CANADIAN JOURNAL OF PSYCHOLOGY, 1982, 36(2), 130-147

Synergistic Ecphory in Recall and Recognition*

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ABSTRACT A general model of retrieval of episodic memory information is described. It provides a framework within which a number of basic phenomena of recall and recognition can be integrated and related to commonly accepted theoretical ideas. The model also provides a simple statement of the relation between recall and recognition as two forms of retrieval: They are similar with respect to the process of ecphory, combining trace information and retrieval information into ecphoric information; they are different with respect to conversion of ecphoric information into recollective experience and memory performance.

RÉSUMÉ Présentation d'un modèle général du recouvrement de l'information en mémoire épisodique. Ce modèle fournit un cadre dans lequel un certain nombre de phénomènes de base relatifs au rappel et à la récognition peuvent être intégrés et reliés à des concepts théoriques communément acceptés. Le modèle présente également une manière simple de comprendre la relation qui existe entre le rappel et la récognition qui sont vus comme deux formes de recouvrement, semblables en ce qui a trait au processus d'ecphorie permettant de combiner l'information de trace et l'information de recouvrement en information ecphorique, mais différents en ce qui a trait au rendement mnémonique et à la conversion de l'information ecphorique en souvenir.

The relation between recall and recognition has recently shifted into a sharp theoretical focus. Many theorists agree that clarification of the relation constitutes a test of the adequacy of our understanding of human memory. Such clarification has been sought through experimental and theoretical analyses of many possible aspects of the relation (e.g., Anderson & Bower, 1972, 1974; Begg, 1979; Brown, 1976; Flexser & Tulving, 1978, in press; Gregg, 1976; Humphreys, 1978; Humphreys & Bowyer, 1980, 1981; LeCocq & Tiberghien, 1981; Lockhart, Craik, & Jacoby, 1976; Mandler, 1980; Rabinowitz, Mandler, & Barsalou, 1979; Rabinowitz, Mandler, & Patterson, 1977; Tulving, 1976; Tulving & Thomson, 1973).

These analyses have been directed at timeless problems, such as the nature of recall and recognition processes and the measurement of recall and recognition, as well as at issues of more recent origin, such as context effects, retrieval processes, independence versus dependence, effect of

*This research was supported by the Natural Sciences and Engineering Research Council of Canada (Grant No. A8632). I am grateful to Robert Lockhart and Michael Watkins for valuable comments. Address reprint requests to Endel Tulving, Department of Psychology, University of Toronto, Toronto, Ontario, Canada M5S 1A1.

one test on the other in successive test situations, recognition failure of recallable words, and word-frequency effects in recall and recognition.

As a result of all this work, we know very much more about recall and recognition, and the relation between them, than we knew only twenty years ago. But, because of the wealth of new experimental facts, and the rich texture of theoretical ideas that have been brought to bear upon these facts, we also run the risk of losing sight of the forest for the trees. The answer to the simple question, 'What is the relation between recall and recognition?' is likely to be either 'It depends' or an elaborate, long, complicated set of statements that leaves the respondent breathless and the questioner overwhelmed.

For some time now, I and my co-workers have answered the question concerning the relation between recall and recognition by asserting that the two processes are more similar than different. This 'continuity' hypothesis holds that retrieval in recall and recognition 'is essentially the same, a joint product of the information stored in the past and that in the immediate environment' (Tulving & Watkins, 1973, p. 739), that 'the process of utilization of trace information in the act of retrieval is thought to be essentially the same for recall and recognition' (Tulving, 1976, p. 37), and that 'the distinction between recall and recognition ... has outlived its usefulness' (Tulving, 1976, p. 73). An alternative hypothesis of the relation between recall and recognition holds that there exist important differences between the processes involved in them (e.g., Anderson & Bower, 1972, 1974; Kintsch, 1970, 1974). Like the continuity hypothesis, the dual-process hypothesis is supported by some empirical facts, but it cannot graciously accommodate some others. Thus the debate about the relation between recall and recognition continues.

This paper presents a revised version of the 'episodic ecphory' view (Tulving, 1976) of the relation between recall and recognition. In the revised version, some of the previously proposed ideas concerning the commonalities of the two forms of retrieval are retained, but the extreme suggestion that there is no essential difference between them is now abandoned. The rejection of the extreme form was dictated by the findings from an experiment that was designed to test the 1976 version of the episodic ecphory view. The experiment is described at somewhat greater length elsewhere (Tulving, 1982, Ch. 14), but it will be briefly summarized later in this paper.

