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Episodic Future Thought: An Emerging Concept

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Abstract

The ability to mentally simulate hypothetical scenarios is a rapidly growing area of research in both psychology and neuroscience. *Episodic future thought*, or the ability to simulate specific personal episodes that may potentially occur in the future, represents one facet of this general capacity that continues to garner a considerable amount of interest. The purpose of this article is to elucidate current knowledge and identify a number of unresolved issues regarding this specific mental ability. In particular, this article focuses on recent research findings from neuroimaging, neuropsychology, and clinical psychology that have demonstrated a close relation between episodic future thought and the ability to remember personal episodes from one's past. On the other hand, considerations of the role of abstracted (semantic) representations in episodic future thought have been noticeably absent in the literature. The final section of this article proposes that both episodic and semantic memory play an important role in the construction of episodic future thoughts and that their interaction in this process may be determined by the relative accessibility of information in memory.

Keywords

episodic future thought, mental time travel, episodic memory, mental simulation

Perhaps one of the most fascinating features of the human mind is the ability to direct one's attention inward, away from the immediate environment and toward a hypothetical scenario or episode (Buckner & Carroll, 2007; Hesslow, 2002; Ingvar, 1979, 1985; Schacter, Addis, & Buckner, 2008). For instance, the ability to simulate alternate pasts and hypothetical futures may be used to regulate emotional states and motivate goal-directed behaviors (Taylor & Schneider, 1989). With regard to memory, victims of traumatic events (e.g., a robbery) often construct alternative representations of the past (e.g., I could have done *X* or *Y*) in an effort to gain meaning and mastery over their emotions (Meyer & Taylor, 1986; Silver, Boon, & Stones, 1983; Taylor, 1983). Similarly, individuals who are rejected by their romantic partners, athletes who make a crucial mistake in the course of a sporting event, and students who have failed exams often think about what they could have done differently. In each case, the ability to simulate alternative versions of the past provides a unique opportunity to learn from mistakes and to better direct behavior in the future (Kahneman & Miller, 1986).

Alternatively, there exist many instances in which simulating a hypothetical future episode may provide a functional benefit to behavior (Taylor, Pham, Rivkin, & Armor, 1998; Taylor & Schneider, 1989). For example, research on cognitive behavioral therapy has shown that the occurrence of problem behaviors may be substantially reduced through the use of mental simulations of the future. Marlatt (1978) reduced recidivism in alcoholics by having patients imagine situations in which they would be tempted to drink and formulate hypothetical plans with which to avoid such temptation. Likewise, partners in troubled relationships often fantasize about better times to come in an effort to diffuse tension, athletes engage in mental practice to fine tune their routines (e.g., Feltz & Landers, 1983), and students often simulate long-term future rewards (e.g., their trip to Europe in the summer) to stir motivation.

Of course, there exist various other ways by which to entertain a hypothetical scenario. In addition to mental simulations of personal past and future episodes, we often daydream about

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fantasies that are not likely to ever materialize (e.g., being the starting pitcher in the World Series) and imagine what it would be like to be someone else. Just as simulations of the past and future provide a functional benefit, so may daydreams (e.g., keeping the mind occupied at times of boredom; Antrobus & Singer, 1964) and simulations of the minds of others (e.g., social communication; Oberman & Ramachandran, 2007). Taken together, it should be of little surprise that previous research has estimated that people spend approximately one third of each waking day simulating various aspects of their lives (Klinger & Cox, 1987).

Recently, the ability to simulate personal future episodes, or *episodic future thought* (Atance & O'Neill, 2001), has received a considerable amount of attention. The focus of the present article will be to elucidate current knowledge regarding this specific mental ability. The article is divided into six main sections. First, I will consider the vocabulary researchers use to describe episodic future thought. Although research into episodic future thought is relatively new, there already exist various terms associated with this concept, and it will be important to keep these organized. The second section will trace the conceptual development of episodic future thought and differentiate the concept from various other forms of mental imagery and future thinking. The third section will outline current methodological approaches used to study episodic future thought. The fourth section will present an overview of specific experimental findings and make some preliminary conclusions based on this research. In particular, episodic future thought has been closely related to the ability to remember specific memories, and I will review the research that has been directed toward better characterizing the underlying nature of this hypothesized relation. The fifth section will consider, in more detail, the functional role of episodic future thought. Finally, I will consider some important issues for future research. In particular, I will discuss the role of abstracted (semantic) representations in the simulation of personal future episodes.

Terminology

First, I will introduce various terms that have been associated with episodic future thought. Generally, the nature of the term used to describe episodic future thought depends on whether it is considered separately from or in conjunction with *episodic memory* (Tulving, 1972, 1983, 2002b). Episodic memory is the ability to remember one-time events from the personal past (e.g., mentally reexperiencing the events surrounding one's college graduation). Episodic memory is typically contrasted with *semantic memory*, a type of memory that is devoid of a feeling of personally experiencing the past (e.g., knowing that one attended college in a particular city). When considered separately, the ability to imagine personal future episodes is variably referred to as *episodic future thought* (Atance & O'Neill, 2001), *prospection* (Buckner & Carroll, 2007; Gilbert, 2006), *simulation* (Schacter & Addis, 2007; Schacter et al., 2008), and *projection* (Okuda et al., 2003). As is suggested by the title of this article, I will refer to this ability as episodic future thought. On purely expositional grounds, the term *episodic future thought* most clearly conveys the central nature of the concept. This advantage is gained from the term's relation to the concept of episodic memory (Tulving, 1972, 1983, 2002b). Just as episodic memories represent particular instances of the personal past, episodic future thought represents the ability to mentally preexperience one-time personal events that may happen in the future.

At other times, episodic future thought is considered directly in conjunction with episodic memory. In this case, researchers will typically speak of a general underlying ability to mentally experience personal events in subjective time. This underlying ability has been referred to as *autonoetic consciousness* (Tulving, 1985; Wheeler, Stuss, & Tulving, 1997) and is believed to enable *mental time travel* (Suddendorf & Corballis, 1997) both into the personal past and future. As will be discussed below (see Conceptual Development), Schacter and Addis (2007) have recently proposed that episodic future thought may not only be related to episodic memory, but that it may actually represent an expression of episodic memory. Hence, although episodic future thought may be considered a unique mental ability, discussion of the concept will typically revolve around its relation to episodic memory.

These are the primary conceptual terms associated with episodic future thought and the context in which they are used. Next, I turn to the conceptual development of episodic future thought. Although psychologists (Kahneman & Tversky, 1982; Singer, 1975) and neuroscientists (Fuster, 1995, 1999, 2001; Ingvar, 1979, 1985; Talland, 1965) have been interested in the ability to contemplate the future for a long time (for a detailed review see Schacter et al., 2008), only recently have researchers in both fields begun to consider the underlying nature of the ability to envision specific personal episodes in the future.

Conceptual Development

Tulving's Observation

Twenty-five years ago, Tulving (1985) presented the case of amnesic patient K.C.,[1] who exhibited a peculiar pattern of memory loss following head trauma sustained in a motorcycle accident. Like many amnesic patients, K.C. had retained much of his cognitive flexibility after the accident. For instance, he demonstrated preserved language function, intelligence, and attention (Tulving, 2002b). In fact, there were many things that K.C. knew about the past. He could recite recently presented information (i.e., he had intact short-term memory) and had little problem speaking about his general knowledge of the world (i.e., semantic memory). However, K.C. was not able to remember any episodes from his personal past. Although he could accurately identify many things from his past (e.g., members of his family, his childhood home, the car he had once owned), he could not remember a single episode associated with this knowledge. K.C. had no episodic memory.

Excerpt of conversation between Endel Tulving and patient K.C.

E.T.: "Let's try the question again about the future. What will you be doing tomorrow?"
(There is a 15-second pause.)
K.C. smiles faintly, then says, "I don't know."
E.T.: "Do you remember the question?"
K.C.: "About what I'll be doing tomorrow?"
E.T.: "Yes. How would you describe your state of mind when you try to think about it?"
(A 5-second pause.)
K.C.: "Blank, I guess."

Box 1. Excerpt of conversation between Endel Tulving and patient K.C. Adapted from Tulving (1985).

Of particular interest to the present discussion, Tulving (1985) also examined whether K.C. could think about his personal future. For example, Tulving would ask K.C. what he might do tomorrow. K.C. was unable to answer this question and other questions like it. Just as he could not remember a single episode from his past, he could not imagine personal future events. When asked to describe the mental state associated with trying to remember his past or imagine his future, K.C. would say that his mind was blank (see Box 1). Moreover, when asked to compare these mental states, he claimed that they were the "same kind of blankness" (p. 4). Based on these preliminary observations, Tulving hypothesized a close relation between episodic memory and episodic future thought.[2]

Autonoetic Consciousness

According to Tulving (1985; see also Tulving, 2001, 2002a), episodic memory and episodic future thought are related in that each represents the manifestation of a special form of consciousness called *autonoetic consciousness*. Specifically, autonoetic consciousness is defined as the ability to "both mentally represent and become aware of subjective experiences in the past, present, and future" and is thought to enable "mental time travel in the personal subjective way that is the hallmark of retrieval from episodic memory" (Wheeler et al., 1997, p. 331). Therefore, patient K.C. may be thought of as lacking autonoetic consciousness. The concept of autonoetic consciousness is further distinguished from *noetic consciousness*, which characterizes the conscious experience associated with semantic memory. An individual is said to be noetically aware when they retrieve general information in the absence of a feeling of reexperiencing the past. Patient K.C. had retained his noetic consciousness. A similar distinction applies to thoughts about the future. The act of mentally preexperiencing a specific personal future episode is a function of autonoetic consciousness. Simply thinking that something may happen in the future, without mentally preexperiencing a specific episode, is a function of noetic consciousness (cf. Dalla Barba, 2000).

