Journal of Experimental Psychology:
Learning, Memory, and Cognition
1986, Vol. 12, No. 2, 295-306


0278-7393/86/$00.75

## OBSERVATIONS

# A Critical Evaluation of the Semantic–Episodic Distinction

Gail McKoon and Roger Ratcliff
Northwestern University

Gary S. Dell
University of Rochester

Tulving (1983, 1984) has recently claimed that a wide range of evidence supports the distinction between episodic and semantic memory systems. He has provided a list of features to describe the differences between the two systems and a set of experimental results to demonstrate the distinction. In this article, we present opposing evidence that invalidates many of the distinguishing features and contradicts interpretations of the supporting experiments. In addition, we argue that the question of whether there are two separate memory systems cannot be answered without a specific theory about the differences between the systems.

It has long been recognized by psychologists and philosophers that experience leaves its effect on the mind in the form of both specific memories for events and knowledge that is not tied to such events (see Herrmann, 1982, for a review). This distinction was eloquently brought to the attention of cognitive psychologists by Tulving in 1972. Tulving distinguished between episodic memory, which records events directly experienced by the subject, and semantic memory, which stores general knowledge of the world.

The purpose of this article is to examine recent updates of the episodic–semantic distinction proposed by Tulving (1983, 1984). The distinction has proved highly influential in the field: From 1972 to 1984 Tulving's original article (1972) received more than 500 citations in the Social Science Citation Index. The distinction is appealing because it allows one to distinguish between two forms of memory that seem intuitively different phenomenologically, and to distinguish between two domains of research, each with its own tasks and variables.

As well as having these heuristic uses, the distinction has been used to interpret a large range of data. On the face of it, it makes sense that newly learned episodes should be organized differently and have different characteristics from semantic knowledge. For example, Tulving (1983) proposed that semantic information is highly interconnected and organized, relatively permanent, and context independent, whereas episodic information was less well organized, highly susceptible to forgetting, and context dependent. Thus it was possible to interpret experimental results concerning context effects, forgetting, retrieval, and so on in terms of the distinction. In addition, it appeared possible to extend the distinction to neuropsychological data concerning amnesia and brain damage. When the ability to form new autobiographical memories is lost, yet old memories are retained, it could be said that the episodic system is damaged while the semantic system is intact. In sum, Tulving's distinction is of great heuristic and pragmatic use. However, an evaluation of the theoretical and empirical status of the distinction, as presented in this article, leads to the conclusion that the case for the distinction is weak.

In the 1983 version of the distinction, Tulving adds a number of new features that were not discussed in the original 1972 article. Tulving (1983) provides a list of diagnostics that are meant to discriminate between episodic memory and semantic memory, and suggests a larger framework in which there are two more memory systems—lexical memory and procedural memory. He also lists a series of experimental results that are intended to support the episodic–semantic distinction. In the 1984 version, Tulving suggests that episodic memory is embedded in semantic memory, rather than being a separate system from semantic memory. He also provides some new support for the distinction.

We criticize Tulving's proposals in three main ways. First, we argue that the episodic–semantic distinction is not well enough defined to be empirically testable and that many of the diagnostics and experimental results are questionable as support for the distinction. Second, we consider in detail the results from experiments cited by Tulving (1983) as evidence for the distinction and present counterarguments and additional data to show that the results are inconclusive. Third, we point out that even if the distinction were successful in providing a basis for separability of experimental effects, the task would remain of modeling the processes that operate within each memory system. Labeling effects as semantic or episodic does *not* provide a theoretical explanation, but only a categorization. Although there are significant single-store models (e.g., Anderson, 1983), the episodic–semantic debate has not led to any significant development of dual-store models.

In the respect that the episodic–semantic distinction is described by a list of distinguishing features and empirical results, it can be compared to the distinction between long-term and short-term memory. A useful description of the short-term/long-

This research was supported by National Institutes of Health Grant HD18812 to Gail McKoon and National Science Foundation Grant BNS 82 03061 to Roger Ratcliff.

We would like to thank M. Berkeley, R. Hastie, D. Herrmann, L. Jacoby, J. Keenan, M. McCloskey, J. Neely, H. Roediger, B. Ross, E. Shoben, and E. Tulving for comments on earlier versions of this article.

Correspondence concerning this article should be addressed to Gail McKoon, Department of Psychology, Northwestern University, Evanston, Illinois 60201.

term distinction has been provided by Craik and Lockhart (1972), who lay out clearly the bases for the distinction, and then point out its weaknesses and suggest an alternative theory. For the short-term/long-term distinction, the distinguishing features of short-term memory were said to be a mainly phonemic code, relatively fast forgetting, and limited capacity, whereas the features of long-term memory were a mainly semantic code, slow (or no) forgetting, and unlimited capacity. These features summarized a large body of data from a variety of experiments, and testing this distinction involved finding new variables (e.g., rate of presentation) that, on theoretical grounds, should affect one memory system but not the other. If such a variable did affect one system and not the other, then the result was taken to be consistent with the distinction. But if experimental separation was not achieved, then theoretical or empirical work was required to resolve the difficulty. In the end, in the mid-1970s, the difficulties overcame the distinction. For example, it was found that codes in short-term memory could be visual, articulatory, or semantic and that forgetting rate and capacity were variable, depending on methods of measurement. In light of recent critiques of levels of processing, we do not want to force a final decision about the distinction between short- and long-term memories. But we do want to make clear that it was possible to falsify the particular short-term/long-term model that was developed by the early 1970s because the model was well-formulated enough to present testable hypotheses and because it was based on a large body of consistent data.

The situation with respect to the episodic–semantic distinction is quite different. The body of data on which the distinction is based is not large. In his chapter on empirical evidence for the distinction, Tulving (1983) cites only a small number of results from experimental work with normal adults. Although there are now neurophysiological data, the distinction was originally based on experimental results from cognitive psychology, and these results do not provide a large data base either for the distinction itself or for the attribution of specific features to one or the other of the two memory systems. In addition, these results appear serendipitous in their relevance to the distinction, a point to be taken up in the Discussion section of this article. Another way in which the episodic–semantic distinction suffers in comparison to the short-term/long-term distinction is that it is not well-formulated enough to present clearly testable hypotheses. This is because of diagnostic features that are not clearly defined and because of complexities involved in possible interactions between the episodic, semantic, lexical, and procedural systems.

These points are taken up in the next sections of the article. First, diagnostic features listed by Tulving (1983, chapter 3) are reviewed and considered with respect to empirical evidence. Second, the empirical and neurological evidence cited by Tulving (1983, 1984) as directly relevant to the distinction is reviewed. Finally, Tulving's 1984 position is discussed.

## Diagnostic Features

In the following discussion, features that seem to be aspects of the same phenomenon are grouped together, and features of application (e.g., semantic but not episodic memories are applied in education) are not considered because they are not relevant to deciding about the status of episodic and semantic memories as separate systems.

### *Definitional Features: Reference, Veridicality, Temporal Coding, Retrieval Query, and Retrieval Report*

Episodic memory has the following characteristics: reference is to oneself; events are believed veridical because they happened to oneself; information is organized temporally; queries are with respect to oneself; and events are "remembered." Semantic memory is characterized by the following attributes: reference, queries, and veridicality are with respect to general knowledge; information is not organized by temporal order; and events are "known." All of these features are true by definition of episodic and semantic memories: It is difficult to see any way of testing them that would speak to the reality of the episodic–semantic distinction independently of this definition. In other words, for example, if episodic memory were not temporally organized, it would not be episodic memory.

The definitional features appear unambiguous and also unchanged since Tulving's (1972) original proposal of the episodic–semantic distinction. But even these features are open to confusion. Although intuition suggests that overlearned personal events (e.g., "the first time I . . .") should be part of permanent semantic knowledge, they would have to remain, by definition, part of episodic knowledge.