To distinguish between the earlier and the present version of theoretical speculations, and for reasons to be mentioned later, the ideas proposed in this paper will be referred to as the Synergistic Ecphory Model of Retrieval. The model is simple but general. It makes no specific predictions, but it makes it possible to integrate a number of basic empirical facts of recall and recognition, and to relate these facts to several commonly accepted theoretical ideas. The model also provides an answer to the question of

what the relation between recall and recognition is like, and it shows how retrieval information can be uncorrelated in recall and recognition although the two sets of underlying processes are similar.

The remainder of this paper consists of four parts: (a) a brief description of the general framework within which the Synergistic Ecphory Model of Retrieval is to be described; (b) a statement of the relation between recognition and recall situations, on the one hand, and theoretical components of the general framework on the other; (c) a description of the Synergistic Ecphory Model of Retrieval, with particular reference to the relation between recognition and recall; and (d) a brief review of experimental facts and theoretical statements that can be seen to be interrelated within the model.

GENERAL FRAMEWORK

The general framework within which the ideas presented in this paper were developed has been discussed at greater length elsewhere (Tulving, 1982) under the name of General Abstract Processing System (GAPS). Only a brief summary of it is given here. It is meant to apply to remembering of all sorts of events, but I will discuss it in terms of the conventional laboratory analogue of episodic memory: remembering of the occurrence of a discrete familiar item on a single occasion in an unfamiliar setting.

The to-be-remembered item or event is converted into a memory trace through the process of *encoding*. The properties of the trace depend on the item, its presentation context, encoding operations performed on it, the cognitive environment in which encoding occurs, and other factors. After original encoding, the properties may be changed through the process of recoding, depending upon the nature of the rememberer's mental activity. The recoded trace, or trace information, or *engram*, represents one important source of information that the memory system uses in creating the memory for the original event.

Another important source of information for the remembering of the event is provided by the external and internal retrieval environment, especially *retrieval instructions and cues*. When the memory system is in the *retrieval mode*, appropriate information is extracted from the cue and brought into interaction with the stored episodic information through the process of *ecphory*. The product of a successful act of ecphory, conjunction of information from the cue and one or more memory traces, is referred to as *ecphoric information*.[1] Like trace information and retrieval information, ecphoric information can be thought of as consisting of elementary components or features. The particular features of a given ensemble of ec-

[1] The present definition of 'ecphoric information' is different from that given in Tulving (1976); the two should not be confused.

phoric information determine the qualitative properties of what the individual remembers, that is, the individual's *recollective experience*. A given recollective experience differs from others with respect to its cognitive contents, its clarity, and the rememberer's belief in its veridicality and its 'pastness.'

Many acts of remembering end with the individual's recollective experience: The individual has an awareness which he or she interprets as memory for an event, and does not act further upon it. In many situations, however, ecphoric information and recollective experience may be converted into some form of overt behaviour or otherwise used in ongoing mental activity. *Conversion* of ecphoric information is a necessary component of the act of remembering as studied in the psychological laboratory: The only way the experimenter can find out about the rememberer's recollective experience is through some observable behaviour. The form of conversion is determined by the rememberer's task. In one of the two tasks with which we are concerned in this paper, recall, conversion takes the form of description of some aspect of the to-be-remembered event, usually its name; in the other task, recognition, conversion requires the rememberer to identify the test item as 'old,' or as 'familiar' by virtue of its identity or similarity with the event. Quantifiable properties of these behaviours define the rememberer's *memory performance*.

