10 Episodic and Semantic Memory[1]

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One of the unmistakable characteristics of an immature science is the looseness of definition and use of its major concepts. In experimental psychology, a discipline less than a hundred years old, we can measure our progress by the number and generality of empirical facts and the

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power and scope of our theories, and we can assess the lack of progress by the degree of ambiguity of our most popular terms.

The concept of memory is a good case in point, although perception, learning, motivation, emotion, and thought could serve as equally relevant illustrations. What exactly do we mean by memory?

The question is worth raising, at this time and in this volume, for at least two reasons. First, the term "memory" has recently been permitted to return from the limbo into which it was swept by the tide of behaviorism some thirty or forty years ago. Since it shows every promise of remaining with us for some time to come, we may be excused for exhibiting some curiosity about its meaning. Second, this book, as its title implies and contents show, is all about memory. But the reader who works his way through all the chapters in their numerical order may experience an abrupt shift in the meaning of the term between Chapters 5 and 6: memory of the later chapters may appear to be not quite the same thing as memory of the earlier chapters. And the reader may wonder, too, exactly what we mean by memory. Raising the question about the meaning of the term "memory," and consequent analyses, one version of which is presented in this chapter, might even make a modest contribution towards the reduction of the degree of ambiguity characterizing one of the most popular concepts of contemporary psychology.

Categories of Memory

In a recent collection of essays on human memory edited by Norman (1970) one can count references to some twenty-five or so categories of memory, if one is willing to assume that any unique combination of an adjectival modifier with the main term refers to something other than any of the referents of other such unique combinations. The list extends from "acquisition" memory, "active" memory, and "auditory" memory near the beginning of the alphabet to "short-term," "very-short-term," and "working" memory near the end. Since this list is only an incidental by-product of the combined efforts of the contributors to the volume, it probably represents a rather incomplete listing of different kinds of memory. Although it may be difficult to determine the exact number of items in a complete list of categories of memory, we would probably be not far off the mark if we doubled the number found in Norman's volume.

Most terms referring to different kinds of memory serve the function of dividing some larger domain of memory, however we conceive of it, into smaller areas within which empirical observations and theoretical

propositions are thought to be generalizable. Such divisions frequently take the form of a dichotomy: two complementary categories exhaust a superordinate category. For instance, we can think of the "whole" memory as consisting of short-term memory and long-term memory. Within the category of short-term memory we can distinguish between auditory and visual memory, and within auditory short-term memory we can create a further dichotomy between articulatory and acoustic memory.

Such dichotomies are among useful heuristic devices for furthering our understanding of mental processes. Almost all of them increment the signal-to-noise ratio in the literature, many of them suggest new experimental questions, and quite a few of them hold the promise of becoming important entries in more permanent taxonomies of cognitive processes. The development of such taxonomies is no less essential in the field of memory than it is in other scientific disciplines. In discussing the importance of the development of propaedeutic categories in a field not far removed from human memory, Melton aptly summarized the problem as follows:

> The noting of the similarities and differences of things and events is the first step in organizing knowledge about nature. These observations are then the basis for classifications of things and events and the formulation of criteria of inclusion and exclusion. This is essential to the generality that is the goal of a science, as well as to efficient communication among scientists [Melton, 1964, p. 328].

A new kind of memory that has recently appeared on the psychological scene is "semantic" memory. As far as I can tell, it was first used by Quillian (1966) in his doctoral dissertation. In the present volume, three chapters are primarily concerned with semantic memory: papers by Rumelhart, Lindsay, and Norman, by Kintsch, and by Collins and Quillian. The question, therefore, naturally arises as to the relation between semantic memory and other kinds of memory.

If I understand the ambitions of the authors of the three chapters correctly, they go considerably beyond merely creating yet another category of memory. All three chapters reflect the orienting attitude of a "unitary" memory system. The authors seem to think of their work as differing from the traditional investigations of human memory and verbal learning mainly in extent rather than in kind. Rumelhart, Lindsay, and Norman, for instance, see as their objective that of developing and describing a memory structure that is capable not only of memorizing facts, but also of solving problems, making logical deductions, and understanding ideas. Kintsch thinks of semantic memory as an organized internal lexicon that represents a person's knowledge of

language and that can serve as a basis for processing information in a variety of memory tasks, including free recall. Collins and Quillian's semantic memory, too, is a highly structured network of concepts, words, and images, capable of making inferences and comprehending language. Although they make no explicit reference to more traditional memory experiments, Collins and Quillian probably would want their "language user" to be able to remember lists of unrelated words.

Despite these explicitly stated or implicitly conveyed intentions of theorists concerned with semantic memory, one may wonder about the term they all use, "semantic memory." A useful concept in science frequently is one whose definition not only makes very clear what it includes, but also what it excludes. For instance, we understand that short-term memory is not long-term memory, auditory memory is not visual memory, and acoustic memory is not articulatory memory. What do we contrast with semantic memory? Semantic memory is not . . . what other kind of memory?