### *Characteristics of Contents: Source, Registration, and Units*

According to Tulving (1983, p. 31), the split between episodic and semantic memories allows one to "separate the remembering of a personal episode from the knowledge of its 'semantic' contents." This separation is difficult to understand because it is not clear what kind of semantic information is included in an episodic trace. According to Tulving, direct perception is the source of episodic information, and the units are "events." In contrast, registration of semantic information requires that the content be understood and related to existing knowledge (Tulving, 1983, p. 37). Tulving (1983) states that a "mere sensation" (p. 36) can be the source of information registered in the episodic system, but at the same time, the sensation can be so meaningless as to go unrecorded in the semantic system. These diagnostics raise a series of interrelated questions. Are events in episodic memory not related to existing knowledge? Do the events not contain information about the referents of the objects involved in the events? The events of episodic memory are said to be propositional, but that term usually involves abstract properties; what would such properties be in episodic memory? How is the beginning and the end of an event known, if not by reference to the event's meaning? Unless we can understand exactly what semantic information is allowed into episodic memory, the characteristics of contents become less than diagnostic for distinguishing episodic and semantic memory.

### *Organization, Inferential Capability, and Access*

Organization of knowledge in the episodic system is supposed to be temporal, and episodic memory is supposed to have little inferential capability. Access for episodic information is supposed to be deliberate or conscious, whereas access for semantic information is supposed to be automatic. These features are considered together here because a series of experiments by McKoon

and Ratcliff (1979, 1980a, 1980b, 1986; Ratcliff & McKoon, 1978, 1981a, 1981b) call them jointly into question.

McKoon and Ratcliff's experiments involved priming with newly learned information. Sentences or pairs of words were presented for study and then pairs of words were presented for test (lexical decision or recognition). The first word of a test pair was a prime, and the second word of the pair was the target. The extent to which the prime facilitated the response to the target relative to a control condition was the amount of priming. One result from these experiments shows that the organization of textual information is not solely temporal; instead, the organization is based on meaning (and so must be the result of inference processes). For example, when a sentence like "The pauper chopped wood and lugged water" was studied, there were equal amounts of priming between *wood* and *pauper* and between *water* and *pauper*, and less priming between *wood* and *water*. So Ratcliff and McKoon (1978) argued that the first two pairs were equally closely connected in memory, reflecting an organization based on meaning, not the temporal order of the words in the sentence.

The same kinds of priming experiments also show that access to newly learned information can be automatic (McKoon & Ratcliff, 1979; Ratcliff & McKoon, 1981a, 1981b). In these experiments, a response was required only to the target, not the prime, so that the delay between presentation of prime and target could be controlled. Priming effects between words from the same studied pair or sentence were found even when the delay between prime and target was as short as 100 ms, and when the probability that prime and target would come from the same studied sentence or pair was very low. These two criteria (taken from Posner & Snyder, 1975) show that access to the newly learned information was automatic. (With respect to access, it should also be pointed out that access to information in semantic memory is sometimes very slow and strategic, as evidenced by the time required to think of a "fruit beginning with the letter *K*.")

In sum, priming effects with newly learned information show organization based on meaning and show automatic access, neither of which should be found with episodic information according to Tulving (1983). One possible response to these findings might be to argue that priming reflects associations in semantic memory, not episodic memory. However, two of the experiments cited by Tulving (1983) as providing direct evidence for the episodic–semantic distinction are studies that attribute priming effects to episodic memory (Herrmann & Harwood, 1980; McKoon & Ratcliff, 1979). Either it must be that these studies do not provide support for the distinction (because priming results reflect semantic information) or it must be that information in episodic memory can be organized on nontemporal bases and be accessed automatically.

### *Retrieval Mechanisms and Context Dependence*

Tulving (1983, p. 48) speculates that retrieval mechanisms might be different in episodic and semantic memory. Such a speculation contrasts sharply with other recent work. The kinds of measures that are used for data bases in investigations of retrieval (e.g., accuracy, reaction time, and growth of accuracy as a function of retrieval time) are the same for episodic and semantic memory, and many recent models of retrieval have been applied both to semantic and episodic information. For example, search models have been applied to recognition (Sternberg, 1969) and to semantic memory (Meyer, 1970), as has a model proposed by Atkinson and Juola (1973; Smith, Shoben, & Rips, 1974). A sequential sampling retrieval process has also been used for both recognition (Pike, Dalgleish, & Wright, 1977; Ratcliff, 1978) and semantic memory (Collins & Loftus, 1975; McCloskey & Glucksberg, 1979; Ratcliff & McKoon, 1982). In fact, taking all modeling efforts together, we would suggest that the similarities between semantic and episodic retrieval far outweigh the differences, and that there is little evidence for separation of the two systems on the basis of retrieval.

Tulving's specific suggestion regarding the differences in retrieval is that retrieval from the episodic system "takes the form of a synergistic combination of the information stored in the episodic system and the information provided by the cognitive environment of the rememberer" (Tulving, 1984, p. 225). In contrast, retrieval from semantic memory is said to occur "relatively independently of the nature of the instigating cue" (p. 225). Despite Tulving's use of the qualifier "relatively," he seems to be arguing that retrieval context plays only a small role in the semantic system. Taken at face value, the data show otherwise, as 20 years of research on the effect of context on word recognition (e.g., Tulving & Gold, 1963), lexical ambiguity (e.g., Tanenhaus, Leiman, & Seidenberg, 1979), and retrieval of semantic facts (e.g., Muter, 1978) have shown. Both Muter (1978) and Neely and Payne (1983) have used procedures in which direct comparisons can be drawn between context effects on the retrieval of episodic and semantic information and found that the effects are quantitatively similar. Results also show that proportion of recallable words recognized plotted against proportion recognized (Tulving & Wiseman, 1975) falls on the same function for both episodic and semantic tasks (Muter, 1978). So the effect of context on retrieval does not appear to provide a useful diagnostic for distinguishing episodic from semantic memory.

### *Vulnerability*

Tulving (1983) argues that episodic memory is more vulnerable (subject to forgetting) than semantic memory. The problem with testing this conjecture is that it is difficult to arrange an experimental procedure in which episodic and semantic memories are equated on dimensions such as degree of learning, difficulty of material, and so on. However, in the one case that comes closest to achieving such control, that is with amnesic subjects, forgetting appears to occur at the same rate for episodic and semantic information. Zola-Morgan, Cohen, and Squire (1983) showed that for a variety of kinds of amnesia, remote memory impairments were parallel for public (largely semantic) and personal (episodic) events. Also, Cohen (1983) has summarized work with H.M. that showed equivalent deficits for newly learned episodic information and semantic information (e.g., public figures; Marslen-Wilson & Teuber, 1975).

### *Recollective Experience, Affect, and Artificial Intelligence*

According to Tulving (1983, p. 48), remembered events "belong to the rememberer" and have a "definite affective tone," all of which are present to a greater degree in episodic memory than

in semantic memory. Basically, we agree, but we attribute the difference to the content of the memories, not to separate stores. Episodic memories have a warm, personal quality essentially by definition, whereas semantic memories, such as the fact that a canary is a bird, are usually impersonal (but see Morton & Bekerian's, 1984, discussion of this point). We do not agree, however, when Tulving speculates that episodic memory, unlike semantic memory, is impossible in a computer. When Winograd's (1972) robot responds to the question, "When did you pick up the green pyramid?" with "While I was stacking up the red cube . . . ," it is retrieving information about "personal" events from its past. It actually did stack up the red cube a short time before. Perhaps Tulving's point is that the robot is not really *consciously* recalling the action of stacking, and that it is the machine's lack of subjective experience that disqualifies it from having an episodic memory. If so, then the point seems to be that episodic retrieval is conscious. However, as we mentioned earlier, experimental evidence indicates that episodic information can be retrieved automatically and hence independently of consciousness (Posner, 1978).

