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# 1

# Episodic Memory and Autonoesis: Uniquely Human?

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> The mental faculties of man and the lower animals do not differ in kind, although immensely in degree.
>
> C. Darwin, *The Descent of Man*

Among the games that scientists play, one of the best known is virtual tug-of-war. Two teams position themselves at the opposite ends of an imaginary rope that represents a continuum of nature, grab their end of the rope, and try to pull the other team over the center line. If they succeed, which actually seldom happens, they would declare their end of the rope the "truth," and themselves the winners.

One long-lasting virtual tug-of-war has to do with the nature of the similarities and differences between the species, especially those between humans and other animals. The existence of the basic similarities has been accepted by intelligent people ever since Darwin's theory of "descent with modification" survived the harshest scrutiny that any set of scientific ideas has had to face, but the battle over the differences continues unabated. The differences typically have to do with humans and the species that occupy the neighboring branches on the evolutionary tree—sometimes chimpanzees and gorillas, sometimes all "greater apes," sometimes all "nonhuman primates," sometimes even other "nonhuman animals," or simply "brutes," as Darwin called all of them. And the two ends of the rope are called "qualitative" versus "quantitative," or, as Darwin put it, "kind" or "degree."

The contestants at one end of the rope believe that there are no essential differences between humans and the various "others," and that whatever differences may seem to exist are either minor or uninteresting in the broader scheme of things. Those at the other end believe that in addition to many (uninteresting or less interesting) simi-

larities between humans and others, there are some truly fundamental differences, that there indeed may be "gaps." So they keep tugging, without realizing that even when one or the other team seems more successful at a given time, the rope itself remains unchanged.

The contributors to this volume deal with the issue of similarities and differences in the nature of consciousness, or "higher mental faculties," of humans and other animals. Many of them will feel like grabbing one end of the rope rather than the other. In my own case, I take a position that others will want to interpret as revealing a preference for differences in kind. But in this case too, the rope will remain whole.

In this essay, I argue that only human beings possess "autonoetic" episodic memory and the ability to mentally travel into the past and into the future, and that in that sense they are unique. Having thus identified myself with one end of the rope, let me hasten to clarify my position. It is important to note that my essay is not meant as delayed rearguard action in support of the myth of *scala naturae.* It is not a campaign for human superiority. It is meant simply as an acknowledgement of both similarities and differences in animal kingdom, an acknowledgment that sometimes comes hard to life scientists, as it comes hard to those who think only of human uniqueness.

At the outset, it is useful to keep in mind the fact that uniqueness is by no means unique to humans. Every species is unique in the sense that it possesses features and traits that other species do not. Some of these unique features may be more conspicuous than others, and some may be better known than others, but the basic principle remains the same: If there were no differences between Species A and B, they would be the same species.

Scorpions locate their prey by seismic vibrations; bats can catch small insects by echolocation in midflight in the darkness of the night; electric fish can perform comparable feats through electrolocation, in ways that scientists have yet to completely fathom; migrating birds know how to reach destinations thousands of miles away. The list of these and similar kinds of spectacular achievements by creatures of nature can go on and on. But neither such unique features nor many less conspicuous differences rule out the general principle of broad phylogenetic continuity. Equally important, broad phylogenetic continuity does not rule out differences between the species, even those that to an external observer may seem like gaps. Diversity in nature can take many diverse forms.

The scientific question of interest is not whether the human mind is similar to or different from those of other animals. Nor is it whether phylogenetic evolution is continuous or whether there are gaps in it. The answer to both questions is either "neither" or "both," and neither

of these answers is terribly informative. A more appropriate question is how and in what sense are the minds of two species similar and how and in what sense are they different, or, how and in what sense the phylogenetic evolution is continuous and in what sense it is not. In the context of these sorts of questions, it may even be appropriate to speculate, as some contributors to this volume do, how, why, and when the current situation might have come about.

It ought to be completely noncontroversial to say that nonhuman animals are conscious, that they have memory, that they can learn, that they can think, that they know what happens in their world—in brief, that they are "intelligent" (Weiskrantz, 1985). It ought to be equally noncontroversial to say that the consciousness of other species is probably different from ours, that their awareness of the world is different from ours, that they are more skilled at some and less skilled at other forms of behavior than we are, and that in general their intelligence is different from ours. Finally, everybody also knows, of course, that in terms of the ultimate biological criterion, survival, an overwhelming majority of the other species are as capable and successful in their world as we are in ours (Darwin, 1874/1998; Macphail, 1998; Shettleworth, 1998).

It is against the backdrop of these musings—the premises of the argument—that I present the thesis (hypothesis) of this essay: Human beings possess a form of memory (episodic memory) and a form of consciousness (autonoetic consciousness, or "autonoesis") that no other animals do. Thus, the thesis is that these two aspects of the mind are unique in humans, in the sense that the mental capacities that define them do not exist in quite the same full-fledged form in other species. They do not exist in insects, in birds, in mice or rats, in cats or dogs, and not even in gorillas and chimps.

Some see the thesis as representing self-evident truth; others may think of it as woefully misguided; still others view it as little more than idle speculation that cannot possibly get us anywhere. Indeed, it is possible to argue that no essential progress has been made toward resolving the issues involved for more than a hundred years. So why try again? There are at least two reasons. One, much of the previous debate has involved issues that have been formulated too broadly to allow an incisive approach. Narrowing it down may help. Two, today we have a bit more evidence relevant to the issues than was available yesterday. Therefore, it may be worth looking at it again.

In this essay, I narrow the issue down to one kind of consciousness (autonoetic) that characterizes the workings of one kind of memory (episodic), and discuss it in light of the empirical findings that can be seen as pertinent to it. The essay consists of five sections, plus a summary:

1. Thesis: Mental time travel exists in humans only.
2. Theory: This thesis is a part of a more comprehensive story of the human brain/mind, the theory of episodic memory.
3. Data: People exist who are fully competent mentally, who have no episodic memory, yet manage to do quite well in staying alive.
4. Analysis: What we know about episodic memory in animals.
5. Resolution: It is in principle possible to obtain solid evidence for the existence of episodic memory in nonverbal organisms.

## THE THESIS

In 1983, I wrote a book titled *Elements of Episodic Memory*, in which I discussed the possibility that episodic memory is functionally different from other kinds of memory. The book opened with the following paragraph:

> Remembering past events is a universally familiar experience. It is also a uniquely human one. As far as we know, members of no other species possess quite the same ability to experience again now, in a different situation and perhaps in a different form, happenings from the past, and know that the experience refers to an event that occurred in another time and in another place. Other members of the animal kingdom can learn, benefit from experience, acquire the ability to adjust and adapt, to solve problems and make decisions, but they cannot travel back into the past in their own minds. (Tulving, 1983, p. 1)

This paragraph set out, somewhat guardedly and rather fortuitously, of course, the main point of the present chapter—*episodic memory is uniquely human*. Reading it 20 years later, it is not difficult to see that it shows its age—I would not say exactly the same thing now. By and large, however, it does not seem to be terribly out of line.

Back in 1983, the claim about the differences between humans and nonhuman animals was introduced primarily as a device of getting a head start on the formidable task of trying to explain to the reader what the new kind of memory—"episodic memory"—was all about. At the time, the study of human memory was still trying to shake the powerful behaviorist or behavioralist (Leahey, 1987) influences of the past, influences in which the idea of unity of all learning and memory, between and within the species, held a dominant position. The throwaway comment on humans sharing not quite all of their learning and memory capabilities with their furry and feathered cousins was supposed to provide a graphic description of the differences between episodic and other kinds of memory.

The casual reference to "mental time travel" similarly served as a device for distancing episodic from other forms of memory. From the beginning (Tulving, 1972) it had been useful to contrast episodic mem-

ory with what, for historical reasons, was called "semantic" memory. Because semantic memory has many features in common with episodic memory—as we will see in greater detail later in the chapter—it was easy for people not to take any proposed differences seriously. The idea of mental time travel was pressed into service as a device that might help others see the difference: Episodic memory did, whereas semantic memory did not, necessarily involve any such time travel.

Finally, the paragraph mentions, even if somewhat indirectly, an idea about episodic memory that sometimes tends to be overlooked, an idea that turns out to be relevant to the issue of the relation between episodic and "episodic-like" memory (Clayton & Dickinson, 1998; Clayton, Bussey, & Dickinson, 2003). The idea is that a happy owner of episodic memory can think about personal happenings ("what") that took place at another time ("when") and in another place ("where")—that is, thinking in Place P1 about a personal experience in Place P2. The ability to "mentally travel in space" is, as we will see, a property of semantic (declarative) memory and is therefore a precondition for mental travel in time, in keeping with the general idea that episodic memory "grows out of," and represents an extension of, semantic memory (Tulving, 1984). Mental "space travel" (imagining different spatial locations) does not require mental time travel (imagining oneself at different times). The present point is that mental time travel always occurs not only in subjective time but also in mental space, and that the mental space of the remembered past and imagined future may be different from the present space. Individuals with (autonoetic) episodic memory can, if the situation calls for it, think here and now about personal happenings in other places and other times. Therefore, if we ask whether other animals have episodic memory, we ask, among other things, whether they can also do so.

As it turned out, until recently not much fuss was made about what the 1983 paragraph said about episodic memory of other animals. Not only had similar thoughts been expressed by many others, they were peripheral to the main message of the book. Just about the only person who rose to defend the impugned repute of our furry friends was David Olton. He had proposed the distinction between working memory and reference memory (Olton, Becker, & Handelmann, 1979, 1980; Olton & Pappas, 1979), and he suggested that these two parallelled the distinction between episodic and semantic memory (Olton, 1984, 1985). At the time it was easy enough to agree with him, as I did (Tulving, 1983, pp. 118–119). Now, thirty years later, the issues have become a bit more complicated, as they frequently do in living science. Let us consider two relevant points.

First, there is no proof that the thesis is true. Indeed, because of its logical nature, it will always remain impossible to prove its truth. The

thesis is based on the absence of evidence contrary to it, and its relatively smooth integration into a larger picture for which supporting evidence is available. The absence of evidence, as everyone knows, is not evidence for the absence, and that is why more evidence is needed. The fit between the thesis and the larger picture (the theory of episodic memory) can be seen as a part of "more evidence." Science does not progress by proving hypotheses true to begin with; it progresses by proving hypotheses false. In the present case, too, it is possible to prove the hypothesis false. In the final section of the essay, I make a suggestion as to what would constitute evidence that the hypothesis is untenable.

Second, the neuropsychological and developmental findings that I summarize in this chapter are relevant to the argument in at least three senses. First, they help delineate more precisely what the mental faculties are that, according to the thesis, nonhuman animals do not have. Second, they illustrate the procedures used to distinguish between different kinds of learning and memory. If there were no way to separate (autonoetic) episodic memory from other forms of memory, the claim that nonhuman animals do not have it would be hollow. No one has much doubted the usefulness of the concept of episodic memory for classificatory ("bookkeeping") purposes, but there has been considerable resistance to the idea that it represents anything special in biological reality. Nevertheless, steady progress in the accumulation of pertinent evidence makes the claim that only humans have episodic memory more readily tractable. Third, the findings are also relevant insofar as they help support the idea that episodic memory is not necessary (even) for humans. If so, the proposition that it does not exist in other animals is less shocking than it would be otherwise. It also would make more acute the question as to why episodic memory may have evolved.

It is reasonable to assume that episodic memory evolved recently, although there is as yet no way to find out whether the assumption is true and, if so, how recently. Because chimpanzees, our closest relatives on the evolutionary tree, do not have humanlike episodic memory, it makes sense to assume that our common ancestors did not have it either. The alternative possibility, that it had evolved in other species too but was somehow lost in the course of evolution, is difficult to imagine. We will return to this issue presently.

## THEORY: EPISODIC MEMORY AND AUTONOETIC CONSCIOUSNESS

Most readers of this volume know that episodic memory has to do with remembering personally experienced events. But there are variations on the theme. Therefore, before we can undertake the task of evaluating the presence of episodic memory in nonhuman animals,

the concept needs to be sharpened. Just saying that it concerns personal happenings is too vague and leaves too much room for nonfocused debate. We need to be as clear as possible about the kind of memory that I am denying to our feathered and furry friends.

