THE UTILIZATION OF HOLOGRAPHIC IMAGES, PARALLEL PROCESSES, AND THE HIPPOCAMPUS IN HUMAN MEMORY

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ABSTRACT

Memory operates via several components. The misconception that memory is a unitary process has been long held by many neurophysiologists as well as psychologists for years now. However, memory is most likely the consequence of three specific components: 1) distributed connectionist system, 2) neurological, and 3) three dimensional holography. The main aim of this paper is to propose that memory is purely a combination of cerebrocentric function and psychological phenomena.

Human memory can retain an almost unlimited amount of information, visual, auditory, textual as well as numerical data, stretching backward for a lifetime. Our very identity depends upon this record of experience. But where is knowledge stored in the brain? Is each thing that we learn stored in its own memory location, the way facts and images are stored in computers and three-dimensional holographic images? According to Karl Lashley, a famous physiological psychologist, memory was stored nowhere in particular. He spent most of his life trying unsuccessfully to find the engram, the storage unit of memory in the brain. His basic strategy was to train an animal to make a simple discrimination, then to systematically destroy small portions of the animal's brain with respect to location and size. The idea was that if the animal still showed evidence of its training, then memory trace or "engram" must have been stored somewhere else in its brain. During one of his experiments, Lashley taught rats to perform a task depending on sight and then deleted ever larger segments from the region of the brain concerned with vision. He found that as long as he left a small portion within any area of the visual cortex intact, the animals could still perform the tasks and even learn new tasks. These results led Lashley to formulate the principles of mass action and equipotentiality whereby the amount of memory affected depends upon the amount of cortex ablated, and that all regions of the cortex are equally important for memory (principle of equipotentiality). In other words, the same knowledge of sound, visual images, numbers, and textual facts, is distributed throughout an entire region of the brain and destroying any one part doesn't fully destroy the knowledge. However, new studies of individuals with normal and damaged brains, and experiments with animals, have proven that memory has several components which has led to a reassessment of Lashley's "mass action" theory.

Although the stores for long-term memory must be widely diffused throughout the brain, part of the mechanism for implanting it is not. It depends upon a region of the brain known as the hippocampus, just inside the temple, under the eaves of the temporal lobe. The evidence for this stems from experimental results and human clinical data. From animal experiments, we know that when monkeys suffer from temporal-lobe lesions, this produces impairments of long-term retention, while frontal-lobe lesions produce short-term memory impairments. Other information concerning long-term memory comes from clinical records of humans with brain damage. One of the most famous cases concerns a man from America named clinically as H.M. who underwent a bilateral mesial temporal lobectomy in the hippocampol zone. What's amazing is the fact that H.M. virtually had no capacity for establishing new long-term memories for most ongoing events.

Although H.M. performed normally on intelligence tests and on special tests for sorting and categorizing various visual and tactual patterns, he was unable to remember the photographs of new faces after a delay as short as two minutes. Since 1953, H.M. has lived from minute to minute. He can only remember his life more or less up to the time of his operation, but nothing after, except for a few minutes at a stretch. Thus, it can be said that H.M.'s short-term memory was largely intact. If he encounters someone with whom he spent the day before, he has no memory of having met them. He will read the same copy of a magazine repeatedly, with fresh interest each time. He will assemble the same jigsaw puzzle over again with little or no improvement or familiarity. When trying to find his way back home, he is lost at first, but manages to find his way once he is in the immediate vicinity of his house. H.M.'s case has been studied by Brenda Milner of the Montreal Neurological Institute for many years, and despite H.M.'s apparent failure to establish long-term traces, she has found that this deficit was not totally absolute. Indeed, H.M. in 1968 recognized President Kennedy's head on a half-dollar coin, named him and said that he had been assassinated. In another instance, H.M. showed retention of test instructions when he correctly described the use of a bell and a stylus after prolonged training on one of the mazes. However, it should be noted here that these results of slight learning may only reflect the incompleteness of his lesion, which permits some recovery of function with time. Other clinical data concerning those patients with complete ablation of the hippocamus showed no signs of memory whatsoever. They were more or less described as vegetative.

