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Autonoetic consciousness: Reconsidering the role of episodic memory in future-oriented self-projection

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Following the seminal work of Ingvar (1985. "Memory for the future": An essay on the temporal organization of conscious awareness. Human Neurobiology, 4, 127–136), Suddendorf (1994. The discovery of the fourth dimension: Mental time travel and human evolution. Master's thesis. University of Waikato, Hamilton, New Zealand), and Tulving (1985. Memory and consciousness. Canadian Psychology/PsychologieCanadienne, 26, 1–12), exploration of the ability to anticipate and prepare for future contingencies that cannot be known with certainty has grown into a thriving research enterprise. A fundamental tenet of this line of inquiry is that future-oriented mental time travel, in most of its presentations, is underwritten by a property or an extension of episodic recollection. However, a careful conceptual analysis of exactly how episodic memory functions in this capacity has yet to be undertaken. In this paper I conduct such an analysis. Based on conceptual, phenomenological, and empirical considerations, I conclude that the autonoetic component of episodic memory, not episodic memory per se, is the causally determinative factor enabling an individual to project him or herself into a personal future.

Keywords: Episodic memory; Autonoetic awareness; Future-oriented mental time travel.

The central nervous system enables its owner to prepare for contingencies that experience suggests will probably be encountered (e.g., Klein, Cosmides, Tooby, & Chance, 2002; Pezzulo, 2008; Suddendorf & Corballis, 1997). Such anticipatory orientation clearly is an adaptive priority: Confronted with the uncertainties that inevitably attend one's environment—even those possessing considerable structure and order—flexible, adaptive strategies greatly benefit an organism's survivability and hence its reproductive success (e.g., Klein, 2013a; Klein, Robertson, & Delton, 2010; Suddendorf, 1994; Tulving, 2005). The temporal scope and imaginative complexity of one's ability to anticipate and plan for contingencies that cannot be known with certainty is an obvious target for natural selection (e.g., Bischof-Koehler, 1985; Klein, Cosmides, et al., 2002; Suddendorf, 2013; Suddendorf & Corballis, 1997).

MEMORY AND FUTURE-ORIENTED MENTAL TIME TRAVEL: A VERY BRIEF HISTORY

Not surprisingly, psychology has taken a strong interest in future-oriented abilities. Attention to the effects (both adaptive and maladaptive) of temporal orientation on behaviour was in full display from the 1940s through the late 1960s. Much of this consisted in evaluating the effects of subjective temporality on variables of concern primarily to clinical, developmental, personality/

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social psychologists (e.g., goals, motivation, personality, psychopathology; for a review see Cottle & Klineberg, 1974). However, by the 1970s interest had waned—work that remained largely focused on questions pertaining to estimations of the duration of objective temporal intervals (a topic whose origins trace to the birth of psychophysics; for review see Fraisse, 1963).

Following a period of relative neglect, the psychology of subjective temporality was reinvigorated by three largely conceptual meditations—Tulving (1985), Ingvar (1985), and Suddendorf (1994). However, the questions addressed had changed: Influenced by the theoretical commitments of the "cognitive revolution", inquiry now was trained on the relation between memory and future-oriented thought. In short order several empirical papers followed (e.g., Dalla Barba, Cappelletti, Signorini, & Denes, 1997; Klein, Loftus, & Kihlstrom, 2002; Williams, Ellis, Tyers, Healy, Rose, & MacLeod, 1996). It was not long before research on memory and what had come to be called future-oriented mental time travel (FMTT) had grown into a thriving enterprise: By the close of the first decade of the new millennium well over one hundred articles had appeared in scholarly venues. Interest shows no sign of abating—as attested to by the increasing pace and broadening scope of the questions being asked, as well as special issues (e.g., the present collection), symposia (e.g., Society for Personality and Social Psychology [SPSP], 2015), and edited volumes (e.g., Michaelian, Klein, & Szpunar, forthcoming).

The role of memory in imagining the future

Given the hindsight provided by contemporary perspectives on neurobehavioural functionality, it seems obvious that our capacity to anticipate and plan is underwritten by access to memories that are relevant to situational demands. However, the link between these two opposite-facing temporal faculties has a very long, fluctuating history. Memory, initially accorded a position of prominence in FMTT, subsequently was deposed. It would be 2000 years before it reclaimed that place of distinction.

The earliest known writing on the relation between memory and subjective temporality dates from the eighth century BC. In his Theogony (West, trans. 1988), Hesiod mentions that one's ability to subjectively transcend objective time is made possible by the faculty of human memory. Whatever currency this idea had on Greek thought in antiquity largely is unknown (what remains of Ionian and Greek philosophical thought from this period largely consists in fragmentary records). What is known is that Hesiod's views subsequently were silenced by the imposing voice of Dante's "master of them who know"—Aristotle (384–322 BC). In his monumental treatment of memory—De Memoria—Aristotle is adamant that the future is known by acts of anticipation, not by acts of memory. "The object of memory is the past" (cited in Sorabji, 1972, p. 13).

Aristotle's pronouncement dominated the intellectual landscape for approximately two millennia (e.g., Coleman, 1992; Klein, 2013a). We thus find Augustine of Hippo (354–430 AD) declaring: "The time of present things past is memory, the time of present things present is direct experience and the time of present things future is expectation" (The Confessions, 1997, Book 11, chapter 20, heading 26). Although scholastic authorities of the Middle Ages proposed emendations to the concept, memory's relation to the past was secure, serving as a stable resting place for scholarly discourse (for reviews see Coleman, 1992; Klein, in press).

It was not until the nineteenth century that memory attained the status of an object of scientific inquiry (e.g., Ebbinghaus, 1885), providing a new perspective from which to evaluate the conceptual warrant of the "received doctrine". Bradley (1887), influenced by Darwinian principles of natural selection, adopted a stance diametrically opposed to the one that had dominated discourse for nearly 2000 years: Rather than saddle memory to the past, he proposed (echoing the long-forgotten insights of Hesiod, though probably for different reasons)—that memory must, of adaptive necessity, be oriented toward the future.

Bradley's (1887) observations proved prophetic—though a rapprochement between memory and

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FMTT had to wait another 100 years. However, by the mid-1980s psychologists had begun to consider a radical possibility: that the evolved function of memory was to focus thought and behaviour on the future rather than on the past (for reviews see Boyer, 2009; Klein, 2013b; Tulving, 2005). Within this framework, one particular type of memory—episodic—was taken to play a foundational role in most forms of FMTT (for recent reviews see Addis & Schacter, 2012; Klein, 2013a, 2013b; Schacter et al., 2012; Suddendorf & Corballis, 2007; Szpunar, 2010).[1]

THE ROLE OF EPISODIC MEMORY IN CONTEMPORARY TREATMENTS OF FMTT

As the connection between episodic memory and FMTT became widely accepted, scholarly treatments—impressive both in quantity and in diversity—began to populate the academic landscape. They included, but were not limited to, examination of neural correlates, developmental trajectory, evolutionary considerations, the specificity and detail of imagined scenarios, and psychopathological (e.g., amnesia, schizophrenia, and depression) implications (for a recent review see Klein, 2013a). Such terms as "episodic future thought" (Atance & O'Neill, 2005; Race, Keane, & Verfaellie, 2011; Schacter & Addis, 2007; Szpunar & McDermott, 2008) "episodic simulation/construction" (Addis, Cheng, Roberts, & Schacter, 2011; Hassabis & Maguire, 2007; Schacter, Addis, & Buckner, 2008), "episodic self-projection" (e.g., Buckner & Carroll, 2007), and "episodic foresight" (e.g., Attance & Sommerville, 2014; Suddendorf, 2010) became the lingua franca of the field.[2]

One possible explanation for the tight focus on episodic memory is that—with two notable exceptions (Atance & O'Neill, 2001; Klein, Loftus, et al., 2002)—initial research and theory examined only the effects of episodic memory on FMTT (Dalla Barba et al., 1997; Suddendorf & Corballis, 1997; Tulving, 1985; Wheeler, Stuss, & Tulving, 1997; Williams et al., 1996). Another possibility (discussed in the section "The problem of conceptual underspecification and theory construction") is that a relation between episodic memory and FMTT simply makes sense (i.e., it has assumed the role of a scientific precommitment—that is, an unstated, but intuitively plausible, presumption that plays a formative role in the questions we pose to nature).

Given this state of affairs, a careful conceptual analysis of exactly what the term "episodic memory" picks out would seem basic to any treatment bestowing on it a position of causal prominence. Unfortunately, most papers on FMTT appear to take for granted that its definitional status is sufficiently well established that explicit explication is unnecessary (most work relies—either explicitly or implicitly—on Tulving's pre-1985 treatment of the construct). Accordingly, before I tackle the relation between episodic memory and FMTT, it would seem prudent to provide an up-to-date treatment of what the term "episodic memory" references.

[1]However, review papers published toward the end the first decade of the 21st century voiced concern over the possibility that episodic exclusivity might be an unnecessary constraint on the memorial underpinnings of FMTT (e.g., Addis & Schacter, 2012; Klein, 2013a; Irish et al., 2012; Kwan et al., 2012). In fact, a considerable number of recent publications (reviewed in Klein, 2013a) provide clear support for Klein, Loftus, and Kihlstrom's (2002) demonstration that semantic memory also underwrites certain forms (mostly nonpersonal) of FMTT.

