kinds of imagined events. It has been pointed out that constructing a fictitious "atemporal" scenario in one's mind—for example, picturing oneself lying on a sandy beach in a beautiful tropical bay (cf. Hassabis et al., 2007)—is in many respects similar to envisioning an anticipated future event: in both cases, one needs to retrieve relevant details from episodic memory and to integrate these details into a coherent event or scene (Hassabis & Maguire, 2007). Interestingly, recent findings suggest that mental images of fictitious atemporal events are indistinguishable from mental images of future events, in terms of amount of detail and associated feeling of experiencing the imagined situation (de Vito, Gamboz, & Brandimonte, 2012). The question that arises, then, is what gives people the subjective sense that they are projecting themselves in their personal future (rather than merely fantasizing)? An intriguing possibility is that this feeling may depend, in part, on the extent to which an imagined event is embedded in higher-order knowledge structures: while prospective thoughts are commonly part of a set of causally and thematically related events, representations of atemporal events may not be structured in meaningful event sequences. Another related question is whether and how the kind of organizational structure evidenced in the present study could play some role in distinguishing between imagined future events and the imagination of events that might have occurred in one's past (see Addis et al., 2009a, for evidence that imagining these two types of events recruits many of the same constructive processes). One possibility would be that the imagined events are integrated in distinct overarching event sequences during the construction process (i.e., are linked to other

past versus future events), which would contribute to place new events in distinct time periods. Future studies designed to investigate the prevalence and nature of event clusters for different kinds of imagined events might be an important next step in elucidating these questions.

Beyond determining the nature of the representational systems underlying prospection, future research should also investigate how and why people draw on different systems to think about their personal future. It is likely that episodic memory and autobiographical knowledge structures are flexibly recruited to different degrees to produce prospective thoughts that best suit current situational demands. For some purposes, it may be sufficient to access general autobiographical knowledge about one's future without imagining any specific scenario (e.g., to keep track of one's goals and set priorities among potentially competing goals). For other purposes, however, it is undoubtedly useful to envision specific aspects of an upcoming event (e.g., to plan concrete actions and successfully carry out one's intentions; Gollwitzer, 1999). It will be interesting to investigate how different representational structures are coordinated to approach one's future from these different perspectives (i.e., general versus specific) and to examine their respective utility in elaborating, regulating, and implementing personal goals.

In summary, the present research shows that many future events are not represented in isolation from one another, but instead are embedded in broader event sequences. This finding provides novel evidence that prospection involves multiple representational systems: not only episodic memory, which provides the source of details for imagining specific events, but also more general autobiographical knowledge structures which link and organize imagined events according to overarching themes and causal sequences.

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