Because H.M.'s left and right hippocampol zones were bilaterally removed, he lost many long-term capacities to remember, resulting in anterograde amnesia. This highly illustrates the importance of the hippocampus, a small sea-horse like body of brain tissue, located along the bottom edge of the temporal neocortex upon which all analysed and refined sensory information is sent to after it has progressed through various neuronal levels from sensory projection areas down through to the complex associational networks of the parietal and temporal cortex. The fact that it forms the final output from the sensory analysers of the neocortex is clear from electrical recordings from its pyramidal cells. During treatment of epileptic patients, electrical stimulation in this zone evoked vivid and realistic mental images moving in real time producing an experience consisting of a combination of sensory modalities all occuring at once. One example describes a patient who visually imagined a scene of a bright summer Sunday morning where a car was being washed and some children were shouting. Such electrical stimulation of the hippocampol zone which produces vivid, realistic images of virtual reality may lend credence to the idea of holographic images in some processes of human memory which will be discussed toward the end of this paper.

Each pyramidal cell in the entorhinal cortex projects to a row of pyramidal cells in the dentate gyrus, which in turn extends to cells in the CA3 zone of the hippocampol gyrus whereby these cells also extend to the pyramidal cells of the CA1 zone. While the cells of the CA1 region extends to the subiculum, the anterior and central thalamus regions and indirectly to the basal ganglia and neocortical areas, the entorhinal cortex also has extensions from the olfactory areas, prepyriform, periamygdaloid cortex and the septum which as a whole reveals the hippocampus as an integrator of information from the neocortex and from the olfactory system, recognizing specific patterns of activity, that produces motivational responses via the motor system and emotional responses via the basal nuclei. Ninety-five percent of these CA3 pyramidal cells are not only multi-modal, but also show signs of memory whereby habituation occurs after a stimulus is repeatedly presented, and shows more responsiveness when the stimulus is new.

These experimental and clinical findings have revealed that Lashley's principle of mass action was not totally correct, for he failed to take into account the importance of the hippocampol zone. With all this said, one can conclude that Lashley's theory of visual, auditory, factual and skillful memory was not complete and lacked information regarding the effects of ablations on the cortex of individual components of memory.

Given today's experimental and clinical data on memory, Lashley's theory of mass action, albeit, incomplete, does hold some support by recent breakthroughs in both computer and holographic laser technology. Today's parallel processing computers provides a good model for Lashley's theory of distributed memory. These massive parallel connectionist systems consist of many interconnected processing units that operate simultaneously in parallel. Each processing unit has some level of activation, and each connection has a positive or negative strength whereby the more positive the two units connection, the more they mutually facilitate each other's activity. Mutual inhibition between the two units occurs when the connection becomes more negative. This simplified functional description of parallel processors is modeled after the neuronal network of the human brain which can also facilitate or inhibit each other's activity. Based upon the activation levels of particular output units, the information that is processed will either excite or inhibit the activation level of every other unit.

As input knowledge enters the computer system (ie. the human brain), the correct output can be obtained so long as the strength of every connection is at a sufficient level. If the output given is wrong, then every connection of every unit must be enhanced in order to attain the correct output at the inception of the next input of knowledge. Because the knowledge of information is distributed throughout every connection and that each input of information influences the value of every strength, then knowledge or information within the system wide network is represented by the total pattern of all the parallel connection strengths. Functional embodiment of the whole is thus important.

Because of the overall influences of these input-output connection networks on acquired memory information, destroying any small set of parallel connections or altering their strengths wouldn't completely diminish memory. This alone could explain why Lashley's rats showed no memory loss no matter what part of their brains he removed.

In pursuit of this theory, which may well be the key to understanding how the human brain works, one should look more closely at what is known about brain cells and the parallel connections between them. Indeed, this is just as important in promoting human understanding as it is to promoting the technological marvel of artificial intelligence. One can see that the framework of the computer parallel connectionist system remarkably resembles the framework of the human brain's neuronal parallel connectionist pattern and system. In fact, one can say that the computer parallel connectionist system was directly modeled after the human brain's neuronal network. For it is already known that the simplest human tasks are difficult for a mechanical robot. One example: the ability to look at the corner of a room, where walls and ceiling meet, and know that the corner goes in, not out. For the human mind, this is easy, but for the robots, the task is extremely difficult. As a consequence of the aforesaid difficulty, electrical engineers and computer scientists use the human brain as a model for their new 'neural network' computers which will permit robots to adapt to their surroundings independently and unassisted much like real humans do.