[2]Theoretical and investigative attention remains largely trained on the contributions of episodic memory to future-oriented thought and behavior—despite increasing evidence for the role played by a range of recently evolved and late-developing cognitive capacities (e.g., systems of knowledge, executive function, scene construction, temporal self-projection, imagination; e.g., Arzy, Collette, Ionata, Fornari, & Blanke, 2009; Craver, Kwan, Steindam, & Rosenbaum, 2014; Irish, Addis, Hodges, & Piguet, 2012; Irish & Piguet, 2013; Kwan et al., 2012; Maguire & Mullally, 2013; Manning, Denkova, & Unterberger, 2013; Mullaley, Vargha-Khadem, & Maguire, 2014; Schacter et al., 2012, Suddendorf, 2010; Zeithamova, Schlichting, & Preston, 2012).

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So, what is episodic memory?

As initially conceptualized, episodic memory was held to provide its owner with a record of the temporal, spatial, and self-referential features of the context in which learning originally transpired. Semantic memory (the other component of the declarative system of long-term memory), by contrast, lacked these features: Its offerings were experienced as knowledge devoid of the contextual elements surrounding its acquisition (e.g., Tulving, 1972, 1983).

An obvious implication of this distinction was that these two types of memory are associated with different temporal phenomenology. Episodic memory, in virtue of its contextual properties, makes it possible for an occurrent mental state to be directly experienced as a re-presentation of events that occurred in one's past. By contrast, the temporal experience associated with semantic memory is restricted to the "here and now": Memorial content is given to awareness as present. Though one can know this content was acquired in the past via an act of inference, a prereflective feeling of reexperiencing the act of acquisition is not part of its given presentation.

These temporal distinctions were fully appreciated by Tulving, and in 1985 he made them the basis for distinguishing between episodic and semantic memory (Tulving, 1985; see also Tulving, 2002, 2005; Wheeler et al., 1997). Focusing attention on the type temporal subjectivity present at retrieval, Tulving proposed that episodic memory is characterized by autonoetic consciousness, while semantic memory entails a form of consciousness he labelled noetic (e.g., Szpunar & Tulving, 2011; Tulving, 1985, 2002, 2005; Wheeler et al., 1997).

Autonoesis, noesis, and mental time travel

Mental time travel refers to the possibility that a first-person perspective can be located at subjective times other than the present. It is manifest in memory when (a) one remembers a past happening as if one were experiencing it again, and (b) in anticipation when one projects oneself into a future experience (for example by imagining what X will be like).

Borrowing terminology from the writings of early twentieth century phenomenologists, Tulving (1985) drew a distinction between two modes of consciousness, which he called autonoetic and noetic (Tulving also identified a mode of consciousness—which he called anoetic—but since it is held to play no role in subjective temporality, it is not discussed herein). A person who possesses autonoetic consciousness "is capable of becoming aware of her own past as well as her own future; she is capable of mental time travel, roaming at will over what has happened as readily as over what might happen, independently of physical laws that govern the universe" (Tulving, 1985, p. 5).

In its role in episodic memory, Tulving described autonoetic consciousness as enabling one to revisit earlier experience, "…a unique awareness of re-experiencing here and now something that happened before, at another time and in another place" (Tulving, 1993, p. 68; for related views see Suddendorf & Corballis, 1997, 2007; Szpunar, 2010; Wheeler et al., 1997). For Tulving, autonoesis is a source of a proprietary phenomenology: "It is autonoetic consciousness that confers the special phenomenal flavor to the remembering of past events, the flavor that distinguishes remembering from other kinds of awareness, such as those characterizing perceiving, thinking, imagining, or dreaming" (Tulving, 1985, p. 3). Importantly for our purposes (see the section, "Autonoetic consciousness is not intrinsic to episodic memory"), autonoesis "does *not* reside in memory traces as such; it emerges as the phenomenally *apprehended* product of the episodic memory system . . . in ways that are as mysterious as the emergence of other kinds of consciousness from brain activity" (Tulving, 2005, p. 17; emphasis added).

Tulving distinguished autonetic from the noetic form of consciousness. Noetic consciousness "allows an organism to be aware of, and to cognitively operate on, objects and events, and relations among objects and events, in the absence of these objects and events" (Tulving, 1985, p. 3). An individual whose memorial experience is noetic

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retrieves information " . . . in the absence of a feeling of re-experiencing the past" (Szpunar, 2010, p. 144).

Thus, noetic consciousness does not provide its owner with a subjective feeling that she or he is mentally traveling back in time to the events and experiences that gave birth to the content in awareness. She or he may infer from subsequent analysis that content given to awareness (e.g., "I know that I saw Jimi Hendrix in concert when I was in High School") refers to the past (e.g., "Although I cannot recollect being at the concert, I know that I was in High School between 1966 and 1970—so I must have seen him in the late 1960s"), or, by logical implication, that the content in awareness must have "come from somewhere" (e.g., "I know that the sun is approximately 93 million miles from earth. I must have learned this fact at some point in my past, though I no longer remember where or when. Most likely in Junior High School"). But these are acts of inference and interpretation contingently joined to the noetic state (provided the individual chooses, or is motivated, to construct such linkage). By contrast, the feeling of subjective time travel is intrinsic to autonoesis—that is, it is prereflectively given, requiring no additional conceptual gymnastics for its realization in awareness.

This is not to say that noesis provides no basis for mental time travel. On the contrary, as Klein, Loftus, et al. (2002) have shown, noetic consciousness enables a form of mental time travel (which the authors called "known time"—i.e., an appreciation of time as chronology) in which temporal knowledge is the product of inferential or interpretive acts, rather than presented directly to awareness (as is the case with autonoesis; for extensive discussion, see Klein, 2014b, in press).

Until recently, noetic forms of mental time travel had received relatively little empirical and theoretical attention. However, in the past 5 years it has become clear that certain forms of mental time travel—particularly ones that enable a person to consider the future chronologically rather than in terms of personal preliving—are enabled noetic consciousness accompanied by interpretive temporal analyses (for recent reviews see Addis & Schacter, 2012; Klein, 2013a).

Thus, of the modes of consciousness identified by Tulving, only autonoesis provides a prereflective feeling of personal temporal experience. It is directly given to awareness and does not require any further considerations or deliberations to justify one's feeling that the content in awareness is connected to the past or future (e.g., Klein, 2013a; Markowitsch, 2003; Tulving, 2005).

With regard to types of declarative long-term memory, autonoetic and noetic consciousness appear isomorphic with the temporal commitments assumed to characterize episodic and semantic memory, respectively (e.g., Klein, 2013a; Markowitsch, 2003; Tulving, 1985, 2002; Wheeler et al., 1997). For present purposes, the crucial point is that FMTT researchers, influenced by the autonoetic properties of episodic recollection, typically have assumed that episodic, not semantic, memory underpins our ability to imagine the future (see the section "The role of episodic memory in contemporary treatments of FMTT"). While recent work suggests that this exclusivity of focus is overly restrictive (e.g., Footnote 1; for reviews see Addis & Schacter, 2012; Klein, 2013a, 2014b), the more fundamental issue is whether episodic memory plays any role in FMTT. In this paper I argue that evidence for such a determinative role largely is lacking. Instead, as I hope to show, a strong case can be made for the proposition that the autonoetic component of episodic memory (rather than episodic memory per se) is the causally relevant player in projection into personal future scenarios.

Autonoesis and episodic memory

The reformulation of episodic and semantic memory in terms of temporal subjectivity avoids a number of messy findings that, over the years, have chipped away at the methodological warrant of relying on the temporal, spatial, and self-referential features of retrieved content to distinguish systems of memory (a practice that continues to characterize memory research). For instance, the contention that episodic, but not

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semantic, memory entails a self-referential component has given way to the well-documented finding that semantic memory also can be self-referential (for reviews see Grilli & Verfaellie, 2014; Klein, 2004; Klein & Lax, 2010; Klein & Loftus, 1993; Renoult, Davidson, Palombo, Moscovich, & Levine, 2012).

In addition, semantic memory is fully capable of providing spatial and temporal information (e.g., "I know that John Lennon was born on 9th October 1940 in Liverpool, UK, although I no longer remember the occasion in which I acquired that knowledge"; for recent reviews see Grilli & Verfaellie, 2014; Klein & Gangi, 2010; Klein & Lax, 2010; Martinelli, Sperduti, & Piolino, 2013). Thus, the core constituents of episodic memory as initially proposed (time, space, and self) also can be found in semantic memory. Accordingly, there are neither logical nor evidential bases for asserting that these systems can be distinguished by analysis of memory content.[3]

This further is demonstrated by cases in which patients congenitally deprived of (or having lost access to) episodic memory, can be taught (or retaught) the temporal, spatial, and self-referential details of their life-narratives—albeit details lacking a feeling of temporally reexperiencing the events and circumstances that they reference (this phenomenological lacuna, of course, assumes that their pathology targets autonoetic consciousness rather than processes mediating the acquisition, storage, or retrieval of acquired content).

For example, patient J.V. suffered neural pathology resulting in the loss of premorbid personal content as well as autonoetic accompaniment, rendering him incapable of engaging in acts of episodic recollection (Stuss & Guzman, 1988). Nonetheless, he successfully relearned many temporal and spatial details of his personal past—although this content was experienced as factual knowledge (which it was!), rather than as a personal reliving. Thus, despite profound episodic impairment, J.V. was able to reacquire his personal narrative via intact semantic memory function.

A similar pattern of lost and relearned personal knowledge is seen in the case of patient M.L. (Levine et al., 1998). A brain trauma left M.L. densely amnesic for episodic memories predating his injury. Despite the severity of impairment, he was able to "relearn significant facts his own past" (Levine et al., 1998, p. 1956). However, that knowledge was not coupled with a feeling of reacquaintance with the act of acquisition. As expected, subsequent testing revealed that M.L.'s autonoetic consciousness was seriously compromised—thus explaining his inability to experientially refer relearned content to its point of origin.