As a specific example of this latter distinction, Klein, Loftus, and Kihlstrom (2002) presented the case of patient D.B., who had sustained brain damage following an anoxic episode. As with patient K.C., the authors reported that D.B. was unable to remember any event from his life or imagine any specific episode occurring in his personal future. Of particular interest, Klein and his colleagues also tested whether D.B. was able to think about the past and future in an impersonal manner (e.g., "think of some issues that have faced your community in the past 10 years"; "think of some issues that will face your community in the next 10 years"). D.B. could answer questions about the impersonal past and future at a similar level to control participants. Hence, as predicted by Tulving's concept of autonoetic consciousness, D.B. was impaired specifically in his ability to think about the past and future in a personal sense.[3]

Incidentally, it was the ancillary distinction between subjective states of mental reexperiencing (i.e., remembering) and knowing that received the greatest attention and made Tulving (1985) a citation classic. To study this distinction, Tulving asked learners for each item they recalled or recognized on a memory test whether they could remember the details of its prior occurrence or if instead they just knew that it had occurred earlier. The remember–know methodological technique (Gardiner, 1988; Gardiner & Richardson-Klavehn, 2000; Rajaram, 1993) has since been widely applied beyond these origins, with little empirical attention directed toward the broader concept of autonoetic consciousness that it was designed to inform. In fact, discussions regarding autonoetic consciousness have focused almost exclusively on episodic memory and the episodic–semantic distinction, with little attention toward episodic future thought. Most publications on the topic of autonoetic consciousness have little to say about episodic future thought (e.g., Gardiner, 2002) and, until recently, have been able to offer little more than anecdotal observations (Markowitsch, 2003; Tulving, 2001, 2002a, 2005; Wheeler, 2000; Wheeler et al., 1997). Although various authors (Atance & O'Neill, 2001; Suddendorf & Corballis, 1997) have attempted to direct attention toward episodic future thought, there has been little interest in empirically studying the concept until recently.

Beyond Autonoetic Consciousness

An impressive number of behavioral (Szpunar & McDermott, 2008a), developmental (Addis, Wong, & Schacter, 2008),

neuroimaging (Addis, Wong, & Schacter, 2007; Szpunar, Watson, & McDermott, 2007), neuropsychological (D'Argembeau, Raffard, & Van der Linden, 2008; Hassabis, Kumaran, Vann, & Maguire, 2007), and conceptual (Schacter & Addis, 2007; Schacter, Addis, & Buckner, 2007, 2008; Suddendorf & Corballis, 2007; Szpunar & McDermott, 2008b, 2008c) papers published within the last 2 years have focused specifically on investigating episodic future thought. To presage this review of the literature, the outcome of this initial burst of studies is highlighted by two highly consistent patterns of results. First, the neural architecture known to support memory for personal life events becomes similarly engaged as people simulate personal future episodes (Addis et al., 2007; Botzung, Denkova, & Manning, 2008; Okuda et al., 2003; Szpunar et al., 2007). Second, those who experience difficulty in remembering their personal past appear to be impaired in their ability to think about personal future episodes. A thorough discussion of this emerging research will be presented below (see Empirical Findings).[4]

In reviewing these preliminary data, Schacter and Addis (2007) made an astute connection between the constructive nature of episodic memory and episodic future thought. One fundamental idea regarding human memory function is that memories for personally experienced events are inherently constructive and not literal records of the past (Bartlett, 1932). Studies indicating that memories for specific events are prone to predictable errors support this claim (e.g., Gallo, 2006; Roediger & McDermott, 1995; Schacter, 1999, 2001). However, it has never been clear exactly why memories for personally experienced events are open to interpretation. Schacter and Addis (2007) hypothesized that episodic future thought is central to understanding the fluid nature of episodic memory. Specifically, the authors proposed that episodic future thought and episodic memory share more in common than the representation of specific and temporally displaced episodes. According to their *constructive episodic simulation* hypothesis, the ability to flexibly recombine features of previous experiences allows an endless number of hypothetical future scenarios to be generated (see also Addis et al., 2007; Corballis, 2003; Corballis, 2007; Okuda et al., 2003; Szpunar et al., 2007).

Episodic Future Thought and Imagination

It is interesting to consider that the current conceptualization of episodic future thought as a constructive process is highly reminiscent of early philosophical considerations of imagination. Many early philosophers, in contemplating the characteristics of human consciousness, held the imaginative capacity of the human mind to be of central importance (White, 1990). Philosophers such as Descartes, Locke, Berkeley, Hume, and Kant, who discussed imagination at some length, regarded the concept as a general capacity for mental representation in the absence of sensory input, and their discussions focused much attention on the distinction between imagination and perception (for a detailed review, see White, 1990). According to these early accounts, one feature that distinguishes imagination from perception is the inherent flexibility associated with manipulating the contents of imagination. For instance, Berkeley (1710/1907, p. 8) noted, "I have a faculty of imagining, or representing to myself, the ideas of those particular things I have perceived, and of variously compounding and dividing them." Similarly, Hume (1739/1958, p. 10) commented on the "liberty of the imagination to transpose and change its ideas." Although these early notions of the imaginative capacity of the human mind may have foreshadowed the constructive conceptualization of episodic future thought, and that of mental simulation more generally (Buckner & Carroll, 2007; Schacter et al., 2008), these early philosophers made no specific mention of a specific ability to envision personal future episodes.

In fact, it is important to distinguish episodic future thought from other forms of nondirected imagery. For example, consider the differences between imagining an elephant, imagining encountering a stray elephant on the way to work tomorrow, and imagining seeing an elephant during a trip to the zoo that one intends to take next week. The first instance represents an example of a more general capacity for mental imagery (e.g., Kosslyn, 1994; Paivio, 1986) that likely underlies the ability to engage in the mental construction of complex personal scenarios, including episodic future thoughts. The second example (a bizarre event) represents a specific personal future episode. However, the event itself does not represent a scenario that one might plausibly entertain unless they are specifically instructed to do so. On the other hand, the final example (the trip to the zoo) represents an upcoming personal event that one might reasonably imagine or plan for in their future (e.g., "What time of day should I go?" or "What animals will I have time to see?"). Hence, although the latter two examples involve generating a specific scenario in one's own future, I suggest that the relevance (plausibility) of the event to one's own life (Klinger, 1971) should be considered in determining whether or not someone is engaging in episodic future thought. We are capable of imagining a large number of scenarios that can be associated with any combination of objects, people, places, and so on. Episodic future thought represents the ability to think about specific events that are relevant to one's own future. Of course, the distinction between plausible and fantastic future events is somewhat tenuous, and future research will need to determine whether there exist any real differences (behavioral or neural) between the two (see Hassabis, Kumaran, & Maguire, 2007).

Episodic Future Thought and Future Thinking

The ability to think about the future does not represent a singular ability but rather a collection of abilities that prepare an organism for behavior in various capacities (e.g., Haith, 1997) and that operate at various levels of awareness (e.g., Suddendorf & Corballis, 2007; Tulving, 2005). With regard to higher order cognition, *prospective memory* and *planning* represent other forms of future thinking that bear a close relation to episodic future thought, but they are not synonymous

with the topic of this article. Prospective memory is defined as the ability to remember to carry out intended activities in the future (Brandimonte, Einstein, & McDaniel, 1996; McDaniel & Einstein, 2007). For example, one may intend to pick up clothes from the cleaners on their way home from work. Such an intention represents a specific personal scenario that will plausibly occur in the future. However, a mental simulation of the future need not necessarily accompany the formation of an intention such as this one. In fact, the extent to which individuals naturally simulate future scenarios when forming intentions is unclear (Kliegel, Martin, McDaniel, Einstein, & Moor, 2007). In any case, the extent to which episodic future thought is involved in prospective memory depends on the extent to which future intentions are simulated. As will be discussed in a later section (see Functional Significance), a subfield of prospective memory research, *implementation intentions* (Gollwitzer, 1993), has shown that imagining when, where, and how one plans on executing their intentions provides a considerable benefit for carrying out those goals.

Another related concept is that of planning. Generally, planning is considered a multicomponent process that operates at various levels of abstraction (e.g., specific versus general) and serves as a predetermined course of action aimed at achieving some goal (e.g., Haith, 1997; Hayes-Roth & Hayes-Roth, 1979). For instance, a task as simple as planning one's daily activities involves defining a variety of goals and subgoals (e.g., attending a meeting, having lunch with a friend, dropping off the car at the shop, writing a lecture), prioritizing those goals (e.g., "I definitely have to attend this meeting" "I can always take the car to the mechanic tomorrow if there is no time today"), monitoring one's progress, reevaluating the original plan, and so on. In terms of levels of abstraction, one may have both general (e.g., "I have to remember to prepare my lecture for tomorrow") and specific (e.g., "I will prepare my lecture in my office after the meeting and will make sure to lock my door in order to avoid any distractions") thoughts about various goals that they wish to accomplish (Hayes-Roth & Hayes-Roth, 1979). In relation to episodic future thought, the ability to simulate specific future events and to adjust plans according to the results of those simulations (e.g., "Seems like I may not have enough time to prepare my lecture after the meeting and before lunch, so I should set aside some time when I get home this evening") represents one important aspect of the planning process. However, it is important to keep in mind that evoking episodic future thought in the course of planning represents only one component of the process. Hence, future-directed cognitions such as prospective memory and planning may evoke episodic future thought but neither is synonymous with this specific mental ability. The relation of episodic future thought to prospective memory and planning has yet to be closely examined.