In this chapter I discuss the possibility that semantic memory, among other things, is not the kind of memory that psychologists have been studying in their laboratories since the time of Ebbinghaus. I will suggest that there are sufficiently fundamental differences between the two forms of memory to recommend that we consider, at least for the time being, the two categories separately. To facilitate subsequent discussion, I will refer to this other kind of memory, the one that semantic memory is not, as "episodic" memory. I will refer to both kinds of memory as two stores, or as two systems, but I do this primarily for the convenience of communication, rather than as an expression of any profound belief about structural or functional separation of the two. Nothing very much is lost at this stage of our deliberations if the reality of the separation between episodic and semantic memory lies solely in the experimenter's and the theorist's, and not the subject's mind.

The distinction between episodic and semantic memory systems should not be construed as representing the beginning of some new theory of memory. Rather, the point of view of the two as separate systems represents an orienting attitude or a pretheoretical position whose major usefulness may turn out to lie in facilitating theory construction, without in any way circumscribing the nature of possible theories. In some sense, the distinction parallels that between sensory and perceptual processes, or between transformations of stimulus energy and stimulus information in perception (Gibson, 1966). No one will seriously want to deny that both sensory and perceptual processes are involved in an organism's awareness of its environment, that sensory processes may be influenced by perceptual processes and vice versa, and that, nevertheless, it fre-

quently makes good sense to talk about laws and principles governing one set of phenomena independently of those applicable to the other. I envisage a similar status for the distinction between episodic and semantic memory.

The notion that memory takes different forms which must not be confused in analyses of phenomena of memory has a long history in the philosophical literature. Thus, the concepts of episodic and semantic memory are by no means new, although the traditional terminology has tended to vary from writer to writer and although the philosophical categories of memory have not had any influence on psychological research.[2] A recent notable exception to this general rule can be found in the monograph by Reiff and Scheerer (1959) who draw a clear distinction between *remembrances* and *memoria,* that is, memories with and without the experience of an "autobiographical index" (p. 25).

Episodic versus Semantic Memory

Let us think of episodic and semantic memory as two information processing systems that (a) selectively receive information from perceptual systems (Gibson, 1966) or other cognitive systems, (b) retain various aspects of this information, and (c) upon instructions transmit specific retained information to other systems, including those responsible for translating it into behavior and conscious awareness. The two systems differ from one another in terms of (a) the nature of stored information, (b) autobiographical versus cognitive reference, (c) conditions and consequences of retrieval, and probably also in terms of (d) their vulnerability to interference resulting in transformation and erasure of stored information, and (e) their dependence upon each other. In addition, psychological research on episodic memory differs from that on semantic memory in several respects.

Episodic memory receives and stores information about temporally dated episodes or events, and temporal-spatial relations among these events. A perceptual event can be stored in the episodic system solely in terms of its perceptible properties or attributes, and it is always stored in terms of its autobiographical reference to the already existing

[2] Munsat (1966) refers to "non-episodic" memory, but I am not aware of anyone who has used the term "episodic" memory. It seems to fit well for our purposes. The term "episode" is a somewhat loose synonym of "occurrence," and one of its dictionary definitions is that of "an event that is distinctive and separate although part of a larger series." Episodic memory is about occurrence of such events.

contents of the episodic memory store. The act of retrieval of information from the episodic memory store, in addition to making the retrieved contents accessible to inspection, also serves as a special type of input into episodic memory and thus changes the contents of the episodic memory store. The system is probably quite susceptible to transformation and loss of information. While the specific form in which perceptual input is registered into the episodic memory can at times be strongly influenced by information in semantic memory—we refer to the phenomenon as encoding—it is also possible for the episodic system to operate relatively independently of the semantic system.

Semantic memory is the memory necessary for the use of language. It is a mental thesaurus, organized knowledge a person possesses about words and other verbal symbols, their meaning and referents, about relations among them, and about rules, formulas, and algorithms for the manipulation of these symbols, concepts, and relations. Semantic memory does not register perceptible properties of inputs, but rather cognitive referents of input signals. The semantic system permits the retrieval of information that was not directly stored in it, and retrieval of information from the system leaves its contents unchanged, although any act of retrieval constitutes an input into episodic memory. The semantic system is probably much less susceptible to involuntary transformation and loss of information than the episodic system. Finally, the semantic system may be quite independent of the episodic system in recording and maintaining information since identical storage consequences may be brought about by a great variety of input signals.

Before expanding on this thumbnail sketch of the two systems in a somewhat greater detail, we should consider some examples of episodic and semantic memory tasks. We must remember, however, that the exercise of identifying various memory situations with episodic or semantic memory is neither simple nor particularly informative, since many tasks contain both episodic and semantic features. The assignment of a task to one or the other category depends upon the kind of memory query addressed to the person, the exact nature of the information to be retrieved, or the nature of the memory claim made about the retrieved information by the person retrieving it. Nevertheless, a short list of examples may help the reader to follow the subsequent arguments in this essay.

