

**The organization of prospective thinking: evidence of event clusters in freely generated  
future thoughts**

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## **Abstract**

Recent research suggests that many imagined future events are not represented in isolation, but instead are embedded in broader event sequences—referred to as event clusters. It remains unclear, however, whether the production of event clusters reflects the underlying organizational structure of prospective thinking or whether it is an artifact of the event-cuing task in which participants are explicitly required to provide chains of associated future events. To address this issue, the present study examined whether the occurrence of event clusters in prospective thought is apparent when people are left to think freely about events that might happen in their personal future. The results showed that the succession of events participants spontaneously produced when envisioning their future frequently included event clusters. This finding provides more compelling evidence that prospective thinking involves higher-order autobiographical knowledge structures that organize imagined events in coherent themes and sequences.

**Keywords:** Future thinking; Propection; Autobiographical memory; Event cluster; Episodic memory; Goals.

## **1. Introduction**

The ability to envision one's personal future is an important aspect of human cognition that has recently sparked a surge of interest in psychology and neuroscience (Schacter et al., 2012; Suddendorf & Corballis, 2007; Szpunar, 2010). Several lines of research converge to show that the capacity to imagine future events is intimately related to the capacity to remember past events, suggesting that both mental activities are supported, at least in part, by common memory representations and processes (for review, see e.g., D'Argembeau, 2012; Schacter et al., 2012; Szpunar, 2010). This has led to the proposal that the imagination of future events involves the extraction of information stored in episodic memory (i.e., details about past experiences, such as previously encountered objects, people, locations, and so on) and the flexible recombination of this information to construct novel scenarios (Schacter & Addis, 2007; see also Hassabis & Maguire, 2007; Suddendorf & Corballis, 2007).

While there is now substantial evidence that episodic memory plays a key role in the elaboration of future scenarios, there are reasons to believe that other representational structures, such as semantic memory and conceptual knowledge, are also involved in this process. First, people frequently think about their personal future in abstract ways (e.g., by envisioning general goals and events; 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). Second, the construction of future event representations relies to a substantial extent on schematic knowledge (Berntsen & Bohn, 2010; Rubin, 2013). Third, patients with semantic dementia present with difficulties in constructing detailed representations of their personal future (Duval et al., 2012; Irish, Addis, Hodges & Piguet 2012). Fourth, neuroimaging studies have shown that the imagination of future events recruits a specific set of frontal, parietal, and temporal regions (e.g., Addis, Wong & Schacter, 2007;

Okuda et al., 2003; Szpunar, Watson & McDermott, 2007; for review, see Schacter et al., 2012), and some of these regions are consistently involved in semantic processing tasks (Binder, Desai, Graves, & Conant, 2009). Taken together, these different lines of research suggest that conceptual knowledge structures contribute to the construction of future event representations. Furthermore, it has recently been found that many future events are not represented in isolation, but instead are causally and/or thematically related to other future events (D'Argembeau & Demblon, 2012). This suggests that future thinking involves higher-order autobiographical knowledge structures that link and organize imagined events in broader themes and causal sequences. In the present study, we focus on this organizational structure of prospective thinking.

To date, the role of conceptual autobiographical knowledge in organizing future thoughts has been mainly inferred from studies that used an event-cuing task to elicit future event representations (D'Argembeau & Demblon, 2012). In such a task, descriptions of autobiographical representations of specific events (memories or future thoughts) are used to cue other memories or future events, and the relational dimensions that characterize each event pair are then evaluated (Brown & Schopfloher, 1998; Brown, 2005; D'Argembeau & Demblon, 2012; Wright & Nunn, 2000). Using this task, we have recently found that pairs of imagined future events frequently involve an *event cluster*, meaning that the two events are causally related, member of the same broader event, or nested within one another (D'Argembeau & Demblon, 2012). While this finding suggests that many future thoughts are not represented in isolation but instead are organized in overarching event sequences, it remains possible that the occurrence of event clusters is in part an artifact of the event-cuing task (Mace, Clevinger & Martin 2010). In this task, participants are indeed explicitly instructed to produce pairs of related events and it could therefore be the case that the observed associations between the members of an event pair are produced *ad hoc* in response

to the constraints of the procedure (rather than reflecting the operation of pre-existing knowledge structures that would organize the construction of imagined events). It thus remains to be investigated whether the postulated involvement of higher-order autobiographical knowledge in prospective thinking can be evidenced in less constrained tasks that do not explicitly require participants to provide chains of associated future events.