Demonstrations of an intact ability to (re)acquire premorbid personal content in juxtaposition with autonoetic impairment is found scattered throughout the literature (e.g., Bindschaedler, Perer-Faver, Maeder, Hirsbrunner, & Clarke, 2011; Broman, Rose, Hotson, & Casey, 1997; Gadian et al., 2000; Guillery-Girard, Martins, Parisot-Carbuccia, & Eustache, 2004; Markowitsch & Staniloiu, 2013; for a review see Klein, in press). Although in many—though not all—cases, relearned material shows less detail than the original, this difference can be accommodated by consideration of the known effects of time in storage on content detail and specificity (for example, multiple trace theory; e.g., Nadel, Hupbach, Gomez, & Newman-Smith, 2012; Nadel & Moscovitch, 1997; for a related view see Dalla Barba, 2002). Although discussion would take us far afield, the relevance of multiple trace theory (and kindred treatments) to the issues at hand can be found in Klein (2013c).

Given these considerations, a conceptually, empirically, and phenomenologically nuanced

[3]It might be objected that other hallmarks presumed to characterize episodic memory (e.g., complexity and coherence) regularly are found when individuals describe memory experience. However, as is discussed in the sections "The system-neutrality of stored content" and "The causal foundation of FMTT: An argument for autonoesis", there is no rational or evidential basis for the expectation that episodic memory necessarily provides more complex and coherent content than semantic memory. As such, studies attempting to identify the contributions of episodic memory exclusively from an analysis of reported content suffer from the logical error of assuming in advance (e.g., contextual detail = episodic recollection) what they are attempting to demonstrate (e.g., episodic recollection = contextual detail).

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definition of episodic memory can be stated. In its most simple form, episodic memory is a type of mental experience. More precisely, it is not the content of an experience, but the manner in which that content is experienced. That manner entails a special mode of temporal subjectivity—one that provides the experiencer with a phenomenological relation to his or her past not conferred by other forms of memory (these ideas receive fuller treatment in Klein, 2013c, in press).

On this view, episodic memory, though dependent on the integrity of a set of subexperiential processes (encoding, storage, and retrieval), is not their inevitable product. These same processes can give rise to a variety of mental experiences (e.g., thought, imagination, belief, desire, inference, plans, attitudes, hope, fear; for discussion, see Klein, in press). To qualify as an episodic memory, content must be subjected to autonoetic consciousness at retrieval (while it might appear that I am equating retrieval with episodic memory, this would be an incorrect reading. The act of retrieval is largely subexperiential. It is a process whose workings can result in memory, but also can result in nonmemorial states such as belief, thought, desire, and so on. It is the act of conjoining of retrieved content with a particular mode of temporal subjectivity that makes experienced content "memory content").

Episodic memory (i.e., recollection) thus consists in two separate, but mutually dependent, parts. First, to qualify as an act of episodic memory a mental state must be causally linked to experiences that the person formerly enjoyed. Second, episodic memory is not simply from the past; it is a special way of being about the past (e.g., Klein, 2013b). To qualify as an act of memory, the content in awareness must present itself as a reexperience of a previously entertained experience (e.g., Klein, 2013c; Markowitsch, 2003; Tulving, 1985, 2005; Wheeler, 2005; Wheeler et al., 1997). This feeling of reexperiencing is prereflectively given to awareness by a concomitant act of autonoesis at retrieval (for evidence, see the section "Autonoetic consciousness is not intrinsic to episodic memory"), rather than as the product of inference or interpretation (of course, if inference subsequently were to evoke—in some unknown manner—autonoetic accompaniment, the content then would be taken as an act of recollection. By contrast if—as often is the case—inference resulted only in an analytic determination that occurrent content issued from past experience, the experience associated with that content would be noetic—that is, one of knowledge or belief, but not recollection).

In summary, the retrieval of content is not sufficient to make its experience an episodic recollection. To so qualify, content must be joined with a prereflective mode of temporal subjectivity (i.e., autonoesis). A practical extension of this position is that content analysis, absent consideration of the mode of temporality in which content is presented to awareness, does not provide a reliable basis for diagnosing the system of memory from which it issues (see Klein, 2013c, in press, and Footnote 3).

The system-neutrality of stored content

Based on these considerations, the presumption that content can be apportioned into episodic or semantic memory based on analysis of its referential properties and contextual detail is called to question. Specifically, on the view presented, there is no episodic system of memory as traditionally construed (e.g., Foster & Jelicic, 1999; Schacter & Tulving, 1994). Rather, there is learned content that is stored in a system-neutral format and is available at retrieval to a variety of experiential outcomes, only one of which is recollection (e.g., judging, categorizing, deciding, believing, imagining, desiring, intending, planning, thinking, recognizing, searching, navigating, hope, fear). The designation "episodic" meaningfully applies only after content has been conjoined with autonoetic consciousness during an act of retrieval (e.g., Klein, 2013c, in press).

In short, the position taken in this paper (see also Klein, 2013c, in press) is that there is no "episodic content" per se (see the sections under "The role of episodic memory in contemporary treatments of FMTT"). Rather, there is "content" that can be experienced in a mental state referred to as

"episodic" provided that content is juxtaposed (at retrieval; see the section "Autonoetic consciousness is not intrinsic to episodic memory") with autonoetic consciousness. But the same (or very similar) content need not be indicative of episodic memory. For example, experienced content lacking autonoetic accompaniment can be taken as semantic knowledge despite having contextual features and details typically (but mistakenly) assumed diagnostic of episodic recollection (e.g., Klein, 2013c, in press; Klein & Nichols, 2013).

On this view, the predicate "episodic" used in conjunction with a variety of future-oriented thought (e.g., episodic foresight, episodic scene construction, episodic self-projection; see the section "The role of episodic memory in contemporary treatments of FMTT") is of questionable utility. What makes an occurrent mental state episodic (rather than, say, an act of thought or imagination) is that it enables a direct, noninferential feeling of reacquaintance with one's past (e.g., Klein, 2013c, in press; Tulving, 1985, 2002; Wheeler et al., 1997). It does this by linking system-agnostic content with past-oriented autonoetic consciousness during the act of retrieval (e.g., Klein, 2013c, in press).

This decidedly is not the phenomenology naturally associated with mental states involving planning and anticipating (although such phenomenology can be elicited when participants are given instructions to report memorial experience during lab-based investigations of FMTT; e.g., Anderson, 2012; Arnold, McDermott, & Szpunar, 2011). Under nonlaboratory conditions, the aspect of autonoetic consciousness elicited by acts of anticipation and planning often is 180 degrees displaced from that found when one undergoes recollective experience (positioning the person toward what will happen, not what previously transpired; e.g., Boyer, 2009; Klein, 2013b, 2014b; Tulving, 2005). Indeed, as is discussed in the section "Autonoetic consciousness is not intrinsic to episodic memory", it is not clear what adaptive function a temporal orientation toward the past (i.e., that associated with episodic recollection) serves with respect to future-oriented mentation.

THE PROBLEM OF CONCEPTUAL UNDERSPECIFICATION AND THEORY CONSTRUCTION

> If we try to solve a problem by means of a notion that does not apply, we cannot help going wrong. (Descartes, 1970, p. 138)

As Heisenberg (1958/1999, p. 58) sagely observes "What we observe is not nature itself but nature exposed to our method of questioning". From this it follows that, "Asking the right question is frequently more than halfway to the solution of the problem" (Heisenberg, 1958/1999, p. 35).

The scientific method thus construed is more than simply posing questions to nature and waiting for her to "push back". To receive answers possessing the resolution necessary to fine-tune our understanding of the object of inquiry, the questions we ask must be the "right" ones. This requires careful analytic treatment of the issues of interest as well as nuanced consideration of the epistemic warrant of concepts receiving methodological consideration (e.g., Klee, 1997).

As noted in the section "The role of episodic memory in contemporary treatments of FMTT", investigation of the part played by episodic memory in FMTT has exploded over the past 15 years. Most of this work (though there are exceptions; e.g., Klein, 2013a; Maguire & Mullalley, 2013; Schacter et al., 2012; Suddendorf, 2010; Szpunar, 2010) has been characterized by a relatively tight experimental focus—emphasizing such questions as similarities and differences (both cognitive and anatomical) between episodic memory and episodic future thought, the developmental trajectory of our capacity to imagine the future, clinical impairments of this ability, the ability of animals to perform tasks requiring FMTT, and what we can learn about the neural substrates of FMTT from radiological analysis. In contrast, sustained treatment of key theoretical presuppositions (e.g., that reexperiencing of the past is the basis by which we imagine the future) has been left primarily to philosophers (e.g., Byrne, 2010; Cornish, 2011; Hoerl, 2008; Mathen, 2010).

One consequence of this apportioning of labour is that the epistemological warrant of our models of

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FMTT remains underspecified. By offloading the task of detailed conceptual analysis to philosophers—who often lack a full appreciation of the complexity of the empiricism on which they train their analytic skills—theoretical structures are erected largely on the basis of empirical outcomes. In consequence, they often provide inadequate conceptual grounding for the principles they embody (for discussion see Klein, 2013a). Newell summarized the problem more than 40 years ago:

> As I examine the fate of our [empirical efforts], looking at those already in existence as a guide to how they fare and shape the course of science, it seems to me that clarity is never achieved. Matters simply become muddier and muddier as we go down through time. Thus far from providing the rungs of a ladder by which psychology gradually climbs to clarity, this form of conceptual structure leads rather to an ever increasing pile of issues, which we weary of or become diverted from, but never settle. (Newell, 1973, pp. 288–289; brackets added for expositional clarity)

It is my contention that the task of scrutinizing the theoretical precommitments that (often implicitly) guide our investigations of FMTT is (a) an essential, but relatively underappreciated, aspect of the process of formulating the "right" questions to address to nature, and (b) a task that needs to be undertaken by those occupying the experimental trenches—psychological FMTT investigators (clearly, a fully collaborative effort between psychology and philosophy would be ideal).