Figure 1 presents a sketch of the interrelations of the major concepts of that part of GAPS that correspond to the process of retrieval. The sketch

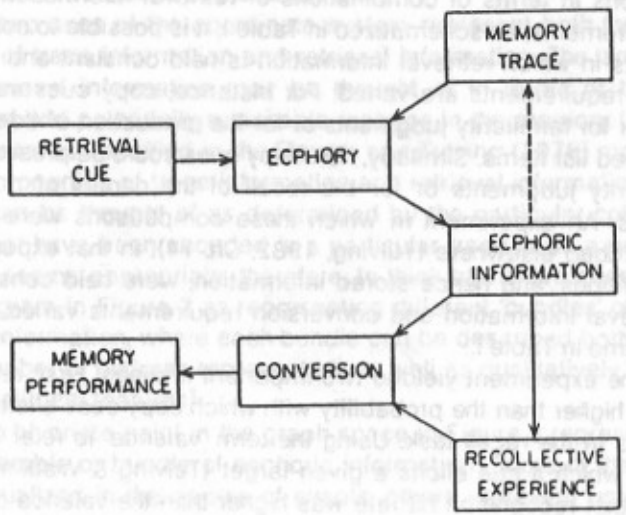

Figure 1 Elements of the retrieval process.

shows seven elements of the act of retrieval: two observable entities - retrieval cue and memory performance; two processes - ecphory and conversion; and three states - memory trace (or engram), ecphoric information, and recollective experience. The relations among these elements, represented by arrows, can be interpreted as 'influencing' or 'determining.'

Some features of the part of GAPS sketched in Figure 1 may be worth emphasizing. First, ecphory and ecphoric information play a central role, and differentiate GAPS from other currently popular conceptualizations of the retrieval process. In GAPS, ecphory and ecphoric information are influenced or determined jointly by information from the (episodic) trace and the (semantic) cue: Ecphory is a synergistic process, and ecphoric information reflects the synergy of encoding and retrieval components of the act of remembering.

Second, GAPS makes an explicit provision for the inclusion of recollective experience as an important element of the retrieval process. Many other current theories of retrieval, including theories of recall and recognition, are concerned only with memory behaviour and have little to say about memory experience.

Third, the retrieval component of GAPS begins with the (recoded) engram and ends with either recollective experience or memory performance. In the whole process of retrieval, we can distinguish between processes that occur before the formation of ecphoric information and those that occur after. This distinction becomes important in the analysis of similarities and differences between recall and recognition.

The similarity between recall and recognition, which has been emphasized in earlier papers (Tulving, 1976; Tulving & Watkins, 1973), applies only to the ecphory component of retrieval; the important difference between recall and recognition, which was not acknowledged in these earlier accounts, has to do with the conversion component.

The process of ecphory, extracting information from the cue and combining it with trace information, is present in both recall and recognition situations. Since the retrieval cues are different, however, ecphoric information in the two situations is also different, even if the engram, or trace information, is identical in both. Thus, ecphoric information differs in recall and recognition situations in the same sense in which it differs in recall situations involving different retrieval cues.

The construction of ecphoric information out of trace information and retrieval information corresponds to neither recall nor recognition. Nor can recollective experience as such be identified with one of these two forms of retrieval. The distinction between recall and recognition becomes meaningful only at the post-ecphoric stage of retrieval, at the stage of conversion: Different kinds or different amounts of ecphoric information are required for the judgment that a test item is 'old', than for the production of the name of

a previously encountered study-list item. It is frequently possible for a person to make a positive recognition judgment on the basis of just the feeling of episodic familiarity of the test item, even if the evidence available for such a judgment is insufficient for recall (e.g., Kintsch, 1974; Mandler, 1980; Moeser, 1977). In general, it seems reasonable to assume that more relevant evidence, or evidence of higher quality, is necessary for successful recall of the name of a studied item than for the judgment that it is familiar.

RECALL AND RECOGNITION SITUATIONS

We can specify the difference between recall and recognition situations in terms of two independent dimensions. One of these has to do with the type of retrieval information, the other one with the nature of conversion requirements. Retrieval information in the recognition situation always includes a copy of the target item, whereas in the recall situation either the cues are other than copy cues or no specific cues are provided at all. With respect to conversion requirements, in the recognition situation the rememberer's task is to convert the available ecphoric information into a familiarity judgment, whereas the recall situation calls for the description or construction of some aspect of the orginal item-event, such as its name.

The two dimensions of retrieval information and conversion requirements can be combined orthogonally to yield a 2 X 2 matrix of retrieval situations, as shown in Table I. The four cells in the contingency table are defined in terms of (a) the presence versus the absence of the copy cue as a part of the available retrieval information, and (b) conversion requirements: judgment of episodic familiarity of the test item versus production of the name of the to-be-remembered item.

