

## THE MEMORY DIVISIONS OF TULVING VERSUS SQUIRE – ADVANTAGES AND DISADVANTAGES FOR NEUROPSYCHOLOGY AND MEMORY ASSESSMENT

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### Abstract

Though already at the beginning of the 20<sup>th</sup> century first attempts on long-term memory subdivisions had been proposed, it was only in the 1970ies and 1980ies that such divisions were recognized by a wide audience. From Endel Tulving came in 1972 the division of memory into episodic and semantic memory, from Mishkin and Petri in 1984 that on a ‘memory’ and a ‘habit’ system. Larry Squire then a bit later suggested a very elaborated outline of memory subdivisions. Commonalities of all proposals are the distinction between simple and complex, or unconsciously/implicitly versus consciously/explicitly acting. Tulving – in interaction with one of the authors (HJM) – nowadays divides into five long-term memory systems, of which two are unconscious (“anoetic” in his terminology), two conscious (“noetic”) and one self-conscious (“autonoetic”). These are – from simple to complex: ‘priming’, ‘procedural memory’, ‘perceptual memory’, ‘semantic memory’ and ‘episodic memory’. Squire’s subdivisions of memory are – compared to Tulving’s – both more simple in one way and more complex in another way: As a more simple distinction he uses the terms ‘declarative’ (consciously processed) and ‘nondeclarative’ (unconsciously processed) memory. He then divides ‘declarative memory’ into semantic and episodic memory, or memory for facts versus for events. ‘Nondeclarative memory’ he divides – similarly to Tulving – into ‘procedural’ and ‘priming’ memory, but then in addition into ‘simple classical conditioning’ and ‘nonassociative learning’. Advantages of Tulving’s model are the simpler divisions, and – above all – the clear separation of ‘episodic’ from ‘semantic’ memory. This last distinction is of major importance, as both neurological and psychiatric are usually not disturbed in ‘declarative memory’ in general, but only in its episodic part, while semantic facts are preserved. Therefore, to speak of impairment in ‘declarative memory’ is not useful. The further detailed diversification of ‘nondeclarative memory’ in Squire’s model is theoretically relevant, but of not much use in the general clinical practice (and is rarely ever tested in patients). Therefore, Tulving’s model of memory subdivisions is recommended from a practical-clinical point of view.

**Keywords:** *Episodic memory, semantic memory, procedural memory, priming.*

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### 1. Introduction

Everyone is familiar with the distinction of memory into short-term and long-term memory. Short-term memory lasting for seconds or incorporating about five bits of information (Miller, 1956; Cowan, 2001). Repeating a short telephone number being an example. Long-term memory on the other hand is seen as principally unlimited in capacity and time. While this distinction still is seen as widely sufficient for people outside the memory field, there was a movement towards a refinement and towards more distinction of long-term memory since more than a century (Ziehen, 1908; Schneider, 1928). Schneider (1928), for example, observed and tested the memory capacities of war veteran patients from World War I and concluded that they may be poor on verbal memory tests, but still show some automated or routine forms of memory. Based on such detailed observations on old memory researchers (e.g., also Semon, 1904), Tulving in 1972 came to the conclusion that memory is not a unity, but has to be divided into an episodic and a semantic memory system (see also Staniloiu et al., 2020a). Eleven years later he refined this assumption in a ground-breaking monography on episodic memory (Tulving, 1983). A year later and based on animal research, Mishkin and Petri (1984) so to say reinvented the distinction of Schneider from 1928 and proposed the distinction between a ‘memory’ and a ‘habit’ system – implying a conscious system of remembering and an unconscious system which produces schematized habits.

This distinction was thereafter taken up by both Endel Tulving and by another eminent memory researcher, Larry Squire. Both of them then developed frameworks or models of memory systems which included the same, “untouched” short-term memory system and a number of long-term memory systems (Tulving & Markowitsch, 1998; Tulving, 2002, 2005; Squire et al., 1994; Squire, 1993).

## 2. The Models

Tulving, in interaction with the first author (HJM) developed the long-term memory model depicted in Figure 1 and Squire the one depicted in Figure 2.

Figure 1. The long-term memory systems after Tulving.

