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# SHORT- AND LONG-TERM MEMORY: DIFFERENT RETRIEVAL MECHANISMS[1]

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The dichotomy between short-term memory (STM) and long-term memory (LTM) probably reflects a somewhat optimistic oversimplification of an extremely complex situation, but it has been with us, in one form or another, at least as long as memory has been studied in the laboratory. Recently the distinction has become the focus of considerable theoretical interest and even controversy. As shown by most papers presented at this symposium, the question of primary interest has to do with the nature of mechanisms or processes underlying the two types of memory. Are these mechanisms or processes similar or different?

The nature of underlying processes can be inferred only from the relations among observable variables. The processes are assumed to be identical, or at least similar, when experimentally manipulable variables or operations have identical effects on observable performance, and different when the effects are different. Since sufficient evidence has been presented at this symposium and since other evidence is available in the literature to show that a number of variables do produce different effects on recall at different retention intervals, it seems to be necessary to conclude that STM and LTM involve at least partially nonoverlapping mechanisms. In other words, the dualistic position seems to be easier to reconcile with experimental facts than the continuity position.

If we accept the dualistic position, we can ask further questions about the distinction between STM and LTM. One such question that sooner or later will have to be asked has to do with the *locus* of the distinction in the sequence of events constituting an act of memory. There are three such events: input of information into the memory store, storage of information (i.e., maintenance of the information in the store), and retrieval of information from the store (Mel-

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ton, 1963). The question, then, is the following: Do the differences between STM and LTM mechanisms reflect differences in input, storage, or retrieval?

Usually the distinction between STM and LTM is made in terms of storage processes. A number of theorists have proposed that separate stores exist for STM and LTM [e.g., Broadbent (1958), Glanzer & Cunitz (1966), Waugh & Norman (1965)]. The STM store is assumed to have strictly limited capacity, with all of the incoming information regularly being displaced by subsequent inputs or simply decaying unless rehearsed, while the LTM store is thought to have much greater capacity for holding information selectively received through the short- term store.

The major weakness of the conception of STM and LTM in terms of separate storage mechanisms lies in its failure to specify the processes responsible for getting the information out of either type of store. Frequently the assumption is made that whatever information exists in either store can be retrieved, by searching through the store, as long as the information exists in the store, but this is clearly an untenable assumption. Recall performance does not only depend on the information *available* in the store, but also on *accessibility* of that information (Tulving & Pearlstone, 1966). Accessibility of stored information is determined by retrieval cues available to the subject at the time of attempted recall. It is possible to think of the function of retrieval cues as that of guiding the search through the store, but the conception of guided search is quite different from one of unguided or probabilistic search.

Given the necessity of postulation of retrieval cues as an important component of the recall process, the identification of STM and LTM with different storage systems loses much of its heuristic usefulness. It seems somewhat more reasonable to explore the view that STM and LTM involve different retrieval processes rather than different storage systems. According to this view, all information that is to be retrieved at a later time, regardless of when it will be retrieved, is stored in one and the same store. Retrieval from this unitary store occurs as a consequence of availability of retrieval cues which bridge the gap between the present environmental demands and the information stored in memory on an earlier occasion. Unless at least one retrieval cue exists for a given unit of information, the unit cannot be retrieved.

What events constitute retrieval cues that provide access to the information about to-be-remembered items in the memory store? In general, the nature of effective retrieval cues is determined by the coding of input material at the time of input. When a to-be-remembered unit is stored, some ancillary information about it is also stored with it. The storage of this ancillary information represents what is referred to as "coding." When some of this ancillary information (or the "code" of the to-be-remembered unit) is available at the time of attempted recall, the code serves as a retrieval cue. The effectiveness of retrieval cues thus depends, among other things, upon coding operations that have taken place at input and the availability of information about these coding operations at

output. Conversely, of course, coding of to-be-remembered units at input facilitates recall only if the ancillary information is more readily accessible at output than are the to-be-remembered units as such.

One type of ancillary information stored with each to-be-remembered unit at the time of input consists of "time tags" (Yntema & Trask, 1963). Such temporal coding provides specific temporal retrieval cues that affect the recall of to-be-remembered units over short periods of time in case of homogeneous series of input events, and perhaps over longer periods of time in case of nonhomogeneous series (cf., von Restorff, 1933). Another type of ancillary information stored at input has to do with semantic and associative features of to-be-remembered units determined by the pre-experimental experiences of the subject (e.g., Tulving & Pearlstone, 1966). Retrieval cues resulting from such semantic coding are effective over much longer intervals than those provided by temporal coding and thus can be thought of as providing the major access route to stored information following longer retention intervals.

Even though we cannot specify the exact nature of different kinds of effective retrieval cues very precisely at the present time, the general conception of the somewhat arbitrary dichotomy between STM and LTM in terms of different kinds of retrieval processes seems to be promising. The ideas I have tried to summarize here have fruitfully guided our own research and thinking at Toronto. We have done a series of experiments in which we have studied the role, function, and nature of retrieval cues of various types, and the results have been most encouraging. The conceptual distinction between STM and LTM in terms of differences in retrieval mechanisms, in my opinion, has a distinct advantage over the dual storage conception in that it forces the theorist to do some hard thinking about retrieval processes as such. A theory of memory is incomplete, or perhaps not even a theory, until it specifies how the information available in the memory store becomes accessible at the time of recall.

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