Rethinking the role of episodic memory in FMTT

In what follows, I focus on an assumption treated as virtually axiomatic in contemporary FMTT research—that is that episodic memory has a special causal potency in regard to future-oriented personal thought. As I hope to show, this assumption is more the product of reasonable stipulation than conceptual analysis.

For example, what adaptive advantage does the experiencing of reliving one's past (i.e., episodic memory) have for constructing future-oriented plans and scenarios? Wouldn't retrieved content known to be from one's past, but lacking a noninferential feeling of having previously been experienced (i.e., semantic memory), be as useful? If not, why not?

As Szpunar and Tulving (2011) argue, it is the autonoetic component of episodic memory that enables a person to travel backward and forward in time (e.g., Szpunar & Tulving, 2011). If that is the case, why not posit autonoesis, rather than episodic memory (which provides the experience of reliving, not preliving), as the causally determinative factor in FMTT?

Drawing on the theoretical considerations presented in the sections under "The role of episodic memory in contemporary treatments of FMTT", I next attempt to show that the connection between episodic memory and FMTT is based more on theoretical precommitments than conceptually and evidentially grounded argument. When such analysis is undertaken, I believe it becomes clear that it is autonoetic consciousness (at least that facet of autonoesis that enables one to imagine a personal future), not episodic memory, that is the causally relevant factor in most forms of FMTT.

THE CAUSAL FOUNDATION OF FMTT: AN ARGUMENT FOR AUTONOESIS

Detecting the footprints of episodic memory from the reported properties of memorial content—a standard tactic of FMTT research—is, as we have seen, fraught with interpretive difficulties (e.g., the section "So, what is episodic memory?"). First, content containing self-referential, temporal, and spatial properties can be associated with episodic and semantic memory (albeit the former is more likely to represent these contextual elements as they were experienced during the act of acquisition).

Second, the coherence and complexity of reported memory content—often employed as an index of episodicity (e.g., Anderson, 2012; Hurley, Maguire, & Vargha-Khadem, 2011; Race et al., 2011; Squire et al., 2010; for a discussion and critique see Arnold et al., 2011)—has neither rational nor empirical justification. While relearned personal histories (e.g., "So, what is episodic

memory?") often—though not invariably—possess fewer details than episodic recollections, content complexity is an unreliable mark of memory status. The content of semantic memory can show considerable intricacy and narrative coherence (for example, knowing the rules for how to behave and what to expect in a restaurant). Conversely, episodic memory can yield content of extreme simplicity (for instance, recollecting a single word from a list; e.g., Gardiner, 2001).

Third, there is no obvious adaptive advantage to retrieving content conjoined with a directly given, prereflective feeling that it references a personal experience from one's past (i.e., episodic memory). Such knowledge can easily be gleaned from temporal markers embodied in the content (e.g., since I know I attended Stanford in the early 1970s, this is must be part of my past; e.g., the case of R.B. see next section) without a need for the additional experience of reliving. In short, it is unclear what part episodic memory (as opposed to content retrieved) plays in the formation of future-oriented plans and scenarios.

Autonoetic consciousness, by contrast, captures a fundamental aspect of the phenomenology associated with mental time travel (e.g., Arnold et al., 2011; Markowitsch & Staniloiu, 2011; Suddendorf, 1994; Szpunar & Tulving, 2011; Tulving, 1985, 2005; Wheeler et al., 1997; for reviews see Markowitsch, 2003; Tulving, 2005; Wheeler, 2005). In this paper I take the position that the enabling factor in FMTT is not the content provided by an act of retrieval, but rather the autonoetic consciousness that accompanies that content (in particular, the facet of autonoesis aimed at the future). While evidentiary grounding provided by stored content may be needed for certain forms of FMTT (reviewed in Klein, 2013a), it never is sufficient. In fact, for some forms of future-oriented mentation it is not required at all (e.g., Klein, 2013d).

Autonoesis, by contrast, is always necessary (at least for projection into a possible personal future; see the section "Autonoesis, noesis, and mental time travel"). Seen in this light, the case can (and will) be made that it is the autonoetic component of episodic memory, not episodic memory per se, that enables one to navigate a personal future. Accordingly, placing episodic memory in determinative juxtaposition with FMTT is an instance of trying "to solve a problem by means of a notion that does not apply". To make this case, however, I first need to show that autonoetic consciousness is a contingent rather than necessary feature of retrieved content.

Autonoetic consciousness is not intrinsic to episodic memory

So, in what does relation between autonoetic consciousness and episodic memory consist? One possibility is that autonoetic consciousness is intrinsic to "episodic content". On this view, episodic memory is the outcome of retrieving autonoetically endowed content. In contrast, a relational interpretation holds that the association between autonoesis and episodic "content" is a matter of contingency (i.e., circumstance) rather than (bio) logical necessity. On this view, the bond between content and autonoesis (resulting in an episodic memory experience) is forged at retrieval.

The available evidence, though not plentiful, favours the relational view—that is, what makes an experience a memory experience is not the nature of the content given to awareness, but the mode of consciousness associated with that content during its retrieval. Consider, for example, the case of patient R.B. (e.g., Klein, 2013b, 2013c; Klein & Nichols, 2013). Following an automotive accident, R.B. exhibited a very rare —though not unique (e.g., Lane, 2012; for review see Klein, 2014a)—memory problem: While fully capable of describing events from his life with the rich contextual detail traditionally associated with episodic recollection, he did not experience this content as episodic memory. Rather, lacking the warmth, intimacy (e.g., James, 1890), and feeling of reliving associated with recollection, it was felt to be known from a third-person perspective. As is seen below, R.B.'s impairment appears to have compromised neither his autonoetic ability (he was not stuck in time and was able to formulate detailed plans) nor stored content (he could produce richly detailed representations of his

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past). Instead, what appear to have come undone were the mechanisms that enable autonoetic consciousness to bond with retrieved content, making possible recollective experience (for discussion see Klein, 2014a).

For example, in response to a request to remember a specific time involving his experiences while a student at Massachusetts Institute of Technology (MIT), R.B. replied:

> When I remember the scene with my friends, studying, I remember myself walking into the room . . . and . . . other things I did and felt [details are recounted]. But it feels like something I didn't experience . . . [like something I] was told about by someone else. It's all quite puzzling.

He continues:

> I can picture the scene perfectly clearly . . . studying with my friends in our study lounge . . . but it has the feeling of imagining . . . like something my parents [might have] described from their college days. It [the memory] not feel like it was something that really had been a part of my life. Intellectually I suppose I never doubted that it was . . . perhaps because there was such continuity of memories that fit a pattern that lead up to the present time. But that in itself did not help change the feeling of [lost] ownership.

Asked to describe childhood memories, R.B. responded:

> I . . . [am] remembering scenes, not facts . . . I am recalling scenes . . . that is . . . I can clearly recall a scene of me at the beach in New London with my family as a child [he then describes the scene in rich contextual detail]. But the feeling is that the scene is not my memory . . . as if I was looking at a photo of someone else's vacation.

Memory of recent events showed a similar dissociation between content and feelings of reliving:

> I remember eating pizza at XXX in Isla Vista about a month before [his accident], but the memory belongs to someone else. But knowing I like pizza in the present . . . now . . . is owned by me . . . when I recall memories from my past I intellectually know they are about me. It just does not feel like it . . . when I remember scenes from before [the accident] they do not feel as if they happened to me—though intellectually I know they did.

R.B.'s memory reports (treated more fully in Klein, 2013c, and Klein & Nichols, 2013) show all the presumed characteristics of episodic recollection, save one important thing—they lack autonoetic accompaniment. They contain detailed temporal, spatial, and self-referential elements that correctly track (all of R.B.'s memories were substantiated by third parties) the manner in which the original learning transpired. What is missing are (a) the feeling that the content present in awareness is a reliving of what previously took place (i.e., recollections), and (b) a nonanalytic confidence that the events remembered actually did take place (for discussion of confidence/certainty and episodic recollection, see Klein, 2014b). Rather, R.B. treated retrieved content as things he simply knew or believed he should know (R.B. reports he relies on inferential processes to decide whether content in awareness could be something he personally experienced). It is important to note that R.B. eventually recovered his ability to conjoin content with autonoetic consciousness, at which time the "same" content now was experienced as a recollection.

While this case stimulates a host of fascinating questions about self and memory (some of which are addressed in Klein, 2012, 2013d, 2014a), the important points for present purposes are (a) autonoetic consciousness is not an intrinsic property of retrieved content (see also Tulving, 2005), (b) content that contains all of the criterial features and richness of detail associated with episodic recollection can be present in awareness, yet not experienced as a personal reliving, and (c) the same (or largely indistinguishable) content can be taken as "inferentially from my past" or "directly from my past" depending on the functional integrity of the mechanisms (presently unknown) that conjoin experienced content and autonoetic consciousness at retrieval.

TAKING STOCK: A BRIEF SYNOPSIS OF EPISODIC MEMORY, AUTONOESIS, AND FMTT

As the evidence presented hopefully makes clear, there is no logical argument or empirical support for the idea that the "who, where, and when" of past experience is unique to episodic memory. While the fact that episodic and semantic memory share properties is not a "death sentence" for partitioning them into distinct categories, it

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highlights the difficulties faced by investigators who rely on "time, place, and self" as the basis for classification. Simply put, these criteria are insufficient to the task for which they (too) frequently have been enlisted.