Let us begin with a thumbnail sketch, or definition, of episodic memory. Because definitions do play a role in the study of nature, even in today's dominant Zeitgeist of "exploratory science," and because definitions have a habit of changing, it is helpful to identify definitions in a way that sets them apart from others in their class. This is why I refer to the present definition as "episodic memory—2004":

> Episodic memory is a recently evolved, late developing, and early deteriorating brain/mind (neurocognitive) memory system. It is oriented to the past, more vulnerable than other memory systems to neuronal dysfunction, and probably unique to humans. It makes possible mental time travel through subjective time—past, present, and future. This mental time travel allows one, as an "owner" of episodic memory ("self"), through the medium of autonoetic awareness, to remember one's own previous "thought-about" experiences, as well as to "think about" one's own possible future experiences. The operations of episodic memory require, but go beyond, the semantic memory system. Retrieving information from episodic memory ("remembering") requires the establishment and maintenance of a special mental set, dubbed episodic "retrieval mode." The neural components of episodic memory comprise a widely distributed network of cortical and subcortical brain regions that overlap with and extend beyond the networks subserving other memory systems. The essence of episodic memory lies in the conjunction of three concepts—self, autonoetic awareness, and subjective time.

Note that episodic memory is conceptualized as a (hypothetical) brain/mind (neurocognitive) system, as indeed is semantic memory, mentioned here in passing. The concept of "memory system" as such has been discussed elsewhere (Nadel, 1994; Schacter & Tulving, 1994; Sherry & Schacter, 1987), and attempts to describe episodic memory in system terms have been made previously (Tulving, 1985a, 1998, 2002b; Tulving & Markowitsch, 1998; Wheeler, Stuss, & Tulving, 1997; see also Nyberg et al., 2000).

Given, then, that the term *episodic memory* in this essay refers to the "episodic memory system," it is important to note what the term does not refer to. It does not refer to a particular kind of memory task, or a particular kind of performance measure in a task, or a particular kind of stored information, or a particular kind of phenomenal experience, or to any alternative sense in which it sometimes appears in the contemporary literature. All these other senses are related to episodic memory, but they are not identical with it (Tulving, 2000). A great deal of confusion and futile debate can be avoided by keeping the distinction between episodic memory and related terms firmly in mind.

Like all other systems, episodic memory consists of a number of interacting neural and cognitive components which together are capable of operating in a manner that the same components in isolation, or in different combinations, cannot. Like all other neurocognitive systems, it is complex and not easily summarized in a few words. It is defined in terms of criteria such as the system's function—what the system does, how it works, the kind of "information" that it deals with, its relations to other systems, and its neural substrates (Schacter & Tulving, 1994; Schacter, Wagner, & Buckner, 2000; for a different conceptualization of memory systems, see Eichenbaum, 2000; Gaffan, 2001). Convergent dissociations, observed across tasks or subjects, play an important role in the identification of the properties of a memory system (Nyberg & Tulving, 1997), but they are not the only features of the definition.

An alternative to the classification of memory in terms of multiple systems is classification in terms of "kinds" (or "varieties") of memory (Roediger, Marsh, & Lee, 2002). The concept of "kinds" of memory, as dealt with by Roediger and his colleagues, is not the same as the concept of memory "systems" (Schacter & Tulving, 1994). For example, Roediger and his colleagues discuss episodic memory, as one of the different "kinds" of memory, primarily in terms of retention performance of healthy adults in experiments involving verbal to-be-remembered materials. In their conceptualization of episodic memory, it would be difficult to raise coherent questions about episodic memory's existence in animals, or to claim that animals do not have it.

### Properties of Episodic Memory

Because the search for the identity of the constituent components of episodic memory has barely begun, not much is yet known about these components. An initial step in the appropriate direction, however, has been taken in the form of postulation of certain "functional properties" of episodic memory. An early, not completely successful attempt at such a formulation was made in Tulving (1983, table 3.1), at a time when few research findings were available to distinguish between episodic and other varieties of memory.

A somewhat more (empirically) disciplined list of the properties, or features, of episodic and semantic memory systems, modified from Wheeler et al. (1997), Tulving and Markowitsch (1998), and Griffiths, Dickinson, and Clayton (1999), is presented in table 1.1. The list consists of a number of key terms or brief phrases, each of which could be greatly extended. It is organized into two sublists.

Both sublists are necessary to convey the full scope of episodic memory. The sublist on the left gives the properties of episodic memory that it has in common with semantic memory, whereas the sublist

**Table 1.1 Features of Episodic Memory**

| Semantic/Episodic Memory—Common Features | Episodic Memory—Unique Features |
|---|---|
| • Key function: Knowing—Registering, storing, and using sharable knowledge of the world<br>• Multimodal input<br>• Transmodal storage<br>• Fast encoding operations—single-trial learning possible<br>• Large, complex, highly structured storage<br>• Stored information is representational—isomorphic with what is, or could be, in the world<br>• Stored information is propositionalizable<br>• Stored information has truth value<br>• Stored information can be used as a basis of inferences<br>• Information processing is highly sensitive to context<br>• Stored information can be accessed flexibly<br>• Stored information is expressed symbolically<br>• System is cognitive—contents can be thought about<br>• Behavioral expression is optional and not obligatory<br>• Operations do not require awareness of time<br>• Operations accompanied by noetic conscious awareness<br>• System interacts closely with other neurocognitive systems, such as those involved in language, affect, and reasoning<br>• Dependent on widely distributed cortical and subcortical neural networks, including temporal lobe and diencephalic structures<br>• Present in a wide range of animals; highly evolved in mammals and birds | • Key function: Remembering—Conscious awareness of happenings in subjective time (chronesthesia)<br>• Makes possible mental time travel in both temporal directions, past and future<br>• Operations accompanied by autonoetic conscious awareness<br>• Operations depend on a remembering self<br>• More recently evolved than other memory systems<br>• Ontogenetic development lags behind other memory systems<br>• More vulnerable to disease, injury, and aging<br>• Operations require the establishment and maintenance of a special neurocognitive set—episodic retrieval mode<br>• Operations depend on semantic memory<br>• Episodic remembering implies semantic knowing, but semantic knowing does not imply remembering<br>• Dependent on prefrontal cortex and other neocortical regions in a way that other systems are not<br>• Probably unique to humans |

on the right gives "unique" properties of episodic memory, properties shared neither by semantic memory nor by any other memory system. The (partial) overlap between the properties of episodic and semantic memory reflects the idea that episodic memory evolved "out of" semantic memory (Tulving, 1984).

The two sublists imply that it is possible to define episodic memory broadly or narrowly. The broad definition comprises all the properties listed in table 1.1, both those on the left and those on the right. The narrow definition includes only the properties listed on the right.

The thumbnail sketch of "episodic memory—2004" presented earlier corresponds to the narrow definition. It is important to note that the thesis of this essay also applies only to the narrow ("unique") definition of episodic memory. It does not apply to the properties that episodic memory shares with semantic memory. Quite to the contrary, the shared properties, those that define semantic memory, do very well in describing learning and memory capacities possessed by many animals, including birds and mammals. Indeed, an important part of the argument here is that many behavioral feats in nonhuman animals that tend to be attributed to humanlike episodic memory are, according to theory, manifestations of a highly complex and powerful memory system, namely semantic (or declarative) memory.

It has been suggested elsewhere (Tulving & Markowitsch, 1998) that "declarative memory" (Squire, 1992; see also Squire & Kandel, 1999) can be thought of as representing features common to episodic and semantic memory, that is, features listed on the left in table 1.1. Defined along these lines, semantic (declarative) memory is a large, complex, multimodal system capable of fast ("single-trial") encoding operations. Information that it handles is representational and can be, even if it need not be, described in propositional format. The representational information has truth value: it corresponds to objects, events, relations, and states of the world. The information is accessible and expressible flexibly, that is, through different input and output routes, and it can serve as a basis of inferences about other objects, events, relations, and states of the world, those that may not have been directly experienced. The operations of semantic (declarative) memory are cognitive (not rigidly tied to behavior) and sensitive to context.

These characteristics of semantic (declarative) memory fit reasonably closely descriptions of declarative memory in the literature (Cohen, Poldrack, & Eichenbaum, 1997; Eichenbaum, 1997; Knowlton & Squire, 1995; Squire, 1987).

It is important to note that neither semantic nor episodic memory as defined here depends on language or any other symbol system for its operations, although both systems in humans can greatly benefit from language. "Semantic memory" is a designation that is what it is for purely historical reasons; a more fitting term for it is "knowledge

of the world." Language may have played an important role in the evolution (or coevolution) of human semantic memory, and probably even more so in the evolution of episodic memory, and it can greatly facilitate the operations of memory and learning systems, but it is not necessary for such operations.

### Relations Between Episodic and Semantic Memory

The two sublists of table 1.1 not only distinguish between two definitions of episodic memory, broad and narrow, they also help describe the relation between episodic and semantic memory. The thumbnail sketch earlier said that "the operations of episodic memory require, but go beyond, the semantic memory system." We can now say that episodic memory represents an extension of semantic memory, both in terms of its emergence in the course of evolution and in terms of its operations. This kind of relation between the two systems, initially sketched in terms of the "embeddedness" hypothesis (Tulving, 1984, p. 260), was later reformulated as the serial parallel independent (SPI) model (Tulving, 1993a, 1995).

The structure of the SPI model reflects the assumed sequence of the two kinds of memory in both phylogenetic evolution and ontogenetic development: semantic memory precedes episodic memory (Nelson, 1993, see also chapter 4, this volume; Perner & Ruffman, 1995; Suddendorf & Corballis, 1997; Wheeler et al., 1997). The importance of this feature of the model lies in the fact that it allows those organisms that have no episodic memory to acquire knowledge of the world, but it rules out acquisition of episodic information without semantic memory. That is, episodic memory is not necessary for the operation of any other memory and learning system. This is why nonhuman animals can do perfectly well without episodic memory.

The functional relations between episodic and semantic memory in the SPI model are process-specific, that is, the relations depend on the processes. Encoding processes are organized serially (S), storage processes in parallel (P), and retrieval processes in the two systems are independent (I). The seriality of encoding of information "into" episodic memory means that the information must be first processed in semantic memory and that, therefore, impairments of semantic memory have consequences for the operations of episodic memory. However, episodic memory is not required for encoding information into semantic memory: organisms with impaired or totally missing episodic memory (nonhuman animals, young children, some brain-damaged patients) are capable of acquiring (complex) knowledge about the world even if they cannot remember (autonoetically recollect) anything of their own past lives. In other words, seriality of encoding implies that only single dissociations are possible in encoding (Tulving, 1995). Parallellity of storage means that corresponding infor-

mation may be stored in both systems. And independence of retrieval means that stored information can be retrieved from one system or the other system, or both, thus allowing for both single and double dissociations between retrieval of episodic and semantic information (for more details on SPI, see Tulving, 2001a).

### Uniqueness of Episodic Memory

The features listed in the right-hand column in table 1.1 define the uniqueness of episodic memory. Four of them can be thought of as being central: (1) episodic memory's function, namely that of mental time travel, or "remembering"; (2) episodic memory's dependence on a remembering "self"; (3) the expression of such remembering through the self's autonoetic consciousness, or autonoesis; and (4) episodic memory's relation to subjectively apprehended time, or "chronesthesia" (Tulving, 2002a).

First, episodic memory's function is to enable mental time travel or remembering, that is, to make it possible for the rememberer to travel back in his or her mind to an earlier occasion or situation in the rememberer's life, and to mentally relive the experienced and thought-about happenings. Semantic memory cannot do so, at least not with a comparable efficacy. Episodic memory allows the individual to remember now, at Time 2, something about what happened at an earlier Time 1, as well as know what happened. Because the output of episodic memory can serve as an input into semantic as well as episodic memory, the remembering individuals can also know what happened on an occasion, even if they do not remember the happening or the occasion.

Only individuals who have episodic memory are capable of remembering past events, in the sense of mental time travel. Other cognitive memory systems may provide access to the past, including one's personal past, but they do so in the absence of autonoesis. For example, both healthy people and those with certain kinds of brain damage can recite autobiographical facts about themselves without necessarily remembering anything. Amnesic patients can tell stories about themselves that have to do with the past, but in doing so they rely on semantic memory ("personal semantic memory" as suggested by Cermak & O'Connor, 1983).

Sherry and Schacter (1987) have proposed that new memory systems evolve when existing systems cannot satisfy the adaptive needs of the organism. The proposal that episodic memory evolved to serve a function not served by other systems, including semantic memory, fits well into Sherry and Schacter's scheme.