### *Interactions Between Memory Systems*

The episodic–semantic distinction is not well defined in several respects, all pointed out by Tulving himself (1983). One complicating factor is the addition of the procedural and lexical memory systems, which are assumed to interact with the semantic and episodic systems. Procedural memory is memory for the particular operations involved in performing a task, and it is contrasted with the propositional episodic and semantic systems. With the inclusion of procedural memory into the system, "it is possible that data discrepant with the episodic–semantic distinction can be accounted for in terms of procedural memory" (Tulving, 1983, p. 10). But then, it could be argued, perhaps data consistent with the episodic–semantic distinction could also be accounted for by the procedural/propositional distinction, rendering the separation of episodic and semantic systems unnecessary. A similar problem arises with lexical memory. Although, as Tulving points out, little thought has gone into understanding the relationship between the lexical, episodic, and semantic systems, still the existence of the lexical system provides another way of explaining away data discrepant with the episodic–semantic distinction.

### *Summary*

The important diagnostic features can be divided into content features (source, registration, units) and process features (organization, inference, access, retrieval, and forgetting). With respect to content features, we find it difficult to understand how semantic content is allowed into episodic memory in such a way as to preserve the episodic/semantic distinction. With respect to process features, we find that most evidence about processes does not support a distinction between episodic and semantic memories. In fact, access, organization, retrieval, susceptibility to forgetting, and dependence on context all appear, from empirical evidence, to be similar for episodic and semantic information.

## Empirical Evidence

Tulving (1983, 1984) presents a number of experimental findings (with normal adult subjects) that in his view speak directly to the issue of the separation of episodic and semantic memories. These are findings by Anderson and Ross (1980), Herrmann and Harwood (1980), Shoben, Wescourt, and Smith (1978), McKoon and Ratcliff (1979), Kihlstrom (1980), Underwood, Boruch, and Malmi (1978), and a series of results that compare word identification and recognition (Jacoby & Dallas, 1981; Jacoby & Witherspoon, 1982; Tulving, Schacter, & Stark, 1982). Each of these is discussed in turn in the sections that follow.

In general, the findings can be divided into two sets: those that were originally presented as attacks on the episodic–semantic distinction and those that Tulving (1983, 1984) has cited in support of the distinction. Tulving has countered those meant as attacks by arguing either that the findings are irrelevant to the distinction or that the findings do, in fact, support the distinction. Findings that Tulving believes support the distinction take the form of dissociations. A dissociation occurs if a single variable affects performance in an episodic task differently than it affects performance in a semantic task.

We criticize Tulving's interpretations in three ways. First, episodic–semantic theory is not well enough specified to allow predictions of which variables or experiments will be relevant to the distinction and which will not. Second, for experiments in which dissociation is obtained, there often exist similar experiments in which the same dissociation is not obtained. Third, for some findings, Tulving's interpretations have no more plausibility than interpretations that assume only a single-store system. These problems are illustrated in the sections that follow.

### *Anderson and Ross (1980)*

Anderson and Ross designed their experiments to show that episodic and semantic memories were not functionally independent. Subjects were asked to learn sentences about, for example, spaniels and dogs, and then were asked to verify whether a spaniel is a dog. The general question was whether response time in the semantic task (verification) would be affected by the newly learned (episodic) information. Specifically, Anderson and Ross thought that presentation of the sentence "A spaniel is a dog" would facilitate verification of the same sentence, but that presentation of "interfering" sentences such as "A spaniel retrieves a ball" would slow verification of "A spaniel is a dog" (predictions derived from their single-memory ACT theory). Although the results of the experiments were complicated (by "false" verification items and by practice effects), effects of the newly learned information on verification were observed. However, the expected interference effect did not appear (for "true" items). Anderson and Ross explained this failure by assuming an implicit rehearsal process; when studying "A spaniel retrieves a ball," subjects rehearsed the fact that a spaniel is a dog. Such rehearsal led to facilitation that counteracted interference effects. Anderson and Ross concluded that with the addition of this explanation for the failure to obtain interference effects, their single-memory theory (ACT) could account for the results of their experiments and that models assuming separate episodic and semantic memories could not account for the results in any obvious way.

In connection with this discussion, it should be noted that interference effects of newly learned information on semantic verification have been found in other experiments. Both Lewis and Anderson (1976) and Peterson and Potts (1982) have shown that learning new facts about a famous person slows verification time for previously known facts.

In contrast to Anderson and Ross (1980), Tulving (1983) does not propose a theory to account for the effects of episodic information on semantic verification. Instead, he suggests that these effects are "largely irrelevant to the problem of the distinction between episodic and semantic memory" (p. 82) and may reflect the procedural memory system. The problem illustrated here is the lack of a method for deciding whether a particular effect speaks to the semantic–episodic distinction. On the one hand, Anderson and Ross (1980) found effects that they used to support a single-store model. On the other hand, Tulving (1983) attributes those same effects to the procedural memory system. This lack of agreement contrasts sharply with the situation with the short-term/long-term distinction, in which there were relatively precise methods for deciding whether particular experimental results spoke to the distinction.

### *Shoben, Wescourt, and Smith (1978)*

Shoben et al. (1978) presented results that they argued supported the episodic–semantic distinction. They used two tasks, recognition and verification, involving the same sentences as materials. One variable was the relatedness of the predicate to the subject in a sentence. For verification, the second variable was the number of different sentences, each with a different predicate, tested about a particular subject noun. For recognition, the second variable was the number of different sentences, each with a different predicate, that were learned about a particular noun. Shoben et al. assumed that the second variable was the same for verification and recognition, and, following previous usage in recognition research, labeled it "fanning." They found that amount of fanning (number of different sentences) affected response time in recognition but not verification. They also found that relatedness affected verification response times but not recognition response times. So they argued for a dissociation: Semantic memory, reflected in the verification task, and episodic memory, reflected in recognition, were subject to different variables.

This interpretation has been criticized by Anderson and Ross (1980), McKoon and Ratcliff (1979), and McCloskey and Santee (1981). First, both Anderson and Ross and McCloskey and Santee point to problems with the way Shoben et al. operationalized the fanning variable and argue that a single-store model such as ACT can well account for the different effects of the different implementations of the variable in the two tasks. Second, the finding that relatedness has no effect in an episodic task is countered by other findings that semantic variables do have effects in episodic tasks (e.g., McCloskey and Santee, 1981; Lewis & Anderson, 1976). Also for Shoben et al.'s particular experiment, relatedness effects in recognition are *not* predicted by the single-store model, ACT (Anderson & Ross, 1980). Finally, a general point to be made is that whether a single- or dual-store model is assumed, an explanation still must be provided for the different results in the two tasks. As McKoon and Ratcliff (1979) noted, even the explanation put forward by Shoben et al. (1978) seems consistent with either kind of model. For effects of relatedness, Shoben et al. assumed that information about the meanings of words was used in verification, whereas information about their occurrence was used in recognition. Certainly, both kinds of information would be present in a single-store memory system. Similarly, for effects of fanning, they assumed that different amounts of information were involved in the processes of recognition and verification, an assumption that could be incorporated into a single-store model.

Tulving (1983, p. 86) responds to criticisms of the results of Shoben et al. (1978) by pointing to the "separate and different explanations of the effects of the two independent variables," and suggesting that the episodic–semantic distinction provides "a unifying framework within which the individual explanations might be integrated." However, at the present time, we do not see any way in which this framework contributes toward the individual explanations or a unification of them or toward relating these results to other empirical findings. The results of experiments like Shoben et al.'s cannot be used to support either single- or dual-store models unless detailed predictions from the two models can be made.

### *McKoon and Ratcliff (1979)*

When McKoon and Ratcliff (1979) published their experiments, they interpreted them as providing evidence against the episodic–semantic distinction. However, Tulving (1983) finds instead that they support the distinction.

