VARIETIES OF MEMORY AND CONSCIOUSNESS: ESSAYS IN HONOUR OF ENDEL TULVING. H. L. Roediger and F. I. Craik (eds). Erlbaum, Hillsdale, NJ, 1989. No. of pages: 445. ISBN 0–89859–935–0 (hardback), 0–8058–0546–x (paperback). Price: $74.95 and $29.95, respectively.

It is sometimes said that there are two types of people: those who believe there are two types of people and those who do not. A postulate of this maxim appears to hold for the contributors to Roediger and Craik's edited volume *Varieties of memory and consciousness: essays in honour of Endel Tulving*. it seems that there are two types of memory researchers: those who believe in two or more types of memory systems and those who do not. Actually the world of memory research, as elegantly explored in the Tulving *Festschrift*, is a bit more complicated because not only do the contributors disagree over whether multiple memory systems exist, those who espouse multiple systems disagree about what those systems are. Indeed, after reading the book I found myself a bit foggy on what a distinct memory system really means. The book includes 20 chapters, written by many of the most prominent researchers in the field, that are divided into four sections addressing the different broad areas of memory research to which Endel Tulving has made important contributions: encoding and retrieval processes; neuropsychology; classification systems for memory; and consciousness, emotion, and memory. All four sections, however, are permeated by a central interest of Tulving: whether and how to classify memory systems.

Much of the evidence offered throughout the text in support of distinct memory systems relies on dissociations (a dissociation involves a pair of experimental manipulations or neurological lesions, manipulation *A* and *B* say) and pair of tasks (call them task *x* and task *y*). If manipulation *A* influences performance on task *x*, but not task *y*, we have a dissociation. Dissociations provide some evidence for distinct systems. However, they may also suggest hierarchical structure; i.e. task *x* may correspond to processes that occur later in the information processing sequence than those associated with task *y*. If, in addition, manipulation *B* influences task *y* but not task *x*, then we have the much-celebrated double dissociation. Double-dissociations between two tasks are held by many authors in this collection to suggest separate systems in the sense that they are each associated with distinct functions.

In one of the most optimistic assessments of dissociations, Weiskrantz reviews the evidence for dissociations resulting from various different forms of neurological damage, and concludes that at least some evidence exists to support hypothesizing distinct systems for short-term memory (STM)/long-term memory (LTM), modalities of STM, knowledge and skill (or what is also known as declarative vs procedural memory), classical vs instrumental conditioning and event (episodic) vs other types of long-term memory. Other researchers also provide neurological dissociations as evidence for distinct memory systems. For example, Cermak

comments on the dissociations between amnesiacs' ability to *analyse* the relationship between two words and their inability to *encode* that relationship in order to benefit from it at the time of retrieval. A number of researchers comment on the remarkable dissociation between amnesiacs' capacity to be influenced by an event while being unable to recall that event phenomenologically. For example, amnesiacs' ability to solve an anagram may be facilitated by previous exposure to its solution, even though they have no recollections of having seen the solution. Both Moscovitch and Schacter use such dissociations to suggest that conscious awareness is a distinct component of the memory system. Indeed, according to Kinsbourne, the role allocated to consciousness may be what distinguishes our hypothetical two types of memory researchers:

> 'What divides those who subscribe to Tulving's two memory system (namely episodic versus the rest) from those who do not is whether they consider the presence or absence of awareness to be a promising organizing principle for distinguishing brain systems' (p. 180).

In addition to neurological dissociations, a variety of researchers describe experimental dissociations as evidence for distinct memory systems. For example, Broadbent notes that recall of spoken words is impaired by interpolated auditory tasks but not visual tasks, whereas the opposite is true for visual memory performance. Accordingly such findings suggest distinct memory codes. Broadbent also notes that concurrent verbal tasks impair the acquisition of rule-based performance but do not affect performance on tasks that are associated with learning that cannot be verbalized. This experimental dissociation provides further experimental support for the distinction between declarative and procedural knowledge. Other researchers further pursue the value of experimental dissociations. Experiments by Jacoby, Kelley and Dywan persuasively demonstrate that the processes that contribute to the feeling that a stimulus is familiar can be quite distinct from those that retrieve the actual memory representation. In addition, Neely rigorously documents eight different types of experimental controls that must be taken into account before experimental dissociations between semantic and episodic tasks can be meaningfully interpreted.

Although many of the authors in the Tulving *Festschrift* favour memory taxonomies, there is a vocal minority who express marked reservations. Murdock suggests that many of the newer memory distinctions may fall victim to the same problems that befell much of the evidence for an STM/LTM distinction. For example, dissociations between the effects of different variables on the primacy and recency portions of the serial position curve have been shown to be equally consistent with a unitary store approach. Crowder suggest that while there is considerable evidence for *coding modularity* corresponding to different sensory modalities, there is little reason to believe in *processing modularity*, in which systems are distinguished by the common processes that they use. Olton shows how the venerable double-dissociation between two tasks can occur with a single memory system if performances on the two tasks are differentially sensitive to task demands. Roediger, Weldon, and Challis suggest that experimental dissociations may be better understood using a 'transfer appropriate processing' approach which assumes a match between the processes employed at encoding and those employed at test. Thus double-dissociations may reflect emphasis on different *processes* rather than different *systems*.

There are a few authors in the text who manage to stay clear of the unitary/multiple memory debate. Anderson provides a fascinating account of a variety of memory phenomena, ignoring the specifics of internal representations and mechanisms, instead exploring the implication of assuming that 'Human memory behaves as an optimal solution to the information-retrieval problems facing humans' (p. 195). Given the mystification that I experienced trying to decide what in fact constitutes evidence for a distinct memory system, Anderson's avoidance of these issues seemed quite refreshing.

As exhilarating as it was to read many of the greatest minds in memory research discuss many of the field's most central issues, I still ended up a bit perplexed. Although much of the text was spent debating the evidence for different memory systems, relatively little discussion addressed what a memory system really means. Do different systems necessarily require distinct neurological substrates? Some say yes (i.e. Roediger *et al.*), others say no (e.g. Broadbent). What about different neural substrates that behave similarly, or the same neural substrate that has distinct functions? What is the distinction between the definitions of processes, systems,

codes, representations, and modules? In one of the rare explicit attempts to define systems and modules, Schacter suggests that

> '... *multiple memory systems* should be invoked only when two putative systems are characterized by fundamentally different rules of operation ... distinct modules that represent domain-specific information need not imply multiple memory systems, because each of the modules could be operating according to similar rules' (p. 376).

But what exactly constitutes fundamentally different, and which rules is Schacter referring to? At some level, surely all mental operations are constrained by similar rules governing neural activity?

Perhaps a better understanding of the value of distinct systems would result from an explicit discussion of how assuming multiple memory systems that each engage in a few selected processes differs from assuming one system that can engage in multiple processes (e.g. Roediger *et al.*). What might be the adaptive function of multiple systems, and how exactly does the assumption of multiple systems help us to understand basic memory mechanisms? These metatheoretical issues are generally missing from this otherwise very thoughtful collection of chapters.

Although at present there is clearly room for improvement, it seems likely that we may never have a definitive answer to what constitutes a meaningful memory system. But as Watkins notes: 'Keep in mind, too, that when we get right down to it, the distinction between night and day is blurred and arbitrary. But we still make it' (p. 70). Well, the distinction between the arguments of those contributors to the Tulving *Festschrift* who believe in memory distinctions and those who don't may also be a bit blurred. But you should read the book.

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