evidence for, or even fits within, the wider framework proposed. The account hinges upon the role of inference-making in remembering: How does this facility arise in the synergistic ecphory model?

Questions of this kind may perhaps be considered as addenda to one of the other principal attractions of the book under discussion. This is the liberal scattering of ideas for future lines of research, and indeed for whole new areas of research. An example is the topic of retrieval mode: the hypothesised state of preparedness into which a person must enter if any potential retrieval cue is to be effective. Regardless of such future developments, however, it is clear that this book already represents a substantial advance in our understanding of the organization of memory.

A fact is a fact is a fact

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In a career spanning more than a quarter century of published work, Endel Tulving has been at the cutting edge of the field of memory. He has a special knack for producing counterintuitive findings and careful arguments that, when fully appreciated, lead to major advances in theoretical development. The list of such products is long: part-to-whole negative transfer, the A + 2B effect, subjective organization, availability versus accessibility, cue-dependency, episodic ecphory, and especially the recognition failure of recallable words. Each of these findings or theoretical principles has dramatically altered the way in which we view the structure and function of the memory system. One of the results of his efforts has been the abolition of distinctions that have had broad appeal for other theorists. Early on, for example, he argued against a qualitative difference between primary (short-term) and secondary (long-term) memory (Tulving 1968a; 1970). Somewhat later, and more to the point of the book under review, he denied that there was a qualitative difference between recall and recognition (Tulving 1974; 1976). In my view his arguments have been extremely compelling, and have promoted the development of a unitary conception of the memory system. So when in *Elements* Tulving argues for a *difference* within the memory system, we are well advised to sit up and take notice.

The general case for a distinction between episodic and semantic memory is intuitively appealing. This is true even of the original argument (Tulving 1972), now described as "inchoate." The empirical evidence mustered in its favor is also extremely compelling. This applies especially to the demonstrations of single dissociations (double dissociations would be even better), where an independent variable is observed to affect performance on one type of task but not the other. In particular, the literature on clinical and experimental amnesias seems to demand a distinction between episodic and semantic memory. Nevertheless, it is unclear exactly what kind of distinction is to be drawn. Tulving wants to go beyond a mere heuristic distinction, or one that postulates different types of knowledge stored in memory. He also rejects a quantitative distinction, which would hold that episodic and semantic memories differ in terms of the number or strength of self-referent and contextual features associated with them. He appears to favor a distinction rooted in biological structure, as if episodic and semantic memories resided in separate locations in the brain, or consisted of separate, parallel, networks of neurons. In this regard, it is worth remembering that the amnesic syndromes, now used by Tulving to suggest a structural distinction between episodic and semantic memory, were used not too long ago to support a structural distinction between primary and secondary memory. Many theorists now favor a unitary model of memory, in which primary memory comprises those memory structures which are activated at any given moment.

Why not opt for a similar solution with respect to the episodic/semantic distinction? Assume that a declarative memory can be characterized as a bundle of features describing an object or event. Such a memory can be portrayed graphically as a set of nodes representing concepts interconnected by associative pathways representing the relations between them to form propositions. Some of these propositions represent semantic knowledge about similarities (e.g., *Grenada is like Afghanistan*), category membership (e.g., *A robin is a bird*), characteristic attributes (e.g., *Birds have feathers*), or other facts (e.g., *A hippie touched a debutante in the park*). Others represent episodic knowledge about personal experiences in which propositions describing some event are linked with others representing the self as actor and experiencer, and the spatiotemporal context in which the event occurred – e.g., *I saw a bird in the park on Thursday afternoon* (Kihlstrom 1984; Kihlstrom & Cantor 1984). According to this argument, the concepts out of which episodic memories are formed are the same as those that comprise semantic memories, but the propositional links are different. Thus, a single memory system can represent both episodic and semantic forms of knowledge, and one is not led to search for anatomical or physiological correlates of the difference between them. Such a proposal does not seem to rely on a hypothesis of associative continuity, in that the associative links involved in episodic and semantic memories are different. But it does assume the transsituational identity of the underlying conceptual nodes.

Perhaps the most compelling experimental evidence in favor of a unitary theory of memory comes from the very experiments Tulving cites as revealing the operation of two separate systems. Typically, there is a dissociation observed between episodic and semantic tasks, which is the primary evidence for two separate systems. But this is also accompanied by a priming effect on the semantic task stemming from the (episodic) study phase. A similar difficulty is presented by free radicals in memory, bits of semantic knowledge, or beliefs, which have their origin in some particular experience but which have lost the self-reference and contextual features that would give the memory episodic nature. Tulving recognizes the problems created by these findings, as they seem to imply that an episode of experience has affected the contents of semantic memory. His appeal to procedural memory as the mediator of the priming effect, and his suggestion that free radicals comprise yet a third form of declarative memory, both have an ad-hoc quality. It would seem much simpler to suggest that episodic memories are formed from semantic memories representing the features of the event, the self, and the situational context. A failure to encode, store, or retrieve the self-referent or contextual features, whether through normal forgetting or some amnesic process, would result in a performance deficit on an episodic-memory task; but the residual activation of the underlying conceptual knowledge would result in temporary facilitation on a semantic-memory task. Similarly, a novel experience would lead both to the formation of a proposition describing the new fact and a linkage between this fact and the personal context in which it was acquired. A failure to encode or preserve these episodic features would have no effect on the status of the fact itself as a new entry into semantic memory, which could then be accessed in the same way that any other semantic memory is retrieved. I admit to difficulty accounting for long-term, modality-specific priming effects. Perhaps these are procedural in nature, though procedures shouldn't be modality specific.