McKoon and Ratcliff (1979) used two different tasks, lexical decision and recognition. For both tasks, subjects studied pairs of words. Then, in recognition test lists, they were asked to distinguish words that had been studied from words that had not been studied, whereas in lexical decision test lists, they were asked to distinguish words (some of which had been studied) from nonwords. The variable for both tasks was the relationship involved in priming between two words presented sequentially in the test lists. The prime and target words were related semantically (e.g., "green grass"), episodically (e.g., the pair "city grass" was studied), or both (e.g., the pair "green grass" was studied).

McKoon and Ratcliff (1979) argued that recognition and lexical decision were prototypical tasks for episodic and semantic information, respectively, so that, if there were separate memory systems, semantic information should not lead to priming in recognition and episodic information should not lead to priming in lexical decision. In fact, these priming effects were obtained, and McKoon and Ratcliff (1979) interpreted them as providing evidence against a dual-store system.

Tulving (1983), on the other hand, reinterpreted McKoon and Ratcliff's (1979) results as evidence for a dissociation between episodic and semantic memories. Because, according to Tulving (1983), in McKoon and Ratcliff's experiments, response times for primed words were a function of kind of priming (semantic, episodic, or both) in recognition but not in lexical decision, their data exhibit a dissociation and so support the episodic–semantic distinction. However, there are several problems with this argument. First, the result that primed response times are not a function of kind of priming for lexical decision may be a floor effect on reaction time; the 0.53-s reaction times obtained for primed lexical decision responses may be the minimum possible under the specific experimental conditions used. Second, for semantically primed response times in lexical decision, Tulving (1983) used the condition in which target words were from the pairs of words studied. It might be more reasonable to use the semantic priming condition in which the target words had not been studied and thus avoid any contamination from episodic memory. If one uses this condition for an estimate of semantic

priming in lexical decision, primed response time does vary as a function of type of priming, going from 0.56 s for semantic priming to 0.54 s for episodic priming and 0.53 s for semantic plus episodic priming. Although these differences are small (only approaching significance, $p = .11$), the direction of the effect is the same as for the recognition data. Third, in recognition, the semantic priming condition was different from the other priming conditions in that the prime word did not appear in the studied list of words. This means that the prime required a negative response whereas the primes in the other conditions required positive responses like the targets. So the semantic priming condition was open to the well-known problems with sequential effects; these effects were evidenced by a 20% error rate in this condition, compared with 3% and 6% error rates in the other two priming conditions. In sum, given these problems, it is clear that McKoon and Ratcliff's data do not neatly provide a dissociation between episodic and semantic memories.

Recently, Neely and Durgunoglu (1985) have further investigated semantic and episodic priming in lexical decision and recognition. They held study conditions constant for the two tasks and varied only test conditions in an effort to ensure that no other variable was confounded with the type of task (although, of course, this does not guarantee equivalent processing in retrieval; once subjects are presented with different tasks, they may employ different strategies or use different kinds of information). Neely and Durgunoglu (1985) found that an episodic prime facilitated responses in recognition but not lexical decision and that a semantic prime inhibited responses in recognition but had little effect in lexical decision. These results are different from the results obtained by McKoon and Ratcliff (1979), although it may be that the difference can be accounted for by the differences in procedures. But the point Neely and Durgunoglu wish to make is that with their procedures, they find dissociative episodic and semantic priming effects in the episodic and semantic tasks. They note that this dissociation might support the episodic–semantic distinction, although they acknowledge that episodic priming in lexical decision has been obtained by McKoon and Ratcliff (1979, 1986) and by other experiments in their own laboratory (Durgunoglu & Neely, 1985). More importantly for our purposes in this article, they also acknowledge that the distinction supported by their results may be one of retrieval processes within a single-store system rather than a distinction between two separate storage systems.

### *Recognition-Identification Studies (Jacoby & Witherspoon, 1982; Jacoby & Dallas, 1981; Tulving, Schacter, & Stark, 1982)*

Several experiments have shown that studying a word increases performance on a later semantic memory task involving that word (identification), but that the amount of the benefit is not correlated with performance in a *yes–no* recognition task. For example, Jacoby and Witherspoon (1982) found that studying a word enhances the probability of identifying it when it is presented very briefly, and that this probability is independent of the probability of recognizing that the word had been studied. In a related study, Jacoby and Dallas (1981) found that varying whether the subject's attention was directed toward the appearance, the sound, or the meaning of the word affected recognition accuracy, but not identification accuracy. Tulving, Schacter, and Stark (1982) found independence between recognition performance and performance in a fragment-completion task. Their subjects studied a list of low-frequency words such as AARDVARK and were later given a *yes/no* recognition test for the words. They were also given word fragments such as A—D—RK to complete. Probability of successful completion of a word was independent of the recognition judgment for that word. This was true for both old and new words.

In these experiments the occurrence of some event (the study of a word) had independent effects on an episodic task (recognition) and a semantic task (identifying a word under conditions of limited stimulus information). According to Tulving (1983) these dissociation effects support the episodic–semantic distinction. There are two points that we can make in response. The first is that it is not at all clear that word identification involves semantic memory. Depending on the taste of the theorist, one could implicate procedural or lexical memory. Our second point is that even if we grant that word identification involves semantic memory, the two-store position does not account for the finding that the effects of prior study in identification and recognition are sometimes not independent. For example, Jacoby and Witherspoon (1982) find that with pseudoword items, recognition and identification are positively related. Why do the memory systems act as if they are separate with some stimuli, but not others?

### *Underwood, Boruch, and Malmi (1978)*

Tulving (1983, 1984) cites the Underwood et al. finding of low correlations between individual subjects' performance in episodic and semantic tasks as support for the distinction. Underwood et al. obtained intercorrelations of performance on 33 different measures of memory performance, five of which were designated as semantic memory tasks: judging word frequencies; vocabulary; spelling; and two Scholastic Aptitude Test (SAT) measures, SAT-verbal and SAT-math. Although the semantic memory tasks were only weakly correlated with most of the episodic tasks, there were some low correlations within the semantic group as well. The SAT-math was correlated with SAT-verbal (.31) but not with any of the other semantic tasks (.08, .09, and .08, for the remaining tasks, respectively). In fact, SAT-math was more correlated with the group of episodic tasks labeled serial learning (.19 and .24), memory span (.13, .24, .27), and interference susceptibility (.36). The high intercorrelations among semantic tasks were restricted to the lexical memory tasks of vocabulary, spelling, and SAT-verbal, a group that also correlated with paired associate and serial learning performance, albeit at a somewhat lower level. In short, the structure of the intercorrelations seems to be much more complex than a simple episodic–semantic division would imply. Furthermore, the tasks labeled semantic are not semantic in the way usually meant in semantic memory research. Thus, conclusions drawn from this research have little to say about the episodic–semantic distinction.

### *Herrmann and Harwood (1980)*

The next experimental result used by Tulving (1983) to support the episodic–semantic distinction comes from a paper by Herrmann and Harwood (1980). They designed their experiment to address the question of whether semantic information affects

the retrieval of episodic information. Of course, it might be that semantic information could be encoded as part of an episodic trace (although, as discussed above, we are not sure of Tulving's position on this). And, when semantic information was encoded as part of an episodic trace, it could affect the retrieval of that trace. But the important question addressed by Herrmann and Harwood (1980) was whether semantic information not involved in encoding would affect retrieval.

Subjects in Herrmann and Harwood's (1980) experiment studied lists of categorized words and then were presented with pairs of words for a recognition test (responding "old" if both words had been studied, "new" if neither had been studied, and "mixed" for one old and one new word). The key results were those for pairs in which neither word had been studied. When other members of the categories had been studied, then response times were faster if the two words came from the same category than from different categories. But when other members of the categories had not been studied, same-category and different-category response times were equal. Herrmann and Harwood (1980) and Tulving (1983) interpreted these results by saying that the semantic variable, category membership, had an effect on the episodic task, recognition, when category information was likely to have been encoded in episodic memory during study, but not otherwise, and Tulving (1983) used these results as support for the distinction between the episodic and semantic memory systems.