Second, episodic memory differs from other kinds of memory in that its operations require a self. It is the self that engages in the mental activity that is referred to as mental time travel: there can be no

travel without a traveler. If it is not self that does the traveling, then who, or what? "Self" and "self-awareness" are among those terms that are indispensable for discussing phenomena of the mind, yet have many meanings that are difficult to define and explicate (Kircher & Leube, 2003). We can think of self as the traveler who engages in mental time travel. Like other components of the system that is episodic memory, self too is defined in terms of its properties, and in terms of its relations to other components of the system.

Some thinkers prefer a philosophical framework for the scientific approach to mental life in which the phenomena to be explained are expressions of processes, but in which the entities that do the processing (agents) are not permitted. Thus, thinking occurs without thinkers, knowing without knowers, and consciousness without anyone being conscious. The idea is to avoid using structural terminology, because it is not fashionable these days. Besides, "self" sounds like the dreaded homunculus that needs to be exorcised by all means possible (Noelle, 2001). But until such time that we have better ways of explaining the phenomenal existences of things such as pain, smell, and recollection of the past, we need an agent such as self for the sake of the completeness of the story (theory). Eventually, self may turn out like phlogiston or aether—a convenient temporary prop. But the problem today is that the story of the mind is incomplete and awkward to tell if a concept like "self" is omitted from it. This is why it should not be exorcised yet.

Third, the conscious awareness that characterizes remembering is different from other forms of conscious awareness, and different in an unmistakable manner. When you remember an event, however vaguely, you are aware that the present experience is related to the past experience in a way that no other kind of experience is. You do not confuse it with perceiving, or imagining, or dreaming, or hallucinating, or having thoughts about what is or could be in the world. In order to be able to refer to the kind of conscious awareness that characterizes episodic remembering, the term "autonoetic consciousness" has been proposed (Tulving, 1985b; Wheeler et al., 1997). The term "autonoesis" was introduced later as a (shorter) synonym for "autonoetic consciousness" (Tulving, 2001b). Autonoesis refers to the kind of conscious awareness that characterizes conscious recollection of personal happenings. It refers to what William James (1890) probably had in mind when he talked about the "warmth and intimacy" of remembering one's past experiences. (The relation between consciousness and awareness is discussed in Tulving, 1993c; for a somewhat different conceptualization of consciousness and awareness, see Chalmers, 1996, especially pp. 28–29.)

Many organisms without episodic memory possess a highly functional semantic memory. Retrieval (use) of information from semantic

memory occurs whenever an organism thinks about, or mentally represents, something that exists or could exist in the world. Such retrieval ("knowing") is accompanied by a form of conscious awareness that I refer to as noetic awareness. Both people and animals are fully capable of knowing things about the world, including things that occurred in their own past. The essential difference is between knowing that something is such and such, or occurs so and so, on the one hand, and remembering that one had a particular experience (witnessed, or felt, or thought something) in a particular place at a particular time. Neither the knowledge of the facts nor the experiencing of past events needs to be complete or accurate in any sense, of course. Nor is it necessary to assume that the distinction between knowing and remembering is always sharp. In real life, many thoughts a person has may have elements contributed by both the semantic memory (knowing) system and the episodic memory (remembering) system.

### Episodic Memory, Autonoesis, and Time

The fourth central feature of episodic memory, and most relevant in the present context, has to do with episodic memory's unique relation to time. Unlike all other forms of biological memory, or memory systems, episodic memory is oriented to time. All other forms of memory operate in time, as does everything else in life, but only episodic memory allows people to consciously reexperience past experiences. Its special relationship to time is neither widely known nor adequately appreciated. Most people naturally associate all kinds of memory with the past and are surprised to learn that this is not so.

Episodic remembering is oriented to the past. When William James (1890) and Henri Bergson (1911) wrote about the "pastness" of memory, they had in mind what we now refer to as episodic memory, even if they did not use the term. At the time, there was no need for it, because what writers meant by "memory" referred either to episodic memory or to the combination of episodic and semantic memory, that is, declarative memory (Squire & Kandel, 1999). Note that Bennett Schwartz, in chapter 9 in this volume, uses the term "palinscopy" to refer to the same idea of "pastness."

The time in which episodic memory operates is the same in which all physical and biological events occur, physical time. But the time in which remembered events occur is different. We can call it subjective time. It is related to but not identical with physical time. The relation between physical time and subjective time is analogous to the relation between the physically present stimulus energy and the psychologically experienced awareness of the corresponding aspects of this energy, as studied in the venerable science of psychophysics. A falling tree in the forest will produce a physical disturbance in the air even if no living thing is nearby, but it produces a sound only if a living

thing hears it. Sound exists as surely as do moving air molecules, but it exists solely by virtue of the interaction between the moving air molecules and brains equipped with auditory systems. The same is true of subjective time—it too exists, but only by virtue of the interaction between physical time and the part of the brain/mind that we call (autonoetic) episodic memory.

Philosophers and others (Dalla Barba, 2000, 2001) sometimes write about the "paradox" that phenomenal experience of pastness emerges from an aftereffect of the past (engram, or memory trace) that itself exists in the present. How is this possible, they wonder? How is it possible for what was to be present in what is?

From the perspective of episodic theory, there are two points to be made about the paradox. First, it exists, or may appear to exist, only for episodic memory. Because there is no pastness in any other memory system in humans, and no pastness in any memory system in all other creatures, the paradox, even if it were "real" otherwise, would not be a paradox of memory in general. Second, human episodic pastness does not reside in memory traces as such; it emerges as the phenomenally apprehended product of the episodic memory system, autonoetic consciousness, in ways that are as mysterious as the emergence of other kinds of consciousness from brain activity. Dalla Barba (2000, 2001) similarly attributes the feeling of pastness to a special kind of "temporal consciousness."

### Autonoetic Future

Subjective time not only covers the past; it also extends into the future. The forward-looking sense of subjective time, or "proscopic chronesthesia" (Tulving, 2002a), is especially noteworthy, because it represents a key feature of autonoesis, which plays such an important role in the human condition. Anticipation of, thinking about, and explicitly or implicitly preparing and planning for the personal future seems to be a thoroughly quintessential human activity. It pervades an individual's daily life, from early in the morning till late at night, as it pervades his or her entire life course, from childhood to old age. If we retained all our other marvelous mental capacities but lost the awareness of the future time in which our lives are going to be played out, we might still be radically different from other animals, but we would no longer be human as we understand humanness.

This remarkable ability of humans to be aware of our own future has already been subjected to thought and study (Atance & O'Neill, 2001; Clayton et al., 2003; Haith, 1997; Haith, Benson, Roberts, & Pennington, 1994; Ingvar, 1985; Klein, Loftus, & Kihlstrom, 2002; Suddendorf & Corballis, 1997), but nowhere yet near to the extent that it deserves. A major stumbling block in this study might have been the absence of a clear conceptual distinction between future-oriented be-

havior and future-oriented thought (cognition). Frequently, the two have been treated as directly related, future-oriented behavior being seen as based on and reflecting future-related thought. Although such concordance between behavior and cognition, and behavior and consciousness, undoubtedly occurs, it does not follow that it always occurs. It is quite possible to imagine that some (even highly complex) future-related behaviors, or behaviors that can be seen as such, occur quite independently of any deliberate conscious activity. As in many other instances of apparent concordance between behavior and cognition, the question about the nature of the relation between behavior and thought will have to be answered on the basis of empirical study; it cannot be solved by assumption (Tulving, 1989a).

Semantic memory, as defined by the features listed in the left-hand column of table 1.1, cannot serve the same function of remembering, in the sense of mental time travel, as does episodic memory. Unlike episodic memory, semantic memory has no special relation to time. Indeed, as already stated, and popular misconceptions notwithstanding, no kind of memory other than episodic has any special relation to time. Semantic memory allows the individual to *know,* at Time 2, something about what happened at an earlier time, Time 1, but it does not allow the individual to *remember* what happened. Semantic memory also allows an individual to construct possible future worlds, but since it is lacking autonoetic capability, it would not allow the individual to mentally travel into his own personal future.

Those without episodic memory can learn, retain what they have learned, make use of what they have retained—and thus they have memory in this sense—but they cannot remember. An event happens and is registered at Time 1 that may have consequences for behavior or cognition at a subsequent Time 2. But this temporal sequence of stages of knowledge acquisition is in no way special to memory. Temporal sequencing of this kind does not distinguish semantic memory from other temporal cause-and-effect sequences in, say, eating a meal, or being vaccinated against malaria, or growing old as one goes through life. There is no need whatsoever for any temporal marker to be attached to and retained about the learned facts of the world. The facts can be put to good use by the owner of a semantic memory system regardless of whether episodic memory is functional or not. It is crucial to distinguish between the consequences of an experienced event and the remembering of the experienced event (Lockhart, 1984).

### Darwin's Moral Beings

When Charles Darwin contemplated the differences in mental characteristics of his subjects in *Descent of Man,* he did make an exception in his insistence on total continuity otherwise:

> A moral being is one who is capable of reflecting on his past actions and their motives—of approving of some and disapproving of others; and the fact that man is the one being who certainly deserves this designation, is the greatest of all distinctions between him and the lower animals. (Darwin, 1874/1998, p. 633)

Darwin's additional writing provides a rather detailed description of what he conceives of as a moral being. Interestingly, this description includes features of such a being that correspond to some of the central features of episodic memory: (1) conscious reflection, (2) self, (3) personal past, and (4) ethical judgment. Thus we see that Darwin anticipated, implicitly at least, the idea that nonhuman animals do not have what we now call autonoetic consciousness. Indeed, by adding man's "ethical aspects" to the equation, he goes beyond it.

It is especially instructive to note that Darwin's moral beings were concerned about the future. This means, by our theory, that they must have had autonoetic consciousness. This raises the question: Can one be a moral being in the absence of autonoesis?

I have to leave the exercise of determining the nature of the relation between autonoesis and moral judgment to others, although at first glance it does not seem to be unreasonable to think of autonoesis as a necessary condition for moral judgment, rather than vice versa. If this is so, then the inability of Darwin's "beasts," like that of very young children, to differentiate right from wrong has its roots in their lack of ability to mentally travel into their own personal futures. Darwin's position on human uniqueness also covers the major properties of Metcalfe and Kober's concept of projectable self—the sensing, imagining, willing, and doubting self (chapter 2, this volume).

### Why Did Episodic Memory Evolve?

Why did autonoetic consciousness and episodic memory emerge in the process of evolution? Wherein lies their evolutionary payoff? What can organisms with autonoetic consciousness do that organisms without it cannot?

Robert Hampton, a contributor to this volume, and a researcher on the opposite end of the rope, put these very questions to me in e-mail correspondence some time ago:

> Thus I would like to know what the possession of episodic memory does for an individual. What additional capacity is provided when one has episodic memory? This needs to go beyond the mere ability to report "I remember that happening to me. My experience of this memory is distinct from others." In other words, what can an animal with episodic memory do that gives it an evolutionary advantage over an animal without episodic memory? Having different covert experiences by itself cannot lead to selection for episodic memory. These experiences need to be turned into adap-

> tive behavior if one can specify what that adaptive behavior is—what an animal with episodic memory can do that another cannot—then one can do an experiment to test for that capacity. (Personal communication, July 2, 2002)

Questions of this kind—why did X evolve—of course are difficult to answer in any case, but when asked about mental capabilities, which do not leave any fossils, answering them becomes essentially impossible, and one can only speculate.

One possible story begins with the assumption that the common ancestors that the species that eventually became *Homo sapiens* shared with what became living pongids, some 5 or 6 million years ago, possessed capabilities that we now identify with semantic memory, but they did not possess episodic memory. Episodic memory emerged, presumably gradually, in the course of human evolution. It may have grown out of a gradual extension of the human mental reach farther and farther back into subjectively apprehended past, perhaps as a sort of temporal stretching of the duration of the subjectively experienced here and now. There are clear evolutionary advantages to being consciously aware not only of what is happening here and now, but also of what happened 5 seconds ago, 10 seconds, a minute, 10 minutes, an hour, a day ago, even if the dimness of such awareness increased monotonically with the retention interval. A special evolutionary leap may have been necessary to produce brains that were capable of bridging the remembering across the diurnal divide. But these unfathomable specifics aside, it is a fact that humans somehow acquired the ability to remember their experienced past, in addition to the earlier acquired skill of knowing of things in the present.

