We recommend that interested readers not stop with the *Précis*, which promises much less than the book delivers. Despite the fact that our view of semantic and episodic memory is very different from Tulving's, few other recent monographs have so stimulated and entertained us. Tulving has always been a brilliant and articulate representative of his discipline, and this book is true to form.

Recoding processes in memory

Elizabeth F. Loftus and Jonathan W. Schooler
Department of Psychology, University of Washington, Seattle, Wash. 98195

As with so many of Tulving's contributions, the broad observations and provocative thoughts contained in *Elements* are certain to influence the future direction of memory research. In brief, Tulving's new book offers an expansion and defense of his 1972 distinction between semantic and episodic memory. In addition, he presents a framework for studying episodic memory, called GAPS for General Abstract Processing System, that outlines a general set of episodic-memory principles. We describe a few kernels of GAPS wisdom that are particularly meaningful to our own research program.

As Tulving correctly notes, one of the pervasive facts about episodic memory has to do with changes over time in recollection of an event. Some changes are due to retrieval conditions, while others are a result of a mutable engram (p. 164). Changes in the engram occur as a result of a variety of processes, and the term "recoding" describes these processes. Recoding operations are central to the functioning of GAPS.

We are sympathetic to the notion of recoding. Over the last several years we have conducted experiments in which subjects view a complex event and are subsequently exposed to new, often misleading, information about the event. For example, they may see a car pass a yield sign but are subsequently "told" it was a stop sign. Under certain conditions, a substantial number of subjects will recall having seen a stop rather than the yield sign. Even strong incentives have failed to produce the original information from memory (Loftus 1983). We have interpreted these results to mean that information to which a witness is exposed after an event is integrated into the witness's memory. In the terminology of GAPS, the original event has been recoded as a consequence of the postevent input.

A question arises as to the fate of the original engrams. Some have suggested that, once formed, they are never changed. The new inputs simply provide additional memory traces which, under proper conditions, can be discriminated from the original ones. However, our view and a strong implication of the recoding process as envisaged in GAPS suggest that after certain modifications of the original engrams, it should not be possible to utilize the information that was originally contained in memory. To show the "recoding hypothesis" to be incorrect can be done quite easily: All one needs is to demonstrate the existence of original information after recoding has allegedly occurred.

Tulving correctly anticipated that attempts to falsify the recoding hypothesis would be forthcoming: Two such efforts have now been published (Bekerian & Bowers 1983; Christiaansen & Ochalek 1983). In these studies, subjects were able to dissociate misleading postevent information from original information even when the postevent information had presumably already been recoded. In one of these studies the critical manipulation involved context reinstatement just prior to the final act of recall, in the other, the critical manipulation involved a strong warning about the presence of erroneous information. It too was given just prior to final recall.

Are we, and GAPS, wrong then, about the fate of recoded information? We think not. With the aid of two ideas – the "free radical" and the "conscious act of retrieval" – we may be able to distinguish between those situations where it is possible to recover original information and those situations where it may not be possible. What appears crucial is whether the critical manipulation occurs prior to conscious recollection or afterward.

Why might conscious recollection be important? Suppose the postevent information leaves a "free radical" or "free fragment" in memory (p. 112), that is, a bit of episodic information detached from the rest of the memory for the episode. Tulving believes that, like free radicals of the chemical world, these bits of memory are highly reactive and unstable. It may be that at the time of the final test, these fragments become laminated, via the act of conscious retrieval, to the memory for the episode. Accordingly, prior to conscious retrieval it is still possible to separate these bits from the original engram whereas afterward it may be exceedingly difficult if not impossible to do so. Recent experiments in our laboratory (Schooler & Loftus 1983) provide support for our proposition that once subjects consciously retrieve a piece of misinformation, they are not readily induced to recover the original engram. Prior to conscious retrieval, they are. In short, we propose that bits of misleading postevent information may exist as free fragments until a subsequent act of retrieval completes the recoding process.

Tulving is sympathetic to the important role of conscious recollection. For him, the act of retrieval is an "event-like mental activity" with many "empirically identifiable consequences" (p. 140). For example, it increases the probability that the event will be recalled on a subsequent occasion.

How "conscious" must the act of retrieval be? We agree with Tulving's emphasis on the distinction between conscious and nonconscious processes. Conscious processing certainly is needed to recall episodic information; that is, by definition, retrieving an episodic memory must include a conscious awareness of the temporal and spatial details associated with its encoding. Other recent research tells us that one's reactions to information can be different depending upon whether it is processed consciously or subliminally (Marcel 1983). Yet questions like (1) how consciously does one need to process postevent information in order for a free fragment to be laid down in the episodic system? or (2) how conscious must the act of retrieval be in order for the recoding process to be maximally completed? remind us that the notion of conscious mental activity is really a matter of degree.

Our hope is that investigators of episodic memory will take Tulving's distinctions as a starting place and run with them. One direction is to distinguish further among the various types of episodic memory. Hertel (1982) has already suggested that thematic episodic memory may differ from memories for specific episodic details. More specifically, she observed that misleading postevent information regarding a specific episodic fact has its greatest effect when it is presented some time after an original event (and just prior to the conscious recall). On the other hand, misleading postevent information regarding the theme of an episodic memory has its greatest effect when it is presented immediately after an original event (and some time prior to conscious recall). This result provides support for a way of further differentiating episodic memory and extending the fruitful work that Tulving has begun.

Inference and temporal coding in episodic memory

Robert N. McCauley
Department of Philosophy, Emory University, Atlanta, Ga. 30322

In *Elements*, Tulving repeatedly describes episodic and semantic memory as "functionally different yet closely interacting" (p. v). They are neither "completely separate" nor "sharply different" (p. 32) and, in fact, have many similarities. The crucial