This support is of questionable value, however, because of the lack of generality of Herrmann and Harwood's (1980) results. McKoon, Ratcliff, and Dell (1985) have found results that are not in agreement with those of Herrmann and Harwood (1980). McKoon et al. designed their experiments with the same goal as Herrmann and Harwood (1980), namely, to investigate whether semantic information affects the retrieval of episodic information. In some respects, the McKoon et al. experiments were similar to the Herrmann and Harwood (1980) experiment; for example, subjects studied categorized lists and were tested for recognition of items from those lists. But there were also procedural differences; in McKoon et al.'s experiments, study time per item was shorter, and items were tested for recognition individually rather than in pairs. With these differences in procedure, McKoon et al. found that for test items whose categories had not been studied, response time was faster for an item preceded by another item from the same category than for an item preceded by an item from a different category. So, McKoon et al. argued that the semantic variable, category membership, did affect performance in the episodic task even when the semantic information could not have been encoded into memory during study.

What can be concluded from these two seemingly contradictory sets of results? One possibility is that semantic information does, in fact, affect retrieval of episodic information. The reason the Herrmann and Harwood (1980) failed to find this effect is that it is small (about 36 ms in one of McKoon et al.'s experiments), smaller than the standard error (53 ms) in Herrmann and Harwood's experiments. This possibility is given some credibility because another effect that Herrmann and Harwood failed to find, facilitation for same-versus-different-category mixed pairs, has been found by Neely, Schmidt, and Roediger (1983), with somewhat different procedures.

The other possible reason for the differences between the results obtained by McKoon et al. (1985) and by Herrmann and Harwood (1980) is the different procedures that were used. If this is the case, then the problem for the episodic–semantic distinction is to explain why the procedural differences led to the different results. This point echoes our contention that the episodic–semantic distinction offers little basis for deciding between two experiments, one that supports the distinction and one that does not.

The conclusion that semantic information does affect recognition receives support from recent work by Dosher (1984). In her experiments, subjects studied pairs of words. One pair might include the word *dog*, another pair the word *cat*. Then subjects were tested for recognition of pairs, using a response signal procedure in which subjects were required to respond immediately upon a signal given at various delays after the test pair was presented. When subjects were asked to recognize whether the words *dog–cat* were studied as a pair, they tended to respond positively early in processing. Only later in processing (after 600 or 700 ms) was that tendency suppressed so that there was a greater proportion of correct, negative responses. The interpretation favored by Dosher is that semantic information is initially retrieved, then later suppressed. This finding, like the McKoon et al. (1985) findings, argues that well-known associations are used in recognition even though those associations were not studied during the encoding phase of the experiments.

### *Kihlstrom (1980)*

Tulving (1983) describes Kihlstrom's (1980) experiment as showing a dissociation between performance on semantic and episodic tasks that supports the episodic–semantic distinction. The episodic task was free recall of a list of words that had been learned under hypnosis, with subjects instructed to forget the list when they awakened. The semantic task was free association, where the stimuli were words likely to elicit the learned list words as primary associates. Subjects highly susceptible to hypnosis recalled almost none of the words, whereas subjects of low to medium susceptibility recalled 86% of the words. But in free association, there were only small differences across the groups of subjects; thus there was a dissociation between performance on the free recall and free association tasks.

Using this dissociation to support the episodic–semantic distinction, as Tulving (1983) does, ignores other cases in which performance on an episodic task was not affected by instructions to subjects to forget the material learned while hypnotized. For example, Graham and Patton (1968) found that a group of subjects hypnotized during learning of a list showed just as much retroactive inhibition from that list as did a normal group of subjects. Such data cannot be ignored; either it argues against the episodic–semantic distinction, or the distinction must account for the difference in results with the different episodic tasks.

### *Conclusion*

The experiments cited by Tulving (1983, 1984) as support for the episodic–semantic distinction (and discussed and criticized above) follow the logic of dissociation. Roediger (1984) has questioned the use of dissociation results as support for separate systems on several grounds. For example, a dissociation might equally well reflect different processes as different systems (Tulving & Bower, 1974), and it is difficult to know for which of the

many dissociations that could be found experimentally new memory systems should be proposed. Tulving replies to Roediger (1984) with the statement that "dissociations represent a necessary but not a sufficient condition for different memory systems" (Tulving, 1984, p. 260). In addition to the experimental dissociations, experiments involving different brain states and studies of pathological cases must be considered. In the next section of the article, we discuss the several different kinds of evidence from these sources.

## Evidence From Studies of Brain Activity and Pathology

### *Effects of Drugs*

The drug studies cited by Tulving (1984) as support for the episodic–semantic distinction obtained dissociations between performance levels on episodic and semantic tasks. In the first study, an alcohol study (Hashtroudi, Parker, Delisi, & Wyatt, 1984), there were two episodic tasks, recall and recognition, and the semantic task was fragment completion. Recall was degraded for intoxicated subjects relative to normal subjects, but fragment completion was not different for the two groups. This would be evidence for the episodic–semantic distinction, except that recognition performance (as measured by $d'$) was also not different for the two groups. Thus, by the logic of dissociation, it would be just as reasonable to argue for the existence of two episodic systems as for separate episodic and semantic systems (see Roediger, 1984, for a similar argument).

In the second study cited by Tulving (1984), level of blood alcohol affected recognition performance but not performance on word fragment completion (Parker, Schoenberg, Schwartz, & Tulving, 1983). But, in state-dependent research, changing a subject's brain state with moderate doses of a drug often does *not* affect recognition (Eich, 1980), and so, without a detailed explanation of the differences between the Parker et al. and other studies, this dissociation is not convincing as evidence for the episodic–semantic distinction.

### *Blood Flow and Evoked Potential Studies*

Wood, Taylor, Penny, and Stump (1980) have shown that patterns of regional cerebral blood flow, an index of neural activity, differ for a recognition task and a semantic classification task. Tulving (1983) has noted the caveats offered by Wood et al., for example, that the two tasks differ on many other dimensions such as difficulty, but still has added the blood flow study to his list of evidence (Tulving, 1984). Baddeley (1984) has further criticized the use of this study as a way of separating episodic and semantic memory by noting that it is possible that any two tasks will differ in blood flow patterns and by posing this question: Would one assume different physical systems for each task?

Clearly what is needed is a systematic study of the blood flow method before it can be taken as evidence for the episodic–semantic distinction. It seems that this is not likely because of the cost of such methods, so we can only take this study as intriguing rather than as strong evidence for a separation of systems.

In like manner, Tulving (1984) cites a statement by Sanquist, Rohrbaugh, Syndulko, and Lindsley (1980) that suggests that the late positive component of the evoked potential is much different in a recognition task than in a judgment task. The conclusion that Sandquist et al. draw is that the late positive component indexes processes associated with stimulus recognition. However, we make the same argument as for the blood flow study and that is that much more work needs to be done before this finding can be used as evidence for an episodic–semantic distinction. For example, if the late positive component only indexed recognition and not recall, there would be no evidence for the episodic–semantic distinction. However, if a range of semantic and episodic tasks of varying degrees of difficulty produced a systematic difference in the late positive component as a function of episodic versus semantic task, this would provide quite strong evidence for a separation of systems.

### *Amnesia*

Results from studies of amnesia seem to hold an important place in the debate about episodic and semantic memory. Tulving has provided a wide range of evidence (1983; see also Schacter & Tulving, 1982) from amnesia studies to support the episodic–semantic distinction, all of which takes the form of finding dissociations such that amnesia affects episodic memory but not semantic memory. However, there are a number of other positions held by students of amnesia. The most popular position at present is that what is spared in amnesia is procedural memory; so, for example, normal performance by amnesics on word fragment completion, perceptual identification, motor tasks such as mirror image tracing and pursuit rotor, jigsaw puzzles, the tower of Hanoi problem, mirror reading, and long-term facilitation in lexical decision are all attributed to an intact procedural system (e.g., Baddeley, 1984; Cohen, 1984; Graf, Squire, & Mandler, 1984; Moscovitch, 1982).