As was alluded to in the introduction to this article, psychologists have conducted research on various aspects of mental simulation (Buckner & Carroll, 2007; Hesslow, 2002; Schacter et al., 2008). Episodic future thought represents one important feature of this general capacity that has recently garnered a considerable amount of interest and is relevant to understanding imagery and future-directed thought more generally. Next, I consider the general methods that have been employed to study episodic future thought along with the emerging data. As I proceed, special care will be taken to evaluate the available data in terms of the prevailing conceptual framework of constructive episodic simulation—that episodic future thought represents a constructive process whereby the contents of episodic memory are sampled to generate novel future scenarios.

Methods of Assessment

Currently, the study of episodic future thought employs one of two approaches: thought-sampling procedures outside of the laboratory and word-cuing paradigms inside the laboratory. In general, thought-sampling procedures require participants to monitor the frequency and content of their thoughts in their daily lives. In some cases, participants may be asked to estimate the frequency with which they have various thoughts over the course of a day (Singer & Antrobus, 1963, 1970, 1972). In other cases, the frequency of thought patterns is sampled more systematically. For instance, participants may be required to carry around a beeper and to report on the content of their thoughts at randomly determined intervals (i.e., whenever the beeper sounds; Klinger & Cox, 1987). Thought-sampling procedures have been previously employed in the study of autobiographical memory (e.g., Linton, 1986) and more generally for characterizing the frequency and contents of daydreams (e.g., Klinger & Cox, 1987). As will be discussed below, thought-sampling procedures have recently been employed to study episodic future thought (Berntsen & Jacobsen, in press; D'Argembeau, Renaud, & Van der Linden, 2009).

Laboratory studies of episodic future thought have also borrowed from the autobiographical memory literature, but they have been more concerned with examining the specific content of personal future scenarios. One popular method used to study autobiographical memory is known as the Galton–Crovitz word-cuing technique (Crovitz & Schiffman, 1974; Galton, 1880). Here, participants are given a word cue (e.g., birthday) and are asked to use it to remember specific details about an event from their past. Likewise, studies of episodic future thought involve presenting participants with word cues and asking them to mentally generate personal future scenarios. To ensure that participants are able to produce detailed mental representations, researchers explain to participants that their simulations need not necessarily be related to the cues themselves. That is, participants are encouraged to elaborate on the first event that comes to mind. In addition, participants are required to rate their mental representations on a variety of phenomenological characteristics. To compare the likeness of episodic future thought to memories for personal events, participants remember (and rate) an equal number of specific events as they imagine.

The majority of research that will be considered in this article has been conducted in the laboratory and typically employs the use of a variant of the word-cuing paradigm. However, because the technique has been used in a variety of experimental settings

Example #1

Cue Word: Money

"I really need to get around to doing my taxes! I'm sitting at my computer in the kitchen. I hear my husband watching TV in the next room--CNN. I'm surrounded by piles of paper and a little bit bewildered, and I have to keep asking him questions. I sort everything into piles and start using TurboTax to add up my W-2 forms, and my wrist gets tired from using the keyboard. I'm bored but am feeling productive, and I know I'll get it done soon. It is kind of annoying. It's a nice, cool day outside, and I'd rather be napping out there."

Example #2

Cue Word: Paper

"Tonight after play practice, I will start to do my bio lab and realize that it will be much easier to do it with Lisa as she is a bio genius. I will walk across the hall to her room, carrying my pencil case and bio lab manual. She will be sprawled on her bed with her computer and she will tease me about needing her help. Then she will say that I should come back to compare answers in a little while, after I have tried doing the questions myself. Although I feel a little frustrated about the work, I go back to my room and try to work on the problems on my own."

Box 2. Excerpts of two sample participant descriptions of plausible future events.

(e.g., laboratory, brain scanner) and with a variety of subject populations (e.g., healthy adults, older adults, amnesic patients), recent studies have provided a great deal of insight into the underlying nature of episodic future thought. As interest in the topic continues to grow, I expect that the complexity of the methodological approaches will follow suit.

Empirical Findings

The emerging literature on episodic future thought has been primarily concerned with delineating our understanding of the following aspects of the concept: the frequency with which we think about personal future episodes in our daily lives, the content and phenomenological characteristics of episodic future thought, the neural characteristics of episodic future thought, and the co-occurrence of deficits of episodic future thought and remembering in various clinical populations. Next, I consider these lines of research in some depth and draw a few preliminary conclusions based on the available data.

Frequency

Over the course of each day, we daydream about a motley assortment of vivid mental events, including the remembrance of memories past, considerations of fictional scenarios, and simulations of future events (Singer, 1966). A few recent studies have specifically examined the frequency with which people think about personal future episodes in their daily lives (Berntsen & Jacobsen, in press; D'Argembeau et al., 2009).

In one such study, D'Argembeau et al. (2009) asked participants to record all the thoughts concerning the future that they experienced over the course of 1 day. On average, participants reported thinking about the future 59 times, or once every 16 min (16 waking hours). In a second portion of the experiment, D'Argembeau and his colleagues asked the same group of participants to record detailed accounts of 10 future thoughts over the course of 5 days. It is important to note that the authors instructed participants to classify each future thought as specific (episodic future thought), general, or abstract. Approximately 43% of the future-directed thoughts reported by participants were classified as episodic in nature. Although future studies will be needed to corroborate and expand on this finding (e.g., D'Argembeau et al. only examined college students), it appears that episodic future thought is a frequently occurring phenomenon in daily life. Next, I consider the content and characteristics of personal future episodes.

Content

As described earlier (see Methods of Assessment), researchers typically assess the specific contents of episodic future thought by having participants generate hypothetical scenarios in response to word cues. For example, consider the following scenarios that sample participants generated in response to the word cues *money* and *paper* (see Box 2). These participants clearly understood the instructions and were able to produce detailed mental representations of specific episodes that might reasonably occur in the future.

In general, episodic future thoughts revolve around the short-term concerns of participants (e.g., "What will I be doing this weekend?" or "When am I going to find time to study for this test?"; (D'Argembeau et al., 2009; D'Argembeau & Van der Linden, 2004; Klinger, 1971; Spreng & Levine, 2006). Accordingly, the contents of episodic future thought are typically characterized by familiar contextual information. That is, when envisioning events that will occur in the near future, participants imagine themselves in the context of familiar

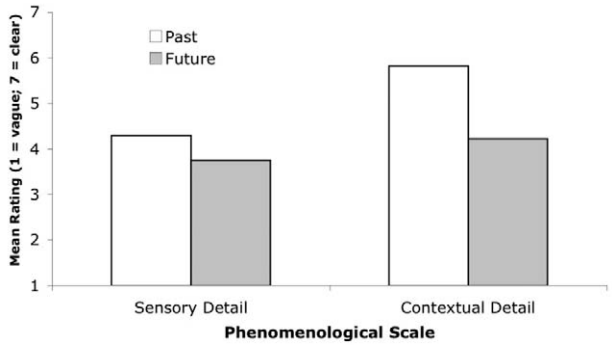

Figure 1. Meaning ratings of sensory and contextual detail on a scale of 1 (*vague*) to 7 (*clear*) for past and future events. In each case, participants rated their mental representations of future episodes as less detailed than memories (*p*s < .001). Data adapted from D'Argembeau and Van der Linden (2004).

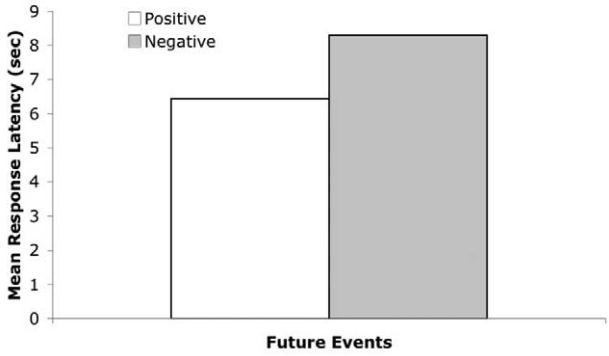

Figure 2. Mean response latencies associated with generating positive and negative future scenarios. Participants were faster to generate positive than negative events (p < .01). Data adapted from Newby-Clark and Ross (2003).

settings and people (D'Argembeau & Van der Linden, 2004; Hassabis & Maguire, 2007). That episodic future thoughts often include familiar context provides some measure of support to the hypothesis that various contents of memory must be sampled for participants to successfully construct mental representations of hypothetical future episodes (Schacter & Addis, 2007; e.g., "Where do I usually spend my weekends?" or "With whom do I usually spend my weekends?").

A recent study tested this hypothesis by manipulating the contents of memory that participants were allowed to sample when thinking about the future (Szpunar & McDermott, 2008a). The study specifically focused on the scenes that participants think about when imagining the future, as scene construction has been hypothesized to be a central feature of episodic future thought (Hassabis & Maguire, 2007). Research from the autobiographical memory literature has shown that recently experienced scenes are mentally represented in more detail than are more remotely experienced scenes (Brewer, 1995). If the contents of memory are regularly sampled during episodic future thought, then the phenomenological characteristics of those memories (i.e., recently experienced scenes vs. remotely experienced scenes) should be preserved when they are projected into the future. Indeed, participants reported more detailed mental representations when thinking about hypothetical future scenarios occurring in more recently experienced scenes (e.g., in one's current home) than in remotely experienced scenes (e.g., revisiting one's childhood home).