In arguing for at least a functional distinction between episodic and semantic memory, Tulving asserts that the two systems can operate independently, although it is more efficient for them to coordinate their activities. But it is difficult to understand how an episodic memory could ever be encoded without contacting the concepts in semantic memory that correspond to

the features of the event. Such an encoding must involve linking self-referent and contextual information either to the semantic memory node itself or to a copy of that node stored separately from the original. Despite Hilgard's (1965, p. 660) dictum, parsimony would seem to favor the former alternative. The desire for parsimony must be frustrated by the distinction between declarative and procedural memory (Anderson 1983; Winograd 1975a) – because, as Tulving notes, the former has a propositional representation and accessibility to consciousness while the latter does not. The episodic/semantic distinction within declarative memory undoubtedly has heuristic value, providing a useful means of categorizing the kinds of information stored in memory and supplied by queries to the memory system, and the kinds of retrieval tasks to which the rememberer can be put (Cantor & Kihlstrom 1982; Hastie & Carlston 1980). But there doesn't seem to be any need to argue for two *separate* propositional systems when one will do. Semantic memories are facts about the world. Episodic memories are facts too, about the self. Facts are facts, and they all ought to be representable within a common pool of declarative memories.

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Armchair theorists have more fun

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Imagine a person who perceives the world in black and white and suddenly discovers that the rest of the world sees colors. The response may not be very different from that of psychologists studying human memory with traditional list-learning procedures when they read Tulving's 1972 article on semantic and episodic memory. It now seems obvious that subjects who repeat back a list of words are remembering not the words, but their occurrence in an autobiographical episode. But what seems obvious now was not then, and to some readers at least, the episodic/semantic distinction suggested that half of human memory remained unexplored despite decades of contemporary investigation.

In making this point clear, Tulving's depiction of semantic and episodic memory has had obvious heuristic value. But in *Elements* he argues that it has more; that it represents a distinction between two systems of memory with the potential for independent function. Unfortunately, the evidence for the dual-systems approach to semantic and episodic memory is far from unequivocal.

The still unresolved debate about imagery and propositional knowledge should have taught cognitive scientists something about the perils of duality assumptions. [See Pylyshyn: "Computation and Cognition," *BBS* 3(1) 1980 and Kosslyn et al: "On the Demystification of Mental Imagery," *BBS* 2(4) 1979.] The present case is particularly problematical because it is unclear what is meant by dual memory "systems," especially when the proposal comes from someone who has long criticized the tendency of theorists to divide memory into boxes. The experimental evidence Tulving reviews seems to consider two potential bases for separating the memory systems: It should be possible for one to operate without affecting the other (a lack of transfer), and there should be some variables that influence the systems in different ways. But as Tulving concedes, virtually any experimental evidence along these lines can be interpreted in terms of a unitary theory of memory, in which distinctions are made between semantic and episodic *knowledge*, semantic and episodic *tasks*, and/or semantic and episodic *decision rules*.

On the basis of the experimental work described, it seems doubtful that anything more is needed than a content distinction between semantic and episodic memory. With the straightforward assumption that "Episodic information is picked up by the learner on a particular occasion, at a particular time in a particular place, and . . . semantic information has no such association with a particular occasion of acquisition" (p. 63), other distinctions follow without the need for postulating dual systems. For example, episodic tasks probe for information about the acquisition context whereas semantic tasks do not, providing ample potential for differential effects of experimental variables.

At first glance, at least, some of Tulving's "armchair arguments" for separate systems seem more persuasive. One in particular concerns the nature of the conscious experience of remembering. To remember semantic knowledge is to have a feeling of knowing, but to remember episodic knowledge is to reexperience. One is cold cognition, the other hot. Somehow this is not captured by models of memory in which episodic and semantic knowledge are distinguished solely by the presence/absence of associations to contextual information. Why should the mere presence of context change the phenomenological experience of retrieving information from memory?

A better account of phenomenological differences between remembering facts and remembering events may lie in considering the nature of the retrieved information. For example, Johnson and Raye (1981) have suggested that certain elements in the traces of past events are particularly useful in evaluating whether those events were real or imagined. These include not only information about spatial and temporal context, but also the sensory quality of the memory trace, its semantic elaboration, and records of how it was encoded. Although these data appear to be represented to different degrees in the traces of real and imagined events, the critical point here is that to some degree they are properties of episodic representations in general. If the activation of such information in episodic traces (the ecphoric component of memory retrieval, as Tulving terms it) were to simulate the perceptual, semantic, and affective reactions of the initial experience, remembering would have the "warmth and intimacy" that William James attributed to it. *Episodic* remembering would, that is. The retrieval of semantic information, lacking the record of a particular encoding circumstance, would be a considerably more barren experience.

Note that differences in the experience of remembering episodic and semantic information do not require the assumption of separate systems. The above hypothetical account, which attributes phenomenological differences to the content of what is retrieved, does require considerable speculation about the nature of the information in memory episodes and the effects of activating that information. Nonetheless, pushing the semantic/episodic distinction along these lines seems more promising than trying to justify a new taxonomy of memory.

The episodic/semantic continuum in an evolved machine

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Tulving's *Elements* is many things. It *is* a superb, if disguised, treatise on the philosophy of science. It is a uniquely informed scientific history of the field of memory, including a clear and concise synopsis of the author's considerable scientific accomplishments and a capsule view of the most influential empirical findings in memory research during the last two decades. Finally, and perhaps most important, it presents a general prethoeretical system – General Abstract Processing System (GAPS) – for the study of human long-term memory.

As a philosophy of science, the book illuminates the processes