The aim of this study was to further investigate the organization of prospective thoughts by dissecting people's spontaneous mode of thinking about events that might happen in their personal future. Asking people to think freely about events from their personal past during a think-aloud procedure and subsequently analyzing their productions has proven extremely useful for determining what kinds of representations are involved in autobiographical memory and how they are organized (Barsalou, 1988). Here, we adapted this procedure to ask people to think freely about events that might happen in their personal future, and we examined whether the succession of events they produced followed a logical order and comprised event clusters. The occurrence of event clusters in freely generated future events would indeed provide more compelling evidence for the operation of general autobiographical knowledge structures in the organization of prospective thinking.

Another aim of this study was to examine whether and how the temporal distance of the envisioned future time period affects people's spontaneous mode of future thinking. Previous studies have shown that temporal distance can not only influence the way events are represented, with distant events being represented with more abstract features and less concrete details than close events (D'Argembeau & Van der Linden, 2004; Trope & Liberman, 2003), but also the way they are organized, with distant events being more frequently part of event clusters (D'Argembeau & Demblon, 2012). This might reflect the operation of long-term goals, which would play a key role in structuring prospective thought (D'Argembeau & Demblon, 2012). In these previous studies, however, imagined future

events were elicited in response to particular cues in the present study we aimed to investigate whether the effects of temporal distance are similar when the imagination of future events is less constrained.

Finally, we also sought to explore the contribution of language in the formation of event clusters in future thought. Although previous research has shown that people frequently use inner speech when imagining and planning for future events (Morin, Uttl, & Hamper, 2011; D'Argembeau et al., 2011), little is known about the exact function of language in prospective thinking (but see Corballis, 2008, for further discussion of this question). According to dual coding theory (Paivio, 1991), language and other forms of mental representations such as visual imagery serve distinct purposes: while visual imagery allows the simultaneous representation of multiple informational units, language contributes to organize units in structured sequences. Following this view, we predicted that language (in particular, inner speech) would play a key role in the organization of future thoughts, as revealed by the occurrence of event clusters.

## **2. Method**

### ***2.1. Participants***

Forty young adults (mainly students at the University of Liège) volunteered to take part in the study (20 females) and were allocated to either the near future condition or the distant future condition. Their age was comprised between 18 and 26 years with a mean of 23 years ( $SD = 2.4$ ) in the near future condition, and between 20 and 26 years with a mean of 23.65 years ( $SD = 1.75$ ) in the distant future condition.

### ***2.2. Material and procedure***

Participants were instructed to report everything that came to their mind (i.e., to “think aloud”; Fox, Ericsson, & Best, 2011) while thinking about events that might happen to them in the near future or the more distant future, depending on the condition. The instructions, which were adapted from Barsalou (1988), were as follows: “What we would like you to do is to think about your future and to describe events that you think will occur during the next week (*near future condition*) / next year (*distant future condition*) (e.g., things that you have planned to do or events that will likely happen to you). Simply describe these events orally, as they come to mind. Describe all that goes through your mind, in the order in which it comes to your mind, when you think about these events. Continue in this way for approximately 5 minutes.” The participants’ descriptions were audiorecorded and the experimenter wrote a short description of each reported event for use in the next phases of the study. Immediately following the think-aloud task, participants were asked to think back to all the events they had described and to consider whether these events followed a logical order and whether they were linked in some way. They also rated the extent to which, overall, they thought about the events using visual images and words; both dimensions were assessed using a 7-point Likert scale (1 = not at all, 7 = very much).

Next, the experimenter read a short description of each event that had been generated during the think-aloud task, and participants had to estimate the time when this event will likely occur (in days and hours in the near future condition; in months, days and hours in the distant future condition); if the time of the event was not determined, they simply wrote “undetermined”. Then, participants rated each event on several 7-point Likert scales: they rated the extent to which the event came to their mind in the form of visual images (1 = not at all, 7 = very much), the extent to which it came to their mind in the form of words (1 = not at all, 7 = very much), whether they had thought about this event in the past (1 = not at all, 7 = very often), the likelihood that it will happen (1 = very low, 7 = very high), its estimated

frequency of occurrence (1 = will occur only once, 7 = will happen many times), its importance (1 = not at all important, 7 = very important), and emotional valence (-3 = very negative, 0 = neutral, 3 = very positive). Participants also mentioned whether or not the event was part of their goals (or described a means to attain one of their goals) by answering “yes” or “no”.