Phenomenological Characteristics

To examine the characteristics of episodic future thought, researchers will typically ask participants to rate their future scenarios on a variety of phenomenological rating scales (e.g., "To what extent was your mental representation of the future characterized by visual imagery?" or "To what extent did you feel like you were pre-experiencing the event?"). To provide some baseline for interpretation, researchers typically compare the phenomenological characteristics of episodic future thought with similar ratings of personal memories (e.g., "To what extent was your mental representation of the past characterized by visual imagery?" or "To what extent did you feel like you were re-experiencing the event?"). Studies examining the phenomenological characteristics of episodic future thought have consistently reported three sets of findings: (a) personal future episodes are rated as being less detailed than are memories for personal events, (b) personal future episodes are rated as being more positive than are memories for personal events, and (c) personal future episodes occurring in the near future are consistently rated as being more detailed than are future episodes occurring in the distant future.

First, participants tend to rate mental representations of personal future episodes as less vivid than memories. For example, D'Argembeau and Van der Linden (2004, 2006) found that, relative to memories for personal events, participants rated episodic future thoughts as less vivid in terms of sensory (e.g., visual, auditory) and contextual (e.g., visuospatial context) detail (see Fig. 1). This finding is consistent with the more general finding that mental representations of imagined events are characterized by fewer sensory and contextual details than actual events (i.e., memories; Johnson, Foley, Suengas, & Raye, 1988). According to reality-monitoring theory (Johnson, Hashtroudi, & Lindsay, 1993; Johnson & Raye, 1981), these differences in phenomenological characteristics are essential because they play a pivotal role in helping people to discriminate imagined events from actual memories.

In terms of emotional valence, mental representations of personal future episodes are consistently rated as more positive than memories for personal events (D'Argembeau & Van der Linden, 2006; MacLeod & Byrne, 1996). This finding corroborates research indicating that people tend to have an optimistic view of their future (Taylor & Brown, 1988). For example, Weinstein (1980) reported that, relative to their peers, participants consistently imagined that they were more likely to experience positive events and less likely to experience negative events in the future. In another study, Newby-Clark and Ross (2003) showed that participants were faster to generate positive future scenarios than negative future scenarios (see Fig. 2). The

authors argued that this finding was a direct result of the fact that people spend most of their time thinking about the future in a positive light, hence making positive future scenarios more accessible (Tversky & Kahneman, 1973).

Finally, when comparing episodic future thoughts to one another, mental representations of events occurring in the near future are consistently rated as more vivid than events occurring in the distant future (e.g., D'Argembeau & Van der Linden, 2004). This finding is typically interpreted in terms of *temporal construal theory* (Trope & Liberman, 2003), which states that "the greater the temporal distance from a future event, the more likely is the event to be represented abstractly in terms of a few general features that convey the perceived essence of the events rather than in terms of concrete and more incidental details of the event" (p. 405). According to Spreng and Levine (2006), if one assumes that episodic future thoughts serve the function of helping to coordinate behavior (see Functional Significance), then it would not be cognitively economical to construct detailed representations of events that will not be relevant for some time to come. Further, it has been suggested that mental representations of near future events are more likely to be characterized by familiar context than distant future events (Szpunar & McDermott, 2008a) and should therefore be represented in more detail (Johnson et al., 1988; Johnson et al., 1993). For example, if asked to imagine a work-related conflict, one is likely to imagine a more detailed scenario transpiring in their current work place (e.g., clear representation of setting and people involved) than in an unspecified setting (i.e., a future job).

In summary, both out-of-laboratory thought-sampling procedures and laboratory-based cuing paradigms have provided some preliminary insights into the frequency, contents, and characteristics of episodic future thought. It is important to note that the emerging behavioral data are generally supportive of the prevailing conceptual framework of constructive episodic simulation. That is, participant descriptions of personal future episodes are characterized by personal, contextual, and emotional information that appears to be pieced together from memory. Later, I will consider in more detail the extent to which this information is characterized specifically by episodic memory and what allowance should be made for the role of semantic memory (see Sources of Information and Accessibility).

Brain Imaging

Functional neuroimaging techniques, such as positron emission tomography (PET) and functional magnetic resonance imaging (fMRI), allow neuroscientists to examine brain activity associated with mental activity. When participants in a research study engage in a given cognitive task, PET or fMRI can provide information about the level of cerebral blood flow (PET) or blood oxygenation level (fMRI) in the particular parts of the brain involved in performing the task.

In the typical design of a neuroimaging study, brain activity associated with two tasks is contrasted with the hope of isolating the brain regions that are important for the cognitive process of interest. In most cases, researchers attempt to contrast a pair of tasks that are similar to one another but vary in one key way. To identify the brain regions that are important for episodic memory, researchers might ensure that the tasks contrasted both require the retrieval of a personal memory but that only one requires the recollection of a specific time and place. For example, requiring a person to remember a specific feature of her first day of high school (a task that would place clear demands on episodic memory) might be compared with requiring the person to retrieve the name of the high school she attended (e.g., Maguire & Frith, 2003). Both tasks require the retrieval of a personal memory, but naming the high school does not involve recollecting experiences at a specific time and place in the past.

Recently, several systematic attempts have been made to examine the neural correlates of episodic future thought (Addis et al., 2007; Addis, Pan, Vu, Laiser, & Schacter, 2009; Botzung et al., 2008; D'Argembeau, Xue, Lu, Van der Linden, & Bechara, 2008; Okuda et al., 2003; Sharot, Riccardi, Raio, & Phelps, 2007; Szpunar, Chan, & McDermott, 2009; Szpunar et al., 2007). In one study, Szpunar et al. (2007) employed the use of a word-cuing paradigm. During an fMRI scan, participants were presented with a series of word cues (e.g., birthday). In one task, participants were asked to use the words to help them imagine personal future episodes. In a second task, participants were asked to use the words to help them remember personal memories. To identify brain regions important for representing personal experiences in time (future and past), the researchers contrasted activity during these two tasks against a third control task that involved many of the processes common to future and past thought (e.g., mental construction of lifelike scenarios) but that lacked a sense of representing oneself in time. Specifically, the control task required participants to use the word cues to help them imagine novel scenarios involving former U.S. President Bill Clinton. Pretesting had indicated that participants found Bill Clinton easy to imagine in a variety of scenarios. Relative to the control task, regions of the medial prefrontal cortex, posteromedial parietal cortex (including parts of the posterior cingulate cortex), and the medial temporal lobes (including parts of the parahippocampal cortex) were similarly engaged as participants thought about personal future and past episodes (see Fig. 3a). It is important to note that participants completed a postscan questionnaire that required them to rate the associated vividness, valence, and emotional intensity of each thought they had during the experiment. Additional analyses that covaried out these factors did not influence the overall pattern of results.

The similarity in neural activity that characterizes episodic future thought and remembering has been taken as evidence that similar processes underlie the two abilities (Buckner & Carroll, 2007; Hassabis & Maguire, 2007; Schacter & Addis, 2007; Spreng, Mar, & Kim, 2009). Of particular interest are posterior cortical regions (e.g., the posterior cingulate cortex, parahippocampal cortex, and hippocampus) that are known to play an important role in the retrieval of personal memories (Cabeza & St. Jacques, 2007; Maguire, 2001; Svoboda,