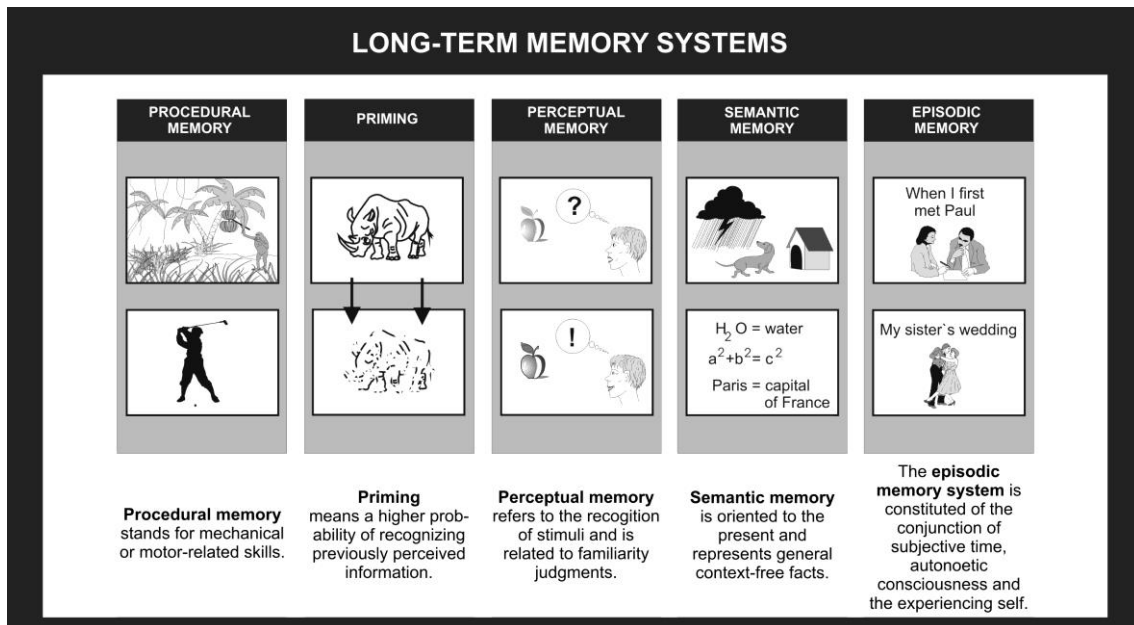
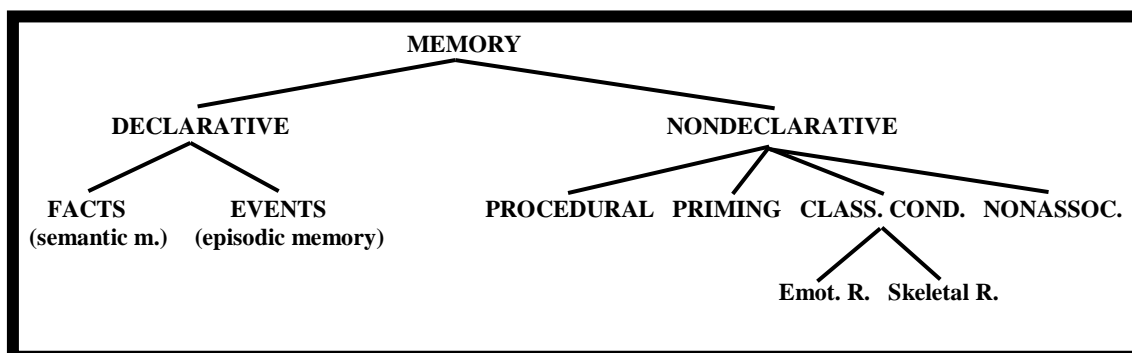


Figure 2. The long-term memory systems after Squire.