The following memory claims are based on mnemonic information stored in episodic memory: (a) I remember seeing a flash of light a short while ago, followed by a loud sound a few seconds later; (b) Last year, while on my summer vacation, I met a retired sea captain who knew more jokes than any other person I have ever met; (c) I

remember that I have an appointment with a student at 9:30 tomorrow morning; (d) One of the words I am sure I saw in the first list I studied was LEGEND; (e) I know the word that was paired with DAX in this list was FRIGID.

Each of these statements refers to a personal experience that is remembered in its temporal-spatial relation to other such experiences. The remembered episodes—whether they be as amorphous as "meeting a retired sea captain" or as precisely circumscribed as "seeing a flash of light"—have no necessary extra-episodic reference of any kind. They are autobiographical events, describable in terms of their perceptible dimensions or attributes and in terms of their temporal-spatial relations to other such events.

Now, consider some illustrations of the nature of information handled by the semantic memory system: (a) I remember that the chemical formula for common table salt is NaCl; (b) I know that summers are usually quite hot in Katmandu; (c) I know that the name of the month that follows June is July, if we consider them in the order in which they occur in the calendar, or March, if we consider them in alphabetical order; (d) I know that uncertainty of an event having five equiprobable outcomes is 2.322 bits; (e) I think that the association between the words TABLE and CHAIR is stronger than that between the words TABLE and NOSE.

Although some of these statements refer to the speaker's "knowledge" rather than his "remembering," all of them can be regarded as memory statements in that their content clearly depends upon information entered into the semantic memory at some earlier time. Unlike episodic memory claims, these statements do not refer to personally experienced unique episodes. Rather, content words in these statements represent linguistic translations of information retrieved about general concepts and their interrelations.

We can now proceed to compare and contrast episodic and semantic memory.

The Nature of Stored Information

Episodic memory is a more or less faithful record of a person's experiences. Thus, every "item" in episodic memory represents information stored about the experienced occurrence of an episode or event. Whether we think of each event, or its representation in memory, as "an ordered list of attributes with their corresponding values" (Bower, 1967, p. 233), as "a collection of attributes which serve to discriminate one memory from another" (Underwood, 1969, p. 559), as an organized pattern of

activity involving vast numbers of cortical cells (Lashley, 1950), or in terms of some other analogue, it can be reasonably completely described in terms of (a) its perceptible properties, and (b) its temporal-spatial relation to other experienced events.

A subject in a laboratory experiment is, at least in principle, equally capable of remembering the occurrence of a highly meaningful and familiar word, a meaningless nonsense syllable, a photograph of a person's face, a line drawing of an unfamiliar figure, or a 2-second 764 Hz pure tone. The subject may find it easier to reproduce some of these events from memory than others, and, indeed, the experimenter may find it convenient to test the subject's memory for some of these events by a recognition test, but no extra-episodic cognitive reference seems to be necessary for registration, storage, and retrieval of such episodic information.

Each experienced event always occurs at a particular spatial location and in a particular temporal relation to other events that already have occurred, events occurring simultaneously with it, or events that have not yet occurred. These temporal relations among experienced events are also somehow represented as properties of items in the episodic memory system. To ask a person about some item in episodic memory means to ask him when did event E happen, or what events happened at time T. Retrieval of information of this kind from episodic memory is successful if the person can describe the perceptible properties of the event in question and more or less accurately specify its temporal relations to other events. Temporal coordinates of an event and its representation in episodic memory of course need not be specified in terms of the clock and the calendar. They could be recorded in terms of temporal occurrences of other events in some as yet little understood manner.

Unlike the relations among items stored in episodic memory, the relations among items in semantic memory are of much greater variety. Some relations among concepts in semantic memory are indeed spatial and temporal, but the large majority of them clearly are not.

Input into the semantic memory system has two sources, perception and thought. When input is perceptual, perceptible attributes of stimulus events are important only to the extent that they permit unequivocal identification of semantic referents of the events. These properties themselves are not recorded in semantic memory. We also know that many perceptual events, in presence of other appropriate input or instructions to this system, result in identical changes in the semantic system. We know very little about the "language" of semantic input generated by thought. It would be entirely useless, therefore, to speculate about the fate of "attributes" of these internal stimulus events. However, it does

not look as if it might be useful to insist on temporal sequence of thought elements as an important determinant of resultant changes in the semantic memory system.

AUTOBIOGRAPHICAL VERSUS COGNITIVE REFERENCE

Let us next briefly consider the question of denotative reference of input signals. A person's episodic memories are located in and refer to his own personal past. Most, if not all, episodic memory claims a person makes can be translated into the form: "I did such and such, in such and such a place, at such and such a time." Thus, an integral part of the representation of a remembered experience in episodic memory is its reference to the rememberer's knowledge of his personal identity. William James' conception of memory was that of episodic memory: "Memory requires more than mere dating of the fact in the past. It must be dated in *my* past" (James, 1890, p. 650). Reiff and Scheerer (1959), in describing the distinction between remembrances and memoria, placed particular emphasis on the presence or absence of autobiographical reference: "The important distinguishing characteristic between these two primary forms of memory is that remembrances are always accompanied by the experience of personal continuity through time, while in memoria this experience is absent" (p. 25).