Along with such an expansion of the subjective time horizon toward the past in remembering occurred a similar, even if possibly more muted, expansion toward the future. Once the brain "discovered" the trick of representing subjective time and making access to it available to the evolving self, through similarly evolving autonoetic consciousness, our distant forbears came to live with the capability of awareness of subjective time in which they and their group existed, their ancestors had existed, and their children and their children were going to exist.

### Evolutionary Payoff: Awareness of the Future

The truly momentous development was the emergence of autonoesis that allowed individuals to imagine and worry about their own future, because it brought with it a radical shift in humans' relation to nature. Instead of using their wits to adjust to the vagaries of nature, including the uncertainties of availability of food, shelter, and protection from predators, humans began to anticipate these problems and take steps to mitigate their unpredictability.

Other early expressions of future-oriented thought and planning consisted of learning to use, preserve, and then make fire, to make tools, and then to store and carry these with them. Furnishing the dead with grave goods; growing their own crops, fruits, and vegetables; domesticating animals as sources of food and clothing; creating the spirit world and endowing its inhabitants with powers that explained otherwise unexplainable natural phenomena, and then inventing ways of placating the spirits through rituals and other proper ways of behavior—these all represent relatively recent developments in human evolution. Every single one is predicated on the awareness of the future.

Future-oriented (proscopic) time sense (chronesthesia) was only one of the necessary conditions that had to be simultaneously satisfied for human culture and civilization to come into being and then to proceed and flourish. But, at least according to the results of the thought experiments that I mentioned, the requirement for autonoetic awareness of the future is one of the more stringent ones.

Hampton (personal communication, July 2, 2002) is right in suggesting that if inner thoughts always remain inner thoughts, that is, if they do not affect behavior, they will die with the one who thinks them. They need to be translated into action to make any difference in the world. The question therefore is, what kinds of inner thoughts, or covert experiences, lead to what kind of action. The world is full of living things that may be said to think, and then act on their thoughts. Or at least it is possible to interpret many observable activities in this way. But an overwhelming majority of these thoughts and the ensuing actions are motivated by the creatures' current needs and are directed at the environment that exists here and now. These thoughts and actions do not change the world from one to which all living creatures must adapt, to one that better satisfies their needs.

These kinds of musings do contain one possible answer to Hampton's query about the biological utility of covert experiences. Inner thoughts, phenomenal awareness of one's world, need not but in fact often do lead to overt action. One notable example of such action is doing something now that will pay off only in the future. Humans with autonoetic episodic memory think about the future, anticipate what challenges and rewards it will bring, and take action now that fit the problems and the expected rewards.

If nonhuman animals do not have autonoetic awareness that they can direct at the imagined but physically nonexistent future, they will not be able to create any culture in the sense of changing the natural world. They may act in ways that a friendly anthropologist can call "culture"—for instance, elements of deliberate instruction of the young by their parents—but that kind of culture works using the same tried-and-true method as does evolution, or development, or

learning: they increase the fitness of the animal by changing the animal. Nature is full of demonstrations that the method works, but it is the plodder's method. The autonoetic *Homo sapiens* invented a truly revolutionary method: They enhanced their own fitness by altering the Earth to suit their needs.

The idea of altering the world was unrivalled by anything that had ever happened on Earth, and it could not have happened without thinking about the future. Creatures lacking the ability to imagine their possible futures might still be capable of impressive feats of intelligence: semantic memory, problem solving, communication, and the like, but they would be unable to act on the basis of their knowledge of the past and their expectations for the future.

To sum up this section, episodic memory evolved because autonoesis, its critical constituent component, added to the already existing ability to mentally travel in space the ability to mentally travel in time, not only into the past but, more important, also into the future. Future-oriented consciousness (proscopic chronesthesia) made possible a feat that had no precedence anywhere in nature: individuals intentionally, voluntarily, consciously taking action in response to something that did not exist in the physical world. As a consequence, humans were able to create a world to fit them, rather than live in one into which they had to fit.

## AUTONOETIC EPISODIC MEMORY: DATA

In this section, I discuss two rather different but converging lines of evidence that speak to the issues of the episodic theory and the thesis of this essay. One line is neuropsychological. The evidence consists of clinical and experimental observations of memory and other cognitive capabilities of certain brain-damaged patients who exhibit dissociations on memory tasks that vary in their assumed dependence on episodic memory. The second line consists of developmental studies that have revealed task dissociations, as a function of children's age, indicative of episodic and semantic memory.

### The Case of K.C.

In 1981, going home from work, a 30-year-old man accidentally rode his motorcycle off the road and suffered brain damage of a highly unusual kind. In addition to dense anterograde amnesia that frequently follows traumatic brain injury, K.C. exhibits an uncommon form of retrograde amnesia in that his previously acquired knowledge of the world (accessibility of the "contents" of semantic memory) is largely intact, while his ability to recollect premorbid personal, autobiographical events is, for all practical purposes, completely lost. [Today, K.C. lives with his parents in Mississauga, near Toronto, in the

family home where they have lived for over 40 years. As his mental capabilities have not changed greatly from the time of his accident, I describe him in the present tense, although a good deal of relevant information is provided by studies done in the past (Hayman, Macdonald, & Tulving, 1993; Tulving, 1989b; Tulving, Schacter, McLachlan, & Moscovitch, 1988). For a recent thorough report on his case, see Rosenbaum et al. (in press).]

In most ways, K.C.'s intellectual capabilities are comparable to those of healthy adults. His thinking is clear, his intelligence is normal; language is normal, he can read and write; he has no problem recognizing objects and naming them; his imagery is normal (he can close his eyes and give an accurate visual description of the CN Tower, Toronto's famous landmark); his knowledge of mathematics, history, geography, and other school subjects is about the same as that of others at his educational level; he can define and tell the difference between stalagmites and stalactites; he knows that 007 and James Bond are one and the same person; he can play the organ, chess, and various card games; his social manners are exemplary; and he possesses a quiet sense of humor.

K.C.'s memory, very broadly defined, too, is unimpaired, and can be considered normal in a number of ways. He has no great difficulty answering questions about semantic (public, objective, shared) aspects of his own past life (autobiographical knowledge), such as his date of birth, the address of his home for the first 9 years of his life, the names of the schools he attended, the make and color of the car he once possessed, and the fact that his parents owned and still own a summer cottage. He knows the location of the cottage, can easily find it on the map, and knows its distance (90 miles) from his home and how long it takes to drive there from Toronto in weekend traffic. He also knows that he has spent a lot of time there.

Note, however, that all this accessible factual (declarative, cognitive, propositional) knowledge, even if it is about his own past, is classified as semantic because it is impersonal, objective, public, and shared with others. K.C. knows things about himself and his past in the same way that he knows similar things about others, friends and family. It is knowledge of one's life from the point of view of an observer rather than that of a participant, the same kind of knowledge that people have about many other aspects of their world.

K.C.'s primary (short-term, or working) memory is normal: he remembers what happened a short-term while (1 to 2 minutes) ago, and his forward digit span is 7 to 8. He can play a whole hand of hearts, or bridge, without any apparent memory handicap. He has no particular problems with many perceptual-motor and cognitive skills, or with the retrieval of premorbidly acquired general knowledge. His perceptual priming performance, as measured by word-fragment comple-

tion, even exceeds that of an average University of Toronto student (Tulving, Hayman, & Macdonald, 1991). And although he is very slow in comparison with healthy controls, he is capable of acquiring novel semantic information (Hayman et al., 1993; Tulving et al., 1991; Westmacott & Moscovitch, 2001).

### K.C.'s Episodic Memory

K.C.'s major problem is that he cannot remember anything that has happened to him. However hard he tries, and however powerfully he is prompted, he cannot bring into his conscious awareness a single event, happening, or situation that he witnessed or in which he participated. This global episodic amnesia covers the span of his whole life, the period from his birth to the present day: he cannot recollect anything from his life either before or after the accident. He knows the address and, when standing in front of it, recognizes the house where he lived for the first 9 years of his life, but does not remember a single event that took place in the house. He does not remember a single visit to the family cottage, and not a single happening there in which he participated. Nor is he capable of remembering anything ever having happened in the house where he has now lived for over 40 years. He knows that he owned a black Honda, but does not remember a single trip he ever took in it.

In the course of studying his amnesia, we collected descriptions of a number of poignant events from his life that would be regarded as highly memorable by everyone—a fight he had in a pub resulting in a broken arm that took him to the hospital, a traffic accident that caused his jaw to be wired shut for a week, the accidental death of his older brother to whom he was close, and a huge chemical spill near his home that caused a 10-day evacuation of over 100,000 people in his neighborhood, including himself. The idea was to test his autobiographical memory with increasingly complete cues about the events. (We also made up a collection of descriptions of otherwise comparable events that had not happened to him, and used them as controls.) The results were clear. Even when he was given full descriptions of the real events, his response was the same as those he gave to the fabricated events: he said he did not remember the events, and did not feel any familiarity toward them.

Thus, although K.C. *knows* a great deal about the world because he learned it before his accident, he does not *remember* anything from the same period in his life (or any other period). This striking dissociation suggests that episodic and semantic memory are subserved by at least partially distinct sets of neural mechanisms. The brain damage that K.C. suffered, a rare one-in-a-million accident, must have greatly impaired the operations of one while leaving the other largely intact.

### Other Cases

Other neuropsychological cases have been described in the literature that are similar to K.C.'s in that they exhibit a disproportionate impairment of episodic memory in relation to other kinds of memory (Calabrese et al., 1996; Giovagnoli, Erbetta, & Bugiani, 2001; Kapur, 1999; Levine et al., 1998; Markowitsch et al., 1993; Rousseaux, Godfrey, Cabaret, Bernati, & Pruvo, 1997; Van der Linden, Brédart, Depoorter, & Coyette, 1996; Viskontas, McAndrews, & Moscovitch, 2000; Wheeler & McMillan, 2001).

Especially striking, both with respect to their behavioral profiles and correlated neuroanatomical pathology, are the cases of young developmental amnesia patients described by Vargha-Khadem and her colleagues (Mishkin, Suzuki, Gadian, & Vargha-Khadem, 1997; Vargha-Khadem et al., 1997, 2003). Their behavioral profiles are interesting inasmuch as they remember little of ongoing experiences and, like K.C., cannot mentally relive the past, yet learn about the world without undue difficulties. Their neuroanatomical damage is interesting inasmuch as it is largely confined to the hippocampus proper and does not extend, as it frequently does, to the subjacent cortex. Thus, despite hippocampal pathology, these young people have managed to acquire normal or near-normal levels of intelligence, including normal language skills and general knowledge of the world. These fascinating cases once again suggest that a fully functioning episodic memory system is not required for the learning of general skills and knowledge. The cases of these young patients once more suggest that episodic memory is not necessary for the learning of general skills and knowledge.

### Self-Awareness and Autonoetic Awareness

What about K.C.'s consciousness? Is he conscious? Is he reflectively or self-reflectively conscious? Does he possess normal self-awareness? Is he autonoetically conscious?

The answers to these questions clearly depend on what one means by the terms. I would say that of course K.C. is conscious. Furthermore, he is self-reflectively conscious. Yet, at the same time, I would also say that he does not have normal self-awareness, and that he is not autonoetically conscious.

On the one hand, he is not in the least confused or uncertain about himself as an independently functioning individual. He knows his name, where he lives, his family, how to take care of himself, the daily routine, how to spend time in the house, and what he does when he goes for walks in the neighborhood. He knows about them in two senses: he carries out relevant actions without any hesitation and usually without any prodding by anyone else, and he can reflect on what

he is doing, that is, he can answer questions appropriately about these actions, when he is asked to do so. As a result of his accident, K.C.'s personality was greatly changed (Rosenbaum et al., in press), but he has even learned his new self as revealed by trait judgments (Tulving, 1993b; see also Klein, Loftus, & Kihlstrom, 1996).

When K.C. is asked about whether his "mind is clear," he has no hesitation in stating that it is, and nothing in his ongoing everyday behavior would lead anyone to question his judgment in the matter. Thus it seems reasonable to say that he has a well-developed and properly functioning self and that he possesses self-awareness. Although he has not yet been formally tested on his understanding of the theory of mind, or metacognition (chapter 2, this volume), I and others who know him well believe that he would have no difficulty passing relevant tests. Indeed, it is not unreasonable to imagine that giving K.C. a Gallup mirror test or even Povinelli's delayed video test (Povinelli, Landau, & Perilloux, 1996) in order to check on his self-awareness would be equivalent to giving Columbia University professors a test of the alphabet.