Finally, participants were asked to determine whether and how the successive events they had described were related to each other. The event descriptions were presented in pairs comprising two successive events (such that the second event of one pair became the first event of the next pair). For each pair of events, participants were asked to assess whether the two events were linked (1) by a causal relation (one was the consequence of the other), (2) by an inclusion relation (one was part of the other), (3) whether they were part of a more general event, and whether they involved (4) the same person(s), (5) the same location, and/or (6) the same activity. These questions were adapted from those used by Brown and Schopflocher (1998) to identify the presence of event clusters (see also D’Argembeau & Demblon, 2012).

Before the think-aloud task, participants were asked to rate their current emotional state using the Positive and Negative Affective Scale (Watson, Clark & Tellegen, 1988; French adaptation by Gaudreau, Sanchez & Blondin, 2006), a 20-item questionnaire assessing positive (e.g., *attentive, enthusiastic*) and negative (e.g., *guilty, nervous*) emotions. At the end of the experiment, they also completed the Individual Differences Questionnaire (Paivio & Harshman, 1983; French adaptation by Grebot, 2000), a 86-item questionnaire measuring imaginal and verbal thinking habits and skills (e.g., “*I find it easy to visualize the faces of people I know*”; “*I have no difficulty in expressing myself verbally*”). These scales were administered to explore potential individual differences in the characteristics of future thoughts and will not be discussed further here.



### **2.3. Scoring**

The specificity of reported events was scored by two independent judges on the basis of audio recording transcriptions. First, each event was scored as specific, categorical/repeated, or extended (see e.g., Barsalou, 1988). A specific event was defined as an event that happens at a specific place and time and that contains enough information to be individualized (e.g., “I will go to the cinema with Jenny watching *The Hobbit* tomorrow”). An event was scored as categorical/repeated when it involved a category of events, without any detail that would individualize the event (e.g., “I will go to the cinema”). Finally, an event was scored as extended when it referred to something happening over more than one day (e.g., “my friends and I plan to go in Germany next weekend”). Inter-rater agreement was good, with Cohen’s kappa = 0.81 in the near future condition and 0.85 in the distant future condition.

We also scored the thematic contents of the events, using the following categories: (1) work and school, (2) social relations, (3) routine activities (e.g., cooking, running errands, and so on), (4) leisure activities, and (5) other (when the event did not fit into any of the preceding categories). Inter-rater agreement was good, with Cohen’s kappa = 0.85 in the near future condition and 0.97 in the distant future condition.

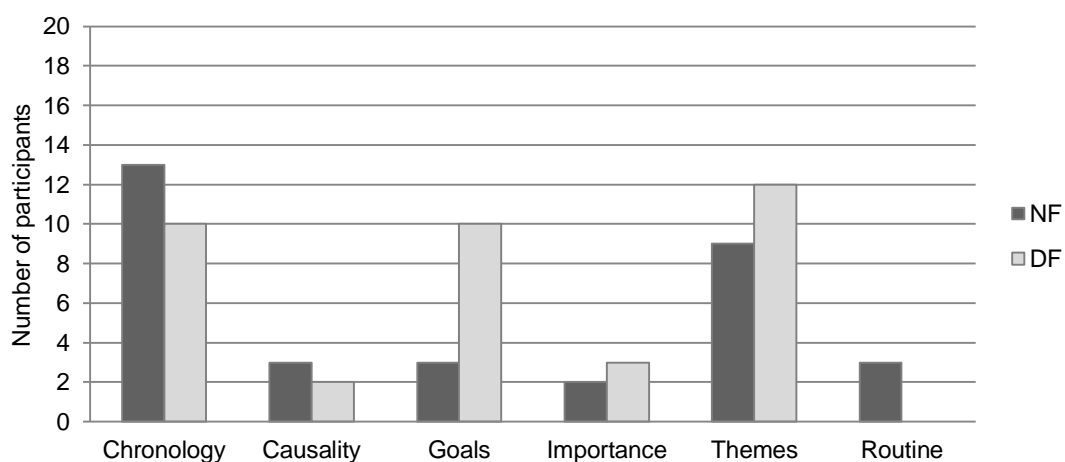
## **3. Results**

Participants in the near future condition reported a total of 281 events, with an average of 14 events per participant ( $SD = 5.92$ ), and participants in the distant future condition reported a total of 201 events, with an average of 10 events per participant ( $SD = 4.48$ ); in the distant future condition, an additional 16 responses were excluded from the analyses because they involved the description of an abstract goal rather than a future event (e.g., “I expect to be more active in the environmental cause”). The number of reported events was significantly