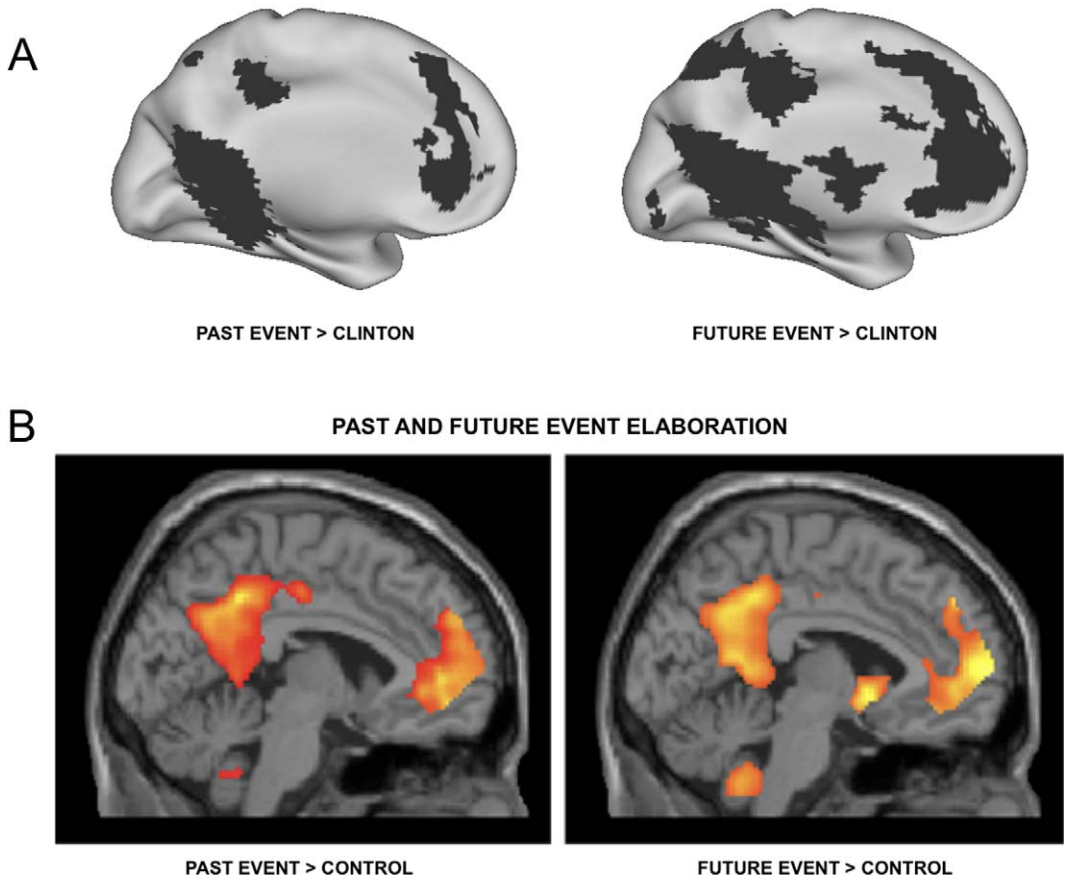

Figure 3. Sagittal slices illustrating the striking commonalities in the left medial prefrontal cortex, posteromedial parietal cortex, and medial temporal lobes as participants thought about personal past and future episodes (relative to control tasks). Data adapted from Szpunar, Watson, and McDermott (2007; A) and Addis, Wong, and Schacter (2007; B). Thresholds were set at $p < .05$, corrected for multiple comparisons (A) and $p < .001$, uncorrected (B).

McKinnon, & Levine, 2006). That episodic future thought engages these regions in a similar manner as remembering suggests that the contents of memory may in fact be accessed as participants think about their future. As further evidence for this claim, Addis et al. (2007) reported that the neural overlap between personal future and past thought was most pronounced in posterior cortical regions as participants elaborated on the contents of their mental simulations. Using fMRI, the authors parsed episodic future thought and remembering into two separate phases: construction and elaboration. That is, once participants had generated a personal future episode in response to a word cue (e.g., *dress*), they were asked to press a button and continue elaborating on the specific details of the episode. Relative to baseline tasks that involved sentence generation and imagery, elaboration of future and past episodes was characterized by an almost complete overlap in regions of the medial prefrontal cortex, posteromedial parietal cortex (including parts of the posterior cingulate cortex), and the medial temporal lobes (including parts of the parahippocampal cortex and hippocampus; see Fig. 3b).

More recently, Szpunar et al. (2009) tested whether posterior cortical regions contribute memory-related contents to episodic future thought by manipulating the extent to which participants were able to draw upon personal memories when thinking about the future. In two tasks, participants imagined personal future and past episodes occurring in the context of familiar settings (e.g., their apartment). In a third task, participants generated personal future episodes occurring in the context of unfamiliar settings (e.g., a jungle). Postscan questionnaires ensured that participants had no specific memories associated with the unfamiliar settings. Regions within the posteromedial parietal cortex and the medial temporal lobes (previously identified by Szpunar et al., 2007) were similarly engaged as participants imagined themselves in familiar contexts. However, the same regions exhibited relatively little neural activity as participants generated personal future episodes in unfamiliar contexts. It appears that posterior cortical structures associated with episodic future thought (and remembering) become engaged to the extent that the simulation of personal future episodes relies on the reactivation of the contents of personal memories.

Although the goal of the foregoing review of the neuroimaging literature has been to elucidate the close relation between episodic future thought and remembering, it is worth noting that interesting differences between the two abilities have also been identified. Most notably, episodic future thought is typically associated with additional neural activity over and above that which characterizes remembering. For instance, Addis et al. (2007) found a considerable degree of neural differentiation between episodic future thought and remembering as participants were initially constructing their mental representations (see also Szpunar et al., 2007). Among the regions that have been identified to show this pattern of activity (i.e., greater activity when considering the future than the past) is the anterior portion of the hippocampus (Addis et al., 2009; Addis & Schacter, 2008; Addis et al., 2007). Addis and her colleagues argue that this difference may be related to the additional relational processes required to bind disparate event details into a coherent mental representation of the future (Bird & Burgess, 2008; Cohen et al., 1999; Eichenbaum, 2001; McClelland, McNaughton, & O'Reilly, 1995; Preston, Shrager, Dudukovic, & Gabrieli, 2004). In support of this conjecture, Addis et al. (2009) recently reported that, relative to remembering, the anterior hippocampus was preferentially engaged as participants imagined novel future and novel past episodes, suggesting that this region plays an important role in piecing together novel episodes more generally.

Finally, it is important to consider that the core set of brain regions associated with episodic future thought and remembering (Schacter et al., 2007, 2008) has also been hypothesized to underlie mental simulation more generally. Buckner and his colleagues (Buckner, Andrews-Hanna, & Schacter, 2008; Buckner & Carroll, 2007) have convincingly reviewed data indicating that regions of the medial prefrontal cortex, posteromedial parietal cortex, and the medial temporal lobes (among other regions) are consistently engaged when participants consider hypothetical scenarios involving both themselves (in the past, present, and future) and others. In line with the arguments presented here, Buckner and his colleagues claim that regions of this core network known to underlie memory retrieval likely contribute the mental contents that are subsequently used to simulate a variety of hypothetical scenarios, including episodic future thoughts. Along similar lines, Hassabis and Maguire (2007) have published an important paper that identifies the ability to reconstruct familiar scenes from memory as a key process to understanding the relation between episodic future thought, episodic memory, and a host of other mental functions that involve placing oneself in a familiar mental context (e.g. mental navigation; see also Spreng et al., 2009).

Brain Damage

Reports of brain damaged amnesic patients have revealed that the inability to remember episodes from one's past is accompanied by a concurrent inability to simulate personal future episodes. I have already considered the cases of patients K.C. and D.B. in some detail (see Conceptual Development). However, these patients were characterized by diffuse (K.C.) and underspecified (D.B.) patterns of pathology, making it difficult to hypothesize which brain regions were responsible for the co-occurring deficits (or if the same brain regions were responsible in both cases).

More recently, Hassabis, Kumaran, et al. (2007) studied 5 patients with brain damage limited to the hippocampus (bilaterally). Like patients K.C. and D.B., these patients had retained their premorbid semantic memory but were densely amnesic for episodic experiences and were markedly impaired in their ability to imagine personal future episodes. Moreover, Hassabis and his colleagues reported that these patients were not able to generate hypothetical scenarios in general and that, relative to control participants, their mental representations were particularly deficient in terms of spatial coherence. For example, when cued to generate a novel episode occurring in the context of an exotic beach (not necessarily in the future), one patient was only able to imagine the sky, whereas control participants conjured highly detailed and integrated scenarios (see Box 3). In line with findings presented by Addis and her colleagues (Addis & Schacter, 2008; Addis et al., 2007), the authors suggested that both remembering and episodic future thought (and mental simulation more generally) rely on an intact hippocampus, which is believed to flexibly combine elements from memory into a coherent mental representation (Cohen et al., 1999; Eichenbaum, 2001, Hassabis & Maguire, 2007). As further support toward this claim, one of the 5 patients, who had previously been shown to possess residual hippocampal function, was able to generate relatively coherent hypothetical scenarios.

Finally, it is important to note that the specific case reports presented in this article represent but a few of dozens of reported cases of amnesia. Most other investigations into the phenomenon of amnesia have, for the most part, focused on the memory problems inherent in such patients. For example, many others have focused on examining the relative effects of brain damage on episodic and semantic memory (Kapur, 1999; Wheeler & McMillan, 2001). Hence, some caution should be exercised in considering the few studies investigating the effects of brain damage on episodic future thought, at least until they are further corroborated by future investigations. Nonetheless, the initial data present an intriguing case for the hypothesis that mentally simulating the future relies on remembering the past, and confidence is gained when converging lines of evidence are considered. Next, I detail studies relating episodic future thought to remembering in various other populations.

Clinical Populations

In general, it appears that individuals who experience difficulty in remembering specific events from their past are unable to generate detailed scenarios that might take place in the future. A considerable amount of evidence supporting this general claim has emerged from research in the fields of aging and development. Briefly, older adults and young children—

Cue: Imagine you are lying on a white sandy beach in a beautiful tropical bay

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Patient: As for seeing I can't really, apart from just sky. I can hear the sound of seagulls and of the sea... um... I can feel the grains of sand between my fingers... um... I can hear one of those ship's hooters [laughter]... um... that's about it. Are you actually seeing this in the mind's eye? No, the only thing I can see is blue. So if you look around what can you see? Really all I can see is the color of the blue sky and the white sand, the rest of it, the sounds and things, obviously I'm just hearing. Can you see anything else? No, it's like I'm kind of floating...

Control: It's very hot and the sun is beating down on me. The sand underneath me is almost unbearably hot. I can hear the sounds of small wavelets lapping on the beach. The sea is a gorgeous aquamarine color. Behind me is a row of palm trees and I can hear rustling every so often in the slight breeze. To my left the beach curves round and becomes a point. And on the point there are a couple of buildings, wooden buildings, maybe someone's hut or a bar of some sort. There's no one else around. Out to sea is a fishing boat. It's quite an old creaking looking boat, chugging past on its small engine. It has a cabin in the middle and pile of nets in the back of the boat. There's a guy in the front and I wave at him and he waves back...[continues]...