On the other hand, K.C. is a densely amnesic person who remembers nothing of what has ever happened to him. It is difficult to imagine that these missing features have no bearing on his awareness of himself. This awareness is not "normal." What is missing is what I have referred to as autonoetic awareness. He is severely deficient when it comes to autonoesis: for all practical purposes, he has no functioning autonoetic self, or Metcalfe and Kober's (chapter 2) projectable self. On Katherine Nelson's (chapter 4) scale of consciousness, K.C. seems to be missing the lower level (3–6 years of age) narrative consciousness but, paradoxically perhaps, seems to have the higher level (5–10 years of age) cultural consciousness. The apparent paradox, however, can be resolved along the lines of the SPI model (Tulving, 1995, 2001a) by distinguishing between the processes of encoding and retrieval.

#### K.C. and the Future

K.C. cannot think about his own personal future. Thus, when asked, he cannot tell the questioner what he is going to do later on that day, or the day after, or at any time in the rest of his life, any more than he can say what he did the day before or what events have happened in his life. When he is asked to describe the state of his mind when he thinks about his future, whether the next 15 minutes or the next year, he again says that it is "blank." Indeed, when asked to compare the two kinds of blankness, one of the past and the other of the future, he says that they are "the same kind of blankness" (Tulving, 1985b). Thus K.C. seems to be as incapable of projecting himself mentally into

his personal future as he is incapable of seeing himself in his personal past. He lacks autonoetic awareness.

It is important to note that K.C. has no greater difficulty with the concept of the future as an aspect of physical time than he has with physical space. He knows and can talk about what most other people know about physical time, its units, its structure, its measurement by clocks and calendars, and the location of events in the world in the past. But such knowledge of time in and of itself does not allow him to remember events as having happened at a particular time. It is necessary but not sufficient. Something else is needed, and this something else—the awareness of time in which one's experiences are recorded—seems to be missing from K.C.'s neurocognitive repertoire. He thus exhibits a dissociation between knowing time and experiencing time, a dissociation that parallels one between knowing the facts of the world and remembering past experiences.

When K.C. is engaged in activities that do not require mental time travel into his own past or future, his awareness is indistinguishable from what most neuropsychologists would consider normal. When he is asked the name of the capital of France, or the difference between stalagmites and stalactites, or thousands of other such facts, there is no sign of any deficiency. In these situations, he is naturally consciously aware of what he is doing, but the kind of consciousness involved is different from autonoesis: it contains no awareness of personal time. We can describe the situation by saying that there is nothing apparently wrong with or missing in his noetic consciousness. Thus, although K.C.'s autonoesis is severely impaired, his capability of conscious awareness of the world beyond subjective time, that is, his noetic consciousness or noesis, is well preserved.

It was this striking pattern of K.C.'s mental life—his extensive repertoire of conscious thoughts about the impersonal world contrasted with his essentially nonexistent conscious thoughts about his own past and future—that first suggested the distinction between noetic and autonoetic consciousness (Tulving, 1985b). K.C. possesses the former and does not possess the latter. Because he is perfectly well aware of his timeless self—self in the present—it seems reasonable to attribute his difficulties with personal past and personal future to deficient, perhaps largely lacking, autonoesis.

This brief description of K.C. can be summarized by saying that he "fails" the test of possession of the episodic memory capacity by all four criteria represented by episodic memory's defining features. He does not remember any personally experienced events; he is not self-aware in the dimension of time; he has no autonoetic awareness; and he does not seem to possess any feeling of subjective time. I concede that some of these assertions may be too strong. It is possible that he

has a little left of one or more of the properties of episodic memory and that we are dealing with a case of severe impairment in episodic memory rather than its total absence (Squire & Zola, 1998). However, this possibility does not change the striking dissociation between episodic and other kinds of memory that the case of K.C. represents.

### Why Is the Case of K.C. Relevant?

The case of K.C. is relevant in the context of the present essay for several reasons. First, unlike many other living beings who have no episodic memory (e.g., nonhuman animals and preverbal children), K.C. is capable of producing reasonably detailed introspective reports about his mental life. Thus he can do what these others cannot—provide direct first-person narrative evidence of the nature of the world of an otherwise normal person without episodic memory and autonoetic capability.

Second, K.C.'s introspective reports are valuable in drawing a connection between mental time travel into the past and mental time travel into the future. There is no simple way of directly comparing these two facets of time, and subjective time at that. Nevertheless, the fact that K.C.'s ability to think about his personal future seems to be as severely impaired as his ability to think about his personal past allows us to assume that mental time travel is a single neurocognitive capability, one whose domain of operations extends from the present in both possible temporal directions. Before his case, it would have been possible to imagine that the remembered time might be functionally different from the imagined future time, and the two might even be subserved by different neural substrates. The case of K.C. supports the idea of the continuity of subjective time, in this sense paralleling physical time.

Recently, an interesting and revealing case, of patient D.B., has been presented by Klein et al. (2002). It speaks rather directly to the issue of autonoetic mental time travel in both directions, the past and the future. As a result of hypoxic brain damage, D.B. suffers severe retrograde episodic amnesia. Like K.C., D.B. has a relatively well preserved general knowledge base, accumulated before the onset of his amnesia, but his ability to recollect premorbid personal experiences is severely impaired. The important new feature of the Klein et al. (2002) study was that they formally tested D.B.'s ability to imagine the future and his ability to anticipate future events. They found that this ability, like his retrograde memory, was fractured along the lines of "personal" versus "impersonal." D.B. has knowledge of the world's past and can intelligently express opinions about the world's probable future. But both his ability to recollect happenings from his own personal past and to imagine his own personal future are severely impaired. The case of D.B. thus formally illustrates a dissocia-

tion between semantic (noetic) and episodic (autonoetic) mental time travel.

Third, it is important to note that as long as K.C. continues to live in a stable world with which he is familiar, that is, with his parents in his home, he has no problem surviving, and surviving well. He is not dependent on others to tell him how to behave, what to do, or how to take care of himself. As long as somebody fills the refrigerator and pays the bills, and water flows from the taps and his bed is ready to be slept in in his bedroom, he manages without any difficulty. He probably also could, if necessary, walk to the supermarket, and (if he has written down what he needs, if he has not forgotten that he has the list in his pocket, and if he has not forgotten to take money with him), he could fill the basket and walk back home. The point is that in a stable environment there is no crying need for episodic memory to live a satisfying life. K.C.'s life may be abnormal and uninteresting by ordinary standards that people in our world are accustomed to, but because he himself is not aware of it, and his needs are taken care of, he has no complaints. When he is asked to rate the quality of his life on a five-point scale (5 "very good," 1 "very bad"), he judges it to be 4.

Fourth, K.C.'s case graphically illustrates the distinction between timeless and time-based self-awareness. As mentioned earlier, his knowledge of physical time is normal. He knows perfectly well what time is, and because he has no problems with thinking and reasoning, he also knows, and can articulate the fact, that he has lived in the past and is going to live in the future. But such knowledge does not translate into a felt time. He does not seem to possess what others do—an ever-present awareness of one's being existing in a subjective sea of time, always in transition from what is now becoming the past to what once was the future. K.C. possesses a noetic (knowing) self, but lacks an autonoetic (or projectable, or time-traveling or remembering self).

### Autonoetic Memory in Children

The hypothesis that episodic memory is not present in animals receives support from the observation that episodic memory is also absent in young children. Young children can act upon their earlier experiences, and they can even verbally describe aspects of these experiences. The question is whether they also (autonoetically) remember these experiences. The proposed answer to the question is that young children do not remember personal experiences, and that the ability to remember events follows rather than precedes the development of the ability to become knowledgeable about the facts of the world (Wheeler, 2000).

The observations concerning the differentially delayed development of episodic memory are still somewhat controversial, and not all developmentalists are willing to interpret them along the lines suggested here. The problem is rather similar to that in the interpretation of learning in animals—many instances of learning can be (anthropomorphically) interpreted as revealing episodic memory, although they need not, because nonepisodic forms of memory are sufficient. When parents witness their 9-month-old daughter crawling to the spot where she previously found her favorite toy, it is quite reasonable for them to conclude that the child remembers the prior episode. Even more convincing is a 3-year-old who verbally answers questions about something that happened to him only a short time ago. It requires only common sense and no specialized knowledge to attribute to the child the ability to recollect the past. Surely an adult, answering the same question, would rely on episodic retrieval, so why should the same inference not apply to the child? The answer to this question is difficult to resolve conclusively, yet additional evidence now suggests that even when young children are able to talk about the details of prior events, it need not mean that they consciously recollect the events (Lockhart, 1984; Nelson, 1993; Wheeler et al., 1997). It is also true, of course, that just because an act of learning can be attributed to nonepisodic forms of memory, it cannot benefit from episodic memory.

The argument here is that children up to age of 4 years or so lack the same kind of episodic memory and autonoetic consciousness that seem to be missing in animals. The relevant findings have been provided by comparative studies of episodic and semantic memory in children between the ages of 3 and 6 years. During these years, children are already highly verbal and very accomplished learners. They can also recall novel events from their lives, sometimes across intervals on the order of months (Fivush, Hudson, & Nelson, 1984). Some of these studies show striking dissociations between episodic and semantic memory. Many of the most relevant studies have examined memory for context or for source. I provide examples below.

If one assumes, as I do, that the operations of episodic memory are critically dependent on autonoetic consciousness, it follows that any child who is incapable of this highest level of consciousness should be unable to recollect the personal past. Therefore, assessing autonoetic awareness in children should set boundary conditions on the presence or absence of episodic memory (Wheeler, 2000).

One relevant piece of evidence comes from the behavior of infants when they are placed in front of mirrors. Exposure to a mirror typically causes older children and adults to begin paying attention to themselves, and it often stimulates them to begin reflecting on their own mental states (Duval & Wicklund, 1973). Before the age of about 18 months, young children will pay attention to their mirror image

but do not realize that it represents their body, and they will not use the mirror as a tool to think about themselves (see Lewis and Brooks-Gunn, 1979, for an extensive discussion of children's behavior around mirrors).

It would be convenient to assume that the toddlers who recognize themselves in the mirror possess self-awareness. And if self-awareness were defined in terms of the mirror test, the statement would be true, by definition. However, passing the mirror test does not mean that the children have autonoetic consciousness, that they are aware of themselves as individuals with a past and a future. Autonoesis emerges only later, as an integral component of episodic memory.

Episodic memory matures gradually, and therefore it is difficult to pin down a particular age at which young children's episodic memory capabilities can be said to have become fully functional. But one magic number that is frequently used in the attempts to do so is 4 years (Nelson, 1992). It does not mean, of course, that episodic memory emerges suddenly around a child's fourth birthday. Nor does it mean that it becomes fully established shortly thereafter. What the number designates is the common finding that most 3-year-olds fail or do poorly on tasks that require them to bring back to mind their own personal experiences, whereas most 5-year-olds do very much better on the same tasks.

One of the most instructive examples of this generalization is provided by experiments reported by Gopnik and Graf (1988). They had 3-, 4-, and 5-year-olds learn about the contents of a drawer in one of three different ways. Some of the children were told about the contents without seeing them, others saw with their own eyes what was in the drawer, and a third group was given hints so they could infer what was there. Gopnik and Graf were interested in two things: (1) Do the children know what is in the drawer? (2) Do they know why they know—was it via seeing, hearing, or inferring? The first question has to do with acquired knowledge, and, over the studied age range, there were no age differences on this question, even on a delayed test when recall was far from perfect. As to the second question, the reasoning was that for the subjects to be able to answer it, they must be able to recollect how they found out about the contents of the drawer. While the 5-year-olds made very few mistakes on this second question, few of the 3-year-olds could respond at levels higher than chance. Thus, all children knew "what" (the contents of the drawer), but only the older ones knew why they knew (remembering the event of seeing what was in the drawer).

The general finding has been replicated in a number of different ways (Lindsay, Johnson, & Kwon, 1991; Wimmer, Hogrefe, & Perner, 1988). It appears that young children cannot, or do not, represent their knowledge as deriving from a particular time in the personal past

(e.g., "I saw that there are crayons in the drawer"), but rather as detached, impersonal knowledge (e.g., "There are crayons in the drawer").