higher for participants who envisioned the next week than for those who envisioned the next year,  $t(38) = 2.41$ ,  $p = 0.02$ ,  $d = 0.78$ .

When asked to report whether the events they imagined followed some logic or were linked to each other in some way, participants spontaneously identified the following organizational dimensions: chronological order, thematic lines, causal relations, urgency or importance of events, goals, and routines. For each these dimensions, we computed the number of participants who reported this dimension, which is shown in Figure 1 for the two time periods. As can be seen, the dimensions that were most frequently identified by participants were chronological order and thematic lines, for both the near future and the distant future. In addition, participants in the distant future condition frequently estimated that the reported events were organized according to goals. Fisher exact probability tests showed that events were more frequently organized in terms of goals in the distant future condition than in the near future condition ( $p = 0.04$ ), while there were no significant differences between the two conditions for the other dimensions (all  $ps > 0.05$ ).

Fig. 1: Organizational dimensions of prospective thoughts reported by participants for the two time periods.



Note: NF: near future; DF: distant future.

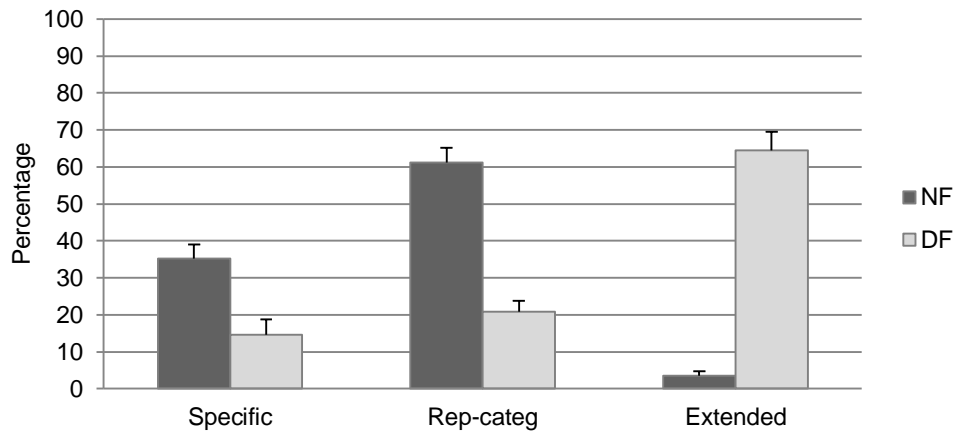
As many participants spontaneously identified chronological order as an important factor organizing the production of future events, we further investigated whether the reported events indeed followed a chronological order. To do so, we examined, for each participant and for each event, whether or not the date when a given event was thought to occur (as estimated by the participant) was further away in the future than the date of the immediately preceding event in the reported event sequence. The frequency of events that followed such a forward chronological order was 80% ( $SD = 18\%$ ) in the near future condition and 62% ( $SD = 24\%$ ) in the distant future condition. The difference between the two temporal periods was statistically significant,  $t(38) = 2.69$ ,  $p = 0.01$ ,  $d = 0.87$ .

In a similar vein, we examined the extent to which successive events involved a common theme. To do so, we computed, for each participant and each event, whether or not the theme of a given event (as categorized by the judges; see Method) was the same as the theme of the immediately preceding event in the reported event sequence; successive events for which thematic content was scored as “other” were not included in this analysis. The frequency of events that involved the same theme as the previously imagined event was 32% ( $SD = 18\%$ ) in the near future condition and 31% ( $SD = 21\%$ ) in the distant future condition; the difference between conditions was not significant,  $t(38) = 0.09$ ,  $p = 0.93$ ,  $d = 0.03$ .