Inputs into the semantic memory system are always referred to an existing cognitive structure, that is, they always have some cognitive reference, and the information they contain is information about the referent they signify rather than information about the input signal as such. Information stored in the semantic memory system represents objects—general and specific, living and dead, past and present, simple and complex—concepts, relations, quantities, events, facts, propositions, and so on, detached from autobiographical reference. If a person possesses some semantic memory information, he obviously must have learned it, either directly or indirectly, at an earlier time, but he need not possess any mnemonic information about the episode of such learning in order to retain and to use semantic information.

Information in episodic memory of necessity must be recorded into the store directly, while semantic memory information can, although it need not, be recorded indirectly or in a piecemeal fashion. For instance, for a person to remember that he experienced an event E_2 after another event E_1, he must have originally experienced those two events in this temporal order. No other possibility exists for entering information about the temporal order of two autobiographical events into episodic memory. On the other hand, it is quite feasible for a person to learn, for instance,

that Napoleon was defeated by Wellington at Waterloo, and then learn, on a subsequent occasion, that Napoleon undertook a futile campaign against Russia, and yet have no difficulty remembering the historically correct sequence of the two events referred to by the two earlier statements, provided he receives appropriate additional information about the sequence.

Consider now a typical memory experiment in which a subject is asked to study and remember a list of familiar words or pairs of words. This is an episodic memory task. The occurrence of a verbal item in a given list, at a particular time, and in specified temporal relation to other items in the list is an autobiographical episode having no necessary extra-episodic denotative reference. The subject has successfully retrieved information about this episode when he responds to the retrieval query with the reproduction of an appropriate copy of the input item.

In experiments where to-be-remembered units are meaningful words that refer to concepts stored in semantic memory, the information in semantic memory may be used at the time of the input of the information into the episodic memory store. We will have more to say about such "encoding" later on in this chapter. While such encoding of a perceptual event frequently facilitates its subsequent retrieval, it does not appear to be a necessary condition for the storage and successful retrieval of episodic information.

Conditions and Consequences of Retrieval

Some of the relevant retrieval characteristics of the two memory systems follow from our discussion of the relation between input and storage in the two systems. For instance, information can be retrieved from episodic memory only if that information had been entered into the store on an earlier occasion. The episodic memory system does not include the capabilities of inferential reasoning or generalization. Inferential reasoning, generalization, application of rules and formulas, and use of algorithms, on the other hand, represent important methods of utilization of information stored in semantic memory. By relying on his semantic memory, it is literally quite possible for a person to know something he did not learn. Thus, for instance, a person may have never learned that March follows June in the alphabetical listing of months, and yet be able to retrieve this bit of knowledge upon an appropriate query.

The consequences of retrieval also appear to differ for the two systems. While retrieval operations can be considered neutral with respect to the contents and structure of semantic memory, in the sense that they

do not change the system, the act of retrieval from either system may, and usually is, entered as an episode into episodic memory. Retrieval as feedback into the episodic system may lead to changes in the contents, and the retrievability of these contents, of episodic memory.

Interference and Erasure of Information

Episodic and semantic memory systems probably differ in their susceptibility to transformation and loss of stored information. While in both systems it is very much simpler to record information in the memory store than to eliminate it from the store, forgetting appears to be more readily produced in the episodic than in the semantic system.

We know a fair amount about conditions of forgetting in episodic memory, but almost nothing about how stored semantic information becomes unavailable or inaccessible. It is probably not entirely unreasonable to assume that loss of information from the episodic memory frequently takes the form of some sort of transformation of that information as a consequence of interference with the temporal coding of stored events. Since information in episodic memory is always temporally dated, and since it can only be retrieved if its temporal date is sufficiently accurately specified by the retrieval cue, interference with temporal coding may render access to the to-be-retrieved material difficult or impossible.

Information in semantic memory, on the other hand, is usually encoded as part of, or assimilated into, a rich multidimensional structure of concepts and their relations, and such embeddedness protects the stored information from interference by other inputs. Postman and Parker's (1970) distinction between substitution habits and accretion habits in paired-associate transfer could be used to describe the effects of new inputs into the episodic and semantic system, respectively.

Interdependence of the Two Systems

Our knowledge about the interdependence between episodic and semantic memory is meager. Theoretical thinking about problems of memory have been strongly influenced by the assumption of continuity of memory, and it is not surprising that under these conditions questions about the relation between the two systems did not make any sense and hence were not raised. One of the heuristic advantages of the distinction between the two systems may lie in the necessity it reveals for exactly these kinds of questions.

We know, of course, about the importance of semantic variables in

determining retrievability of material learned in episodic memory experiments of many different kinds—the first five chapters of this volume describe and refer to many such experiments—and these effects can be regarded as evidence for the important role that the semantic system plays in storage and retrieval of episodic memory information. The processes and mechanisms involved in semantic encoding of perceptual events, however, are not at all well understood. Why, for instance, is it easier to remember that word *B* was seen at the same time as word *A*, as members of a to-be-learned pair of words, if the concepts corresponding to the words in semantic memory are closely related?