In a related but slightly different theoretical characterization of the amnesic syndrome, Warrington and Weiskrantz (1982) attribute the amnesic deficit to the disconnection of a "dynamic cognitive mediational memory system" (responsible for the manipulation, interrelation, and storage of information) from the semantic system. They distinguish this view from a strict episodic–semantic view because of experimental findings that amnesic subjects show some retention in paired associate learning, especially for highly associated pairs such as *milk–cow* or *walk–run* and for pairs made up of rhyming words. The fact that amnesics show paired-associate learning that is little different from normal performance under some conditions and the fact that performance is sometimes improved when preexisting knowledge is involved lead to the rejection of a strict episodic–semantic interpretation.

The view of Warrington and Weiskrantz (1982) is quite similar to Wickelgren's (1979) more detailed theory of chunking and consolidation. Wickelgren proposes that chunking (or forming new nodes) is the critical process involved in cognitive learning and that amnesia results from damage to the system (the hippocampal-limbic arousal system) that allows the formation of new nodes. Although the details of the theory are quite different from those proposed by Warrington and Weiskrantz (1982), there is a marked similarity between the two in terms of a global explanation of the deficit.

One critical set of investigations concerns the ability of amnesics to access semantic and episodic information learned prior to their becoming amnesic. Tulving argues that only prior episodic memories have been lost. Cermak and O'Connor (1983) have presented the case of one subject (SS) who seems to show an

absence of any preamnesic episodic memory. The subject, an expert on lasers, shows excellent semantic knowledge (he is able to read technical reports on new laser research and explain them as he reads), but he is unable to retain the new knowledge. More importantly for the present discussion, Cermak and O'Conner argue that the subject shows no episodic memory for personal events prior to the onset of amnesia. Although the subject is able to produce much information about his childhood and young adult life, he seems unable to focus on individual specific episodes in which he participated, and so Cermak and O'Connor seem to argue that the anecdotes are actually part of semantic memory and that the subject has lost the episodic system. In contrast to Cermak and O'Connor's findings with this subject, both Baddeley and Wilson (1983) and Zola-Morgan et al. (1983) have found amnesics' memories for preamnesia personal events to be unimpaired, despite their difficulties with postamnesia memories.

Another case of amnesia that seems to show a loss of episodic memory for events prior to amnesia has been reported by Schacter and Tulving (1982). Although semantic knowledge was intact, this patient appeared to have completely lost all his memory for personal events, including his name, home, occupation, and family except for a very few islands of childhood memory. However, there is an inconsistency in interpretation of the syndromes displayed by this patient and the patient reported by Cermak and O'Connor (1983) as evidence for the episodic–semantic distinction. Cermak and O'Connor's patient showed considerable memory for episodic events that were termed as "equivalent to one's being able to recount a family story more because it had become family folklore than because it was truly remembered." If such memories are to be classified as semantic, as Cermak and O'Connor classified them, then the patient studied by Schacter and Tulving, who had lost all personal memories, had lost these kinds of semantic memories and would no longer show a strict episodic–semantic dissociation. On the other hand, if it were assumed that what Schacter and Tulving's patient had lost was episodic memory and not semantic memory, then Cermak and O'Connor's patient could not be said to have lost all of episodic memory but only selective aspects of episodic memory.

Although much of the research on amnesia seems to have important implications for the episodic–semantic distinction, at a detailed level, the picture can be complicated. In general, Tulving has used results from the study of amnesia like those mentioned above to support the case for a distinction between episodic and semantic memory systems. But we agree with Baddeley (1984) that this interpretation appears to represent a minority view and that the distinction that seems to have garnered most support is a procedural/declarative distinction (which Tulving also accepts). Although we would not go as far as Crowder (1982) and claim that we have learned nothing about normal functioning from the study of amnesia, we do have some sympathy for Crowder's view that analyses of amnesia reflect, at a lag, the attitudes currently fashionable toward general forgetting theory.

## Tulving's 1984 Position: Episodic Memory Embedded Within Semantic Memory

Recently, *The Behavioral and Brain Sciences* published a series of critical reviews of Tulving's 1983 book. Among these were papers that evaluated the episodic–semantic distinction. These critiques were followed by a reply from Tulving in which he acknowledged difficulties with his previous views and, as a result of some of the points made in the critiques as well as changes in his own thinking, suggested a major modification of his position on the episodic–semantic distinction. The new position is that episodic memory is a distinct but interactive subsystem embedded within semantic memory. Although Tulving did not commit himself with complete certainty to this position, it nevertheless deserves attention.

One critical question to ask about the new position is how it differs from the old one. First, Tulving (1984) notes that an embedded episodic system differs from a separate one in that the embedded system would not be able to function independently of the semantic system. Since we had difficulty imagining how an episodic system could function on its own, we find the new position more to our liking on this point. Second, Tulving states that embedding the episodic system in the semantic system allows for the generation of episodic inferences using the inferential capacities of semantic memory (see McCauley's, 1984, comments on this point). Again, given our earlier discussion of the need for inferencing with both episodic and semantic information, we prefer the new position. Third, the new view of the distinction focuses, according to Tulving, on episodic memory as a "higher," and developmentally and phylogenetically later, subsystem of semantic memory. This is an intriguing possibility. However, evidence for it must await a clearer exposition of how we could tell whether infants and nonhumans possess episodic memory. Fourth, the new position predicts that amnesic syndromes should involve impairment in (a) episodic memory only or (b) episodic and semantic memory, but not (c) semantic memory only. We do think that this prediction is more likely to be confirmed than that from the old view, in which amnesia was predicted to be purely episodic in nature. As discussed earlier, amnesia does seem to involve both semantic and episodic information.

With respect to the problems we have raised with the episodic–semantic distinction, we can see many problems that the new version of the distinction does not address. First, all of the criticisms of Tulving's use of experimental results to support the distinction still seem to apply because the distinction still does not provide a procedure for predicting under what conditions a dissociation should occur. Experimental results that show particular dissociations can still be countered with other results that do not show those dissociations. Second, although the content features of episodic memory are less problematic because an embedded episodic system could more easily be understood to contain semantic information and allow inferencing, the features of processing still raise difficulties. For example, is the organization of episodic information temporal, as Tulving (1983) originally claimed, or can it be semantic? Can access to episodic memory, originally said to be strategic, now be automatic? Are retrieval processes for episodic and semantic information the same or different? In general, what does it mean for episodic memory to be embedded in semantic memory?

One way in which Tulving (1984) attempts to answer this question is with an analogy to the visual system. Although some aspects of the structure of the visual system support the idea that Tulving seems to have in mind, there are a number of subsystems that range from having different kinds of information carried by the same neural pathways (motion vs. form, Lennie, 1980; Van Essen & Maunsell, 1983) to different kinds of infor-

mation being completely integrated (motor plus visual information, Baker & Berthold, 1977). Thus it seems that an appeal to the nature of the visual system allows one the freedom to interpret the episodic and semantic systems in ways that range from highly interactive through to almost independent.

Another way to interpret the embeddedness view is that it is close to a single-store view. We, in fact, see little difference between an interactive embeddedness view and a single-store view. However, we expect that Tulving and other dual-store theorists will disagree and assert that an important distinction is still present in the embeddedness view. The source of this anticipated disagreement would be that Tulving's position has a very high "albedo." The theorist can easily see his or her own position reflected when regarding Tulving's. In the absence of an explicit theory of the relation between the encoding, storage, and retrieval of episodic and semantic information, this state of affairs will prevail. In the final section of the article, we elaborate on the need for such a theory.

## Discussion

Our criticisms of the episodic–semantic distinction have covered both the features of the distinction and the empirical evidence for it. We find that the features do not separate the two memory systems in a clear, testable fashion. In addition, we have concluded that the experimental and neuropsychological evidence for the distinction is weak. Most of this evidence involves dissociations, and our comments can be summarized by three points regarding Tulving's use of dissociative evidence.