Conventional recognition and recall situations occupy two of the four cells in the matrix. The recognition situation is defined by the presence of the copy cue *and* the familiarity-judgment conversion, whereas in the recall situation the copy cue is absent (some other cue may be present) *and* the rememberer's mission is to produce the name of the item or items previously studied. The proportion of 'correct' responses in the two situations defines the level of memory performance.

It may be worth noting that although recognition-memory experiments usually include non-copy cues (distractors or lures), the presence of such cues is not a necessary defining characteristic of the 'recognition situation.' It is perfectly possible to give recognition tests to subjects in experiments in which no distractor items are present, and obtain results that are not materially different from those obtained under conventional conditions (e.g., Begg, 1979; Wallace, Sawyer, & Robertson, 1978).

The other two cells in the matrix in Table I also represent realistic retrieval situations. The situation in which a non-copy cue is presented for a familiarity judgment corresponds to the presence of distractors in a conventional recognition test. When the rememberer judges a non-copy cue to be familiar, he has made a false positive or a 'false recognition' (Underwood, 1965) response. Subjects' memory performance in the recognition situation is frequently interpreted in light of the relative frequency of false positive responses.

TABLE I

Differences between recall and recognition situations

	Conversion requirement	
Retrieval information	Familiarity judgment	Name production
Copy cue	Recognition	---
Non-copy cue	---	Recall

The situation represented by the upper right-hand cell in the matrix in Table I is one in which the rememberer is provided with a copy cue and his task is to produce the name of the previously studied (identical) list item. Although perfectly realizable and entirely meaningful, the task has been used in only a few experiments (Tulving, 1974; Tulving & Watkins, 1973).

Given the description of the relation between recognition and recall situations in terms of combinations of retrieval information and conversion requirements, as schematized in Table I, it is possible to conceive of experiments in which retrieval information is held constant and only the conversion requirements are varied. For instance, copy cues may be presented either for familiarity judgments or for the production of (identical) names of studied list items. Similarly, non-copy cues could be presented either for familiarity judgments or for the recall of the names of previously studied items. An experiment in which these comparisons were made has been described elsewhere (Tulving, 1982, Ch. 14). In that experiment, encoding conditions, and hence stored information, were held constant, and type of retrieval information and conversion requirements varied according to the scheme in Table I.

The experiment yielded two important findings. First, recognition hit rate was higher than the probability with which copy cues elicited (identical) list items in the recall task. Using the term 'valence' to refer to the probability with which a cue elicits a given target (Tulving & Watkins, 1975), we can say that recognition hit rate was higher than the valence of copy cues. The second finding had to do with the relation between false positive responses

made to extralist associative cues in the recognition task, on the one hand, and the valence of the same cues in the recall task, on the other. This relation was *negative*: Extralist associates of target words that elicited large numbers of false positive responses in the recognition test were relatively ineffective retrieval cues in the recall test; conversely, more effective associative cues were seldom (falsely) judged to have occurred in the study list. The Synergistic Ecphory Model of Retrieval, to be described next, was developed to account for these findings as well as other basic facts about recall and recognition.

SYNERGISTIC ECPHORY MODEL OF RETRIEVAL

The concepts that we have been discussing - engram, retrieval information, ecphoric information, and different conversion requirements in recognition and recall - can be integrated into a simple but general model of retrieval. A schematic description of the model is shown in Figure 2. The horizontal axis of the coordinate system represents (episodic) trace information, and the vertical axis represents (semantic) retrieval information. The two-dimensional space defined by the two axes corresponds to ecphoric information. The two curved lines in the diagram represent two conversion thresholds, the lower for familiarity judgments of the kind made in the recognition task, the upper for the production of the name of the retrieved item-event, as required in the recall task.

The two axes of the coordinate system represent both the quantity and quality of trace information and retrieval information. The 'amount' of trace and retrieval information may be thought of in terms of the number of encoded and potentially matchable features in the memory trace or the retrieval cue, as specified in the Flexser and Tulving (1978) model. The qualitative properties of trace information and retrieval information, on the other hand, can be thought of as determined by the particular collection of features that have been encoded in a particular trace or on a particular occasion. It seems appropriate, therefore, to think of the two coordinate axes of the diagram in Figure 2 as representing different 'bundles' of trace and retrieval information, where each bundle can be described both quantitatively (the number of features represented) as well as qualitatively (the identity of the constituent features).