Answers to this and many other similar questions in the literature have often been deceptively simple. For instance, many investigators, adopting the implicit assumption of continuity between episodic and semantic memory, would explain the subject's facility in remembering that *B* occurred simultaneously with or next to *A* in terms of an association between *A* and *B*, an association that may already be quite strong prior to the experiment and that may be even further strengthened when the two words occur side by side. The probability of retrieval of *B*, given *A*, according to this view, is simply a function of the strength of the association between the two items.

If we accept the distinction between episodic and semantic memory along the lines of the present essay, this explanation of the effect of pre-experimental associations on the memory for co-occurrence of the two items at the same time in close spatial contiguity is inadequate. Certain predictions from this explanation also run counter to the encoding specificity principle (Postman, this volume, p. 16; Thomson & Tulving, 1970) that questions the general utility of the "associative continuity" hypothesis. The encoding specificity principle emphasizes the importance of encoding events at the time of input as the primary determinant of the storage format and retrievability of information in the episodic memory system, and points to the necessity of further study of the process of encoding, including semantic encoding.

Although the semantic system frequently influences encoding of perceptual events and, hence, the nature of information stored in episodic memory, there are probably many situations outside the laboratory in which recording and retention of episodic information is relatively independent of information stored in the semantic system. Sensory impressions, such as seeing a flash of light, a person's face, or hearing a fragment of a melody, can probably be remembered quite well without the intervention of the semantic system.

It is not unreasonable to assume that the semantic memory system can also function quite independently of episodic memory. Consider,

for example, a situation in which a person reads or hears a short story. Information about the episode of reading or hearing the story is entered into episodic memory, and the contents of the story are registered in semantic memory, in the code of the semantic system and disregarding the specific input events and their perceptible properties. Retrieval of information about the story from semantic memory may take the form of translation of the "internally stored thematic surrogate" (Dooling & Lachman, 1971) into natural language. The product of this translation process may have only an accidental resemblance to the set of original input events. In a recent experiment reported by Howe (1970), for instance, subjects heard a 160-word passage and were tested for its recall two minutes later. On the average, they produced 81.5 words in recall, of which 29.8 were "correct," in that they corresponded to input words, and 51.7 words were "additions," words that had not occurred in the original input passage. This large number of intrusions contrasts starkly with the very low frequency of intrusions in experiments in which input lists consist of unrelated words. Since it is reasonable to assume that a sizable proportion of the 29.8 "correct" words were in fact unidentifiable intrusions, the correspondence between the subjects' output and the original input, scored by episodic memory measures, was rather slight, although the subjects in this experiment could reproduce more than 40 percent of the "idea units."

Relatively little is known about the role that the perceptual system and episodic memory play in the storage of information into semantic memory. Problems of acquisition of semantic information, and problems of modification of existing semantic structures, have not yet been studied by students of semantic memory. The paper by Greeno in the present volume is concerned with the problem of acquisition of a cognitive structure. Although Greeno deals with a highly specific situation, learning of the binomial theorem, his general approach may well help guide future research into the development and growth of an individual's semantic memory.

Laboratory Studies of Episodic and Semantic Memory

In typical episodic memory experiments, the subject must remember that such and such an item—the equivalent of a discrete perceptual event or experienced episode—occurred at such and such a time, in such and such a temporal relation to other items and other kinds of autobiographical events. These experiments almost invariably are concerned with "accuracy" of the subjects' performance. Thus, the subjects' responses in episodic memory experiments are usually classified into "cor-

rect" and "incorrect" ones, depending upon correspondences and discrepancies between the experimental input and the subjects' output. The whole tradition of research in episodic memory strongly reflects this concern with how accurately the subject remembers the material presented to him, rather than, say, what he remembers. Studies of clustering and subjective organization, in addition to earlier research on "qualitative changes in retained activities" (McGeoch & Irion, 1952, pp. 363–367), constitute conspicuous exceptions to the general preoccupation with accuracy or some other measure of power of performance.

To the extent that semantic memory has been studied experimentally at all, two lines of research can be discerned. One is directed at the elucidation of the structure of semantic memory, while the other is represented by attempts to study retrieval processes in semantic memory.

The structure of semantic memory must be almost exclusively inferred from characteristics of the subject's output alone. Since input conditions responsible for the existing semantic structure are usually not known, at least not to the extent they are known and can be specified in studies of episodic memory, the experimenter simply cannot be concerned with correspondences and discrepancies between input and output. One consequence of this state of affairs is that experimenters are much less likely to rely on purely experimental observations for their inspirations and insights about the structure of semantic memory, and much less likely to do the same kinds of experiments that have become traditional in the field of episodic memory in those cases where they do seek guidance for their theorizing from empirical observations. Quite apart from the fact that they seldom raise questions about when any particular fact, concept, or some other item of information in semantic memory was perceived, learned, or somehow else acquired by the subject, they usually make no attempt to classify subjects' responses in studies of semantic memory into correct and incorrect ones. For instance, when inferences about semantic structure are made on the basis of subjects' free associations (e.g., Deese, 1965), all responses subjects make in response to a given stimulus word are accepted as equally useful data by the experimenter. In these studies there is no good and bad performance, and subjects never make errors. Similarly, in studies in which the experimenter wishes to draw inferences about the structure of semantic memory from the way in which subjects sort a set of lexical items into categories on the basis of "similarity of meaning" (Miller, 1969), subjects' behavior is not evaluated with respect to accuracy or some other measure of goodness of memory.