Box 3. Excerpts of hippocampal patient and control participant responses when asked to think about themselves in a hypothetical scenario on an exotic beach. Data adapted from Hassabis, Kumaran, Vann, and Maguire (2007).

characterized by impaired and underdeveloped episodic memory, respectively—are generally unable to simulate detailed mental representations of future episodes (Addis et al., 2008; Atance & Meltzoff, 2005; Atance & O'Neill, 2005; Busby & Suddendorf, 2005; Suddendorf & Busby, 2005; for detailed reviews see Szpunar & McDermott, 2008b, 2008c). Similar patterns of deficit have been observed in various clinical disorders. As with aging and development, the prerequisite for a deficit in episodic future thought appears to be an inability to remember personal episodes with any degree of specificity. Next, I consider two such disorders in some detail, namely depression and schizophrenia.

In one study, Williams et al. (1996) presented suicidally depressed individuals with a series of sentence cues (e.g., ''Imagine an event that would make you feel proud'') and asked them to generate specific memories and plausible future scenarios. Relative to control participants, depressed individuals produced memories and future thoughts that were characterized by general statements and lacking in specific detail, which is consistent with previous research (Williams & Broadbent, 1986; Williams & Dritschel, 1988). Indeed, it has been hypothesized that depressed individuals adopt a generic retrieval style to reduce the possibility of evoking potentially threatening (i.e., specific) memories (Williams, 1996, 2006). Williams and his colleagues further argued that the general level at which the contents of memory were accessed in depressed individuals influenced the level of specificity with which those individuals could construct personal future episodes. As further support for this conjecture, the authors showed that inducing a generic retrieval style in control participants led them to later imagine future scenarios that were also lacking in specific detail.

In a similar study, D'Argembeau et al. (2008) examined the ability of patients with schizophrenia, also known to possess episodic deficits (e.g., Achim & Lepage, 2003; Danion et al., 2005), to generate plausible future scenarios. Relative to control participants, patients with schizophrenia generated memories and future thoughts that were lacking in specific detail (see Fig. 4). Furthermore, D'Argembeau et al. (2008) and Williams et al. (1996) both reported that the specificity of episodic future thought and remembering were highly correlated within participants ($r = .72$ and .57, respectively). That is, participants (schizophrenic or control; depressed or control) who remembered vivid memories were more likely to generate vivid mental representations of the future (see also Addis et al., 2008). This consistent pattern of data further corroborates the hypothesis that common processes mediate mental simulations of the personal future and past.

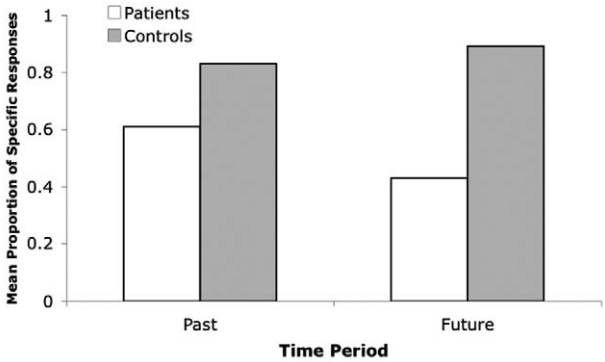

Figure 4. Mean proportion of specific (episodic) responses generated by patients with schizophrenia and healthy controls when thinking about personal memories and future events. The mental representations generated by patients with schizophrenia were generally less specific than those of control participants ($p < .001$). Data adapted from D'Argembeau, Raffard, and Van der Linden (2008).

One potentially fruitful avenue for future research will be a closer examination of whether deficits of episodic future

thought in depression and schizophrenia are possibly associated with specific underlying brain abnormalities. In a recent review of the literature, Schacter et al. (2008) point out that hippocampal atrophy has been associated with both depression (Bremner et al., 2000) and schizophrenia (Velakoulis et al., 2006). This observation is potentially informative considering current interest in the role of hippocampus in episodic future thought. Specifically, it will be important for future work to determine whether the integrity of the hippocampus and other neural regions associated with episodic future thought are related to the specificity with which various clinical populations simulate personal future episodes.

Summary

Although research on episodic future thought is a recently emerging area of interest, a considerable amount of data has already accumulated that furthers our understanding of the concept. The content of this initial burst of data may be summarized in five points. First, it appears that episodic future thoughts make up a considerable proportion of daily musings. An initial report (D'Argembeau et al., 2009) has estimated that approximately half of future-directed thoughts include episodic content, suggesting that the ability to contemplate specific future episodes plays an important role in daily life (see Functional Significance). The remaining four points seemingly converge on the idea of constructive episodic simulation, which states that episodic future thought represents an expression of episodic memory (Schacter & Addis, 2007): (a) verbal protocols of episodic future thought are characterized by context that is highly familiar to participants (e.g., D'Argembeau & Van der Linden, 2004), (b) neural regions believed to underlie the retrieval of personal memories are similarly engaged by episodic future thought (Addis et al., 2007; Szpunar et al., 2007), (c) damage to these regions (particularly the hippocampus) is associated with impairments of both remembering and episodic future thought (e.g., Hassabis, Kumaran, et al., 2007), and (d) patient populations characterized by poor episodic memory exhibit a concurrent inability to imagine their future in a vivid way.

The evidence I have considered, in particular those data that indicate a close relation between personal future and past thought, have led some to suggest that "the primary role of mental time travel into the past is to provide raw materials from which to construct and imagine possible futures" (Suddendorf & Corballis, 2007, p. 302). Although this statement has considerable merit in light of the available data, three important questions need to be considered before one ascribes a functional benefit to episodic memory in terms of its role in episodic future thought. First, are there instances in which the ability to remember specific events from one's past may help to direct future behavior without the need to necessarily simulate a hypothetical scenario? As will be discussed below, the answer is "yes" and the functional role of episodic memory in terms of looking back into the past should not be underestimated. Second, are there circumstances in which simulating the future procures a functional benefit? Again, the answer is "yes." In particular, simulating the future appears to help people better plan their behavior (see Functional Significance). Given the evidence indicating a close relation between episodic future thought and episodic memory, this second point emphasizes a functional role for episodic memory in terms of looking forward to the future. Finally, to what extent do mental simulations of personal future episodes rely on nonepisodic information? Unlike the first two questions, there exists very little speculation and no research that has addressed this important issue. In the final section of this article (see Sources of Information and Accessibility), I consider the possibility that episodic future thought, like episodic memory (Tulving, 1983), also relies on semantic information. Next, I review evidence for the functional role of episodic memory and episodic future thought.

Functional Significance

Episodic Memory

Before addressing the functional benefit of episodic future thought, it is important to first acknowledge that episodic memories themselves may help to coordinate behavior without the need of necessarily evoking mental simulations of the future (Pillemer, 2003). For instance, consider the example of John, who has just attended his first formal dinner party and who was surprised by the fact that his best pair of jeans and buttoned-down shirt did not necessarily meet the criteria of "formal." If John is lucky enough to be invited to another similar party, it is likely that the memory of his social transgression will serve to inform his behavior in the future (e.g., purchasing a suit).[5] That is, the specific memory of embarrassment provides enough information to direct John's behavior without the need to simulate a future scenario (although such simulations may often come to mind).

When a particular event is experienced under many similar instances, the common characteristics of the episodic memories that represent each singular instance may be abstracted into representations of well-known situations or *scripts* (Abelson, 1981; Schank & Abelson, 1977). For example, John will have eventually attended many formal dinner parties and will generally know what to expect each time he attends (e.g., manner of dress, appropriate table manners). Here again, John's memory may serve to inform his future behavior, although the directive force is no longer associated with a specific memory. Even so, John is likely to come across experiences in the future that deviate from his script of a formal dinner party. For example, imagine that John became involved in a heated (and largely unpleasant) debate about politics in the course of the most recent dinner party he attended. It is likely that this new experience would lead John to engage in more appropriate topics of conversation at future parties. In fact, Schank (1999) and his colleagues have argued that specific memories of deviations from scripts become appended to scripts to help people better understand the array of possible experiences they might

encounter in a given situation and to allow for better direction of future behavior (cf. Bartlett, 1932). Again, the episodic memory provides the information necessary to direct behavior without the need to simulate a future scenario.

A similar line of research has been conducted in the context of using trait knowledge to predict one's own and other people's behavior (Klein, Cosmides, Tooby, & Chance, 2002). Briefly, both specific (episodic) and summary (semantic) knowledge may be drawn upon when making a prediction about how one will behave in a future instance. Klein and his colleagues argue that specific episodes are useful when there exists little experience in relation to oneself or another person and the future instance in question. However, when specific experiences have accumulated, trait summaries can be used to predict behavior (e.g., "She is always friendly"). The important point, for our purposes, is that this line of research further emphasizes that memory (episodic or semantic) often provides sufficient information to direct behavior without the need to necessarily simulate the future.

Under what circumstances is simulating a future sequence of events necessary to gain a functional benefit? To answer this question, let us reconsider John's initial formal dining experience. John had the embarrassing experience of showing up underdressed to a formal dinner. Subsequently, John used his memory for this experience (and perhaps related simulations) to avoid similar mishaps in the future (i.e., he was motivated to buy a new suit). That is not to say, however, that this set of circumstances does not afford John the opportunity to put his ability to think about specific future scenarios to good use. In fact, doing so might enhance the probability that John will follow through with his future intentions (i.e., buying a suit). Although episodic (and semantic) memory often provide sufficient information to help anticipate (or motivate oneself toward) future outcomes, simulating the course of various hypothetical situations may provide additional information of possible contingencies that may help to better coordinate behavior (Hayes-Roth & Hayes-Roth, 1979). Returning to our example, although John does not necessarily have to simulate the episode of buying a suit, doing so could help him to foresee potential obstacles related to carrying out his intention and he could use this information to formulate a better plan.