Each bivariate point in the graph space in Figure 2 represents a particular ensemble or bundle of ecphoric information. Some of these ensembles are actualized in the course of events, others represent unrealized potentialities only. Actualization of ecphoric information is effected by the process of ecphory which results in the synergy of trace information and retrieval information. The quantitative and qualitative properties of a given ensemble of ecphoric information are determined by the quantitative and

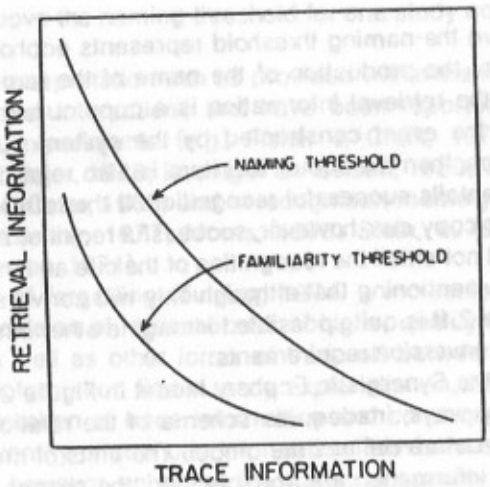

Figure 2 Schematic structure of the Synergistic Ecphory Model of Retrieval.

qualitative properties of trace information and retrieval information; they may include emergent properties, properties not readily predictable from traces and cues. The properties of an ensemble of actualized ecphoric information determine the nature of a given recollective experience, as well as the limits of its convertibility into overt behaviour and its usability in other cognitive and behavioural processes.

The two conversion thresholds divide the total space of ecphoric information into three regions. The region below the familiarity threshold consists of ensembles of ecphoric information that are insufficient for recognition: Their properties are such that they fail to give rise to the feeling of (episodic) familiarity that would make it possible for the rememberer to make a positive judgment about the test item.

The region between the two thresholds in Figure 2 represents bundles of ecphoric information that contain and, when actualized, provide sufficient evidence for making positive familiarity judgments, but insufficient evidence for the construction of the name of the original item-event. In situations of this kind, the subject would judge a test item to be 'old' in the recognition test. Yet, if the same test item were provided as a retrieval cue in the recall task, the subject could not use it for the production of the (identical) name of the previously studied list item. In the experiment mentioned earlier, such an outcome was observed in a certain proportion of cases (Tulving, 1982, Ch. 14).

The region above the naming threshold represents ecphoric information that is sufficient for the production of the name of the target event. If the stimulus carrying the retrieval information is a copy cue, that is, identical with the name of the event constructed by the system out of the given ecphoric information, then the cue or test item is also regarded as familiar: Successful recall entails successful recognition. If the retrieval information is carried by a non-copy cue, however, successful recall of the name of the studied event need not entail the recognition of the cue as familiar.

It may be worth mentioning that although only two conversion thresholds are shown in Figure 2, it is quite possible to imagine other thresholds, corresponding to other conversion requirements.

The diagram of the Synergistic Ecphory Model in Figure 2 is only a very rough and, in many ways, inadequate schema of the relations among the concepts whose structure defines the model. The units of measurement of trace and retrieval information are not specified, the shapes of conversion thresholds are completely arbitrary, and the implied definition of ecphoric information as an addition of vectors coincident with the two coordinate axes has no deep significance.

Nevertheless, some of the features of the diagram are intended to convey certain ideas about the Synergistic Model, and these may be worth noting briefly. The first, and most important, is the idea that ecphoric information, which underlies recollective experience and memory conversion, is determined jointly by trace information and retrieval information. This means that the information stored about an event, whether in its original or some recoded form, is only a co-determinant of what the rememberer remembers about the event. The second feature is the suggested possibility of a trade-off between trace information and retrieval information: Inadequate quantity or quality of one can be compensated for by the other. Third, conversion thresholds are asymptotic with the two coordinate axes: The thresholds and the axes do not intercept. This feature of the model implies that there exist limits to the trade-off between stored information and retrieval information. In the limiting case, in the absence of relevant stored information, no recollective experience can come about, regardless of how 'rich' or 'elaborate' or 'effective' is the retrieval information, and vice versa. Fourth, the diagram suggests that situations may occur in which ecphoric information resulting from an act of conjunction of stored and retrieval information is well in excess of what is needed for the successful accomplishment of a particular task. We could say that under these conditions memory performance is 'over-determined.' Chronic problems of over-determination lead to ceiling effects in memory experiments; they can be corrected by reducing either the trace information or the retrieval information. Fifth, the placement of the naming threshold above the familiarity threshold expresses the hypothesis that the construction of the name of a

remembered event always requires ecphoric information of higher quality than does the judgment that a given stimulus looks familiar.