It is true that in investigations of semantic memory that have relied on reaction times as indices of structural characteristics of semantic

memory (e.g., Collins & Quillian, 1969; Schaeffer & Wallace, 1970) some responses subjects make are regarded as "incorrect" and excluded from consideraton, but in these studies incorrect responses are attributed to sources other than subjects' semantic memories.

Studies concerned with retrieval from semantic memory, on the other hand, do use accuracy as a criterion of subjects' performance. In these experiments the subject is asked to complete a meaningful word—to "find" it in the mental lexicon—on the basis of a fragment of the word as a cue (e.g., Horowitz, White, & Atwood, 1968), or to tell exactly what and how much he knows about a word whose definition he is given when he cannot quite produce the word itself (Brown & McNeill, 1966). Experiments on tachistoscopic identification of words can also be thought of as relevant to the problem of retrieval from semantic memory, as are studies in which subjects are asked to decide whether a particular string of letters is or is not a meaningful word, and their reaction times observed (Rubenstein, Garfield, & Millikan, 1970).

Utility of the Distinction

In this section of the chapter we will briefly consider some recurrent problems in the study of human memory whose solutions may be affected by the pretheoretical point of view about the distinction between episodic and semantic memory.

Association and Contiguity

The core of all definitions of the concept of association, as Postman (1968; also this volume) has pointed out, is the sequential order of verbal units. Sequential order of units has received a great deal of attention in the past work on verbal learning, primarily in the context of paired-associate and serial-anticipation list-learning experiments. Consideration of the broader range of episodic memory situations—including free recall, recognition memory, verbal discrimination, the Brown-Peterson paradigm, recency judgments, and others—reveals that memory for the sequential order of input items is always an important ingredient of the subjects' task. The concept of association, therefore, can be used in descriptions of the subjects' accomplishments in episodic memory situations.

The use of associative language is admittedly easier in some situations than others. It is perfectly acceptable, for instance, to say that the

subject learned an association between A and B if the subject remembers that events A and B occurred at the same time. And whether we think of A as a part of the retrieval query that specifies the time at which another event occurred whose name the subject is expected to retrieve from memory, or as a stimulus that elicits the associated response B, may indeed be simply a matter of preference. It is probably more difficult to recast in associative terms the subjects' memory claim that he remembers events A, B, and C having occurred in a longer series of events, and that the temporal interval between A and B was approximately twice as long as that between B and C, but a determined association theorist may be able to manage this one, too. By and large, then, there is nothing wrong with the concept of association as a purely descriptive term in the study of episodic memory.

Difficulties do arise, however, when the concept is pressed into service as an explanatory tool. Its shortcomings become apparent especially clearly in the course of examination of the proposition that contiguity is necessary for learning or for association formation. Both Postman and Voss elsewhere in this volume have again emphasized the important role that contiguity plays in learning.

If learning means the subject's memory for the temporal co-occurrence or immediate succession of two events, A and B, then obviously contiguity is necessary. If learning refers to the subject's memory for the occurrence of three events, A, B, and C, and his memory for the temporal interval between A and B as approximately twice as long as that between B and C, then it would seem to be more appropriate to talk about stored information about temporal relations among events rather than contiguity. Contiguity is a temporal relation, and a special kind of temporal relation at that, but there are other aspects of temporal relations that the episodic system is capable of handling. If we explain learning as association-formation based on contiguity, the explanation would apply only to some aspects of the operation of the episodic memory system. Recourse to the concept of implicit contiguity, or functional contiguity (Voss, p. 182; Wallace, 1970) does not provide an entirely satisfactory way out, since it is difficult to imagine how the proposition that associations are built up through implicit contiguity could be denied by any experimental data. The conservative conclusion at this time seems to be that the utility of association as an explanatory concept in episodic memory has not been demonstrated. This is why it may be preferable to describe subjects' behavior in episodic memory tasks in terms of storage and retrieval of information about events and their temporal relations. Such description leaves the problem of explanation of the behavior wide open, as it should be.

Sequential associations and ordering of verbal units has been regarded as highly critical for the production and comprehension of language. For this reason one might think that the concept of association figures prominently in the study of semantic memory. This does not appear to be the case, however. Contiguity of input does not seem to be an important determinant of the structure of the mental thesaurus. Input events widely separated in time may become closely related when they are coded into semantic memory. Invocation of implicit mediators or implicit contiguity, as Postman hints on p. 40, here, too, is not likely to be effective because of impossibility of experimental rejections of such claims.