By contrast, the autonoetic/noetic criterion (and its assessment by "remember/know" tasks; e.g., Gardiner, 2001; Tulving, 1985) captures a fundamental feature of memory phenomenology, providing a rationally sound and empirically grounded means for identifying types of memorial experience. A strong implication of the relational view (see the section "Autonoetic consciousness is not intrinsic to episodic memory") is that prior to (or in the absence of) a concurrent act of autonoesis, retrieved content is system-neutral. Depending on the type of subjective temporality associated with content during retrieval, the same content can be experienced as episodic or semantic memory (for extended discussions see Klein, 2013c, in press). An implication of this view is that, prior to retrieval, content is subjectively atemporal: While it may contain chronological referents—for example, I saw Hendrix when I was in High School—this information is derivative, acquired in virtue of subsequent analysis rather than prereflectively given.

Since some forms of FMTT travel do not require access to previously acquired content (e.g., personal diachronicity; Klein, 2013d), atemporal, system-agnostic content cannot be necessary for FMTT in all its manifestations.[4] However, even when content is required, in the absence of a sense of subjective temporality it is left without temporal compass. In short, it is the future-oriented aspect of autonoetic consciousness, not the act of recollection (i.e., content + past-oriented autonoesis), that serves as the platform from which we project ourselves into a personal future.

AUTONOESIS, NOT EPISODIC MEMORY, ENABLES OUR ABILITY TO TRAVEL INTO THE PERSONAL FUTURE: EMPIRICAL FINDINGS

As I hope to have shown, a variety of theoretical considerations provide traction for the position that autonoetic consciousness—not the episodic memories in which it normally manifests—provides the neurocognitive scaffolding necessary to navigate one's future. More, it is not autonoesis in toto, but rather that aspect that takes the future as its temporal pole.

This is not to imply that episodic memory cannot play any role in FMTT. Rather, it means that episodic memory is not a necessary constituent of most forms of temporal self-projection (e.g., Klein, 2013d) and that the term "episodic", used in reference to future-oriented mentation, does more to obfuscate than illuminate the neurocognitive operations mediating future-oriented imaginings involving the self (Mathen, 2010).

Some support for these ideas comes from a recent study by Klein, Robertson, and Delton (2010). Participants were shown a list of objects (e.g., matches, television) and were asked to decide whether these were objects (a) they remembered taking on a previous camping trip (the "episodic memory" condition; note that participants all were pretested to ensure they had clear recollections of camping), (b) likely to be found on a generic camping trip (the "semantic memory" condition), or (c) they might plan to take in preparation for a future camping excursion (the "FMTT" condition).

While participants in all three conditions identified the same subset of objects as camping-relevant, there were important mnemonic differences—for example, a subsequent test of memory

[4]To fully appreciate the temporal commitments of FMTT and the diversity of its manifestations, one must recognize the difference between temporal experience conceived as a constant flow from future to present to past, with temporal designators continually changing ontological status (e.g., what once was future now is present, what once was present now is past, etc.), and temporal experience as a fixed, earlier–later (or before–after) chronology in which temporal placement of an event is invariant (e.g., 4th April 1982 is, and always will be, prior to 4th April 1983). These two modes of temporal conceptualization are not logically reducible, one to the other (e.g., Loizou, 1986; McTaggart, 1908; for an opposing view, see Cornish, 2011). Moreover, they map reasonably well onto the types of FMTT assumed to depend on autonoetic and noetic consciousness, respectively. Fuller discussion can be found in Klein (2013a) and Klein, Loftus, and Kihlstrom (2002) as well as Dalla Barba (2002).

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for the objects they made decisions about revealed that participants in both the episodic and semantic conditions differed from those in the FMTT condition both in amount and type of items recalled (e.g., the episodic and semantic memory conditions produced statistically equivalent recall, but both recalled significantly fewer items than did participants in the FMTT condition). Additional differences between past (e.g., episodic memory) and future (e.g., episodic foresight) oriented mentation also are discussed at length by Suddendorf (2010).

The finding that a number of observable differences emerge when participants are required either to access episodic memory or to plan for the future shows that episodic recollection and FMTT are not coextensive. Of course, FMTT still may require recollective acts, but its realization may be layered with additional processes that account for the obtained dissimilarities. Accordingly, such results do not constitute a knock-down against an episodic basis for FMTT. However, neither do they offer any support. At best, the findings presented by Klein et al. (2010) sanction the conclusion that, under the experimental conditions utilized, episodic recollection shows greater affinity to semantic processing than to future-oriented processing with regard to measures of retention. Fortunately, findings from individuals suffering impairments of recollective ability provide additional reasons to question the role of episodic memory in FMTT.

Data from patients suffering episodic memory impairment

One useful way to place the constituents of a system (e.g., FMTT) on view is to examine them when the system to which they belong has broken down. A system's constituents—normally masked by the fluid manner in which they work together to affect a common end—are laid bare as the whole of which they are part unravels (e.g., Klein, Rozendal, & Cosmides, 2002; Rosenbaum, Gilboa, & Moscovitch, 2014). Accordingly, in what follows I draw on evidence from individuals suffering impairments of episodic memory and autonoetic consciousness.

A unique perspective on the relation between autonoesis, episodic memory, and FMTT is provided by (rare) occasions in which autonoetic consciousness and mental content remain intact but their ability to bond at retrieval is compromised (for extended discussion, see Chapter 5 of Klein, 2014a). Under these circumstances, the autonoetic model of FMTT predicts that the patient's ability to construct plans for his or her future should remain intact despite the loss of episodic recollective ability (presumably resulting from an inability to forge a connection between autonoetic consciousness and retrieved content).

This is exactly what is found. For example, patient R.B. (see the section "Autonoetic consciousness is not intrinsic to episodic memory") had no difficulty forming highly detailed, often personal, plans (Klein & Nichols, 2013). For instance, R.B. reports:

> During the "un-owned" period I was able to plan for the future. Although my working memory impairment). . . made it challenging. When I slowly returned to work, it was hard to plan a complex strategy. I had to think of useful things to do and then do them. The best compensation I found was to separate the planning of the strategy from the execution. It worked best if I made a list of "Things To Do".

R.B. thus maintained access to content (often self-referential), but this content, broken free of its autonoetic moorings, was unable to be realized as episodic recollection. Nonetheless, due to his intact autonoetic ability, he was capable of constructing personally relevant scenarios to guide future thought and behaviour (although issues with working memory made it a challenge). In R. B. we clearly see the enabling effects of autonoetic consciousness on FMTT in the face of a virtually complete breakdown in recollective experience.

Consider next the case of Zasetsky, a Russian soldier in World War II. As a result of battle, he suffered massive neural damage to areas controlling higher cortical functions such as the analysis, synthesis, and organization of complex associations: He was rendered aphasic, perceptually and proprioceptively disoriented, and hemianopic. Most relevant for present purposes, he also experienced total impairment of both anterograde and retrograde episodic memory function (though he

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maintained some semantic function). Eventually, under the tutelage of Luria and others, Zasetsky slowly and painfully regained a rudimentary ability to read, write, and perform basic bodily functions. Consequently, he was able to provide a record of his thoughts and feelings, eventuating in a book documenting his experiences (Luria, 1972).

Although there are many remarkable aspects of this case study, I focus on one with direct relevance to the topic at hand. Despite monumental episodic memory dysfunction, Zasetsky maintained the ability (and desire) to plan for his personal future. He was aware of his deficits and was greatly troubled by their effects. To address his misfortune, he formulated clear goals to improve his situation and expressed unmistakable motivation to carry them forward. Indeed, it was his intact ability to imagine himself in a better life that gave him the strength to undertake the arduous rehabilitative programme that eventually made it possible for him to regain partial contact with the external world.

In short, though lacking episodic memory, Zasetsky clearly was not stuck in the present. The future was real for him, and he went to considerable efforts to ensure that it would be more congenial than the situation in which he found himself after battle. Here we have another case of an individual who, lacking episodic memory (and, based on Luria's observations, likely to have serious issues with content availability and/or accessibility) nonetheless could orient toward and plan for a personal future by drawing on the meagre cognitive resources he still possessed conjoined with intact future-oriented autonoetic consciousness.

Accessibility to stored content absent autonoetic accompaniment compromises one's ability to imagine and plan for the personal future

Amnesic patient H.M. provides a similar take-away message, albeit for rather different reasons. As a result of a surgical resection of his medial temporal lobes performed in his mid-20s, H.M. was left profoundly amnesic for events experienced following his procedure (e.g., Scoville & Milner, 1957). In contrast to his severe anterograde impairment, memory for events preceding surgery was partially spared. For example, he remembered his father's gun collection in rich detail: "There were pistols —.32, .38, and .44 caliber—and there were at least two rifles, both .22 caliber, one of them fitted with a scope. Behind the house, the field rose into woods and there was no road" (Hilts, 1995, p. 84). H.M. remembers seeing birds—even a pheasant—but not being allowed to use his father's weapons to hunt, except for an occasional squirrel. He fondly remembers keeping his "eyes open" and listening for "chirping noises" that might signal the presence of parentally sanctioned prey. In addition, he could provide memories of hunting and fishing trips made with his father and his own friends.

Although the status of his autonoetic consciousness was not tested, aspects of H.M.'s case suggest that his autonoetic abilities were severely compromised by surgery (although there still is discussion about whether his preserved memories were episodic, the consensus now is that they were the result of his largely intact semantic memory function; e.g., Corkin, 2013; Squire, 2009). For example, in an interview with Hilts (1995), H.M. presents the picture of an individual who is severely disoriented in time:

Hilts:	"How old are you?"
H.M.:	"Well, I don't know."
Hilts:	"How old do you feel?"
H.M.:	"I don't remember the year now . . . I think I am about thirty-three" (he was 50).
Hilts:	"So you feel like you are thirty-three?"
H.M.:	"I feel like I am, but it's sort of a natural deduction." (i.e., an act of inference ratherthan a prereflective sense of subjective temporality).
Hilts:	"How old were you when you had your operation?"
H.M.:	"Gee, I don't know."
Hilts:	"If you were to tell me the date that sounds most likely to you that you had youroperation, what date would you choose?"
H.M.:	"I think of '78, right off" (it was 1953).