(Abbreviations: m. = memory; CLASS. COND. = classical conditioning; NONASSOC. = nonassociative; Emot. R. = Emotional Responses; Skeletal R. = Skeletal Responses)



### 2.1. Tulving’s model

Tulving’s model is based on five long-term memory systems. *Procedural memory* is largely motor-based, but includes also sensory and cognitive skills (routines). *Priming* refers to a higher likelihood of re-identifying previously perceived stimuli. *Perceptual memory* allows distinguishing an object, item, or person based on distinct features. *Semantic memory* is context-free and refers to general facts; it encompasses general knowledge of the world. *Episodic memory* is context-specific with respect to time and place. It allows mental time travel and is based on self-reflection (autooiesis). Examples are events such as the last vacation or the dinner of the previous night. The terms “remember” and “know” describe the distinction between episodic and semantic memory, as remembering requires conscious

recollection embedded in time and space and with an emotional flavoring, while knowing represents a simple, though conscious, yes/no distinction without further connotations. Tulving (2005) assumes that during ontogeny (as well as during phylogeny) memory development starts with the procedural and priming memory systems and ends with episodic memory, a system that he reserves for human beings, while all other systems can be found in animals as well. With respect to dimensions of consciousness, Tulving considered the first two memory systems as being *anoetic*, the next two as *noetic*, and the episodic to be *autonoetic*. So, in line with data from memory research in human infants (Nelson & Fivush, 2004, 2020) he emphasizes that the semantic (*noetic*) memory system develops before the episodic (*autonoetic*) memory system. Only this last one is based on self-consciousness and – consequently – on a developed ego.

## 2.2. Squire's model

Squire distinguishes into two major branches of memory: declarative (about which can be spoken) and nondeclarative (which works without semantic descriptions). The declarative system has two divisions (fact and event memory), which for Squire seem to be of equal importance, as he put them on the same level. The nondeclarative memory systems are manifold and contain the same priming and procedural memory systems which can be found in Tulving's classification, but in addition two forms of simple learning (classical conditioning and nonassociative learning) which are based on phylogenetically old brain structures below the cerebral cortex and reaching down to the spinal cord.

Squire's model has on the one hand several similarities with that of Tulving (the incorporation of episodic, semantic, procedural, and priming memory systems and the distinction into consciously processed = declarative and unconsciously processed = nondeclarative memory systems), on the other hand it has important differences. The severest difference is that Squire uses the term 'declarative' to incorporate both episodic and semantic memories. Subsuming both of these systems creates the following problems:

- Noetic and autonoetic memory processing is not differentiated.
- Most neurological and many psychiatric patients with memory problems have their memory problems in episodic memory only; therefore, describing that their 'declarative' memory is impaired fails to make justice to their deficit.
- The subdivision of declarative memory into fact (semantic) and event (episodic) memories lets them appear on an equal, non-hierarchical level.

## 2.3. Comparison of the memory systems of Squire and Tulving

Tulving sees a clear hierarchy between the consciously processed memory systems, where episodic memory stands at the top. This hierarchical arrangement is justified, as episodic memory processing requires a synchronous activation of factual and emotional components which then constitute the representation of an event (Staniloiu & Markowitsch, 2020). Furthermore, self-reflection (*autonoesis*) is required to attribute the events as having been experienced by oneself in the past. We *remember* the episode by traveling back in time. Fact memory on the other hand is a pure knowledge-based system, where he *know* that a table has a plate and legs. Semantic memory therefore is a system oriented towards the present – no time traveling is required to name an item a table and we usually do not have an emotional relation to tables.

This differentiation in complexity is reflected in memory development, where children first acquire facts about their environment – that is, they learn in a semantic manner. Only later in life and based on narratives (conversations with their parents) they acquire episodic memory and perform mental time travels (cf. Figures 2 and 3 of Markowitsch & Staniloiu, 2022, or Figure 1 of Nelson & Fivush). Vice versa, brain diseases such as dementia first lead to a deterioration and decay of episodic memories, while semantic fact memories remain preserved for a long time (e.g., Lecouvey et al., 2019; Seidl et al., 2011; Urbanowitsch et al., 2013).

## 3. Example and conclusions

A proper example for the discrepancy between fully preserved semantic or fact memory and fully blocked episodic or event memory are patients with the psychiatric disease condition, named 'Dissociative amnesia' (Staniloiu & Markowitsch, 2014; Staniloiu et al., 2018, 2020b). These patients usually have no memory of their personal past, that is no episodic memory, while they can function normally in everyday situations because of their preserved semantic and procedural memory. They know who is president of their country or who was Einstein, though they cannot remember their closest relatives.

This example demonstrates the usefulness of Tulving's hierarchy of memory systems and speaks against the careless use of the term 'declarative memory'. A cautious reflection of memory terminology is therefore advisable both in research and clinical applications.

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