While the precise order of input events is sometimes important for distinguishing between subtle differences in the meaning of a sentence, and while it always determines the grammaticality of the sentence, a person can pick up a good deal of semantic information from awkwardly ordered and ungrammatical sentences. An ordinary language user, as Collins and Quillian (this volume, p. 346) point out, does not usually go around analyzing grammaticality of sentences, but rather tries to understand them. The role that sequential ordering of input plays in recording information into the semantic memory, therefore, is not yet exactly known, although it seems likely that the concept of association, as it has been used in the more traditional work on episodic memory, will be largely dispensed with in studies of semantic memory. In describing the structure of semantic memory, for instance, the authors of the three relevant chapters in this volume rely heavily on labeled and directed relations among the nodes of the network representing semantic memory. These labeled and directed "associations" in semantic memory contrast with unlabeled and nondirected relations among words in models of episodic memory, such as Anderson's FRAN model described by Bower elsewhere in this volume.

Encoding and Organization

The concepts of encoding and organization both refer to the possibility that the internal representation of a given perceptual input may assume different forms depending upon certain operations performed on the input, or on its representation in the memory store. (In the latter case it may be more appropriate to refer to recoding and reorganization.) The two terms differ in that encoding implies the transformation of the input independently of other perceptual inputs, while organization carries the implication of changes in the memory trace of an event that are influenced by the presence of certain other traces in the episodic

memory store. Thus, for instance, temporal encoding of an input implies the registration of the date of an episode without regard to other episodes, although it may be more appropriate to assume, as I mentioned earlier, that this may not represent the way the system works, and that the temporal date of a stored event may be determined by its organization in relation to other events with their temporal dates. Similarly, semantic encoding of a verbal item in episodic memory implies that the trace of the item is influenced by the information already available about its referent concept in semantic memory, while semantic organization refers to the grouping of items in a given set that somehow reflects the semantic relations among the corresponding concepts.

The most primitive form of organization is based on temporal and spatial proximity of elements in perceptual inputs and displays. Both Bower and Postman, in this volume, discuss the contributions of Gestalt psychology to the understanding of the principles of perceptual unitization. Since episodic memory is a more or less faithful record of temporally organized perceptual episodes, the first two of the four points in the Gestalt argument Postman considers (pp. 4–5)—that mnemonic organization mimics the initial perception of the events to be remembered, and that this organization is determined by proximity relations among component units—would seem to be quite appropriate even today, provided we are talking about the episodic memory system. The relevance of these two points to semantic memory is quite questionable. It also seems rather obvious that this kind of primitive organization need not depend on semantic memory.

Information in the semantic system plays a role in organization of verbal material, the extent of its involvement being dependent upon the basis of organization. If, for instance, three words in a list of to-be-remembered words are HAT, CAT, and MAT, they may be organized into a higher-order unit in terms of either their pronunciation or similarity of letter sequences. While in both cases the rules for organization may originate in semantic memory, organization of the three terms does not depend on semantic relatedness of the words. On the other hand, if the three words were CAT, LION, and TIGER, the encoding of each in terms of its semantic referent provides the basis for their organization into a higher-order unit. A person not familiar with English is likely to organize HAT, CAT, and MAT into a group, but not CAT, LION, and TIGER. Since acoustic coding is less dependent upon the semantic system than is semantic coding, it can be considered to be more direct. The fact that acoustic coding requires less time than semantic coding (Shulman, 1970) thus may reflect different degrees of involvement of the semantic system in the two types of coding and organization. A

similar parallel lies in the distinction between primary and secondary organization in free recall (Tulving, 1968). Primary organization depends much less on the semantic system than secondary organization. Indeed, recency effect in free recall as a manifestation of primary organization can be regarded as a consequence of ready accessibility of terminal list items through their distinctive input positions or acoustic traces as retrieval cues.

Frequency and Repetition

The distinction between episodic and semantic memory influences one's attitudes towards frequency and repetition of events in memory. Consider a simple experiment in which the subject's task is to remember common English words. How do we interpret a situation where one or more items are presented more than once in the same list (e.g., Waugh, 1967)? In his well-known paper on attributes of memory, Underwood (1969) suggests that one of the attributes of memory is frequency. In recall of a single list with repeated items, the frequency attribute manifests itself in subjects' capabilities of making reasonably accurate judgments about the frequency with which each one of the presented items occurred in the list. This capability is assumed to be based on different values of the frequency attribute of items. This conception is logically similar to the notion of "occurrence information" that is thought of as being "stored in memory for each word" (Bower, Lesgold, & Tieman, 1969, p. 492; also Mandler, this volume), and that presumably is different for words that occurred in the list twice, once, or not at all.

This conception of frequency seems to require the assumption that an identical event occurred n times in a list, with $n \geqq 0$. In the world of perceptual events this something, of course, is the nominally identical physical stimulus, and in the semantic memory system it might be its corresponding concept. The point of view of frequency attribute, or occurrence information, then is that a given item A is one and the same item, regardless of where or when it occurs, and that the frequency attribute of the internal representation of the item is updated every time the item occurs in the list.