A feature of the model that may cause some conceptual difficulty is the idea that conversion thresholds separate sets of ecphoric information that differ from one another qualitatively. Traditionally, the concept of threshold in physiology and psychology has been predicated on quantities measurable at least on an ordinal scale. In the Synergistic Ecphory Model, threshold is simply a way of describing the fact that two different sets of bundles of information exist, one of which can and the other one of which can not be used for a particular purpose. How the elements of the two sets are described need not matter for such a classification.

The Synergistic Ecphory Model, with its ordered thresholds, has a certain superficial similarity to the old, now discredited, theory that recall requires stronger memory traces than recognition. Such a theory is at variance with a number of empirical facts, such as study-test interactions in recognition and recall (Anderson & Bower, 1972; McCormack, 1972; Tulving, 1976) and recognition failure of recallable words (Tulving & Thomson, 1973). When conversion thresholds are defined in terms of ecphoric information, that is, in terms of both trace information *and* retrieval information, the conflict between theory and data vanishes. This point will be illustrated in the next section of the paper.

EXPERIMENTAL FACTS AND THEORETICAL IDEAS

We will now briefly consider how some basic experimental facts concerning recall and recognition as well as certain theoretical ideas fit into the model.

Identical Traces

Let us begin with the facts pertaining to a situation where trace information is held constant, that is, where one and the same event is encoded under fixed conditions, and where only retrieval conditions vary.

1. The well-known fact that recognition of a studied item frequently succeeds when its free recall fails is attributable to differences in ecphoric information, brought about by differences in retrieval information, in the two situations. Retrieval information present in the free-recall task is also present in the recognition task, but the retrieval information contained in the copy cue is available to the rememberer only in the recognition situation.

2. The fact that recognition hit rate is higher than the valence of copy cues in the recall situation (Tulving, 1982, Ch. 14) is attributable to the higher threshold for naming than for familiarity judgments. That is, even when both trace information and retrieval information are held constant, the resultant ecphoric information may be sufficient for recognition but not recall.

3. The fact of differential effectiveness of different retrieval cues in recall (e.g., Bahrick, 1969; Bregman, 1968; Nelson & Brooks, 1974) fits into the model in a straightforward manner: Differences in retrieval information bring about differences in ecphoric information.

4. The phenomenon of recognition failure of recallable words (Tulving & Thomson, 1973; Watkins & Tulving, 1975) is a special case of a situation in which stored information is held constant and retrieval cues varied. When a rememberer fails to recognize a previously studied item, it means that the copy cue did not produce sufficient ecphoric information to exceed the familiarity threshold; when he succeeds in recalling the same to-be-remembered item to a different cue, it means that the ecphoric information resulting from the application of the cue to the stored information exceeded the naming threshold.

5. A false positive response in the recognition test reflects a state of affairs where the ecphoric information produced by the distractor item and the information in episodic memory exceeds the familiarity threshold, and the memory system fails to detect the difference between the test item and the corresponding ecphoric information.

6. Finally, consider the negative correlation between the false positive responses made to the extralist associates of targets in the recognition test and the valence of these associative cues in the recall test (Tulving, 1982, Ch. 14). A cue that is falsely recognized, but is not effective in bringing about the recall of the target item, corresponds to a situation in the model in which the bundle of actualized ecphoric information is above the familiarity but below the naming threshold. On the other hand, a cue that produces ecphoric information that exceeds the naming threshold, and thereby the familiarity threshold, is not falsely recognized because it is discriminably different from the actualized ensemble of ecphoric information.

Different Traces

Experimental facts gleaned from situations in which both trace information and retrieval information are varied provide even greater flexibility in matching the data to theory. Many phenomena entailing comparisons of recognition and recall performance of different items, or items encoded under different conditions, can be fitted into the model without difficulty. Consider the following examples.