### ***3.1. Characteristics of future event representations***

The percentages of specific, categorical/repeated, and extended events reported in the two conditions are shown in Figure 2. Participants who envisioned the next week reported more repeated-categorical events,  $t(38) = 8.23$ ,  $p < 0.001$ ,  $d = 2.67$ , more specific events,  $t(38) = 3.65$ ,  $p < 0.001$ ,  $d = 1.18$ , and fewer extended events,  $t(38) = -12.03$ ,  $p < 0.001$ ,  $d = 3.90$ , than participants who envisioned the next year.

Fig. 2: Mean frequencies (and standard errors) of specific, repeated-categorical, and extended events for the two time periods.



Note: NF: near future; DF: distant future.

The thematic content of events reported in the near future and distant future conditions are shown in Table 1. A series of *t*-tests showed that the frequency of events belonging to each thematic content category did not differ significantly between the two conditions, except for the category “other” which was more frequent in the distant future condition (see Table 1).

Table 1: Types of thematic contents of prospective thoughts for the two time periods.

Thematic content	Near future		Distant future		<i>t</i> (38)	<i>p</i>	<i>d</i>
	Mean frequency (%)	<i>SD</i>	Mean frequency (%)	<i>SD</i>			
Work/School	43.50	19.17	42.17	18.81	0.22	0.83	0.07
Relations	15.39	11.32	10.28	10.34	1.49	0.14	0.48
Hobbies	21.18	14.88	25.40	16.68	-0.84	0.40	0.27
Routine	16.35	12.97	9.45	11.46	1.78	0.08	0.58
Other	3.57	6.95	12.69	14.18	-2.59	0.01	0.84

The future events’ characteristics as assessed by the 7-point Likert scales are shown in Table 2. Representations of future events involved a high amount of visual images and a moderate amount of words in the two conditions, without significant differences between

conditions.<sup>1</sup> In both conditions, participants reported events they had previously thought about and the envisioned events were judged as having a high likelihood of occurrence. The estimated frequency with which the events would likely occur in the future was higher in the near future condition than in the distant future condition. On the other hand, the personal importance of the events was higher for the distant future compared to the near future. There was also a tendency for distant future events to refer to personal goals more frequently than near future events, although the difference just failed to reach statistical significance. Finally, on average, the reported events had a positive valence, with no difference between the two conditions in this respect.

Table 2: Characteristics of prospective thoughts for the two time periods.

Dimensions	Near future		Distant future		<i>t</i> (38)	<i>p</i>	<i>d</i>
	Mean	<i>SD</i>	Mean	<i>SD</i>			
Visual pictures	5.02	1.05	4.85	1.28	0.46	0.65	0.15
Words	3.09	1.49	2.95	1.16	0.33	0.74	0.11
Thought before	4.54	0.96	4.75	1.10	-0.63	0.53	0.20
Likelihood of occur.	5.95	0.45	5.68	0.62	1.58	0.12	0.51
Frequency	4.69	0.88	3.52	0.94	4.04	<0.001	1.31
Importance	5.10	0.71	5.67	0.87	-2.28	0.03	0.74
Emotion	0.99	0.57	1.23	0.73	-1.16	0.25	0.38
Goal <sup>a</sup>	70.40	20.56	81.83	17.12	-1.91	0.06	0.62

<sup>a</sup> Mean and standard deviation of frequencies (%) of “yes” responses.

<sup>1</sup> When considering the entire set of produced events as a whole (cf. the global ratings obtained before each event was individually assessed; see Method), participants also estimated that they used visual imagery to a large extent (near future:  $M = 5.15$ ,  $SD = 1.22$ ; distant future:  $M = 4.40$ ,  $SD = 1.53$ ) and words to a moderate extent (near future:  $M = 3.15$ ,  $SD = 1.39$ ; distant future:  $M = 3.35$ ,  $SD = 1.56$ ) for representing the events. The amount of visual images tended to be higher in the close future condition than in the distant future condition, although the difference was not statistically significant,  $t(38) = 1.71$ ,  $p = 0.09$ ,  $d = 0.55$ , and the two conditions did not differ regarding the amount of words,  $t(38) = -0.43$ ,  $p = 0.67$ ,  $d = 0.14$ .