Additional conversation leaves little doubt that H. M. lives a subjective existence in which his sense of being a temporal continuant is severely compromised in both chronological directions (e.g., it is not uncommon for him to comment that he feels confined to life in the present; Corkin, 2013).

Thus, despite H.M.'s ability to retrieve some contextually rich content from his past, his lack of autonoetic accompaniment has devastating

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consequences for his capacity to project himself into the future. H.M. can do nothing without specific directions from others. When asked about his ability to anticipate a personal future, he offers that he cannot even imagine "what I should be doing next" (Hilts, 1995, p. 119). As Corkin (2013) observes, H.M. does not make predictions about his future; if pushed to do so he typically fails to respond.

A similar conclusion is reached from examination of the case of patient D.B. (e.g., Klein, Loftus, et al., 2002: Klein, Rozendal, et al., 2002). Following an anoxic episode, D.B. suffered a complete loss of both anterograde and retrograde episodic function. Testing, however, revealed that at least some of this was due to autonoetic impairment (e.g., he was able to accurately recount a few specific incidents from his past, but unable to situate them in the proper temporal context). Testing revealed severe temporal disorientation (e.g., Klein, 2013d; Klein, Rozendal, et al., 2002).

As anticipated, despite preservation of some learned content, D.B. was unable to make any plans for his future. Though he successfully answered questions about impersonal future happenings, this presumably was due to his partially intact knowledge of public events and his preserved understanding of the language of time—for example, the meaning of the words such as "past", "present", and "future" (e.g., Klein, 2013d).

Summary of empirical findings

The take-away message is that patients showing partial or complete loss of episodic function can still navigate a personal future—provided their autonoetic abilities remain intact. In addition, patients showing access to stored content, but unable to associate that content with autonoetic consciousness (as the result of either a loss of autonoetic ability or failure to connect content with autonoesis at retrieval), are unable to imagine themselves in future-oriented scenarios.

In short, while content may be a necessary component for some forms of FMTT (e.g., Klein, 2013a), it is not sufficient to enable a person to escape the confines of the subjective present. Future-oriented personal imaginings require future-oriented autonoetic consciousness. The content to which that mode of consciousness is conjoined may be a necessary condition for some forms of FMTT, but it is never sufficient.

Based on these considerations, it would be interesting to test amnesic patients suffering from impaired access to content (due to pathologies targeting acquisition, storage or retrieval), but possessing intact autonoetic abilities. A direct prediction is that such individuals would show little or no impairment of FMTT (depending, of course, on the extent to which content plays a role in the particular manifestation of FMTT under scrutiny), despite presenting varying degrees of episodic dysfunction.

CONCLUSIONS: THE RELATION BETWEEN EPISODIC MEMORY AND FMTT REVISITED

We now know that mental time travel into the past can be thought to consist in two conceptually distinct and separately measurable processes: "knowing" and "remembering" (e.g., Tulving, 1985). A large number of experiments have shown that these two behavioural measures reflect partially overlapping, but different sets of processes (for a review see Dunn, 2004). These processes typically are associated with noetic and autonoetic consciousness, respectively.

Before these two kinds of ecphory (e.g., Schacter, 1982; Tulving, 1983) were discovered, they almost always were taken to issue from single faculty (often labelled "recognition", though recent evidence suggests "remembering" and "knowing" apply to recall as well; e.g., Rybash, 1999), and numerous theories were woven around that faculty (e.g., Brown, 1976). The analytical and experimental separation of "remembering" (autonoesis) and "knowing" (noesis) has proven quite fruitful (both conceptually and experimentally) and thus can be seen as a step forward in addressing the "right sort" of questions to nature.

In research on FMTT, there has, to date, been no comparable division—although it is easy to

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imagine the conceptual and empirical utility of postulating one. While isolated hints in that direction can be found in the literature (e.g., Arnold et al., 2011; D'Argembeau & Van der Linden, 2004; Klein, 2013a), a sustained treatment of the issue is (to the best of my knowledge) still waiting to make an appearance.

The goal of the present paper was to provide such treatment. To gain traction, I chose to focus on the type of memory most commonly taken to be causally relevant to future-oriented self-projection—that is, episodic. Based on the analyses presented, I conclude that a strong case can be made that it is the autonoetic constituent of episodic memory (in particular, its future-oriented presentation), rather than episodic memory per se (which draws on past-oriented aspects of autonoesis), that constitutes the necessary condition for enabling temporal self-projection into the future.

Clearly, I have not addressed the phenomenon of FMTT in its fullness. For example, as originally theorized by Atance and O'Neill (2001) and empirically captured by Klein, Loftus, et al. (2002), some forms of FMTT (primarily nonpersonal) are based semantic memory—a proposition that, following nearly a decade of empirical neglect, has again assumed scientific respectability. In addition, as discussed by Klein (2013a), Schacter et al., (2012), and Suddendorf, Addis, and Corballis, (2009), among others, different forms of self-projection rely on factors other than (or in addition to) retrieved content. The nature and degree of involvement of FMTT with these factors remain to be more fully addressed.

A question that plagues (or at least should) most empirical treatments of the role of episodic memory in FMTT is "what exactly sanctions this presumed relation?". One commonly held (though seldom voiced) answer is that "episodic content" serves as the foundation on which we construct future-oriented self-projections (e.g., Wheeler et al., 1997). But, as the evidence and arguments offered in this paper suggest, when carefully scrutinized this idea is less than compelling.

Another line of evidence marshalled in support of an episodic/FMTT connection is that these two phenomena share many neural substrates (primarily in the medial temporal lobes: e.g., Addis, Wong, & Schacter, 2007; Arzy, Collette, Ionata, Fornari, & Blanke, 2009; Race et al., 2011; Schacter & Addis, 2007; Verfaellie, Race, & Keane, 2013). This apparently confers a degree of respectability on the hypothesis that episodic memory (somehow) is involved in FMTT.

However, as argument and evidence presented in this paper show, this inference requires more support than a demonstration of neuroanatomical overlap. For example, in what way or ways do these shared structures contribute to episodic memory (which consists in a number of causally determinative constituents; e.g., Klein, German, Cosmides, & Gabriel, 2004)? Are they involved in memory experience? Or do they store the content that subsequently can be recruited by memories (or by other processes) that play a role in FMTT?

Moreover, since memory is an experience, it would seem that for episodic memory to underwrite FMTT, individuals should have recollective experiences while formulating future-oriented scenarios. But, to the best of my knowledge, naturalistic studies of the relation between recollective experience and future-oriented imaginings have yet to be conducted (also see Footnote 1).

Interestingly, radiological analyses and neuroanatomical data suggest that autonoetic consciousness is associated with structures in the frontal, not temporal, lobes (e.g., Abraham, Schubotz, & von Cramon, 2008; Piolino et al., 2007; Tulving & Szpunar, 2012; Wheeler et al., 1997). Finding that separate neural networks are associated with content storage and autonoetic consciousness provides provisional (though far from conclusive) support for the idea that memory is the experienced outcome of temporal processes acting on content (which is assumed to be stored in structures in the temporal lobes: for review see Gabreili, 1998) during retrieval. Although content associated with the medial temporal lobes may eventuate, on retrieval, in a memory experience, the processes that affect this transformation—as might be expected on the basis of the relational model (see the section "Autonoetic consciousness is not intrinsic to episodic memory")—appear to be elsewhere in

the brain (recent work suggests the parietal cortex also may be involved in autonoesis; e.g., Nyberg, Kim, Habib, Levine, & Tulving, 2010).

Clearly much remains in question about the role of memory in FMTT. But this much is clear: It is not sufficient to place the predicate "episodic" in a two-part relation with achievement words (e.g., foresight, simulation, projection) in the absence of careful reflection on exactly what the term "episodic memory" picks out. If our rapidly growing body of empiricism about future-oriented temporality—an ability whose complexity and reach separate us from the remainder of the animal kingdom (e.g., Klein, 2013a; Suddendorf, 2013)—is to attain meaningful direction, a number of challenging issues will require the sustained, critical analysis of front-line researchers.

REFERENCES

Abraham, A., Schubotz, R. I., & von Cramon, Y. (2008). Thinking about the future versus the past in personal and non-personal contexts. *Brain Research*, *1233*, 106–119.

Addis, D. R., Cheng, T., Roberts, R. P., & Schacter, D. L. (2011). Hippocampal contributions to the episodic simulation of specific and general future events. *Hippocampus*, *21*, 1045–1052.

Addis, D. R., & Schacter, D. L. (2012). The hippocampus and imaging the future: Where do we stand? Frontiers in Human Neuroscience, 5, Article 173.

Addis, D. R., Wong, A. T., & Schacter, D. L. (2007). Remembering the past and imagining the future: Common and distinct neural substrates during event construction and elaboration. *Neuropsychologia*, *45*, 1363–1377.

Anderson, R. J. (2012). Imagining novel futures: The roles of event plausibility andfamiliarity. *Memory*, *20*, 443–451.

Arnold, K. M., McDermott, K. B., & Szpunar, K. K. (2011). Individual differences in timeperspective predict autonoetic experience. *Consciousness and Cognition*, *20*, 712–719.

Arzy, S., Collette, S., Ionata, S., Fornari, E., & Blanke, O. (2009). Subjective mental time travel: The functional architecture of projecting the self to the past and future. *European Journal of Neuroscience*, *30*, 2009–2017.