7. Study-test interactions in comparisons of recall and recognition, demonstrating that recall is, and recognition is not, affected by some difference in the study condition (Anderson & Bower, 1972; McCormack, 1972; Tulving, 1976), correspond to a situation in the model where ecphoric information produced by the copy cue is above the familiarity threshold for both study conditions, whereas ecphoric information resulting from the

recall cue is above the naming threshold for one study condition but not the other.

8. A similar interpretation can be provided within the model for the many encoding/retrieval interactions that have been reported in the literature, both in recall experiments (e.g., Fisher & Craik, 1977; Jacoby, 1973; Masson, 1979; Ozier, 1978; Roediger & Adelson, 1980; Thomson & Tulving, 1970; Tulving & Osler, 1968) and in recognition-memory experiments (e.g., Geiselman & Glenny, 1977; Morris, 1978; Stein, 1978; Thomson, 1972; Tulving & Thomson, 1971).

9. Reversal of forgetting (Tulving, 1974) - increasing retention scores through the provision of retrieval cues of higher quality after forgetting has occurred - as well as other forms of trade-off between trace information and retrieval information find a ready explanation in the model. Forgetting reflects deterioration of trace information and consequent lowering of the quality and quantity of ecphoric information. Provision of more appropriate retrieval cues, however, enhances the quality or quantity, or both, of ecphoric information, resulting in 'reversal' of forgetting. Although it is logically impossible to prove deterioration of trace information (Tulving, 1974), it is reasonable to assume that such deterioration occurs. The model relates trace-dependent forgetting to cue-dependent forgetting.

Theoretical Ideas

Let us next briefly discuss some theoretical notions in light of the model.

10. Recall and recognition are similar or continuous (Tulving & Watkins, 1973) insofar as there is no essential difference in the ecphoric process: Regardless of the nature of the cue, the extracted retrieval information is combined with, brought into interaction with, or brought to bear upon the stored information, resulting in the construction of an ensemble of ecphoric information that serves as a basis for recollective experience and other forms of conversion.

11. Although the ecphoric process is the same in recall and recognition, it is quite possible for the retrieval information in recall to be uncorrelated with the retrieval information in recognition. The assumption of such retrieval independence plays a critical role in accounting for the orderliness of outcomes of a large set of experiments in which recognition failure of recallable words has been observed (Flexser & Tulving, 1978). Thus the assumption of retrieval independence in recall and recognition is perfectly compatible with the assumption of the essential similarity of ecphoric process in the two situations.

12. The basic difference between recognition and recall lies in different informational requirements for the successful performance of the two tasks. In the model, these differences are expressed in terms of different

conversion thresholds: Recall requires more and richer ecphoric information than does recognition.

13. The model makes explicit the conditions that determine the degree of subjectively-felt episodic familiarity: Familiarity reflects the similarity between the information provided by the retrieval cue, or the test item, on the one hand, and the information contained in the actualized ensemble of ecphoric information, on the other. Familiarity is *not* determined by the similarity between the test item and the memory trace, except insofar as the memory trace resembles the actualized ecphoric information.

14. In the recognition-memory task, the test item serves two different functions: (a) the retrieval information extracted from it in the process of ecphory enters into interaction with stored information in the production of ecphoric information; and (b) it provides a criterion against which ecphoric information is compared in making the recognition decision.

15. The distinction between ecphoric process and ecphoric information, on the one hand, and conversion of ecphoric information into behaviour, on the other, corresponds to the distinction between memory and decision components of the theory of signal detection (Lockhart & Murdock, 1970; Murdock, 1974). Differences in the rememberer's confidence in his recognition decision may be represented in the model by different conversion thresholds.

16. The model illustrates, in a rough manner, how qualitative properties of memory traces and retrieval cues, and qualitative differences in their product, ecphoric information, determine quantitative characteristics of memory performance. In an experimental situation, the proportion of actualized ensembles of ecphoric information that lie above a given conversion threshold determines the probability with which relevant responses are made in the experimental task; the degree of 'over-determination' of the response - the extent to which a given ensemble of ecphoric information exceeds the conversion threshold - may be thought of as correlated with the response latency (Murdock, 1974; Ratcliff, 1978).

17. The concept of trace 'strength' may be thought of, in the model, as corresponding to the concept of the 'amount' of trace information. But trace strength by itself is a relatively unimportant variable, since its transformation into ecphoric information depends as much on its own properties as those of the retrieval information that is brought into interaction with it. The model makes clear how it is possible for observed memory performance to be higher for weak traces than strong ones.