### 3.2. Event clusters

Our main aim in this study was to examine whether and how the successive events participants had described were related to each other. A total of 261 pairs of successive events were produced in the near future condition, with an average of 13 pairs per participant ( $SD = 5.92$ ), and a total of 178 pairs of successive events were produced in the distant future condition, with an average of 9 pairs per participant ( $SD = 4.52$ ). Table 3 shows the mean frequency and standard deviation of each kind of relational dimension characterizing the pairs of events, as assessed by the participants.

Table 3: Prevalence of event clusters for the two time periods.

	Near future		Distant future		$t(38)$	$p$	$d$
	Mean frequency (%)	$SD$	Mean frequency (%)	$SD$			
Event clusters	48.03	25.90	65.86	20.91	-2.39	0.02	0.78
Causality	27.54	16.52	40.61	28.85	-1.76	0.08	0.57
Inclusion	16.98	17.01	24.77	20.21	-1.32	0.19	0.43
General event	39.39	29.44	46.29	27.28	-0.77	0.45	0.25
Common elements	41.13	21.17	43.62	27.57	-0.32	0.75	0.10
Same person	18.95	14.65	28.37	21.68	-1.61	0.11	0.52
Same location	21.12	15.88	16.00	12.87	1.12	0.27	0.36
Same activity	20.59	19.13	28.04	22.51	-1.13	0.27	0.36

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

Following previous studies (Brown & Schopflocher, 1998; D'Argembeau & Demblon, 2012), events were considered to be members of the same cluster if the participant indicated that pair members were causally related, part of the same broader event, or nested within one another. As can be seen from Table 3, a substantial proportion of event pairs involved an event cluster (in both conditions), and event clusters were significantly more frequent in the

distant future condition than in the near future condition.<sup>2</sup> For both temporal periods, the most frequent dimension characterizing event clusters was the presence of a common broader event, followed by causal relations and inclusion relations; there were no significant differences between temporal conditions regarding the frequency of these dimensions, although causal relations tended to be more frequent for the distant future than for the near future. Pairs of events also frequently involved some common element(s), such as the same person(s), location, and/or activity, with no differences between the two time periods in this respect. In line with previous studies (Brown, 2005; Brown & Schopflocher, 1998), events more frequently shared some common element(s) when they were part of an event cluster (the mean proportion of events sharing at least one common element was 0.63,  $SD = 0.29$ , for clustered pairs and 0.22,  $SD = 0.30$ , for non-clustered pairs),  $F(1, 34) = 46.99, p < 0.001$ , and this effect did not interact with the temporal period,  $F(1, 34) = 1.49, p = 0.23$ <sup>3</sup>.

Next, we investigated the extent to which language contributed to the organization of future events, as assessed by the different relational dimensions characterizing event clusters. To examine this question, the ratings of the amount of words experienced when representing each member of an event pair were averaged together and used as a dependent variable in a random intercept multilevel model (with event pairs as level 1 units and participants as level 2 units) with the presence of the relational dimension of interest as a dichotomous predictor

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<sup>2</sup> As mentioned in the previous section, a substantial number of reported events were not specific and instead referred to repeated/categorical or extended events. It could therefore be that the proportion of event clusters reported here is overestimated due to the presence of general event representations in the reports (see Mace et al., 2010). To address this issue, we investigated the occurrence of event clusters for pairs that were constituted of only specific events. Across the two time conditions, 56 pairs were composed of two specific events and, among these pairs, the prevalence of event clusters was 61%. This indicates that the high prevalence of event clusters reported above cannot simply be explained by the presence of general event representations in the reports.

<sup>3</sup> Four participants (one in the near future condition and three in the distant future condition) were excluded from this analysis because of missing values (i.e., all events they reported were part of an event cluster).

variable. The results showed that events that were related to each other by a causal relation were represented in words to a greater extent than non-causally-related events (*coefficient* = 0.287, *SE* = 0.101, *Z* = 2.84, *p* = 0.004); this effect did not interact with the temporal period (*coefficient* = 0.049, *SE* = 0.202, *Z* = 0.24, *p* = 0.81). The amount of words used to represent the events was not significantly related to the presence of a common general event (*coefficient* = 0.116, *SE* = 0.101, *Z* = 1.15, *p* = 0.25) or the presence of an inclusion relation (*coefficient* = 0.025, *SE* = 0.119, *Z* = 0.21, *p* = 0.83) between members of an event pair.