1. For many of the experimental and neuropsychological dissociations cited as support for the distinction, we have pointed to very similar experiments or cases in which no dissociation between episodic and semantic memory was found.
2. In a few cases of dissociation between an episodic and semantic task, we have pointed to related cases in which two episodic tasks dissociated from each other, one behaving exactly like the semantic task.
3. For some of the evidence, we (and others) have suggested that no true dissociation is present, and thus the results are consistent with a single-store view.

In general, the use of dissociation evidence will be problematic as long as the episodic–semantic distinction lacks a set of principles that allow one to decide what evidence does and does not address the distinction. In the absence of these principles to guide the selection of evidence, dissociations can be gleaned from the literature wherever they are found, and cases in which no dissociation or the wrong dissociation is found can be ignored. As Hintzman (1984, p. 241) points out, "If one wants to claim that a dissociation outcome supports the episodic–semantic distinction, one must show that the dissociation is predicted by theory that embodies the distinction." We think that a theory could take the form of either an explicit model of memory that encompasses both episodic and semantic information, or, less ambitiously, a framework for organizing independent variables, so that each variable's predicted effect (or lack thereof) on the episodic and semantic systems is derived directly from the features of the distinction. At present this is not the case. For example, what feature of the distinction leads to Shoben et al.'s (1978) fan effect in an episodic task, but not in a semantic task? Along with this framework, it would be important to specify the relative contributions of the episodic, semantic, and other systems to particular experimental tasks. For example, what system is primarily involved in fragment completion? In the absence of a specific theory, we see no way in which the status of the episodic–semantic distinction can be clarified.

At this point, it may be worth considering whether the current situation in memory research is such that the episodic–semantic distinction is theoretically useful even though problematic. For example, it might be that there is no other theory that is not equally problematic. Although it is not within the scope of this article to provide an alternative, we should point out that there does exist one alternative theory that is well developed and accounts for a number of phenomena with a unified semantic–episodic store, and that is Anderson's (1983) ACT theory. As mentioned above, ACT accounts for the results of Shoben et al. (1978), Anderson and Ross (1980), and the experiments showing activation of semantic information in episodic tasks and the automatic activation of episodic information. ACT could as well explain much of the amnesia data, because declarative (propositional) knowledge is treated differently than procedural knowledge. For the separate episodic–semantic view to provide an equally useful theoretical framework, it would need to be much more specific. Although it would not have to be at the level of specificity of ACT, it would at least have to provide a description at the level of the qualitative aspects of Atkinson and Shiffrin's (1968) model of long- and short-term memory. Atkinson and Shiffrin's model (as well as others) encompassed both short- and long-term processes, and the features that separated the stores were closely tied to experimental variables. For example, it was agreed that differences in coding between the stores (phonemic vs. semantic) could be tested by varying the semantic and (or) phonological similarity of the words to be remembered.

To conclude, we do not think that more progress will be made toward an understanding of memory for semantic and episodic information until more theoretical work is done. The episodic–semantic distinction is an interesting idea that has had much heuristic value for interpreting and generating data over the past 14 years. Now it needs theoretical development.

## References

Anderson, J. R. (1983). *The architecture of cognition.* Cambridge, MA: Harvard University Press.

Anderson, J. R., & Ross, B. H. (1980). Evidence against a semantic–episodic distinction. *Journal of Experimental Psychology: Human Learning and Memory, 6,* 441–465.

Atkinson, R. C., & Juola, J. F. (1973). Factors influencing speed and accuracy of word recognition. In S. Kornblum (Ed.), *Attention and performance* (Vol. 6, pp. 583–612). New York: Academic Press.

Atkinson, R. C., & Shiffrin, R. M. (1968). Human memory: A proposed system and its control processes. In K. W. Spence & J. T. Spence (Eds.), *The psychology of learning and motivation* (Vol. 2, pp. 89–105). New York: Academic Press.

Baddeley, A. D. (1984). Neuropsychological evidence and the semantic/episodic distinction. Commentary on Tulving, E., Precis of *Elements of episodic memory. The Brain and Behavioral Sciences, 7,* 238–239.

Baddeley, A., & Wilson, B. (1983). *Differences among amnesia and between amnesics: The role of single case methodology in theoretical analysis and practical treatment.* Paper presented at Princeton Symposium on Amnesia, Princeton, NJ.

Baker, R., & Berthold, A. L. (1977). *The control of gaze by brain stem neurons.* New York: Elsevier.

Cermak, L. S., & O'Connor, M. (1983). The anterograde and retrograde retrieval ability of a patient with amnesia due to encephalitis. *Neuropychologia, 21,* 213–234.

Cohen, N. J. (1983). Preserved learning capacity in amnesia: Evidence for multiple memory systems. In N. Butters & L. Squire (Eds.), *The neuropsychology of memory* (pp. 83–103). New York: Guilford Press.

Collins, A. M., & Loftus, E. F. (1975). A spreading-activation theory of semantic processing. *Psychological Review, 82,* 407–428.

Craik, F. I. M., & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behavior, 11,* 671–684.

Crowder, R. G. (1982). General forgetting theory and the locus of amnesia. In L. S. Cermak, (Ed.), *Human memory and amnesia.* (pp. 33–42). Hillsdale, NJ: Erlbaum.

Dosher, B. A. (1984). Discriminating preexperimental (semantic) from learned (episodic) associations: A speed-accuracy study. *Cognitive Psychology, 16,* 519–555.

Durgunoglu, A., & Neely, J. H. (1985). *Episodic and semantic priming in a lexical decision task following paired associate learning.* Manuscript submitted for publication.

Eich, J. E. (1980). The cue-dependent nature of state-dependent retrieval. *Memory & Cognition, 8,* 157–173.

Graf, P., Squire, L. R., & Mandler, G. (1984). The information that amnesic patients do not forget. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 10,* 164–178.

Graham, K. R., & Patton, A. (1968). Retroactive inhibition, hypnosis, and hypnotic amnesia. *International Journal of Clinical Experimental Hypnosis, 16,* 68–74.

Hashtroudi, S., Parker, E. S., Delisi, L. E., & Wyatt, R. J. (1984). Intact retention in acute alcohol amnesia. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 10,* 156–163.

Herrmann, D. J. (1982). The semantic–episodic distinction and the history of long-term memory typologies. *Bulletin of the Psychonomic Society, 20,* 207–210.

Herrmann, D. J., & Harwood, J. R. (1980). More evidence for the existence of separate semantic and episodic stores in long-term memory. *Journal of Experimental Psychology: Human Learning and Memory, 6,* 467–478.

Hintzman, D. L. (1984). Episodic versus semantic memory: A distinction whose time has come—and gone? Commentary on Tulving, E., Precis of *Elements of episodic memory. The Brain and Behavioral Sciences, 7,* 240–241.

Jacoby, L. L., & Dallas, M. (1981). On the relationship between autobiographical memory and perceptual learning. *Journal of Experimental Psychology: General, 3,* 306–340.

Jacoby, L. L., & Witherspoon, D. (1982). Remembering without awareness. *Canadian Journal of Psychology, 36,* 300–324.

Kihlstrom, J. F. (1980). Posthypnotic amnesia for recently learned material: Interactions with "episodic" and "semantic" memory. *Cognitive Psychology, 12,* 227–251.

Lennie, P. (1980). Parallel visual pathways: A review. *Vision Research, 20,* 561–594.

Lewis, C., & Anderson, J. (1976). Interference with real-world knowledge. *Cognitive Psychology, 8,* 311–335.

Marslen-Wilson, W. D., & Teuber, H. L. (1975). Memory for remote events in anterograde amnesia: Recognition of public figures from newsphotographs. *Neuropsychologia, 13,* 353–364.

McCauley, R. N. (1984). Inference and temporal coding in episodic memory. Commentary on Tulving, E., Precis of *Elements of episodic memory. The Brain and Behavioral Sciences, 7,* 246–247.

