Episodic autobiographical memories over the course of time: Cognitive, neuropsychological and neuroimaging findings

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A B S T R A C T

The critical attributes of episodic memory are self, autonoetic consciousness and subjectively sensed time. The aim of this paper is to present a theoretical overview of our already published researches into the nature of episodic memory over the course of time. We have developed a new method of assessing autobiographical memory (TEMPart task), which is specially designed to measure these specific aspects, based on the sense of re-experiencing events from across the entire lifespan. Based on our findings of cognitive, neuropsychological and neuroimaging studies, new insights into episodic autobiographical memories are presented, focusing on the effects of age of the subjects interacting with time interval in healthy subjects and lesioned patients. The multifaceted and complex nature of episodic memory is emphasized and it is suggested that mental time travel through subjective time, which allows individuals to re-experience specific past events through a feeling of self-awareness, is the last feature of autobiographical memory to become fully operational in development and the first feature to go in aging and most amnesias. Our findings highlight the critical role of frontotemporal areas in constructive autobiographical memory processes, and especially hippocampus, in re-experiencing episodic details from the recent or more distant past.

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“Yester day evening, as I was taking a solitary walk . . . ; I was roused from my thoughts by the warbling of a thrush perched on the uppermost branch of a birch. At that very instant, its magic notes conjured up images of the family estate . . . suddenly transported back into the past, I gazed once more upon the countryside where I had so often heard the thrush’s song. When I listened to it then, I was as sad as I am now.” (Chateaubriand, Mémoire d'outre tombe [Memoirs from beyond the tomb], 1848)

1. The concept of lifelong episodic autobiographical memory

In previous centuries, philosophers and psychologists regarded memory as a power of the mind responsible for our self-identity (e.g. James, 1890; Locke, 1690). It was a unique property, as illustrated by Théodule Ribot (1881): “I have made the journey from Paris to Brest a hundred times. All these images overlap to form an unclear mass—a single, vague state, if the truth be told. Of all these journeys, only those connected to some important event, be it happy or unfortunate, appear to me as memories: only those that arouse secondary states of consciousness are situated in time.” In the same vein, James (1890) emphasized that “memory requires more than mere dating of a fact in the past. It must be dated in my past. In other words, I must think that I directly experienced its occurrence. It must have that “warmth and intimacy” . . . as characterizing all experiences “appropriated” by the thinker as his own” (volume I, p. 650). This view closely parallels current conceptions of episodic memory, placing an emphasis on the subjective recollective experience and on pastness. The ambition of this paper is to present a theoretical overview into the multifaceted and complex nature of episodic memory emphasizing its temporal complexity, i.e. changes with the age of subjects, interacting with the age of memories, based on our already published researches in terms of cognitive, neuropsychological, and functional neuroimaging approaches.

According to its most recent definition, episodic memory refers to personal events recollected in the context of a particular time and place – the “what”, “where” and “when” – and with some reference to oneself as a participant in the episode (Tulving, 1985, 2001, 2002). With the development of the theory of episodic memory, the essence of this memory system has shifted away from specificity and towards the phenomenal experience of remembering (Brewer, 1996; Baddeley, 2001; Gardiner, 2001; Tulving, 2001,...

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and semantic memory systems are associated with two distinct
tions rely on, but go beyond, the semantic memory system. Episodic
and semantic memory systems are associated with two distinct
states of consciousness: autonoetic and noetic consciousness. Auto-
noetic consciousness, which is a sine qua non of episodic memory,
is defined by a sense of self in time and the mental reliving of sub-
jective experiences arising from the encoding context. Hence, based
on a combination of self, autonoetic consciousness and subjectively
sensed time, episodic memory makes it possible to travel mentally
through subjective time, from present to past, and thus to recol-
lect, one’s own previous experiences via autonoetic consciousness.

The central tenet of this theory therefore revolves around phe-
nomenological re-experiencing and the sense of self in time. The
neutral bases of episodic memory and autonoetic consciousness are
thought to be subserved primarily by the prefrontal cortex, but also
by the medial temporal lobe (Tulving & Markowitsch, 1998; Vargha-
Khadem et al., 1997). By contrast, semantic memory is associated
with noetic consciousness, which denotes the subject’s ability to
be aware of information about the world in the absence of any
remembering, and is subserved by a broad set of neocortical areas
(including frontal, temporal and occipital cortices).