18. Different 'tests' of retention - such as free recall, cued recall, and recognition - are conceptualized in the model as representing situations with differentially effective retrieval cues. But the overall effectiveness of cues, like the overall 'strength' of a trace, is a less important variable than is the match between the cue and the stored episodic information. Hence the

distinction between cue effectiveness and cue valence (Tulving & Watkins, 1975).

19. Since retrieval of episodic information, according to the model, always depends on the interaction between trace information and cue information, and not on either of these alone, it makes little sense to talk about 'encoding effects' or 'retrieval effects' in episodic memory. It is possible, of course, to hold either trace information or retrieval information constant, and vary the other, but such a stratagem does not mean that the source of information that is not manipulated has no effect on what the rememberer remembers or what his memory performance is like.

20. The rememberer's mental experience - recollective experience - and its qualitative and quantitative characteristics are only indirectly influenced by episodic trace information; they are directly determined by ecphoric information. It is assumed, however, that not all of ecphoric information need be accessible to conscious awareness.

21. The subjective feeling of pastness that accompanies remembering of events is determined, in the model, by the extent to which the mix of ecphoric information contains (episodic) trace information: The strength of the feeling varies directly with the weight of the contribution that the stored episodic information makes in determining the quantitative and qualitative properties of ecphoric information. The feeling of pastness, thus conceived, is not necessarily correlated with other measurable aspects of performance, such as proportion of 'correct' responses. The trade-off relation between trace information and retrieval information in determining ecphoric information lying above a given conversion threshold allows the rememberer to make many correct responses, even if the underlying ecphoric information contains relatively little episodic trace information, that is, even if the subjective feeling of pastness is not strong.

CONCLUSION

The Synergistic Ecphory Model of Retrieval I have briefly described in this paper supersedes the theoretical speculation concerning recall and recognition that I had suggested previously (Tulving, 1976). Although the present formulation retains many ideas from the earlier package, it is also different in important respects. The earlier idea that there is no essential difference between recognition and recall now seems to have been wrong. The critics who have questioned this earlier idea (e.g., Humphreys & Bowyer, 1981; LeCocq & Tiberghien, 1981; Tiberghien, 1980) turn out to have been justified in their concerns.

The present model provides a reasonably simple and straightforward statement of the relation between recall and recognition. The two processes are essentially similar with respect to the important process of ecphory,

combining trace information and retrieval information into ecphoric information that forms the basis of recollective experience and memory performance. They are different with respect to post-ecphoric components of the retrieval process, requiring different amounts or kinds of ecphoric information for the successful accomplishment of the task.

The Synergistic Ecphory Model has a number of affinities with the ideas concerning recall and recognition described by other theorists. For instance, the idea that recognition can occur on the basis of just an experienced feeling of familiarity, under conditions where more detailed information about the to-be-retrieved event is not accessible, has been advocated by a number of writers (e.g., Atkinson & Juola, 1973; Jacoby & Dallas, 1981; Lockhart, Craik, & Jacoby, 1976; Mandler, 1980; Mandler, Pearlstone, & Koopmans, 1969; Tiberghien, 1976). Similarly, Moeser (1977) argued that recognition is a two-stage process. The first consists of the activation of many episodic traces that have sufficient features in common with the retrieval cue; in the second stage, retrieval of a particular trace from among those actuated in the first stage is effected. Moeser's two stages of retrieval are represented in the Synergistic Ecphory Model in the form of the familiarity conversion and naming conversion thresholds. The Synergistic Ecphory Model also has many features in common with Kintsch's theory of episodic memory (Kintsch, 1974). Kintsch's assumptions that episodic traces are separate from the existing semantic structures, his postulation of pattern matching and pattern completion as the basic mechanisms of recognition, the suggestion that pattern matching and pattern completion occur in parallel, and the postulated existence of different thresholds for recall and recognition (Kintsch, 1978) are mimicked by the features of the Synergistic Ecphory Model.

Thus it appears that a consensus seems to be emerging in the theoretical analysis of the relation between recall and recognition. Further thought and study will show whether the emerging agreement represents a way station on the direct path to the future, or whether it constitutes a sideways movement so well known in the history of psychology.

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