INTRODUCTION

Memory is one of the most important functions of the human brain, yet its understanding — why and how it does what it does — has so far eluded us. Research in memory has been a frustrating task not least because of the intimate familiarity with what we are trying to understand, and partly also because the human cognitive system has developed as an interactive whole; it is difficult to isolate its component modules — a necessary prerequisite for their thorough elucidation.

Before one embarks on a new research area its general demands and underlying theoretical hypotheses should be stated.

FUNDAMENTAL DEMANDS OF RESEARCH IN MEMORY

The first demand to the student of memory, and of cognitive abilities in general, is to attempt to separate those topics that appear capable of explanation by available approaches from those for which no ready explanation even in outline seems available.

The second demand concerns the properties and attributes of the human brain that the researcher must aim to account for. Some of these are:

1. the redundancy and self-restorative nature of the brain mechanisms connected with learning and memory;
2. the capacity to learn;
3. the modification and refinement of the information already stored;
4. the local character of computations (a local change shouldn’t require large modifications);
5. the existence of sensory-specific modules that independently convey information to the language module.

The third demand concerns to the evaluation of the research done and the choice of those methods that seem to lead to the most relevant results. It has become clear that the most reliable approach to the study of the brain
activity is to regard it as a large and complex information processing system. Central to this approach is the belief that human cognitive capacity can fruitfully be viewed as some kind of symbolic system. Thus, much is to be learned by developing computational theories for aspects of human information processing and comparing the results of these theories and their implementations with human performance on the same tasks. Behavioral phenomena may suggest or constrain possible information processing tasks whose properties can be studied computationally, and thus might lead to the search for previously unrecognized behavioral consequences that they imply.

In an information processing approach, such as the one to which I subscribe, there is a distinction (pointed out by Marr and Poggio [6]) between the various levels at which our information processing device may be understood: at one level, there is the theory of computation, which is what is computed and why, and at the next level is the particular algorithm, or way in which the computation is carried out. My present goal is to elaborate the computational theories of some of cognitive abilities of the human brain. The particular implementation, although eventually important, plays only a secondary role at the moment.

THEORETICAL HYPOTHESIS OF RESEARCH

(1) To understand various disabilities resulting from lesions to the brain helps us to understand the normal function of the brain.

(2) Data are important for the process of developing the theory; ideas and hypotheses that are at the variance with the data have to be rejected.

(3) We should bear in mind that the facts that we deal with are soft and the working domain ill understood, so our intellectual resources would be misplaced if at the present they are spent on the construction of elaborate mathematical structures.

LEVELS OF RESEARCH INTO MEMORY

Memory may be studied at several levels. At the most physiological end one would study the neural basis of memory, how the hardware implements the storage process. Examples of theories at this level are the cerebellum [4], [8], the mathematical theory of associative memory devices [7]. Although