McCloskey, M., & Glucksberg, S. (1979). Decision processes in verifying category membership statements: Implications for models of semantic memory. *Cognitive Psychology, 11,* 1–37.

McCloskey, M., & Santee, J. (1981). Are semantic memory and episodic memory distinct systems? *Journal of Experimental Psychology: Human Learning and Memory, 7,* 66–71.

McKoon, G., & Ratcliff, R. (1979). Priming in episodic and semantic memory. *Journal of Verbal Learning and Verbal Behavior, 18,* 463–480.

McKoon, G., & Ratcliff, R. (1980a). The comprehension processes and memory structures involved in anaphoric reference. *Journal of Verbal Learning and Verbal Behavior, 19,* 668–682.

McKoon, G., & Ratcliff, R. (1980b). Priming in item recognition: The organization of propositions in memory for text. *Journal of Verbal Learning and Verbal Behavior, 19,* 369–386.

McKoon, G., & Ratcliff, R. (1986). Automatic activation of episodic information in a semantic memory task. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 12,* 108–115.

McKoon, G., Ratcliff, R., & Dell, G. S. (1985). The role of semantic information in episodic retrieval. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 11,* 742–751.

Meyer, D. E. (1970). On the representation and retrieval of stored semantic information. *Cognitive Psychology, 1,* 242–299.

Morton, J., & Bekerian, D. A. (1984). The episodic/semantic distinction: Something worth arguing about. Commentary on Tulving, E., Precis of *Elements of episodic memory. The Brain and Behavioral Sciences, 7,* 247–248.

Moscovitch, M. (1982). Multiple dissociations of function in amnesia. In L. S. Cermak (Ed.), *Human memory and amnesia* (pp. 337–370). Hillsdale, NJ: Erlbaum.

Muter, P. (1978). Recognition failure of recallable words in semantic memory. *Memory & Cognition, 6,* 9–12.

Neely, J. H., & Durgunoglu, A. (1985). Dissociative episodic and semantic priming effects in episodic and semantic memory. *Journal of Memory and Language, 24,* 466–489.

Neely, J. H., & Payne, D. G. (1983). A direct comparison of recognition failure rates for recallable names in episodic and semantic memory tests. *Memory & Cognition, 11,* 161–171.

Neely, J. H., Schmidt, S. R., & Roediger, H. L. (1983). Inhibition from related primes in recognition memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 9,* 196–211.

Parker, E. S., Schoenberg, R., Schwartz, B. S., & Tulving, E. (1983). Memories on the rising and falling blood alcohol curve. *Bulletin of the Psychonomic Society, 21,* 363.

Peterson, S. B., & Potts, G. R. (1982). Global and specific components of information integration. *Journal of Verbal Learning and Verbal Behavior, 21,* 403–420.

Pike, R., Dalgleish, L., & Wright, J. (1977). A multiple-observations model for response latency and the latencies of correct and incorrect responses in recognition memory. *Memory & Cognition, 5,* 580–589.

Posner, M. I. (1978). *Chronometric exploration of mind.* Hillsdale, N.J.: Erlbaum.

Posner, M. I., & Snyder, C. R. (1975). Attention and cognitive control. In R. L. Solso (Ed.), *Information processing and cognition* (pp. 55–85). Hillsdale, NJ: Erlbaum.

Ratcliff, R. (1978). A theory of memory retrieval. *Psychological Review, 85,* 59–108.

Ratcliff, R., & McKoon, G. (1978). Priming in item recognition: Evidence for the propositional structure of sentences. *Journal of Verbal Learning and Verbal Behavior, 17,* 403–417.

Ratcliff, R., & McKoon, G. (1981a). Automatic and strategic priming in recognition. *Journal of Verbal Learning and Verbal Behavior, 20,* 204–215.

Ratcliff, R., & McKoon, G. (1981b). Does activation really spread? *Psychological Review, 88,* 454–462.

Ratcliff, R., & McKoon, G. (1982). Speed and accuracy in the processing of false statements about semantic memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 8,* 16–36.

Roediger, H. L. (1984). Does current evidence from dissociation experiments favor the episodic/semantic distinction? Commentary on Tulv-

ing, E., Precis of *Elements of episodic memory. The Behavioral and Brain Sciences, 7,* 252–254.

Sanquist, T. F., Rohrbaugh, J. W., Syndulko, K., & Lindsley, D. B. (1980). Electrocortical signs of levels of processing: Perceptual analysis and recognition memory. *Psychophysiology, 17,* 568–576.

Schacter, D., & Tulving, E. (1982). Memory, amnesia, and the episodic/semantic distinction. In R. L. Isaacson & N. E. Spear (Eds.), *Expression of knowledge* (pp. 33–65). New York: Plenum Press.

Shoben, E. J., Wescourt, K. T., & Smith, E. E. (1978). Sentence verification, sentence recognition, and the semantic–episodic distinction. *Journal of Experimental Psychology: Human Learning and Memory, 4,* 304–317.

Smith, E. E., Shoben, E. J., & Rips, L. J. (1974). Structure and process in semantic memory: A featural model for semantic decisions. *Psychological Review, 81,* 214–241.

Sternberg, S. (1969). Memory-scanning: Mental processes revealed by reaction-time experiments. *American Scientist, 57,* 421–457.

Tanenhaus, M. K., Leiman, J. M., & Seidenberg, M. S. (1979). Evidence for multiple stages in the processing of ambiguous words in syntactic contexts. *Journal of Verbal Learning and Verbal Behavior, 18,* 427–440.

Tulving, E. (1972). Episodic and semantic memory. In E. Tulving & W. Donaldson (Eds.), *Organization of memory* (pp. 381–403). New York: Academic Press.

Tulving, E. (1983). *Elements of episodic memory.* New York: Oxford University Press.

Tulving, E. (1984). Precis of *Elements of episodic memory. The Behavioral and Brain Sciences, 7,* 223–268.

Tulving, E., & Bower, G. H. (1974). The logic of memory representations. In G. H. Bower (Ed.), *The psychology of learning and motivation* (Vol. 8., pp. 265–301). New York: Academic Press.

Tulving, E., & Gold, C. (1963). Stimulus information and contextual information as determinants of tachistoscopic recognition of words. *Journal of Experimental Psychology, 66,* 319–327.

Tulving, E., Schacter, D. L., & Stark, H. A. (1982). Priming effects in word-fragment completion are independent of recognition memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 8,* 336–341.

Tulving, E., & Wiseman, S. (1975). Relation between recognition and recognition failure of recallable words. *Bulletin of the Psychonomic Society, 6,* 79–82.

Underwood, B. J., Boruch, R. F., & Malmi, R. A. (1978). Composition of episodic memory. *Journal of Experimental Psychology: General, 107,* 393–419.

Van Essen, D. C., & Maunsell, J. H. R. (1983). Hierarchical organization and functional streams in the visual cortex. *Trends in Neuroscience, 6,* 370–375.

Warrington, E. K., & Weiskrantz, L. (1982). Amnesia: A disconnection syndrome? *Neuropsychologia, 20,* 233–248.

Wickelgren, W. A. (1979). Chunking and consolidation: A theoretical synthesis of semantic networks, configuring in conditioning, S-R cognitive learning, normal forgetting, the amnesic syndrome, and the hippocampal arousal system. *Psychological Review, 86,* 44–60.

Winograd, T. (1972). *Understanding natural language.* New York: Academic Press.

Wood, F., Taylor, B., Penny, R., & Stump, D. (1980). Regional cerebral blood flow response to recognition memory versus semantic classification tasks. *Brain and Language, 9,* 113–122.

Zola-Morgan, S., Cohen, N. J., & Squire, L. R. (1983). Recall of remote-episodic memory in amnesia. *Neuropsychologia, 21,* 487–500.

Received March 18, 1984
Revision received April 17, 1985 ■