The studies just described may even overestimate children's abilities to understand how they learned information. The critical test questions used by Gopnik and Graf (1988) and others only asked children to differentiate between different intraexperimental sources of information (seeing, hearing, inferring). Many children cannot acknowledge the simple fact that a recently learned bit of information has been acquired recently. In one experiment (Taylor, Esbensen, & Bennett, 1994), 4- and 5-year-old children were taught unfamiliar color names (e.g., chartreuse, taupe). All the children learned the names easily, and after learning were able to select items from an array of colors according to the specified name. They were then questioned about when they had learned the new color names. Incredibly, a large majority of the 4-year-olds claimed to have "always" known these names, and only a few would admit that they had been taught the colors that day. The 5-year-olds performed markedly better in identifying the source of their knowledge, although a few of them consistently made this same source error. Across several experiments, the authors showed that young children typically are unaware of recent learning events and claim to have known recently acquired information for a long time. Thus, it looks as if children are better at making use of learned facts than they are of identifying the episode during which the facts were learned. One plausible reason for such failure is that because they lack fully fledged episodic memory, the children actually do not remember the learning episode. This suggestion is consistent with the idea that childhood amnesia reflects nothing more nor less than the absence of episodic memory in young children (Perner & Ruffman, 1995).

Children's ability to remember how and when and in what setting they learned a new fact can be assessed even more directly. When this is done, findings again suggest a magical number of 4 as the number of years needed to develop a nearly fully operational episodic memory system.

When young children are more directly assessed for the extent to which they suffer from source amnesia, the findings again point to a critical age around 4 years. Drummey and Newcombe (2002) used the paradigm like the one introduced by Schacter, Harbluk, and McLachlan (1984). Children were taught new facts in the laboratory setting (e.g., "giraffes are the only animals that cannot make a sound") and were later tested for (1) their knowledge of the learned facts and (2) their recollection of the learning episode. Children's retention of the learned facts showed steady improvement with age from 4 years to 8 years. At the same time, however, the 4-year-olds were very much

worse than the older children in remembering where and how they had learned the facts that they now knew.

These lines of research show what young children can, and cannot, do. There is little question that children as young as 3 or 4 years can talk about events from their own lives. But an important limitation appears to be that the event must have been novel. It is a common finding that when young children are asked to talk about novel or interesting events that occurred several months ago, they are able to do so (Fivush et al., 1984). Yet if they are asked in the evening what happened at school that day, they do not know; they cannot remember. Children below the age of about 5 years can only talk about daily events if something unusual has happened.

For a period of at least a few years, children may have what Katherine Nelson (1984) has called a "general undifferentiated knowledge base," perhaps even at the age of 4 years. Information exists in the knowledge base in noetic form only. Even when a child can master semantic concepts like "time," "future," "yesterday," and "me," there is some considerable period of time, on the order of years, before there is a qualitative shift in thought, allowing the child to remember the past episodically.

One example of a test that probably cannot be used with young children is the remember/know task (Gardiner, 1988; Gardiner & Richardson-Klavehn, 2000; Rajaram & Roediger, 1997). If children are truly pre-episodic and have not yet developed the capacity to recollect the past autonoetically, then it will not make any sense to ask them to distinguish between remembering and knowing. Evidence that these terms are problematic for children was reported by Johnson and Wellman (1980). (It is edifying to note that this study appeared many years before the formally articulated distinction between remembering and knowing.) They found that 4-year-olds were not cognizant of differences between cases of remembering, knowing, and guessing, although in some cases they could distinguish their mental state from an externally perceived state. Five-year-olds showed some ability to differentiate these mental states, while 6-year-olds generally had a very solid command of the terms. The authors stress that this is not a simple vocabulary problem, as children of that age are fully capable of acquiring and using words and concepts that, to adults, are much more sophisticated than words like "know" or "guess." Difficulties likely stem from the inability to monitor one's own mental states.

Nelson and Fivush (2004; see also chapter 4, this volume) have recently proposed a major social-cultural theory of the development of autobiographical memory, which for them represents a subset of episodic memory (for a somewhat different idea on the relation between episodic and autobiographical memory, see Conway & Pleydell-

Pearce, 2000). Autobiographical memory is said to entail a "personal significance that characterizes specific memories that re-appear many times during one's life, often decades after the event." They are contrasted with "lesser episodic memories [which] tend to lead an ephemeral existence, leaving little trace in the future." Nelson and Fivush contend that autobiographical memory emerges following a number of changes developments in language, consciousness, and self-awareness. The developing system begins with a basic, functional declarative-like memory system that is able to retain information about events (routines and episodes) for weeks or, eventually, months. A critical addition, however, is the beginning of language comprehension and expression, especially the burgeoning capacity to provide labels to elaborate upon and retain information. Around the age of 18 months, young children begin to establish a cognitive self (see also Howe & Courage, 1993) which serves as a foundation for encoding and understanding ongoing events. For the first time, a child can begin to understand his own special place in the world (and his own idiosyncratic feelings), as distinct from others.

An additional necessary step occurs when parents and other adults begin to talk about past and future events in the presence of the child, especially when the adults describe such events narratively. Such conversations provide the support for the child's developing concept of time. It is between about the ages of 2 and 5 years that developing language and narrative skills allow children to represent and become aware of complex sequences of events, and to think about the events in terms of a personal past, present, and future.

In summary of this section, young children represent a prime example of a population that possesses some critical aspects of episodic memory but lacks others. As such, the discussion of children's memory may be useful as a way to understand our eventual interpretation of evidence from animal research. Children between the ages of 2 and 5 years can encode, store, and retrieve declarative-like information and learn new facts about the world, and they are fully capable of applying this learned information flexibly and confidently. Yet developmental limitations in their conscious awareness place boundary conditions upon their uses of memory. It is not until children can reflect upon subjective experiences in the past, present, and future that they can experience the past episodically. Evidence from multiple, diverse sources implies that, below the age of approximately 4 or 5 years, young children lack the linguistic, representational, and "self"-related skills to reflect upon the personal past. The developmental findings not only emphasize the role that a fully developed human brain plays in episodic memory; they also underscore the fact that episodic memory is not necessary in a world in which one's needs

can be and are satisfied without remembering autonoetically what happened in the past.

## ANALYSIS: EPISODIC MEMORY IN ANIMALS

We now return to the main point of this chapter and the question: Do animals other than humans possess episodic memory? Hundreds of articles have been written on the topic of mental capacities of animals, and to say that the topic is controversial is to greatly understate the vehemence with which the issue has been pursued. By restricting our analysis of the mental capacities to episodic memory, it is possible to expect closer agreement.

The answer to the question is multiply determined. It depends partly on what one means by episodic memory, partly on the kinds of evidence one considers, and partly on how one interprets the evidence. When episodic memory is defined loosely as "memory for (specific) past events," then the standard commonsense answer is that of course animals have it. Every owner of a pet dog or cat, every visitor to the monkey cages in the zoo, anyone who has ever watched Walt Disney cartoons knows that even if animals are not like people in every way, they are like people in many ways, and those many ways include their memory abilities. They may not have human language, may lack the capacity for abstract reasoning, and may fall short on some other esoteric human traits (the likes of musicality, religiosity, science, literature, and love of the arts), but surely they know what they are doing in their daily lives and they naturally remember it too. When one sees a dog bury a bone one day and next day make a beeline to the place, it is easy to imagine that on the first day the dog was completely aware of his purpose in burying the bone, and that on the second day he was completely aware of having done so the day before.

This kind of anthropomorphically driven thinking, which Charles Darwin put to scientific and practical use in his *Descent of Man* (Darwin, 1874/1998), and which George Romanes (1881) developed to high art, comes naturally to human minds. Despite Lloyd Morgan's (1894) early strictures against it, in the form of his famous canon, and continued urgings of caution by contemporary writers, it is very much alive today. It is quite possible that anthropomorphizing is an evolutionary adaptation, as suggested by Povinelli and Vonk (2003, p. 157) in their musings about why the chimpanzee mind seems so suspiciously human: "the human mind may have evolved a unique mental system that cannot help distorting the chimpanzee's mind, obligatorily recreating it in its own image. This idea should be taken seriously. After all, from change-blindness, to false memories, to cognitive disso-

nance, don't we already know the various ways in which the human mind systematically distorts its own workings?"

Many memory researchers have adopted the commonsense notion and have taken it for granted that animals have episodic memory. A good example is provided by the animal model of memory and amnesia proposed by Squire and Zola, and their associates (Alvarez, Zola-Morgan, & Squire, 1994; Squire, 1987; Squire & Zola, 1998). A central tenet of the model is that the hippocampal system plays a critical role in declarative memory. The hippocampal declarative memory system covers both memory for events (episodic memory) and memory for facts (semantic memory) and is the same in rats, monkeys, and human beings (Squire, 1992). If animals have declarative memory, and if declarative memory comprises both episodic and semantic memory, then, logically, animals must have episodic memory. Comparable views are held by Eichenbaum and his collaborators (Eichenbaum, 2000; Eichenbaum, Otto, & Cohen, 1996), although the critical neuroanatomy is seen somewhat differently from Squire and Zola.

The idea seems perfectly reasonable; otherwise its popularity would not have lasted. But what it demonstrates above all is how subtle important differences in brain and behavior can be, and how difficult to come to grips with. On closer reflection, there are several problems with it.

First, in common sense and theories based on it, the question of the existence of episodic memory in animals is "solved" by postulation instead of empirical inquiry. Memory for events and memory for facts are lumped together as one and not treated separately. The practice may serve for certain purposes—such as investigation of the neuroanatomical correlates of declarative (conjunction of episodic and semantic) memory—but it possibly cannot help to answer the question I am asking here.

Second, the kinds of tasks that have been used in evaluations of the hippocampal declarative memory system do not, and cannot, distinguish between memory for events and memory for facts. A great deal of laboratory research on animal memory is essentially concerned with perceptual (recognition) memory (Aggleton & Pearce, 2001; Wright, Santiago, Sands, Kendrick, & Cook, 1985), as is research done with preverbal human infants (Rovee-Collier & Hayne, 2000), and requires no declarative (semantic and episodic) memory. The widely used DNMS (delayed nonmatching to sample) and other kinds of object recognition tasks can be effectively executed by identifying the stimulus objects on the basis of their perceived novelty or familiarity. Moreover, there is increasing evidence that the execution of DNMS tasks does not even depend on the integrity of the hippocampus (Aggleton & Brown, 1999; Aggleton & Pearce 2001; Murray, 1996; Murray & Bussey, 2001; Mishkin, Vargha-Khadem, & Gadian, 1998). The abil-

ity of animals to perform the task, and the effects of experimentally induced lesions on the performance, therefore, have no bearing on the issue of whether animals have episodic memory. Even when we consider tasks that cannot be handled at the level of perceptual memory alone, it turns out that most of them require only semantic memory and not episodic. Young children can acquire knowledge about the world efficiently and rapidly long before they develop the ability to recollect specific happenings from their past (Nelson, 1993). Although not all amnesic patients are capable of doing so (Kopelman, 2002; Manns, Hopkins, & Squire, 2003), some amnesic patients, who have severely impaired or no functional episodic memory, can nevertheless acquire new semantic information (Guillery et al., 2001; Hamann & Squire, 1995; Hayman et al., 1993; Kitchener, Hodges, & McCarthy, 1998; McKenna & Gerhand, 2002; Rajaram & Coslett, 2000; Van der Linden et al., 2001; see also Verfaellie, Koseff, & Alexander, 2000).

Third, the kinds of tasks that have been typically used in laboratory studies usually test the subjects' knowledge of what they perceived or what they did at the time of study (training), and may also test the subjects' knowledge of the spatial coordinates of the to-be-remembered objects (where something was). However, they do not challenge the subjects' knowledge of the time of the occurrence (when) of the event in question (Griffiths et al., 1999). Thus, one key element of episodic memory, the temporal dimension of what is remembered, has been lacking in laboratory experiments on animal memory.

Clayton and Dickinson and their colleagues have remedied this shortcoming, and reported ingenious and convincing demonstrations of memory for time in scrub jays. Scrub jays are food-caching birds, and connoisseurs when it comes to choosing what they eat. When they have food they cannot eat, they hide the food and recover it later. Because some of the cached foods (such as wax worms and crickets) are preferred but perishable and must be consumed within a few days of caching, while other foods (such as seeds and nuts) are less preferred but do not perish easily, for efficient recovery the birds must recall not only cache locations (What did I hide where?) but also the time of caching (When did I do it?). Clayton and her colleagues made clever use of these facts in designing their laboratory experiments, whose outcomes clearly showed that, even days after caching, scrub jays knew not only what kind of food was where but also when they had cached it. Similar laboratory findings of these kinds have not yet been reported for rodents or nonhuman primates.

