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Episodic elaboration: Investigating the structure of retrieved past events and imagined future events

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ABSTRACT

Five experiments investigated the cognitive processes involved in the elaboration of past and future events. A production listing procedure was used, in which participants listed details of each event in forwards chronological order, backwards chronological order, or free order. For both past and future events, forwards and free ordering conditions were reliably faster than backwards order. Production rates between past and future temporal directions did not differ in Experiments 1a, 1b, and 3. However, in Experiment 2, the elaboration of future events was faster than the elaboration of past events. This pattern can be explained by the findings of Experiment 4, in which production rates were faster for likely events than for unlikely events but only in the future condition. Overall, the findings suggest that the elaboration of future, but not past, events, is facilitated when constructed around current goals.

1. Introduction

Episodic memory constitutes the 'system that receives and stores information about temporally dated episodes or events' (Tulving, 1983, p. 21). It incorporates autonoetic consciousness, whereby individuals mentally time travel into a past event through sensory and perceptual re-experiencing and identification of the event as a part of their personal existence (Wheeler, Stuss, & Tulving, 1997). Episodic memories, together with personal semantic information, create a system of autobiographical knowledge structures that maintain information on the progress of personal goals and provide a coherent sense of self identity (Conway, 2001, 2005). Recently, a growing body of literature has explored the notion that the mental time travel system used for episodic recall is also used to imagine events in the future. It has been posited that individuals use their memory as a database of information through a process of flexible reconstruction to generate descriptions of novel future scenarios (Schacter & Addis, 2007a, 2007b; e.g. Schacter, Addis, & Buckner, 2007, 2008). This constructive episodic simulation hypothesis, therefore, suggests that similar cognitive and neural structures and processes should be engaged in both episodic memory retrieval and future episodic simulation.

The retrieval of an episode from memory is thought to constitute a two-stage process (see S. J. Anderson & Conway, 1993; Conway, 2001). The first stage, *construction*, involves the retrieval of a memory of a particular event from the large database of information held about one's personal past. This process can require an effortful top-down search, termed generative retrieval, which ensues voluntarily in response to a particular cue. However, in some cases, it can occur via a non-effortful

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and involuntary pathway, termed direct retrieval, whereby the representation is automatically generated through a bottom-up process without the need for executive resources. The second stage of retrieval, *elaboration*, occurs as the individual holds the constructed event within working memory and pieces together the disparate details to provide a coherent description of the event (Conway & Pleydell-Pearce, 2000; Conway, Pleydell-Pearce, & Whitecross, 2001; Conway & Rubin, 1993). To date, a growing body of literature has compared the cognitive processes involved in constructing past and future episodes. In contrast, there has been relatively little research specifically comparing the elaboration phase of past and future episodic thinking. To date, the only direct comparison between the elaboration phase of past and future thinking is a neuroimaging study by Addis, Wong, and Schacter (2007). As Addis et al. noted, previous studies have typically collapsed across the construction and elaboration phases. The aim of the current study was to compare the cognitive processes involved in the elaboration of past and future episodes.

Research exploring the construction phase of episodic memories and future thoughts provides support for the notion that the same cognitive and neural substrates are involved in both processes. Work by D'Argembeau and colleagues (D'Argembeau and Demblon, 2012; D'Argembeau and Mathy, 2011) suggests that autobiographical knowledge structures provide a framework for organising future events, with personal goals acting as key anchors within this organisational framework. This work, alongside other behavioural studies, suggest that future event simulation often involves a search through these hierarchically organised information structures, and makes use of similar generative and direct pathways to access episodic information as are evidenced in memory retrieval (R. J. Anderson, Dewhurst, & Nash, 2012; Berntsen & Bohn, 2010; D'Argembeau and Mathy, 2011). Furthermore, neuroimaging work has demonstrated that past and future thinking engage the same core autobiographical memory network (see Schacter et al., 2012 for a review).

Alongside these similarities, however, a number of differences have emerged with respect to the mental construction of past and future episodes. For instance, behavioural findings suggest that spontaneous future thinking is more abstract (R. J. Anderson & Dewhurst, 2009) and generation of specific events in response to cue words is slower for future compared with past events (R. J. Anderson et al., 2012). Furthermore, neuroimaging data demonstrate increased neural activity and a number of differentially recruited areas when an individual is constructing future, compared with past, events (e.g. Addis et al., 2007). It has been argued that, whilst both processes source details from the same autobiographical memory information system, future thinking is a more effortful process. Future episodic simulation, unlike memory retrieval, involves flexible recombination of episodic details and it is this additional activity that places increased demands on the underlying cognitive, particularly executive, resources. This is illustrated by the finding of D'Argembeau, Ortoleva, Jumentier, & van der Linden (2010) that the specificity of future events was positively correlated with executive processes but the specificity of past events was not. Similarly, a neuropsychological study by de Vito, Gamboz, Brandimonte, Baroni, Amboni, and Dalla Salla (2012) found that impaired future thinking in Parkinson's Disease was associated with poor executive control. Taken together, these studies support the notion that the construction of future episodes is often an effortful process and that, in comparison to retrieval of past events, can place increased demands upon executive resources.

As noted above, there has been relatively little research explicitly comparing the elaboration stage of past and future episodic thought. The neuroimaging study by Addis et al. (2007) investigated the neural activity associated with the construction and elaboration of past and future events. Differences were observed between past and future thinking during the construction phase, with both the right hippocampus and frontopolar aspects of the right medial prefrontal cortex being uniquely recruited during the construction of future events. In contrast, they found extensive overlap in neuronal activity when comparing past and future elaboration, particularly in areas known to respond to self-referential material such as the left medial pre-frontal cortex. They did, however, evidence activation in the posterior right middle temporal gyrus and the left parietal lobule when an individual elaborated upon a future, compared with past, event. The latter of these areas is thought to be involved in the selective retrieval of information from within memory. Addis et al. argued that future event simulation is likely to place heavier demands on selective retrieval processes than episodic memory retrieval due to the need to combine disparate details from numerous episodic events within memory in order to create a novel future scenario.

Previous behavioural research into the elaboration phase has primarily focused on the descriptions of past and future events. For instance, when individuals are asked to freely describe future episodes they contain significantly less episodic and sensory detail compared with their memory counterparts. However, to date, there is little work exploring the organisation of information within, and the cognitive processes underlying, the elaboration stage of future event simulation. In order to elucidate the role of memory in imagining future events, it is important to establish not only how we construct future events, but also how we elaborate upon them and the processes used in piecing together, structuring and organising the individual episodic details into a coherent description.

S. J. Anderson and Conway (1993) developed a production listing procedure to examine the process of elaboration when retrieving episodes from memory. They asked participants to recall autobiographical events and write a list of the distinctive details of the event. The dependent variable varied across experiments, and was either the number of details listed within a set timeframe (10 and 30 s) or the time taken to list 10 details. By manipulating task demands, whereby detailing instructions varied so that events were described in one of four different orders (forwards chronological, backwards chronological, order of interest or free recall), they examined the role of temporal and thematic structures in the organisation of information within specific events. They argued that the free recall condition would engage the participants' spontaneous production strategies and, thus, would have the fastest production rates. They argued that the other conditions required participants to organise their knowledge prior to responding; therefore, if temporal (forwards and backwards chronological ordering) and/or thematic (order of interest) knowledge represented the underlying organisation structure of autobiographical elaboration