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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.

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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

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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, 2005; Brown & Schopflocher, 1998; 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 and, 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 (D'Argembeau et al., 2011; Morin, Uttl, & Hamper, 2011), little is known about the exact function of language in prospective thinking (but see Corballis, 2009, 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.

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