Atance, C. M., & O'Neill, D. K. (2001). Episodic future thinking. *Trends in Cognitive Sciences*, *5*, 533–539.

Attance, C. M., & Sommerville, J. A. (2014). Assessing the role of memory in preschooler'sepisodic performance on episodic foresight tasks. *Memory*, *22*, 118–128.

Bindschaedler, C., Perer-Faver, C., Maeder, P., Hirsbrunner, T., & Clarke, S. (2011). Growing up with bilateral hippocampal atrophy: From childhood to teenage. *Cortex*, *47*, 931–944.

Bischof-Koehler, D. (1985). On the phylogeny of human motivation. In L. H. Eckensberger & E. D. Lnatermann (Eds.), *Emotion and reflexivitaet* (pp. 3–47). Vienna: Urban & Schwarzenberg.

Boyer, P. (2009). What are memories for? Functions of recall in cognition and culture. In P. Boyer & J. V. Wertsch (Eds.), *Memory in mind and culture* (pp. 3–28). Cambridge, UK: Cambridge University Press.

Broman, M., Rose, A. L., Hotson, G., & Casey, C. M. (1997). Severe anterograde amnesia with onset in childhood as a result of anoxic encephalopathy. *Brain*, *120*, 417–433.

Brown, J. (1976). *Recall and recognition*. New York, NY: John Wiley & Sons Ltd.

Bradley, F. H. (1887). Why do we remember forwards and not backwards? *Mind*, *12*, 579–582.

Buckner, R. L., & Carroll, D. C. (2007). Self-projection and the brain. *Trends in Cognitive Sciences*, *11*, 49–57.

Byrne, A. (2010). Recollection, prediction , imagination. *Philosophical Studies*, *148*, 15–26.

Coleman, J. (1992). *Ancient & medieval memories*. New York, NY: CambridgeUniversity Press.

Corkin, S. (2013). *Permanent present tense: The unforgettable life of amnesic patient H. M.* New York, NY: Basic Books.

Cornish, D. (2011). Earlier and later if and only if past, present and future. *Philosophy*, *86*, 41–58.

Cottle, T. J., & Klineberg, S. L. (1974). *The present of things future: Explorations in the human experience of time*. London, UK: Collier Macmillan Publishers.

Craver, C. F., Kwan, D., Steindam, C., & Rosenbaum, R. S. (2014). Individuals with episodic amnesia are not stuck in time. *Neuropsychologia*, *57*, 191–195.

Dalla Barba, G. (2002). *Memory, consciousness and temporality*. Norwell, MA: Kluwer Academic Publishers.

Dalla Barba, G., Cappelletti, J. Y., Signorini, M., & Denes, G. (1997). Confabulation: Remembering another' past, planning ?another' future. *Neurocase*, *3*, 425–436.

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D'Argembeau, A., & van der Linden, M. (2004). Phenomenal characteristics associated withprojecting back into the past and forward into the future: Influence of valence andtemporal distance. *Consciousness and Cognition*, *13*, 844–858.

Descartes, R. (1970). *Philosophical letters*. Oxford, UK: Clarendon Press. (A. Kenny, Ed. and Trans.).

Dunn, J. C. (2004). Remember-know: A matter of confidence. *Psychological Review 111*, 524–542.

Ebbinghaus, H. (1885/1913). *Memory: A contribution to experimental psychology*. New York, NY: Teacher's College, Columbia University. (Translated by H. A. Ruger & C. Bussenius).

Foster, J. K., & Jelicic, M. (1999). *Memory: Systems, process, or function?* New York, NY: Oxford University Press.

Fraisse, P. (1963). *The psychology of time*. London, UK: Harper & Row Publishers.

Gabrieli, J. D. E. (1998). *Cognitive neuroscience of human memory. Annual Review of Psychology*, 49, 87–115.

Gadian, D. G., Aicardi, J., Watkins, K. E., Porter, D. A., Mishkin, M., & Vargha-Khadem, F. (2000). Developmental amnesia associated with early hypoxic-ischaemic injury. *Brain*, *123*, 499–507.

Gardiner, J. M. (2001). Episodic memory and autonoetic consciousness: A first-person approach. *Philosophical Transactions of the Royal Society B*, *356*, 1351–1361.

Grilli, M. D., & Verfaellie, M. (2014). Personal semantic memory: Insights fromneuropsychological research. *Neuropsychologia*, *61*, 56–64.

Guillery-Girard, B., Martins, S., Parisot-Carbuccia, D., & Eustache, F. (2004). Semantic acquisition in childhood amnesic syndrome: A prospective study. *NeuroReport*, *15*, 377–381.

Hassabis, D., & Maguire, E. A. (2007). Deconstructing episodic memory with construction. *Trends in Cognitive Sciences*, *11*, 299–306.

Heisenberg, W. (1958/1999). *Physics and philosophy*. Amherst, NY: Prometheus Books.

Hilts, P. J. (1995). *Memory's ghost: The strange tale of Mr. M*. New York, NY: Simon &Schuster.

Hoerl, C. (2008). On being stuck in time. *Phenomenology and the Cognitive Sciences*, *7*, 485–500.

Hurley, N. C., Maguire, E. A., & Vargha-Khadem, F. (2011). Patient HC with developmental amnesia can construct future scenarios. *Neuropsychologia*, *49*, 3620–3628.

Ingvar, D. H. (1985). "Memory for the future": An essay on the temporal organization ofconscious awareness. *Human Neurobiology*, *4*, 127–136.

Irish, M., Addis, D. R., Hodges, J. R., & Piguet, O. (2012). Considering the role ofsemantic memory in episodic future thinking: Evidence from semantic dementia. *Brain*, *135*, 2178–2191.

Irish, M., & Piguet, O. (2013). The pivotal role of semantic memory in remembering the past and imagining the future. *Frontiers in Behavioral Neuroscience*. doi:10.3389/fnbeh.2013.00027.

James, W. (1890). *Principles of psychology (Vol.1)*. New York, NY: Henry Holt and Company.

Klee, R. (1997). *Introduction to the philosophy of science: Cutting nature at its seams*. New York, NY: Oxford University Press.

Klein, S. B. (2004). The cognitive neuroscience of knowing one's self. In M. A. Gazzaniga (Ed.), *The Cognitive Neurosciences III* (pp. 1007–1089). Cambridge, MA: MIT Press.

Klein, S. B. (2012). The self and its brain. *Social Cognition*, *30*, 474–518.

Klein, S. B. (2013a). The complex act of projecting oneself into the future. *WIREs CognitiveSciences*, *4*, 63–79.

Klein. S. B. (2013b). The temporal orientation of memory: It's time for a change ofdirection. *Journal of Applied Research in Memory and Cognition*, *4*, 222–234.

Klein, S. B. (2013c). Making the case that episodic recollection is attributable to operationsoccurring at retrieval rather than to content stored in a dedicated subsystem of long-term memory. *Frontiers in Behavioral Neuroscience* 7, 3. doi:103389/fnbeh.2013.00003

Klein, S. B. (2013d). Sameness and the self: Philosophical and psychological considerations. *Frontiers in Psychology: Perception Science*. doi:10.3389/fpsyg.2014.00029.

Klein, S. B. (2014a). *The two selves: Metaphysical commitments and functionalindependence*. New York, NY: Oxford University Press.

Klein, S. B. (2014b). Autonoesis and belief in a personal past: An evolutionary theory ofepisodic memory indices. *Review of Philosophy and Psychology*, *5*, 427–447.

Klein, S. B. (in press). What memory is. *WIREs Cognitive Science*.

Klein, S. B., Cosmides, L., Tooby, J., & Chance, S. (2002). Decisions and the evolution of memory: Multiple systems, multiple functions. *Psychological Review*, *109*, 306–329.

Klein, S. B., & Gangi, C. E. (2010). The multiplicity of self: Neuropsychological evidence and its implications for the self as a construct in psychological research.

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The Year in Cognitive Neuroscience 2010: Annals of the New York Academy of Sciences, *1191*, 1–15.

Klein, S. B., German, T. P., Cosmides, L., & Gabriel, R. (2004). A theory of autobiographicalmemory: Necessary components and disorders resulting from their loss. *Social Cognition*, *22*, 460–490.

Klein, S. B., & Lax, M. L. (2010). The unanticipated resilience of trait self-knowledge in the face of neural damage. *Memory*, *18*, 918–948.

Klein, S. B., & Loftus, J. (1993). The mental representation of trait and autobiographicalKnowledge about the self. In T. K. Srull & R. S. Wyer (Eds.), *Advances in social cognition* (Vol. *5*, pp. 1–49). Hillsdale, NJ: Erlbaum.

Klein, S. B., Loftus, J., & Kihlstrom, J. F. (2002). Memory and temporal experience: The effects of episodic memory loss on an amnesic patient's ability to remember the past and imagine the future. *Social Cognition*, *20*, 353–379.

Klein, S. B., & Nichols, S. (2013). Memory and the sense of personal identity. *Mind*, *121*, 677–702.

Klein, S. B., Robertson, T. E., & Delton, A. W. (2010). Facing the future: Memory as anevolved system for planning future acts. *Memory & Cognition*, *38*, 13–22.

Klein, S. B., Rozendal, K., & Cosmides, L. (2002). A social-cognitive neuroscience analysis of the self. *Social Cognition*, *20*, 105–135.

Kwan, D., Craver, C. F., Green, L., Myerson, J., Boyer, P., & Rosenbaum, R. S. (2012). Future decision-making without episodic mental time travel. *Hippocampus*, *22*, 1215–1219.

Lane, T. (2012). Toward an explanatory framework for mental ownership. *Phenomenologyand the Cognitive Sciences*, *11*, 251–286.