### The Fourth Problem

The three problems I have mentioned—solving a theoretical issue by postulation rather than empirical inquiry, difficulty of distinguishing

memory for events and memory for facts, and the absence, until recently, of evidence of memory for when an event occurred—are simple in comparison with the fourth. What I here call the fourth problem is the central one.

How do we know what kinds of mental experiences accompany memory-based activities in nonverbal organisms? How can we find out whether there is any evidence for episodic memory in its narrow (unique) definition in animals, given that animals do not talk, and that even rudiments of human-taught language, known from some very rare cases, cannot be used for the purpose? How can we find out whether animals autonoetically remember past experiences? That they are capable of mentally traveling in time? Do Clayton's clever scrub jays actually remember when they cached the wax worms and when they cashed the peanuts, or do they know, on some other basis, how to act at the time of the recovery of the food?

Scientists and others interested in the issue do not doubt that their fellow human beings, like they themselves, have the capacity to mentally travel in time and the capacity to distinguish the kind of conscious awareness that accompanies mental time travel from other forms of consciousness. Normal human beings can remember events such as a visit to Washington, DC; they know, without necessarily remembering any personal encounter, what the capitol in Washington looks like; and they can perform behavioral feats, without any conscious awareness that they are using their memory, such as unhesitatingly completing the word fragment C-P-T-L. These kinds of distinctions, between autonoetic, noetic, and anoetic consciousness (Tulving, 1985b) come to humans as naturally as the ability to tell the difference between seeing white and black, or hearing a ping and a thud, or feeling the difference between a sharp and a dull pain. The extensive human literature on the distinction between two kinds of conscious awareness, remembering and knowing (Gardiner, 1988; Gardiner & Richardson-Klavehn, 2000; Rajaram & Roediger, 1997), together with early findings of neural correlates of subjectively experienced states (Düzel, Vargha-Khadem, Heinze, & Mishkin, 2001; Eldridge, Knowlton, Furmanski, Bookheimer, & Engel, 2000) has helped do away with the fourth problem in the study of human memory. But as yet no one has come up with a comparable solution to the fourth problem in the study of animal memory.

The fourth problem as such looms large in the thinking of others who have thought about the time sense in animals, and who have arrived at conclusions similar to those I am arguing for here. An exceptionally thorough and lucid discussion of the topic is found in an article by Suddendorf and Corballis (1997); another is an equally detailed and scholarly treatment of the same theme by Roberts (2002; see also Roberts & Roberts, 2002).

In an article titled "Mental Time Travel and the Evolution of the Human Mind," Suddendorf and Corballis (1997), in much greater depth than I have been able to do here, have anticipated and laid bare the kinds of arguments I have been presenting. I very much agree with most of the things that they say, including their main point that "the ability to travel mentally in time constitutes a discontinuity between humans and other animals," their sober observation that "the importance of mental time travel as a prime mover in human cognitive evolution has not been adequately recognized," and their declaration that "the real importance of mental time travel applies to travel into the future rather than into the past." I am also in complete agreement with their assessment of the development of time sense in young children and with their idea that language, although greatly facilitating the use of the human capacity for mental time travel, is not necessary for it.

Suddendorf and Corballis (1997) have done a further good deed in bringing to the attention of Anglophone readers what they refer to as the Bischof-Köhler hypothesis. This hypothesis is "that animals other than humans cannot anticipate *future* needs or drive states, and are therefore bound to a present that is defined by their current motivational state." The thesis of this essay is clearly very similar to it, except perhaps in that it is a part of a broader theory of episodic memory, with all the ramifications that it entails. Because the original texts do not seem to be readily accessible, a more informed comparison has to wait for the future.

Roberts's (2002) article is titled "Are Animals Stuck in Time?" After a thorough review, and after appropriate caveats, he concludes that although the picture is not entirely clear, most of the evidence suggests that animals are indeed stuck in time. Even chimpanzees' ability to imagine their extended future is in doubt. Wolfgang Köhler (1917/1927), famous for his discovery of "insight" in chimpanzees, noted this kind of shortcoming in the mental makeup of his otherwise intelligent subjects: "The time in which the chimpanzee lives is limited in past and future" (p. 272). Roberts (2002) suggests that chimpanzees are able to "think future," in the sense of planning ahead to solve problems, only when (1) they are hungry, and (2) they can see the food reward they will receive for solving the problem. In other words, solving a complex goal-oriented task seems to depend on the anticipated satisfaction of a current need in the very near future.

I myself stumbled across the idea that mental time travel into the future may be more important than mental time travel into the past, in a quest for the answer to the question of biological utility of episodic memory. What is episodic memory good for? Given that there are relatively few obvious advantages of episodic memory over semantic memory—kind of "who really needs to know when or where a past

event happened; the important thing is the lessons we can learn from the fact that it did happen"—it is easy to think of episodic memory as an evolutionary frill, as a Stephen Jay Gould kind of spandrel. When I first attempted to speculate about the adaptive utility of episodic memory, all I could offer was the thought that it provides knowledge in which one can be more confident than the knowledge that is frequently obtained second hand (Tulving, 1985b). It may have been plausible, but not convincing.

My more recent thought on the topic was that episodic memory's adaptive value lies in the autonoetic awareness of subjective time, and especially future time (Tulving, 2002a). The idea is that this kind of awareness may have been a critical driver of human cultural evolution. Culture is usually thought of as a behavior pattern of a community. I use the term, because of the lack of a better one, to signify the sum total of the differences between the world as it existed before humans changed it and as it exists now (or has existed at various times before the present). It includes changes in both of the two human realities, physical and mental.

The key notion behind human cultural evolution can be put simply: For anyone to take steps at one point in time that would make the unpredictable, frequently inhospitable natural environment more predictable at a future time, it is necessary to be able to be consciously aware of the existence of a future. An animal that cannot "think future"—cannot pre-experience possible happenings, as suggested by Atance and O'Neill (2001)—that is, cannot think about time that has not yet arrived, will not initiate and persist in carrying out activities whose beneficial consequences will become apparent only in the future, at a time that does not yet exist. For the human species, the masters of the awareness of the future, that nonexistent time has been and continues as a powerful determinant of higher-level behaviors, behaviors not motivated by the satisfaction of physiological needs. Awareness of the future has radically changed the humans' relationship with their environment. When one thinks about it, it becomes clear that a staggeringly large proportion of human behavior today—social, economic, political, religious, and otherwise—is governed, both directly and indirectly, by awareness of the future. At any rate, the point is that the ability to think about the future, as articulated by Suddendorf and Corballis (1997; see also Suddendorf, 1994), can be seen as all-important on a fundamentally broader scale of things.

## RESOLUTION

It is commonly thought that the question of whether or not animals can and do travel mentally in time can never be answered. Language is necessary, the argument is, for the verification of phenomenal men-

tal processes, such as autonoetic awareness of time. Because animals cannot talk, their mental processes will forever remain beyond the domain of objective science. This is why researchers such as Robert Hampton (chapter 11, this volume) suggest that we should limit our concerns regarding animal learning and memory to observable behavior and leave subjective experience out. Nicola Clayton and her colleagues (Clayton, Bussey, Emery, & Dickinson, 2003) have also proposed purely behavioral test criteria—content, structure, and flexibility—but these are for episodic-like memory rather than episodic memory, because they do not address the criterion of autonoesis.

### Phenomenal Experience Without Language?

A minor obstacle to accepting the "behavioral resolution" of the problem of episodic memory in animals is that there exist people like myself. We are very much interested in objectively observable behavior—this is, after all, the mainstay of our science—but we also wish to reach beyond behavior and scientifically study the even more puzzling and fascinating domain of subjective reality. If we leave the phenomenal considerations out of the equation and limit ourselves to "mindless" behavior, we will automatically deny ourselves any hope of getting at concepts such as autonoesis. A major obstacle lies in the well-established fact that it is always possible to account for any form of behavior in a number of different ways. Some of these accounts may appear more reasonable or plausible than others, but their evaluation is usually highly subjective, determined as much by the characteristics of the observers as the characteristics of the observed behavior.

A useful criterion that can be applied in situations of this kind is Lloyd Morgan's (1894) canon. The canon does not solve the problem of disagreements among observers, but its application does impose constraints on the domain of possible interpretations of the observed behavior. A typical problem situation is one in which the animal behaves in a way that encourages a human observer to impute mental time travel to the animal but which also leaves open the possibility of accounting for the behavior without the need to invoke such a complex concept. Your pet dog burying the bone one day, and digging it up the next, is an excellent example of the situation. Human beings, lucky owners of autonoetic episodic memory, are intimately familiar with problems of finding their car in a huge parking lot, and equally familiar with the solution: You "just remember" where you left it. By analogy, it makes sense to imagine that the dog's ideas about the out-of-sight bone are based on the same kind of a just-remember internal mechanism. The possibility, the thesis of this essay, that just remembering is an unbelievably complicated and near-miraculous invention of nature, only available to healthy humans older than 4 years or so, does not occur to a casual observer. But it must be considered, because

an alternative, and simpler, explanation is that the dog acts on its noetic knowledge, acquired during a particular episode but not stored in episodic memory, that the world is the kind of place where there's a bone buried in a particular place. The dog's knowledge-guided action is like that of any other intelligent organism who has no episodic memory. K.C. knows that the world is a place in which he, as an individual, owned a black Honda. He knows that there are fictional characters like James Bond who have aliases like 007. He also knows that "dogs confront bullfrogs," because he learned it in an experiment (Tulving et al., 1991). Therefore, when he is asked to complete the sentence frame "dog confronted . . . ?" he is happy to respond with the word "bullfrog," without remembering, and without any need to remember, that he himself saw the complete three-word phrase only 5 minutes ago. Similarly, the 4-year-old who has just learned the color name "chartreuse" and now displays the knowledge, without remembering the learning event that occurred 10 minutes earlier, is also doing nothing more than exhibiting her noetic skills.

Thus, the difficulty in demonstrating episodic memory in animals lies in the availability of simpler explanations of "episodic-looking" behavior, explanations that do not require evoking episodic memory. But if so, the logical solution to the problem is obvious. Arrange for the animal to engage in a kind of episodic-looking behavior for which no such simpler explanation is possible. Make the invoking of episodic memory necessary. In other words, set up a situation in which a nonlinguistic organism exhibits behavior that can be readily accounted for in terms of phenomenal ability such as autonoetic awareness but cannot be accounted for in terms of mindless behavior.

One straightforward suggestion of a test designed along these lines was proposed by Thomas Suddendorf in his MA thesis (Suddendorf, 1994), which provided the basis for the Suddendorf and Corballis (1997) article that I referred to earlier in this essay. As the thesis is available on the Internet, I leave it to the interested reader to get its details. What is important are the basic principles that should be generally agreed upon: It is necessary to reliably show that animals engage in an activity that (1) is not instigated and maintained by the animals' motivational states or the presence of discriminative stimuli in their internal or external environment, and (2) has no immediate relevance to satisfying present needs but has consequences that have value to the animal at a future time. Under these conditions, it becomes not only meaningful but necessary to argue that the observed behavior reflects awareness of and ability to think about one's personal future. This then would be evidence for mental time travel, and hence evidence for autonoetic episodic memory.

Suddendorf's suggestion means that, at least in principle, the possibility of proving the Bischof-Köhler hypothesis wrong is open already.

Given the expectation that creative experimenters in the future will come up with additional clever designs (Morris, 2001), the possibility of rejecting the central hypothesis of this essay becomes increasingly probable, and the challenge that it entails practically manageable.

Herein lies the challenge to comparative psychologists. In pursuing the challenge, they may find useful hints on how to proceed from studies of brain-damaged patients who lack the ability to mentally travel in time, as well as studies of young children who are extremely capable learners in the absence of episodic memory.

I am not convinced that the kind of surprise that Zentall, Clement, Bhatt, and Allen (2001) wrote about is necessary for the test—healthy humans benefit from their autonoetic consciousness in many life situations that are not unexpected. And I agree with Bennett Schwartz (chapter 9, this volume; see also Schwartz, Colon, Sanchez, Rodriguez, & Evans, 2002; and discussion of the issue by Morris, 2001) that the important feature of episodic memory, and hence of a test for it, need not be built around immediate, single-trial learning. Young children, long before they acquire episodic memory, learn not only to avoid hot stoves but also acquire scores upon scores of new words every day after a single exposure, in ways that still mystify developmental psychologists. In addition, there is no reason to doubt that a great deal of adults' acquisition of new knowledge of the world occurs on a single "trial." It is for these reasons that "fast encoding" is assigned to the category of properties that semantic and episodic memory systems have in common, shown on the left-hand side of table 1.1.