Episodic Future Thought

Evidence for a functional benefit of episodic future thought has been reported in three ostensibly separate lines of research: coping, goal-achievement, and implementation intentions. One interesting point to consider is that research in each of these areas preceded current interest in episodic future thought. However, each line of research is directly relevant to this article, as participants were required to construct vivid mental images of personal future episodes occurring in a specific time and place (see Implementation Intentions for a potential exception). More specifically, researchers in these fields have differentiated between the efficacy of simulating a positive outcome (outcome simulations) and the process of working toward a positive outcome (process simulations) in promoting adaptive behavior. An outcome simulation is associated with visualizing the instance in which one attains their goal and the positive feelings associated with that goal. Process simulations, on the other hand, emphasize focusing on the process associated with achieving one's desired goal. Rather than imagining oneself in the desired state, which might bring momentary satisfaction, one would envision the necessary steps required to achieve their goal (Taylor & Pham, 1996). Generally, it appears that simulating the process of working toward a positive outcome is most functional. Next, I consider specific evidence for this claim.

Coping. According to the mental health literature, the mental simulation of personal future episodes has two discernable benefits for coping with stressful events: emotion regulation and problem solving (Taylor & Schneider, 1989). The former strategy consists of entertaining hypothetical scenarios in an effort to ameliorate the distress often arising in response to stressful events (i.e., outcome simulations). For instance, Brown, MacLeod, Tata, and Goddard (2002) showed that worry about an upcoming future event was reduced following the active generation of a positive hypothetical scenario related to the future event. As an example, partners in a troubled relationship often imagine that they will be happy in the future as a means of diffusing emotional tension. However, any benefit gleaned from such simulations may be temporary. That is, focusing on positive fantasies may provide a momentary sense of relief, but it will not lead the individual toward a successful resolution (Oettingen, 1996). Alternatively, mental simulations may stir the emotions necessary to motivate an individual toward enacting problem-solving behaviors (Oettingen, 1996; Oettingen & Mayer, 2002; Taylor & Pham, 1996). Returning to our example of the troubled relationship, one could use a positive image of the future as motivation to work toward resolving the conflict.

One way of increasing the efficacy of future-directed thought as a means of ultimately relieving stress is to further simulate the process of working toward a desired goal. Mental simulations of the future provide a unique opportunity to anticipate potential obstacles and to use that information to plan behavior accordingly (Hayes-Roth & Hayes-Roth, 1979; Taylor & Schneider, 1989). Hence, rather than fantasizing about a desired positive outcome, our worried partner might benefit from simulating a variety of hypothetical scenarios (e.g., "How will they react if I do X or Y?") and choosing amongst them to determine the most appropriate course of action. In one study, Taylor et al. (1998) asked college students to identify personal life events that were currently a source of stress (many students described problems of an interpersonal nature). Some of the participants were then asked to simulate the process of working through the stressful event (i.e., what steps will you take to resolve the problem), whereas others were asked to simulate a successful outcome (i.e., imagine the satisfaction in having successfully dealt with the problem). One week later, participants simulating the process of working through the problem reported more positive affect and had

Table 1. Effects of Mental Simulation on Exam Performance

Variable	Process simulation	Outcome simulation	Control
Number of days of study	5.20[a]	4.11[a,b]	3.20[b]
Number of hours of study	14.05	12.39	10.20
Exam grades (%)*	73.18	67.61	65.28

Note. Means in the same row not sharing a common subscript are significantly different from each other ($p < .05$). Table adapted from Taylor et al. (1998).
*The average score of students not participating in the experiment was 68.29%.

engaged in more active coping strategies outside the laboratory. The ability to simulate the process of working toward a goal provided an organizational structure that could be used to fine tune their behavior.

Goal Achievement. What about other, less emotionally charged circumstances? What is the role of episodic future thought in relation to goal-directed behavior more generally? In one study, the relative effectiveness of outcome and process simulations was tested in a classroom setting (see Taylor et al., 1998). College students were asked to approach an upcoming midterm examination in one of several ways. Some of the students were asked to think about how it would feel to get an A on the test (outcome simulators). Specifically, outcome simulators were asked to imagine coming up to the building where their scores were posted, locating their identification numbers on the list of scores, and the feeling they would have after seeing that they had aced the test. Further, outcome simulators were asked to perform this simulation for 5 min each day leading up to the exam (approximately 1 week). Meanwhile, another group of students was asked to imagine what it would take for them to get an A on the test (process simulators). Process simulators were required to imagine where they would study and the various measures they would take to ensure that they made proper use of their study time (e.g., turning off music, being in a quiet place). Process simulators were also asked to perform this simulation for 5 minutes each day leading up to the exam. In a third, control group, students simply monitored their study habits, without receiving any particular instructions to simulate future scenarios. Relative to the self-monitoring control group, the process simulators showed a higher gain in performance than did the outcome simulators (see Table 1). It appears that by simulating effective study strategies, students in the process simulation group had developed a plan for success. In fact, participants in the process simulation group reported engaging in more effective studying habits outside the laboratory than did the participants in the outcome simulation group (see also Buehler, Griffin, & Ross, 1994; Pham & Taylor, 1999).

Thus far, I have considered the role of simulating personal future episodes, and process simulations in particular, in fostering coping and goal-directed behavior. Generally, the act of imagining various approaches to reaching a desired goal appears to provide information toward coordinating a plan of action. In a related line of research, Gollwitzer and his colleagues (Gollwitzer, 1993, 1996, 1999) have shown that elaborating on future action sequences may benefit goal-directed behavior by helping to facilitate the initiation or implementation of those actions at a future time. Evidence related to this hypothesis is reviewed below.

Implementation Intentions. Gollwitzer (1993, 1996, 1999) has reported on an extensive line of research indicating that the simple act of forming an intention to implement an action leads to a high likelihood of completing that action. According to Gollwitzer, a goal intention represents the formulation of a goal that one intends to achieve. Once a goal is in place (e.g., I want to achieve *X*), one may further form an implementation intention that specifies the context within which they intend to achieve that goal (i.e., when, where, and how). Gollwitzer suggests that implementation intentions are particularly effective in directing behavior because they increase the probability that the context-action association will be evoked in an automatic fashion. That is, a given context will be more likely to cue a particular response if it has been previously associated with that response. Orbell, Hodgkins, and Sheeran (1997) found that women who set themselves the goal of performing a breast self-examination in the next month benefited considerably from forming implementation intentions. Participants were first asked to indicate how strongly they intended to comply with this goal. Then, some of the participants were asked to further specify when and where they would perform the self-examination. In the absence of implementation intentions, participants with a strong intent to perform the breast self-examination complied 53% of the time. The completion rate was 100% when implementation intentions were specified.

Taylor and Pham (1996) suggest that implementation intentions are similar to process simulations in that they require the individual to specify when, where, and how a given goal will be enacted. However, implementation intentions do not always explicitly require that these details be mentally simulated. It will be interesting for future research to examine whether or not implementation intentions are naturally accompanied by the construction of specific personal scenarios (e.g., McDaniel, Howard, & Butler, 2008).

Summary

Often times, episodic (and semantic) memories provide sufficient information to direct one's behavior toward a future goal. That is not to say, however, that episodic future thought cannot promote a functional advantage to behavior. Indeed, I have considered evidence that simulating a personal future episode can help to better coordinate behavior in various contexts (e.g., interpersonal relationships, classroom settings). It is important to note that the research considered in this section provides direct evidence of how engaging in episodic future thought provides a functional benefit that goes beyond speculations of how the

concept likely acted as an evolutionary driving force (Suddendorf & Corballis, 1997, 2007; see also Boyer, 2008).

According to the prevailing conceptual framework of constructive episodic simulation, a primary function of episodic memory is to provide the building blocks from which episodic future thoughts are constructed (Schacter & Addis, 2007). Although there is considerable evidence implying that this represents an important function of episodic memory, one final question deserves consideration. Specifically, does episodic future thought rely solely on episodic memory or do mental simulations of personal future episodes make use of other sources of information? Next, I consider the possibility that both episodic and semantic information are utilized in the construction of personal future episodes. Further, I propose a specific mechanism that determines the extent to which episodic and semantic information is sampled in the simulation of episodic future thoughts.[6]

Sources of Information and Accessibility

To date, there exists a considerable amount of evidence indicating that the ability to construct a specific mental representation of a personal future episode is closely related to the ability to reconstruct mental representations of personal past episodes. This striking parallel has led to the hypothesis that episodic future thought represents an expression of episodic memory (Schacter & Addis, 2007). Specifically, it has been suggested that the contents of episodic memory may be sampled and recombined in various ways in the course of constructing a coherent mental representation of a novel future scenario. For instance, consider the example of Angie, who is preparing to attend her company Christmas party. Angie is anxious about the event because a fellow coworker that she is infatuated with will be there. Naturally, Angie may imagine a variety of potential scenarios that might transpire that night (e.g., ''What will happen if I attempt to strike up a conversation?'' or ''What will happen if I avoid him and enjoy the night with my friends?''). In each case, Angie is able to simulate future episodes that contain information about the specific settings, people, and emotions involved (D'Argembeau & Van der Linden, 2004). However, the extent to which the contents of her simulations reflect elements of episodic memories remains unclear. That is, although Angie may have specific episodic memories associated with each one of the features that are prominent in the various hypothetical scenarios she imagines (e.g., the setting and people involved), relying strictly on the contents of episodic memory may not represent the most efficient route by which to construct these scenarios.