As episodic memory refers to events recollected in the context
of a particular time and place, and with a degree of autobiogra-
phical reference, autobiographical memory (AM) has long been
regarded as being episodic in nature. Moreover, autobiographi-
cal memory gives researchers the opportunity to study episodic
memory using self-relevant material that is more closely related
to the current definition of episodic memory (Tulving, 2001, 2002)
than that used in most standard tests of episodic memory (Piolino,
2008). The latter rarely make a distinction between the differ-
ent components (content and context) of episodic memory and
do not measure very lengthy retention intervals, autobiographical
references or rich phenomenological and idiosyncratic aspects
of memory. Interestingly, the assessment of autobiographical memory
makes it possible to investigate not only the ability to recall
a specific and meaningful personal event, locating it in time and
space, but also the ability to travel back into the past and relive
specific details of that event which distinguish it from any simi-
lar ones. However, as has so often happened in the history of
memory conceptions (Baddley, 2001; Scoville & Milner, 1957),
neuropsychological examinations of patients have proved to be
an additional source of evidence. Drawing on their pioneering
study of the amnesic patient KC, Tulving, Schacter, Mclachlan and
Moscovitch (Tulving, Schacter, Mclachlan, & Moscovitch, 1988; see
Rosenbaum et al., 2005, for a review) were among the first to pro-
pose a clear distinction between the episodic component of AM
(disturbed in KC), containing personal specific events situated in
time and space, and a semantic component (preserved in KC), stor-
ing general knowledge about one’s past, such as the names of
acquaintances, personal addresses, generic events and self-concept
(Tulving, 1993). This study provided evidence that people can gain
mental access to their personal past not only through autonoetic
remembering but also through just knowing. Accordingly, semantic
memory includes not only general information about the world,
but also knowledge about previous personal events and experiences
that one can no longer remember. More recently, Conway, Singer,
and Tagini (2004) claimed that the retrieval of autobiographical
memories depends on a complex, self-driven set of control pro-
cesses and involves the episodic memory system, which contains
event-specific sensory–perceptual–cognitive–affective details, and
the long-term semantic self, which contains more abstract
 autobiographical knowledge (i.e. generic events and conceptual
knowledge). Therefore, autobiographical memory is now rec-
ognized as being multifaceted, containing a body of general
knowledge, as well as unique experiences specific to an individual,
which have been accumulated since childhood, and which allow
him/her to construct a feeling of identity and continuity (Conway
& Pleydell-Pearce, 2000; Piolino, Desgranges, & Eustache, 2000;
Wilson & Ross, 2003). When it comes to the relationship between
self and memory, Tulving’s conception emphasizes the episodic
aspects of the self, defending the role of a phenomenological self in
the construction and maintenance of subjective continuity in time
and personal identity.

The episodic component of AM contains specific personal
events, with phenomenological details situated in time and space
pertaining to one’s self, and presupposes very lengthy retention
intervals. Its essence lies in the autonoetic state of consciousness,
which enables a personal event to be consciously recollected in its
original encoding context and implies mental time travel. Episodic
AMs have several core characteristics: they not only concern
unique, personal events situated in time and space, but also presup-
pose phenomenological details (i.e. perceptual, cognitive, affective
internal contextual details), self-relevance, the conscious recollec-
tion of these events and the rememberer’s personal perspective
(Brewer, 1996). Visual mental imagery and emotional experi-
ence are critical phenomenological characteristics of episodic AM
retrieval. Hence, the subjective sense of remembering almost
invariably involves some sort of visual (Greenberg & Rubin, 2003)
and emotional (Rubin & Berntsen, 2003) re-experiencing of an
event. Unlike episodic AM, the semantic component of AM is char-
acterized by a noetic state of consciousness, in which one is capable
of retrieving general facts about personal events, but not of reex-
periencing specific contexts. Therefore, not all memories that are
autobiographical have an autonoetic character mediated by the
episodic memory system.

One of the most interesting current debates about episodic
memory revolves around whether and how memories change over
time. One of the merits of AM studies is that they have painted
a much more dynamic picture of memory consolidation, storage
and retrieval than strictly “experimental” studies, i.e. those in the
Ebbinghaus tradition. There is a strong body of evidence that,
rather than being only determined by the length of the retention
interval, the distribution of episodic AMs across a long lifespan
reflects the survival of vivid memories from late adolescence and
early adulthood compared with other remote periods – the so-
called reminiscence bump (Rubin, Wetzler, & Nebes, 1986; Rubin
& Schulkind, 1997; Rubin, Rahhal, & Poon, 1998) – which represents
a potent landmark for the current self (Conway & Pleydell-Pearce,
2000), serving to maintain a sense of identity and continuity in the
present. Furthermore, with the passage of time and the repetition
of similar events in the phenomenal experience of remembering real-
world events, there is a shift away from autonoetic consciousness
and towards noetic consciousness, i.e. from episodic to seman-
tic memory (Conway, Gardiner, Perfect, Anderson, & Cohen, 1997;
Robinson & Swanson, 1993). This shift is in line with the idea
that most features of very long-term memories become semantic-
cized over time (Cermak, 1984), becoming a mixture of semantic
knowledge and specific experiences (see also Piolino, Lamidey,
Desgranges, & Eustache, 2007; Westmacott & Moscovitch, 2003 for
an illustration of this concept in the recollection of names of con-
temporary celebrities). The nature of AM retrieval and conscious
experience depends on the ratio of episodic to semantic elements
(see Cabeza & St Jacques, 2007, for a similar view). It has been pos-
tulated that the loss of episodic details and the emergence of a
conceptual organization cause a “Remember-to-Know” shift over
time, as a result of repeated encounters with similar events. It is
worth noting that repetition has been shown to influence autobi-
ographical recollection, whether it be “internal” repetition (thinking
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