Here I would like to propose another version of a definitive test of autonoetic episodic memory that can be administered to nonlinguistic animals such primates. (Nonprimate versions require fine-tuning of some of the practical details.)

### The Spoon Test

It is indeed difficult to see how one could differentiate between autonoetic remembering and noetic knowing in nonverbal organisms in situations where both the remembered events and acquired knowledge are derived from the past. But if one accepts the idea that autonoetic consciousness encompasses not only the past but also the future, the problem becomes tractable. The resolution of the fourth problem lies in autonoetic awareness of the future.

Here I propose a future-based test of autonoetic consciousness that does not rely on and need not be expressed through language. In order for us to be able to unambiguously refer to the kind of a test for autonoetic episodic memory that I have in mind, and that others would find convincing, let me refer to it as the spoon test. Because no other spoon test exists in the literature, the use of the term gets us immediately to the idea referred to.

In an Estonian children's story with a moral, a young girl dreams about going to a friend's birthday party where the guests are served delicious chocolate pudding, her favorite. Alas, all she can do is to watch other children eat it, because everybody has to have her own spoon, and she did not bring one. So the next evening, determined not to have the same disappointing experience again, she goes to bed clutching a spoon in her hand.

We do not know much about the heroine of the story. But we can surmise that she is intelligent, can learn from experience, is capable of reasoning, and can solve problems like that of the missing spoon: If they do not give you one, bring your own. At this point in the story in this essay, we also know that she can mentally travel in time, not only into the past but also into the future, that therefore she must possess autonoetic consciousness, and, furthermore, that she is probably more than 4 years old.

I would like to suggest the spoon test as a possible kind of test for the purpose of assessing the presence of autonoetic episodic memory in any species, or, indeed, in any individual member of a species. The test is independent of linguistic or other symbolic abilities of the tested species or individuals, and does not require any first-person testimony regarding phenomenally apprehended processes or states. Yet, if successful, it would provide evidence of the kind that could not be readily explained without the postulation of something like covert, neurocognitively grounded, autonoetic consciousness of one's existence in protracted time and the ability to make use of this consciousness. Therefore, if successful, the test would force the rejection of the hypothesis.

To pass the test, the individuals must act analogously to carrying their own spoon to a feast that is likely to come in another place and at another time. In practical terms, a chimpanzee or gorilla "spoon" could be a straw for drinking water that is not otherwise accessible. They can do so, the argument is, if and only if they possess the ability to mentally travel into (or foresee, preexperience, anticipate) the future. Lloyd Morgan's canon would not apply in this case, because it is difficult to imagine any simple explanation of the behavior in question that does not include a reference to a neurocognitive capacity like autonoesis.

The spoon test can be arranged in a number of specific ways, provided that three general requirements are observed. Its first, central requirement is that the test subject must deliberately engage in behavior that could not come about in the absence of mental time travel into the future. That means, as already discussed, the behavior in question must not be instigated by, and must not satisfy, a present need or be governed by current physiological states.

A second important requirement is that the execution of the critical behavior should not be triggered, evoked, or guided by specific environmental stimuli that were present in the original learning situation. This requirement has turned out to be the most difficult one to meet in past research on episodic memory in animals. Yet is critical because in its absence one cannot rule out the possibility that the behavior is governed by nonautonoetic associative learning and retrieval mechanisms. This means that the test subject must not be tested in the same environment in which the to-be-remembered information was encountered or the event witnessed.

A third requirement is that the critical behavior should turn out to satisfy a need that will be a part of the physical or psychological reality of the animal on an occasion that actually will arise in the future. Behavior serving to satisfy current needs, or triggered and maintained by a discriminative stimulus potentiated during an earlier learning episode, requires no mental time travel; it can occur, even if on a particular occasion it need not occur, independently of the current, perceptually present reminders of the learning episode. Behavior not serving any current needs but serving future needs does so.

The spoon test has implications for the possibility of observing future-oriented behavior in animals in their natural habitat. For example, it is not the making and using of tools that is critical, but rather storing them, or carrying them from one place to another, that points to mental awareness of the future. Goodall (1986) has reported such behavior in her chimpanzees of Gombe. If the observations could be repeatedly confirmed, under conditions where no physiological need for food and hence food-related behavior is present, they would constitute evidence against the thesis of this essay. Conversely, using the same line of argument, deliberate burial of the dead is a possible piece of evidence of future thinking in early hominids, but more convincing is the provision of the dead with grave goods.

Finally, note the requirement regarding a different place: The future intention should be directed at something that happens in a place other than one in which the present preparatory action is carried out. The spoon has to be picked up here and now, with a deliberate intention of putting it to use somewhere else at a future time. The major reason for the insistence on different place has to do with the minimization of the influence of the present situational cues on the spoon-carrying behavior. [Keeping in mind the Clever Hans story, the requirement for differences between original learning and present test should be extended to the experimenters, as indeed has been done in some of the well-controlled recent studies (Menzel, 1999; chapter 9, this volume; see also Schwartz et al., 2002).] In their research on "what, where, and when" of memory with scrub jays, Clayton and

colleagues (Clayton et al., 2003; Clayton & Dickinson, 1998) tested the knowledge of the jays' spatial (where) component of an earlier event in the same environment in which the original learning took place. Thus their "where" component of the jays' knowledge was defined in terms of differences in local space, within one and the same visual environment. Testing episodic recollection of an event in a place other than the one in which the event took place would make for a more realistic analogue.

### Is the Spoon Test Unfair?

Is the spoon test too difficult for nonhuman animals? Are we expecting and demanding too much? Are all the conditions that the nonhuman test subjects must meet to satisfy really necessary? In general, by repeatedly changing the rules of the game and setting the bar at increasingly high levels, are we being unfair to our fellow travelers on Spaceship Earth? Let me briefly note three points.

First, the spoon test is not difficult by human standards. Many, if not most, 5-year-old children would have no trouble passing it, and the rest of humankind takes the kind of abilities required to pass the test so much for granted that they have not even found it necessary to develop special terminology to discuss it objectively. Indeed, generations of humans have been taking thousands upon thousands of spoon tests over thousands upon thousands of years, even if they did not know they were doing so. And they have been passing them satisfactorily, at least some of the time, even if not always with flying colors. They have learned what the world is like from their experience and then, being armed with the extraordinary insight that the world in which they and their children will have to live will be there tomorrow, and again the day after, and even after the next dry season, or the next cold season, they have gone ahead to fashion it into a more hospitable place to live. The discovery that one need not always adapt to the world as it exists, and that one can change aspects of it for the better, has been made only by a few species, scattered here and there through the animal kingdom. In all cases other than humans, the ability to shape the world to better suit one's needs is limited in scope and requires no autonoetically guided learning. In the case of humans, the discovery that one can improve one's chances of survival by reshaping the world was based on the presumably gradual emergence of a wholesale awareness of a dimension of the world that does not exist as a component of the brain/mind in other species. Like the electric fish with their self-generated electromagnetic fields in which they can detect signals of which other creatures under the sea remain unaware, and like the migrating birds that are sensitive to the magnetic properties of the earth which exist for others only physically but not physiologically, human beings are blessed with a remarkable

awareness of a dimension of the world that seems to have eluded the grasp of other nervous systems. The slow emergence of this special kind of awareness, autonoesis, in ways that we can only guess at, must have been one of the most momentous events in human evolution.

Second, as to the fairness of moving standards, think of the electric fish, or bats, or barn owls, and imagine them trying to test humans on the kinds of brain/mind achievements that they take very much for granted. If Dr. Doolittle asks them, would they admit being worried about the tests being fair for humans? I think not. If something is possible for one species, it is, in principle, obviously possible for another.

Third, it is regrettable, perhaps, that our ideas about the world, including ideas about the brain/mind and memory, do not stay put over time. Life would be simpler if they did. For example, Nicola Clayton's scrub jays would have been certified as full-fledged episodic creatures back in 1972. But whether we like or do not like the changes in our ideas about nature, there is no other way in science. Science lives and survives only as long as there is progress in its understanding of nature, and change is a necessary condition of progress. Those who seek and need the comfort of permanent certainty can find it in other scripts and books composed by great authorities.

## SUMMARY

Many claims have been made about human uniqueness, that is, about human brain/mind capacities that other animals do not possess. The list of such capacities is long. It is reasonable to assume that no single item in the list alone is responsible for "making us what we are." What makes humans unique is a collection of capabilities that emerged in human evolution some time after what became the human line broke off from what became the chimpanzee line.

In this essay, I have discussed what I believe is a worthy candidate on the list of unique human traits, namely autonoetic episodic memory. Autonoetic episodic memory makes it possible for people to engage in a kind of conscious activity, mental time travel, that is beyond the reach of living creatures who do not possess episodic memory. Mental time travel takes the form of remembering personally experienced and thought-about events, occasions, and situations that occurred in the past, together with imagining (preexperiencing) personal happenings in the subjectively felt future.

Autonoetic episodic memory is a singular, even if underappreciated, achievement of biological evolution. Its separate existence was largely unknown until recently, and its relationship to other kinds of memory has not yet been thoroughly studied. We have good evidence

of its existence only in humans, but even among humans the distribution and prevalence of (autonoetic) episodic memory is not yet well known. It is reasonable to assume that there are (large) individual differences among humans in autonoetic episodic memory, but the matter has not yet been studied. It is even possible to imagine that intelligent and cognitively capable human beings live in our world today who have no autonoetic episodic memory and who may not be even (fully) aware that they lack a kind of consciousness that others sometimes talk about. This issue seems to be worthy of careful study quite independently of the central thesis of this essay.

Episodic memory is unique to humans in the sense that no other animals have yet been reliably reported as being capable of behaviors that require episodic memory. Many kinds of complex behaviors of many kinds of animals can be, and have been, interpreted as manifesting episodic memory, and in many cases these behaviors do have many features in common with behaviors that are grounded in episodic memory. Practically invariably, however, the same behaviors can also be interpreted more parsimoniously, as manifestations of semantic or declarative memory, which do not provide for, and do not require postulation of, the apprehension of subjective past or subjective future time.

The hypothesis that episodic memory does not exist in nonhuman animals is part of, and follows from, a broader theory of episodic memory that is meant to be (1) internally consistent, or at least as consistent as possible at the present stage of our knowledge, and (2) not clearly contradicted by any empirical facts, at least as they are known to us today.

A central part of the theory is the assumption that episodic memory "grows out of but remains embedded within" other memory systems, in particular semantic memory (Tulving, 1984, p. 260). Semantic (or declarative) memory temporally precedes episodic memory both in phylogenetic evolution and in ontogenetic human development, and it provides a foundation for the operations of episodic memory in organisms that possess it. To accept the thesis of this essay, one must accept the idea of the precedence of semantic over episodic memory, along the lines indicated above, or in some improved form. This idea is one of the linchpins of the theory.

The hypothesis of the uniqueness of episodic memory in humans, like many other scientific hypotheses, is difficult to prove, for logical reasons. But it is amenable to evaluation by empirical data, and it can be proven false. I have suggested one scenario, dubbed the spoon test, whose empirical demonstration would be contrary to the uniqueness hypothesis. The test is independent of linguistic or other symbolic abilities of the tested species or individuals and does not require any

first-person testimony regarding phenomenally apprehended processes or states. Yet, if successful, it would provide evidence of the kind that could not be readily explained without the postulation of covert, neurocognitively grounded, autonoetic consciousness of one's existence in protracted time and the ability to make use of this kind of conscious ability. That is, if successful, the outcome of the test would force the rejection of the hypothesis as currently formulated.

Finally, what about Darwin's differences in kind and in degree between humans and others? What about the rope of phylogenetic continuity with its two ends? How do the various claims for human uniqueness, including autonoetic episodic memory, fit into the picture?

There is no profound mystery here, and no need to create one. There are things that bees, birds, and humans all do. But there are also things that bees do but birds and humans do not. There are things that birds do that bees and birds do not. And there are also things that humans do but bees and birds do not. All living creatures are similar to one another in many ways, and they are also different from one another in many ways. The differences are neither in kind nor in degree; they are differences in light of similarities. Life is part of an endless matrix of sameness and diversity that is nature.

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