To illustrate this point, I shall elaborate further on one specific future instance that Angie might think about (e.g., having a conversation). When Angie contemplates the nature of a hypothetical conversation with her fellow coworker, she is likely to construct a vivid representation of the setting in which the event is taking place (e.g., a banquet hall), the individuals involved (e.g., her coworker), and the emotions associated with the event (e.g., excitement, anxiety).[7] What sources of information does Angie draw upon to construct this scenario? For example, does the setting she imagines (e.g., the banquet hall) represent a specific memory of that particular (or similar) setting(s)? Alternatively, might her mental image of the setting consist of an abstracted representation of a banquet hall (Schank, 1999)? Similarly, does the behavior of the particular individuals involved (e.g., the interaction with her coworker) represent samples of relevant episodic memories or abstracted information of how the specific individuals involved behave in specific contexts (Klein et al., 2002)? Next, I consider the possibility that the extent to which episodic and semantic representations are drawn upon in constructing mental simulations of personal future episodes depends on the accessibility of relevant information to the mental simulation of interest. That is, the content of episodic future thought likely reflects the information that comes to mind most easily (Kahneman & Tversky, 1982; Szpunar, in press; Tversky & Kahneman, 1973).

For instance, consider the setting (banquet hall) where Angie imagines that the Christmas party will take place. It is likely that the information Angie relies on to construct this aspect of her future thought depends on the extent of her experience with the setting itself. If Angie's company hosts its annual Christmas party at the same venue each year, and if Angie has been an employee of this company for 20 years, it is likely that Angie will not need to remember a specific instance associated with the banquet hall. Instead, her abstracted representation of that specific banquet hall (i.e., an aggregate of repeated experiences) is likely to be more accessible (cf. Schank, 1999). Alternatively, imagine that Angie has only been with the company for 2 years and that this will be the second party that she attends at this particular venue. In this case, Angie's mental representation of the setting for the future event might indeed rely on her specific episodic experiences. Finally, it could also be the case that this is Angie's 1st year with the company and that she has never been to this particular banquet hall. In this case, Angie's mental representation of the setting might evoke specific memories of the most recent banquet hall that she attended or perhaps her general idea of what banquet halls typically look like.

A similar line of reasoning may apply to various other features of Angie's mental simulation. For example, Angie's mental representation of the coworker will also likely depend on the extent of her previous experiences with them. If Angie has known this person for several years, then her simulation of the manner in which they behave will likely be best represented by her abstracted representation of this particular individual's behavioral tendencies (Klein et al., 2002). However, if Angie has just recently met this coworker, then specific episodes from the past might be the only information that she has to rely on to construct the hypothetical scenario.

Hence, whether the information that is used to simulate personal future episodes is episodic or semantic (or even a combination of the two) would seem to depend on the relative accessibility of relevant memory representations. More specifically, abstracted (semantic) representations that are relevant to a given simulation should generally be more accessible than

episodic representations of similar information. Episodic representations, on the other hand, might serve an important role in the simulation of future episodes when repeated experiences with specific aspects of a scenario are absent. Of course, it could also be the case that details of recent (and relevant) episodic memories may take precedence over abstracted representations on occasion. Future work will need to address these possibilities (cf. Hedge, 2007).

It is important to note that these claims may require a reevaluation of the prevailing conceptual framework of constructive episodic simulation. That is, although there should be little doubt that the contents of memory are sampled in the construction of personal future episodes, it may be unlikely that this sampling is restricted solely to elements of specific episodic memories. Rather, the final product of episodic future thought likely represents a mixture of various episodic and semantic details that are flexibly recombined to form a coherent mental representation of a specific future episode. Nonetheless, the final product represents a specific episode.[8]

The arguments presented here also raise the possibility that specific future episodes may be constructed without the need to necessarily rely on the contents of episodic memory per se. For instance, in the example presented above, had Angie been a long-term employee of her company and a long time companion of her romantic interest, she would not necessarily need to access the contents of any specific memories when imagining a conversation that might transpire at her company Christmas party. This presents an interesting question for future research. If episodic future thought does not necessarily have to rely upon the contents of specific episodic memories, then why are amnesic patients unable to accomplish this task? One possibility is that a similar set of processes underlies episodic future thought and episodic memory (i.e., binding of multiple memory units—both episodic and semantic—into a coherent representation of a specific scenario), and the hippocampal damage that characterizes amnesic patients likely precludes them from being able to engage such processes.

In addition, it may be important for future research to examine exactly which aspects of semantic knowledge remain intact in amnesic patients. For instance, is a patient who is able to name the street of their childhood home (personal semantic knowledge) also able to imagine the layout of that home (abstracted representation of repeated experiences)? Neither task requires traveling back into the past to reexperience a specific episode. However, it is unlikely that both tasks draw upon the same form of semantic information.

Currently, there exist few data to support the idea that mental simulations of personal future episodes (and perhaps mental simulations in general) are dictated by the underlying accessibility of relevant units of information from memory (but see Szpunar, in press). Hence, the claims made here should be taken as tentative speculations. Nonetheless, considerations of the relative accessibility of memory representations may present a useful framework by which to consider the dynamic interplay of both episodic and semantic information in the simulation of episodic future thought.

Concluding Remarks

The ability to mentally simulate hypothetical scenarios represents an emerging area of interest in both psychology and neuroscience (Buckner et al., 2008; Schacter et al., 2008). Episodic future thought represents one facet of this general capacity that has begun to receive a considerable amount of interest. Here, I have reviewed the initial findings that have shaped our understanding of this concept and identified important avenues for future research. In general, episodic future thought represents a frequently occurring mental phenomenon that has clear adaptive implications for behavior. Moreover, research findings from neuroimaging, neuropsychology, and clinical psychology have implicated a close relation between episodic future thought and episodic memory: both share similar neural correlates and are typically reported as co-occurring deficits in various patient populations. Such consistency in the data has led to the suggestion that episodic future thought represents an expression of episodic memory such that the contents of episodic memory are flexibly sampled and recombined in order to generate novel future scenarios (Schacter & Addis, 2007).

However, the fact that episodic future thought and episodic memory are so closely associated does not necessarily imply that episodic future thoughts should be characterized solely by the contents of episodic memory. In the final section of this article, I discussed various instances of episodic future thought that could reasonably be considered to rely on the contribution of both episodic and semantic information. Although future research will be needed to more fully examine the claims presented here, it is proposed that the extent to which episodic and semantic memory contribute to episodic future thought is determined by the relative accessibility of information in memory that is relevant to the mental simulation of interest. Finally, it may be that the most appropriate manner by which to entertain evidence of a close relation between episodic future thought and episodic memory is in terms of processes. Both abilities involve generating detailed representations of specific episodes and it is likely that (a) similar processes support these abilities (e.g., flexible recombination of both episodic and semantic contents of memory), (b) similar neural correlates underlie these processes, and (c) these processes may be similarly impaired in various patient populations.

Notes

1. Patient K.C. was originally referred to as patient N.N.
2. Tulving (1985) did not actually coin a specific term for the concept of episodic future thought. In fact, the term was first used by Atance and O'Neill (2001).
3. For completeness, Tulving (1985) also identified a third form of consciousness called *anoetic consciousness*. Anoetic consciousness is hypothesized to reflect the mental experience (or lack thereof) of retrieval in the absence of awareness (e.g., implicit memory).
4. This article considers the conceptual development and current understanding of episodic future thought as it relates to humans. Although there exists a considerable amount of evidence that

nonhuman animals possess the ability to anticipate their future, the extent to which other specifies are capable of simulating specific future episodes remains unclear (for a recent review, see Suddendorf & Corballis, 2007).

5. Although this scenario may not best exemplify what might be considered an adaptive advantage in the classic evolutionary sense (e.g., meeting basic needs), it certainly highlights an important advantage in terms of healthy interpersonal functioning (e.g., avoiding social exclusion).
6. Although various authors have recently espoused the concern that theories of future thinking must take into consideration the role of semantic knowledge (Schacter et al., 2007, 2008; Suddendorf & Corballis, 2007), there has been no formal consideration of the role of semantic representations in the construction of personal future episodes.
7. It is important to point out that there may exist important individual differences associated with episodic future thought. For instance, there may be individual differences regarding the extent to which some people engage in episodic future thought at all. As noted in the Functional Significance section, although episodic future thought may procure a functional benefit, engaging in the process is not always necessary. It will be interesting for future research to consider whether there exist various groups of people who are more or less likely to engage in episodic future thought (e.g., Norem & Illingworth, 1993; Quoidbach, Hansenne, & Mottet, in press; Zimbardo & Boyd, 1999). In addition, current methodological approaches to episodic future thought stress the involvement of mental images in the construction of hypothetical future episodes. It is possible, however, that individuals differ in their ability to think about their world in an quasivisual manner and such differences could underlie important differences in the extent to which certain people think about their future using imagery (D'Argembeau & Van der Linden, 2006).
8. It is important to point out that episodic and semantic information are also thought to interact in the construction of episodic memories (Tulving, 1983). The main difference between episodic memory and episodic future thought is that episodic memories represent events that have already taken place and for which semantic information likely serves to fill in details, whereas episodic future thoughts represent events that have yet to take place.

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