SOME CURRENT TRENDS IN MEMORY

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A review of current research, methods and theoretical standpoints in memory processes, covering mainly North American work.

Memory research at many North American universities is largely concerned with short-term memory paradigms. However the "boxes in the head" model of memory, with its sensory store, short-term store, and long-term store, has ceased to be predominant. There is no longer the degree of unanimity which enabled Murdock, in 1967, to propose a "modal model". For example, a recent paper by Craik and Lockhart (1972) examines the case for and against multi-store models and comes out in favour of an approach which emphasises the type of processing performed on incoming information, rather than its passage through a pre-arranged series of stores. Even at Stanford, the home of the STM/LTM model, Atkinson and his colleagues have moved from a study of the properties of the stores themselves, such as storage size and forgetting rates (e.g. Atkinson, Brelsford, & Shiffrin, 1966), to a study of control processes such as rehearsal (e.g. Rundus & Atkinson, 1970; Rundus, 1971).

An interest in attribute models of memory began with Bower's multi-component model (Bower, 1967), in which an item is treated not as a unit but as a vector of attributes. Then Underwood (1969), somewhat to the surprise of his contemporaries, outlined his case for an attribute view of memory. Bower has since produced an alternative attribute model (Bower, 1973) and there have been several other varieties as well (e.g. Norman & Rumelhart, 1970). It is not clear to what extent these theoretical developments have influenced research, but certainly there have been a number of recent experiments on the encoding and retention of different attributes. Many of the attributes investigated have been physical characteristics of the stimuli, such as modality (e.g. Bray & Batchelder, 1972; Hintzman, Block, & Inskeep, 1972; Kirsner, 1972), voice (Craik & Kirsner, in preparation; Hintzman, et al., 1972), upper or lower case (Kirsner, in preparation), verbal or pictorial presentation (Wells, 1973), and spatial location (Murdock, 1969; Rothkopf, 1971). However, the work by Wickens and others on release from proactive interference has provided one way of looking at the encoding of both semantic and physical categories (e.g. Wickens, 1970; Reutener, 1972).

Much of the credit for the current interest in imagery must go to Paivio, although by no means all researchers in this area share his fascination with the paired-associate paradigm or his rather "S-R" approach (Paivio, 1971). Hopefully, interest is now passing from a concern with word/picture comparisons (e.g. Paivio, Rogers & Smythe, 1968; Wells, 1972) and visual versus verbal encoding (Paivio, 1969) to a more detailed analysis of the processing of verbal and non-verbal stimuli (Kolers, 1972) and an interest in the constructive processes involved in structuring any kind of response or image.

One of the simplest and most widely known memory models for a particular experimental paradigm has been Sternberg's memory scanning model (Sternberg, 1966, 1969). This reaction-time model assumes that subjects serially scan through memory to determine if the probe item was in the list; the scanning may be exhaustive or non-exhaustive, depending on the experimental conditions. In the last few years the model has been somewhat discredited because it cannot account for serial position effects (Corballis, Kirby, & Miller, 1972; Kirsner & Craik, 1972) or any deviation from a linear increase in reaction time as a function of set size (that is list length). In addition, a strength model (Corballis et al., 1972) and a parallel processing model (Murdock, 1972) can account for the same data as the Sternberg model and for some of the troublesome findings as well, thus casting doubt on the notion of serial scanning in memory.

Mathematical models continue to be used in many areas, not only for reaction-time phenomena. For example, a forthcoming book by Murdock includes an extension of his single-store model (Murdock, 1967, 1970, 1972) to all the standard short-term memory paradigms. However, a number of other researchers have moved away from mathematical models to computer simulation, even for traditional tasks such as free recall (Anderson & Bower, 1972). Norman and his colleagues have been attempting a major simulation of long-term information storage (e.g. Rumelhart, Lindsay, & Norman, 1972; Lindsay & Norman, 1972). Computer simulation and mathematical modelling are not just alternative techniques; they involve different approaches to memory. Mathematical models are ideally suited to predicting response probabilities whereas simulation focusses attention on the storage of individual items and requires much more detailed specification of the processes operating in a task. There are problems in evaluating simulation programs as general results cannot be readily established—to find out the predicted consequences of various experimental manipulations it is virtually necessary to obtain a copy of the program and run it through yourself. Mathematical models are more readily accessible as predictions from them can usually be worked out from the information given in published articles.

The general simulation models such as Norman's are even more difficult to test than are the specific models such as Anderson and Bower's, although in some cases indirect tests can be made using reaction-time data—see Collins and Quillan (1969) and the spate of similar articles which followed. But are these problems of testing all-important? Memory research has been consistently pre-occupied with quantitative prediction to the detriment of analyses of the processes involved in memory. For example, we have been concerned with the probability of a correct response without giving much consideration to the problem of how it is possible to make a correct response at all in the task under investigation. Models such as those of Norman and his colleagues have a salutary effect in correcting the existing imbalance. So do articles such as Tulving's (1972) attempt to distinguish between semantic and episodic memory; I do not like his distinction but it does force experimenters to analyse the nature of the questions which they require subjects to answer.

The two major external influences on memory research in the last four or five years have been linguistics and artificial intelligence. They have had little effect on studies of short-term memory but they have been extremely important to psychologists beginning to think about how we store and organise our knowledge of the world. Both influences can be seen in Norman's work, whereas others such as Kintsch (1972) have been more influenced by linguistics. Although psycholinguistics began when psychologists became interested in Chomsky, his concern with grammar made his work of little use to those psychologists investigating the structure of long-term memory. However, the work of the post-Chomsky linguists, sometimes referred to as the generative semanticists, has provided a stimulating source of new ideas and concepts. The most influential linguist to date seems to have been Fillmore (1968, 1969).

Artificial intelligence, at MIT anyway, has also been affected by some of the developments in linguistics, and memory. There has been a move away from convergence theorems for general problem solvers to heuristic devices which, like humans, can sometimes get stuck but can also find very quick solutions. Work with children has been used as a source of ideas as well as a testing ground for various hypotheses. The concepts of most relevance to memory are those relating to internal descriptions, retrieval systems, and the heterarchical control of processing. (Heterarchies are like hierarchies except that in a heterarchy control can switch from level to level if problems arise whereas a hierarchy is restricted to a straightforward movement from bottom to top.) The best introduction to this work is probably Minsky and Papert's (1972) progress report from the MIT Artificial Intelligence Laboratory. Also worth reading is Winograd's (1972) report of his program for understanding natural language. This program is particularly interesting, first of all because it is deliberately restricted to a micro-world about which the program gradually builds up knowledge, and secondly because, through the use of heterarchical control, the program is able to make use of grammatical rules, semantic structure, and a general problem solver in its analysis of natural language statements.

What can be said, in summary, about current trends? In the last decade there has been an amazing increase in memory research, and there is no sign of this growth abating. Marked changes in theoretical orientations have occurred; information theory and verbal learning, which provided the conceptual frameworks in the early 1960s, have been supplanted or supplemented by ideas about encoding, storage, and retrieval processes. To quote Norman (1970), "More and more the processes involved in memory are being described in terms very similar to those used to describe the processes of perception, of thinking, and of problem-solving." In order to cope with the complexity of human behaviour it is necessary to investigate sub-systems, such as memory, while ignoring or minimizing difficulties in other sub-systems, such as motivation or perception. Nonetheless, it is a promising development when the theoretical concepts in different areas become compatible, for after all, humans do function with all sub-systems operating together.

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