#### **4. Discussion**

Using an event-cuing task, we recently found that many imagined future events are not represented in isolation, but instead are part of event clusters (D'Argembeau & Demblon, 2012). While this observation suggests that prospective thinking involves higher-order autobiographical knowledge structures that link and organize imagined events in broader themes and causal sequences, the production of event clusters could simply reflect an artifact of the event-cuing task, as participants were explicitly required to provide chains of associated future events. To address this issue, the present study examined whether the occurrence of event clusters in prospective thought is apparent when people are left to think freely about events that might happen in their personal future. The results showed that the succession of events participants spontaneously produced when envisioning the next week or the next year frequently involved event clusters. Furthermore, the previously observed effect of temporal distance on the frequency of event clusters was replicated in the less constrained conditions of this study, with event clusters being more frequent when envisioning the distant future than when envisioning the near future. Finally, we investigated the role of language in the



organization of future thought and found that inner speech was related to the production of causal sequences between imagined events.

Overall, the frequency of event clusters produced in this study (i.e., 48% in the near future condition and 66% for the distant future condition) was somewhat lower than the frequency of clusters previously observed using the event-cuing task (which ranged from 74% to 81%, depending on the envisioned time period; D'Argembeau & Demblon, 2012). The fact that the successive events produced in this study often formed clusters is quite remarkable, however, given that participants were not explicitly instructed to generate chains of related events or to organize their production in any way. Participants were simply instructed to describe all that went through their minds, in the order it came to their minds, so there was no a priori reason to expect that they would produce event clusters, unless one postulates that higher-order autobiographical knowledge structures organize the generation of events. If such knowledge structures would not be operating, one would expect that the successive events produced by participants would either be unrelated to each other or would share surface features (i.e., episodic details, such as the people or location involved), but without forming broader themes and causal sequences. Besides the occurrence of event clusters, it is also interesting to note that, when asked to consider whether the future events they had imagined followed some logic or were linked to each other in some way, many participants spontaneously mentioned that the events were organized along thematic lines and followed a chronological order. Overall, the present findings thus provide more stringent evidence that many imagined future events are not represented in isolation, but instead are organized in coherent themes and sequences.

In line with our previous findings (D'Argembeau & Demblon, 2012), we also found that the occurrence of event clusters in prospective thought increased with temporal distance, and this was especially so for the occurrence of causal relations between events. Furthermore,

participants in the distant future condition spontaneously estimated that the imagined events were organized according to personal goals to a greater extent than participants in the near future condition. Previous research has shown that goals tend to guide and shape the construction of future event representations (Christian, Miles, Fung, Best & Macrae, 2013; D'Argembeau & Mathy, 2011). Personal goals may, in particular, contribute to organize events in meaningful causal sequences, especially for the distant future (D'Argembeau & Demblon, 2012; see also Brown, 2005, for discussion of the role of goals in the formation of event clusters for past events). Of course, these results do not preclude the possibility that goals play some role in organizing near future thoughts, but other organizing principles may be preponderant for that time period. The present study suggests that one such principle is chronological order. Many participants spontaneously reported that the succession of events they imagined followed a chronological order and, when looking at the dates when each envisioned event was expected to occur, we found that 80% of events in the close future condition and 62% of events in the distant future condition were indeed reported following a forward chronological order. Previous research has shown that temporal order is an important organizational dimension in autobiographical memory (e.g., Radvansky, Copeland & Zwaan, 2005), and the present findings suggest that temporal order also plays a key role in organizing prospective thought. The fact that near future thoughts were especially prone to follow a forward chronological order may reflect the use of temporal landmarks (i.e., the days of the week) as a strategy for envisioning events in the near future. It should also be noted that most reported events had already been thought about (as indicated by participants' ratings), and it could be that organizing these event representations in forward temporal order helps to keep track of expected events as a function of their imminence.

When looking at the contribution of language to the organization of prospective thought, we found that words were used to a greater extent for representing events that were

causally related to each other than for representing non-causally-related events. Previous research has shown that inner speech plays an important role in future thinking and, in particular, in planning processes: planning is indeed the most frequent self-reported function of inner speech (Morin et al., 2011), and future thoughts that serve a planning function are frequently represented in the form of words (D'Argembeau et al., 2011; Stawarczyk, Cassol & D'Argembeau, 2013). The present findings dovetail nicely with these studies and further suggest that language may play some role in making causal connections between imagined events. According to Paivio (1991), the verbal system indeed supports the sequential organization of ideation, which would not be possible on the basis of mental imagery alone. Language and narratives play critical roles in autobiographical memory (Habermas & Bluck, 2000; Rubin, 2006), and developmental research suggests that language is not simply the way in which memories are expressed, but is instrumental in providing an organizational structure for remembered events (Fivush & Nelson, 2004). In the same vein, language may provide the representational scaffolding that allows one to organize envisioned future events in coherent causal sequences that could be used for planning purpose.