From the point of view of episodic memory, however, each event a person experiences is always unique in the sense that in all of his previous autobiographical history there has not been another experience exactly like the present one. An event that occurs now, of course, can be perceived and encoded as similar or somehow else related to other events, but there can be no dichotomy between repetition of one and the same item and presentation of different items. There is no particular reason,

according to this point of view, to single out nominal identity of stimulus events as a basis of classification of events into categories whose size the subject is asked to judge. We can ask how many times word *A* occurred in the list, but we can also ask about the frequency of animal names in the list, or words containing letter "o." If we assume that the subject can estimate the number of occurrences of word *A* in the list on the basis of its frequency attribute or occurrence information, what is the "memory" or the entry in some permanent memory store whose frequency attribute or occurrence information permits the subject to make estimates about the number of animal names or words beginning with "o"?

The adoption of the point of view of the distinction between episodic and semantic memory (a) permits us to avoid some of the conceptual difficulties inherent in the assumption of frequency attribute or occurrence information attached to some earlier representation of the perceptual event in some permanent memory store, (b) leaves open the possibility of asking questions about the effects of repetition in situations in which the relation between "repeated" events is something other than nominal or physical identity, and (c) suggests that in experiments in which items are repeated within a list the subject be asked not to report what words occurred in the list, but rather tell what events occurred in the list, that is, report repeated occurrences of nominally identical items.

Some Other Problems

The scope of the present work does not permit us to consider some other problems in the study of human memory for which the proposed distinction between episodic and semantic memory has implications. In this final section, however, I would briefly like to at least mention some of them.

The problem of exactly how to interpret subjects' responses that may represent "guessing" rather than memory, for instance, may appear in a new light if we realize that in episodic memory experiments we are testing subjects for their memory of specific events. Correspondence between a word in an input list and the same word in the subject's recall protocol, therefore, cannot always be regarded as evidence for subject's remembering the occurrence of that word in the list. The possibility that the subject retrieves information from his semantic memory in an episodic memory experiment should not be overlooked, particularly in those experiments in which the number of intrusions is large. Consider again Howe's (1970) experiment referred to earlier (p. 393). A typical subject in that experiment recalled 80 words, 30 of which were "correct"

and 50 "incorrect." In describing that experiment I briefly mentioned the possibility that some of the 30 "correct" words may have simply represented accidental correspondences between the subject's translation of the semantic information about the story into natural language on the one hand and the presented list of input items on the other hand. How could we test the subject for "true" episodic information in this case? One possibility would be to give the subject the 80 words he produced in recall, tell him that 30 of these occurred in the input passage and 50 did not, and ask him to select 30 words out of 80 that he in fact remembers from the input. This is not the place to go into computational details of such a test, but it should be clear that the procedure would permit assessment of the degree to which specific words recorded by the subject in his output represented remembered episodic units.

The distinction between episodic and semantic memory may also be quite useful in understanding data such as those reported by Thomson and Tulving (1970) in support of the encoding specificity principle. In absence of the distinction, it would be more difficult to explain why subjects cannot take advantage of strong preexperimental associations between words that serve as retrieval cues and words that occurred in an earlier input list. The remarkable precision with which "selector mechanism" works, as well as the problems posed by the "interference paradox" (Underwood & Schulz, 1960) also may become somewhat clearer and comprehensible if we keep in mind the distinction between episodic and semantic memory.

Finally, we have heard frequent and justified complaints that many decades of research and study by psychologists interested in human learning and memory have not yielded many significant insights that could be used for the improvement of education and for the betterment of learning in classrooms. If it is true that past research in human learning and memory has been concerned primarily with episodic memory, and if it is true that classroom learning has little to do with students' remembering personally experienced events, then it is not surprising that empirical facts and theoretical ideas originating in the verbal learning and human memory laboratories have little bearing on theory and practice of acquisition of knowledge.

Summary

In this chapter I have tried to present a case for the possible heuristic usefulness of a taxonomic distinction between episodic and semantic memory as two parallel and partially overlapping information processing systems. Episodic memory refers to memory for personal experiences

and their temporal relations, while semantic memory is a system for receiving, retaining, and transmitting information about meaning of words, concepts, and classification of concepts.

I argued that the two memory systems differ from each other (a) in the nature of stored information, (b) with respect to the denotative reference of input events, (c) in terms of conditions and consequences of retrieval, and possibly (d) in their susceptibility to interference and erasure of stored information. In handling mnemonic information for verbal materials the two systems frequently interact, but the extent of dependence of one system on the other may vary with the particular task.

Laboratory studies of human memory and verbal learning have almost exclusively been concerned with phenomena of episodic memory. The large majority of typical memory tasks reduce to the requirement that the subject remember what particular perceptual event occurred in what temporal (sometimes also spatial) relation to other events. The relatively scant literature on semantic memory consists primarily of studies of free association to, and classification of, word stimuli, as well as studies of retrieval times for semantic information.

The possible range of advantages of the distinction between episodic and semantic memory has not yet been explored. Some illustrative cases were briefly considered in the chapter by relating the concept of two memory systems to problems of association and contiguity, encoding and organization, and frequency and repetition. It is not entirely inconceivable that the adoption of the distinction—at least until such time that experimental and theoretical developments dictate a more parsimonious taxonomy—could aid in the solution of a number of outstanding problems of human memory.

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ORGANIZATION OF MEMORY

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