

BOOK REVIEWS

Structure of Knowledge

Organization of Memory. Edited by E. Tulving and W. Donaldson. Pp. xiii+423. (Academic: New York and London, April 1972.) \$17.50.

It is, of course, the organization of our knowledge that makes possible the use of that knowledge in mental processes and behaviour. The fact that information is stored is clearly a prerequisite, but if memory were simply retention, and knowledge were simply stored like so much furniture in a warehouse, it would be useless. Evidently information is organized to reflect its semantic significance, and it is this that makes such human activities as thought and language possible. This book is fascinating because much of the material in it is related to this issue which might be thought of as one of the most important in psychology at present.

Because there are some aspects of memory which are measurable, many experimental psychologists have chosen to start with these. Thus success in recalling lists of words can give clues as to how the remembered material is organized by a subject both at the time of learning and in memory. The greater part of the book is devoted to chapters of varying quality in which experiments of this general kind and the conclusions arising from them are discussed. Perhaps the best of these chapters is by Bower, who with several associates has made quite successful attempts to unravel the structure of semantic meaning with which subjects invest even meaningless material in order to attempt to remember it. But the tasks presented to the subjects in paired associate learning experiments, or even in free recall tests of lists of words, are not necessarily revealing applications of our mental apparatus. One might indeed wonder why, if memory is so important for human intelligence, human performance on memory tasks is so feeble. There would certainly be nothing remarkable about a computer or for that matter a man armed with a pencil and paper able to store and regurgitate a handful of words. But this comes back again to the fact that

it is not retention as such that is important but organization. If in the more traditional research on memory, retention was seen as important, it was perhaps because treating memory as some kind of receptacle for input information was a theoretical device which could be handled, while models for organization just did not exist.

But this has now changed, and in this volume the most striking chapters attack the organizational issue directly. Rather than asking how people perform when faced with trivial memory tasks that they are not quite able to accomplish, the authors of these chapters are mainly concerned with how knowledge is organized to make possible the understanding of natural language. In such matters our use of computers is central. But this use does not emphasize the triviality of the task; rather by setting out to write computer programs which will understand natural language, we can begin to appreciate what some of the central psychological issues of human memory really are.

Collins and Quillian in their chapter emphasize this point even in their title, "How to make a language user". Quillian was one of the first to program a network of nodes and directed links representing a structure of semantically organized verbal knowledge. In his system nodes represented words or concepts and links of specific kinds represented certain attributes and relationships of these concepts. The system contained dictionary definitions, coded into the format of nodes and links. On being asked to relate two words the computer traversed this semantic network and output sentences in pidgin English which compared and contrasted the input words in a way which seemed intuitively reasonable to human language users. Subsequently Quillian developed his program to show how his network could interpret segments of English, coping with anaphoric reference by making certain deductions from the structure of stored information. Collins and Quillian have also conducted a series of psychological experiments to investigate how human language users organize information

about attributes and relations of words they use. In their present paper they discuss computational and experimental work, pointing to problems such as the deployment of tacit knowledge in many cognitive tasks and the uses of analogy and metaphor which with the newer computational methods seem at least to be in sight, if not quite within reach.

Since Quillian's first papers were published, Fillmore's account of case grammar has appeared. In this account verbs are represented as relationships taking certain actual or potential arguments such as actor, instrument, location, etc. Kinch's chapter contains an interesting discussion of the properties of case grammars and related forms, in the context of how lexical information is organized in memory. In another interesting chapter, Rumelhart, Lindsay and Norman also capitalize on this development in linguistics, as well as on the type of program recently written by Winograd, in which knowledge is represented as a set of procedures which can call each other. Rumelhart *et al.* describe a formal notation to represent concepts (with their relationships and attributes), events and sequences of events, and they also describe an equivalent computational form. A curious aspect of their account is the rather sinister thread of violence running through almost all the examples used: "Hearing the snarling and growling, Perrault raises his rifle", "John murders Mary at Luigi's", even "John breaks a window of his house with a hammer because he wants to collect the insurance" and so on and so on. Whether the preference for words like "hit" and "break" in linguistic analysis reflects in more than one sense some primitive significance of such concepts is not clear. Although Rumelhart *et al.* seem only to have programmed a small part of their model, and indeed have only used that to explain learning of lists, what is clear is that some form of model exhibiting and depending upon the semantic structure of knowledge is going to be central to any understanding not only of memory, but of language, thought, perception, and indeed all mental processes.

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