Besides identifying the frequency of event clusters in a relatively unconstrained future thinking task, the present study also allowed us to examine the characteristics of individual future events and to determine how they vary according to the envisioned time period. Participants reported more events in the near future condition (see also D'Argembeau et al., 2011; Spreng & Levine, 2006), and the expected frequency of occurrence of imagined events was rated higher for the near future than for the distant future. In line with previous observations (D'Argembeau et al., 2011), near future thoughts involved specific events to a greater extent than distant future thoughts. On the other hand, distant future events were rated as more important and corresponded in large part to events related to personal goals. These results are in accordance with previous research showing that with increasing temporal

distance, envisioned events are more personally relevant (Berntsen & Bohn, 2010; Stawarczyk et al., 2013) and conceived in a more abstract and decontextualized form that conveys the perceived essence of the events (Trope & Liberman, 2003). Contrary to previous findings (e.g., Berntsen & Bohn, 2010; D'Argembeau & Van der Linden, 2004), we did not observe a significant difference between representations of close and distant future events in terms of visual imagery. It should be noted, however, that in the present study close and distant future events were not matched in terms of specificity, so the comparison of visual imagery between the two kinds of events should be taken with caution. Be that as it may, for both time periods, participants indicated that events came to a large extent in the form of visual images. Visual imagery is an integral component of autobiographical memory and future thinking (D'Argembeau & Van der Linden, 2006; Rubin, 2006); it provides a medium for simulating what possible futures would be like, which may in turn orient choices and motivate action (Conway, Maeres & Standart, 2004).

Interestingly, when examining the kinds of general event representations that were reported for the two time periods, we found that participants in the near future condition mainly reported repeated/categorical events, whereas participants in the distant future condition mainly reported extended events. Several factors could explain this difference. First, some participants reported that they thought about their daily routine for generating events that might happen in the next week, which could in part explain the occurrence of repeated/categorical events; on the other hand, no participant reported to have thought about daily routines in the distant future condition. Second, given the short time period involved in the near future condition (i.e., one week), the opportunity of generating extended events (events lasting longer than a day) was necessarily more limited than in the distant future condition. Third, and more interestingly, it could be that people spontaneously adapt the granularity (degree of precision or scope) of future event representations according to the

envisioned temporal period. This could reflect a process of cognitive economy whereby summary representations of extended time periods are more prevalent when representing the more distant future, while the frequency of representations of specific events that could happen during these extended periods increase when they move closer to the present. Although this is a plausible hypothesis, the extent to which the temporal granularity/scope of future thoughts varies systematically with temporal distance remains to be investigated in detail.

Another question that deserves further study is the role of self-related processes in the formation of event clusters. Previous research suggests that personal goals and self-images play an important role in the construction and organization of past and future thoughts (Brown, 2005; D'Argembeau & Demblon, 2012; D'Argembeau & Mathy, 2001; Rathbone, Conway, & Moulin, 2011), but whether or not the occurrence of event clusters is specific to autobiographical information remains to be determined. Recent findings indicate that past and future thoughts about close others share some features with past and future thoughts about the self (while both types of thoughts differ to a larger extent from past and future thoughts about non-close others; Gryzman, Prabhakar, Anglin & Hudson, 2013). It could thus be the case that the organizational principles evidenced here also contribute to structuring event knowledge relating to close others, although this possibility awaits empirical scrutiny.

In conclusion, the present study shows that when asked to freely generate events that might happen in their personal future (in whatever order they came to mind), people do not produce events in a random manner. Instead, the successive events they report are often linked to each other to form broader event sequences. This finding provides new support for the view that prospective thinking involves higher-order autobiographical knowledge structures that organize imagined events in coherent themes and causal sequences, and our

results further suggest that inner speech may play an important role in creating this organizational structure.

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