Levine, B., Black, E., Cabeza, R., Sinden, M., McIntosh, A. R., Toth, J. P., Tulgin, E., & Stuss, D. T. (1998). Episodic memory and the self in a case of isolated retrograde amnesia. *Brain*, *121*, 1951–1973.

Loizou, A. (1986). *The reality of time*. Aldershot, UK: Gower Publishing Co.

Luria, A. R. (1972). *The man with a shattered world*. Cambridge, MA: Harvard University Press.

Maguire, E. A., & Mullally, S. L. (2013). The hippocampus: A manifesto for change. *Journal of Experimental Psychology: General*, *142*, 1180–1189.

Manning, L., Denkova, E., & Unterberger, L. (2013). Autobiographical significance in past and future public semantic memory: A case-study. *Cortex*, *49*, 2007–2020.

Markowitsch, H. J. (2003). Autonoetic consciousness. In T. Kircher & A. David (Eds.), *Theself in neuroscience and psychiatry* (pp. 180–196). Cambridge, UK: CambridgeUniversity Press.

Markowitsch, H. J., & Staniliou, A. (2011). Memory, autonoetic consciousness, and the self. *Consciousness and Cognition*, *20*, 16–39.

Markowitsch, H. J., & Staniloiu, A. (2013). The impairment of recollection in functional amnesic states. *Cortex*, *49*, 1494–1510.

Martinelli, P., Sperduti, M., & Piolino, P. (2013). Neural substrates of the self- memory system: New insights from a meta-analysis. *Human Brain Mapping*, *34*, 1515–1529.

Mathen, M. (2010). Is memory preservative? *Philosophical Studies*, *148*, 3–14.

McTaggart, J. M. E. (1908). The unreality of time. *Mind*, *68*, 457–484.

Michaelian, K., Klein, S. B., & Szpunar, K. K. (forthcoming) *Seeing the future: Theoretical perspectives on future-oriented mental time travel*. Oxford, UK: Oxford University Press.

Mullaley, S. L., Varga-Khadem, F., & Maguire, E. A. (2014). Scene construction indevelopmental amnesia: An fMRI study. *Neuropsychologia*, *52*, 1–10.

Nadel, L., Hupbach, A., Gomez, R., & Newman-Smith, K. (2012). Memory formation, consolidation and transformation. *Neuroscience and Biobehavioral Reviews*, *36*, 1640–1645.

Nadel, L., & Moscovitch, M. (1997). Memory consolidation, retrograde amnesia and the hippocampal complex. *Current Opinion in Neurobiology*, *7*, 217–227.

Newell, A. (1973). You can't play 20 questions with nature and win: Projective comments on the papers of this symposium. In W. G. Chase (Ed.), *Visual information processing* (pp. 283–308). San Francisco, CA: Academic Press.

Nyberg, L. Kim, A. S. N., Habib, R., Levine, B., & Tulving, E. (2010). Consciousness ofsubjective time in the brain. *Proceedings of the National Academy of Sciences*, *107*, 22356–22359.

Pezzulo, G. (2008). Coordinating with the future: The anticipatory nature of representation. *Minds & Machines*, *18*, 179–225.

Piolino, P., Desgranges, B., Manning, L., North, P., Jokic, C., & Eustache, F. (2007). Autobiographical memory: The sense of recollection and executive functions after severe traumatic brain injury. *Cortex*, *43*, 176–195.

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Race, E., Keane, M. N., Verfaellie, M. (2011). Medial temporal lobe damage causes deficits in episodic memory and episodic future thinking not attributable to deficits in narrative construction. *Journal of Neuroscience*, *31*, 10262–10269.

Renoult, L., Davidson, P. S. R., Palombo, D. J., Moscovitch, M., & Levine, B. (2012). Personal semantics: At the crossroads of semantic and episodic memory. *Trends in Cognitive Sciences*, *16*, 550–558.

Rosenbaum, R. S., Gilboa, A., & Moscovitch, M. (2014). Case studies continue to illuminate the cognitive neuroscience of memory. *Annals of the New York Academy of Sciences*. doi:10.1111/nyas.12467

Rybash, J. (1999). Aging and the autobiographical memory: The long and bumpy road. *Journal of Adult Development*, *6*, 1–10.

Saint Augustine. (1997). *The confessions*. Hyde park, NY: New City Press. (Translated by M. Boulding).

Schacter, D. L. (1982). *The stranger behind the engram: Theories of memory and the science of psychology*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Schacter, D. L., & Addis, D. R. (2007). The cognitive neuroscience of constructive memory: Remembering the past and imagining the future. *Philosophical Transactions of the Royal Society B*, *362*, 773–786.

Schacter, D. L., Addis, D. R., Hassabis, D., Martin, V. C., Spreng, R. N., & Szpunar, K. K. (2012). The future of memory: Remembering, imagining, and the brain. *Neuron*, *76*, 677–694.

Schacter, D. L., Addis, D. R., & Buckner, R. L. (2008). Episodic simulation of future events: Concepts , data, and applications. *Annals of the New York Academy of Science*, *1124*, 39–60.

Scoville, W. B., & Milner, B. (1957). Loss of recent memory after bilateral hippocampallesions. *The Journal of Neurology, Neurosurgery and Psychiatry*, *20*, 11–21.

Sorabji, R. (1972). *Aristotle on memory*. Providence, RI: Brown University Press.

SPSP Annual Convention. (2015, 26–28 February). *Subjective Time & Mental Time Travel*. Long Beach Convention Center, Long Beach, California.

Squire, L. R. (2009). The legacy of patient H. M. for neuroscience. *Neuron*, *61*, 6–9.

Squire, L. R., van der Horst, A. S., McDuff, G. R., Frascino, J. C., Hopkins, R. O., & Maudlin, K. N. (2010). Role of the hippocampus in remembering the past and imagining the future. *Proceedings of the National Academy of Sciences*, *107*, 19044–19048.

Stuss, D. T., & Guzman, D. A. (1988). Severe remote mmeory loss with minimal anterograde amnesia: A clincial note. *Brain and Cognition*, *8*, 21–30.

Suddendorf, T. (1994). The discovery of the fourth dimension: Mental time travel and human evolution. (Master's Thesis). University of Waikato, Hamilton, New Zealand.

Suddendorf, T. (2010). Episodic memory versus episodic foresight: Similarities and differences. *WIREs Cognitive Science*, *1*, 99–107.

Suddendorf, T. (2013). *The gap: The science of what separates us from other animals*. New York, NY: Basic Books.

Suddendorf, T., Addis, D. R., & Corbaillis, M. C. (2009). Mental time travel and theshaping of the mind. *Philosophical Transactions of the Royal Society B*, *364*, 1317–1324.

Suddendorf, T., & Corballis, M. C. (1997). Mental time travel and the evolution of the human mind. *Genetic, Social, and General Psychology Monographs*, *123*, 133–167.

Suddendorf, T., & Corballis, M. C. (2007) The evolution of foresight: What is mental time travel, and is it unique to humans? *Behavioral and Brain Sciences*, *30*, 299–313.

Szpunar, K. K. (2010). Episodic future thought: An emerging concept. *Perspectives on Psychological Science*, *5*, 142–162.

Szpunar, K. K., & McDermott, K. B. (2008). Episodic future thought and its relation to remembering: Evidence from ratings of subjective experience. *Consciousness and Cognition*, *17*, 330–334.

Szpunar, K. K., & Tulving, E. (2011). Varieties of future experience. In M. Bar (Ed.), *Predictions and the brain: Using our past to generate a future* (pp. 3–12). New York, NY: Oxford University Press.

Tulving, E. (1972). Episodic and semantic memory. In E. Tulving & W. Donaldson (Eds.), *Organization of memory* (pp. 381–403). New York: Academic Press.

Tulving, E. (1983). *Elements of episodic memory*. New York: Oxford University Press.

Tulving, E. (1985). Memory and consciousness. *Canadian Psychology/ PsychologieCanadienne*, *26*, 1–12.

Tulving, E. (1993). What is episodic memory? *Current Directions in Psychological Science*, *2*, 67–70.

Tulving, E. (2002). Episodic memory: From mind to brain. *Annual Review of Psychology*, *53*, 1–25.

Tulving, E. (2005). Episodic memory and autonoesis: Uniquely human? In H. S. Terrace & J. Metcalfe (Eds.). *The missing link in cognition: Origins of self-reflective consciousness* (pp. 3–56). Oxford, UK: Oxford University Press.

Tulving, E., & Szpunar, K. K. (2012). Does the future exist? In B. Levine & F. I. M. Craik (Eds.), *Mind and the frontal lobes: Cognition, behavior, and brain imaging* (pp. 248–263). New York, NY: Oxford University Press.

Verfaellie, M., Race, E., & Keane, M. M. (2013). Medial temporal lobe contributions to future thinking: Evidence from neuroimaging and amnesia. *Psychologica Belgica*, *52*, 77–94.

Wheeler, M. A. (2005). Theories of memory and consciousness. In E. Tulving & F. I. M. Craik (Eds.). *The Oxford handbook of memory* (pp. 597–608). Oxford, UK: Oxford University Press.

Wheeler, M. A., Stuss, D. T., & Tulving, E. (1997). Toward a theory of episodic memory: Thefrontal lobes and autonoetic consciousness. *Psychological Bulletin*, *121*, 331–354.

Williams, J. M. C., Ellis, N. C., Tyers, C. Healy, H., Rose, G., & MacLeod, A. K. (1996). The specificity of autobiographical memory and imageability of the future. *Memory & Cognition*, *24*, 116–125.

Zeithamova, D., Schlichting, M. L., & Preston, A. R. (2012). The hippocampus and inferential reasoning: Building memories to navigate the future. *Frontiers in Human Neuroscience*, *6*, 1–14.

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