Nevertheless, the author proposes that it is this parallel connectionist system and the electromagnetic field it produces that also lies at the heart of a new and different theoretical foundation in memory involving the third interrelated component of memory which is holography. For it is the cascade effect of this very parallel connectionist system, at varying strengths, that produces the interference patterns necessary for the manifestation of holographic images in the brain. And although Karl Pribram first introduced the notion that holograms held just as much information as human memory, he was unsuccessful in producing the organic neuronal model that would lay the foundation of how such holograms could be manifested in the human brain.

The relevance of the holographic model to human memory is reinforced by the experimental results of the late Wilder Penfield from Oxford University. Wilder Penfield used electrodes to stimulate the temporal lobes of many of his own human patients, specifically in the area of the hippocampus which always evoked vivid responses like random flashbacks into a patient's past. To the patient's, these flashbacks were recorded to be extremely vivid and realistic. Penfield may have provided evidence that the human brain retains a complete and permanent holographic record of the stream of consciousness that is produced by electrochemical processes.

Holograms are essentially three-dimensional visual images projected into space recreated from mathematically definable wave and interference patterns derived from laser beams. They sweep over neurons and networks of neurons and eventually from a three-dimensional pattern of coded information which remains whole even when big chunks of neural substance are destroyed. One cubic centimeter of holographic film can store over ten billion photographic images. A three-dimensional holographic image representing an object cannot be visually distinguished from the real object. The holographic visual image is a by-product of an electrical and chemical process. The visual images and sensory impressions generated by the brain are holographic in nature. Every image and impression is composed of electromagnetic energy that consists of matter and, as such, are real. The three-dimensional holographic image is essentially produced by bombarding a photographic plate with an unfocused pattern of light waves from a split laser beam. Beaming a laser at the plate at the right angle converts these patterns of interference light wave forms into the original visual image.

The very nature of holograms are distinctively important in the way that it stores images. Indeed, if one develops a hologram on a glass plate, and then smash it with a hammer, one could randomly pick-up any piece, view it by laser light, and see the whole picture image again completely, even though it may have lost some quality of sharpness. The image is diffused through the hologram rather as an item of memory distributed throughout the brain. At the present, modern research have produced holographic images that also store sound holophonically. Thus, a scrap of information can trigger the release of an immense amount of both visual and auditory information.

CONCLUSION

Memory is not only diffused throughout the brain via organic neuronal parallel processors and electrochemically produced holographic matrix, but is implanted by and also found in the multi-modal CA3 pyramidal cells of the hippocampol gyrus, where various memories diffused throughout the brain can be directed to and located by the aforesaid hippocampus. It can be theorized that human memory is a combination of cerebrocentric function and purely psychological phenomena. It is proposed that memory can be explained by a combination of distributed memory systems, cybernetic parallel processors, and the three-dimensional holographic model, whereby the following interrelated processes of memory storage are involved in combination: 1) impulses from the five senses are directed to the brain, converging and interfering as they overlap within the brain's cells; 2) the sum total of all of the incoming interference patterns are distributed and stored throughout the brain; and 3) the massive facilitatory action of the human parallel neuronal connectionist system of the brain with its simulataneous levels of neuronal excitation electrochemically produces the field of electromagnetic energy needed for the brain's organically produced hologram. Moreover, memory is retrieved in the following manner: 1) the oculomotor system serves as a focus for the optical reference on a particular object perceived; 2) the audio, olfactory, visual, tactile, and emotional impulses serves as the brain's full spectrum directional reference; 3) the outside stimuli are converted into neuronal signals which is then processed through the brain's neuronal parallel connectionist system; 4) the processed neuronal signals of knowledge and information are then sent to the hippocampus; and 5) once all four operations are executed, the hippocampus sorts through the unique pattern of processed signals and utilizes such patterns in order to pinpoint and then direct, like a directional finder, the sensory reference to the exact location of the impression, image, or information in the system wide brain cell network, where the mental image, impression or alphanumerical information is finally accessed, leading to memory recall. Therefore, this newly adapted model of memory fully explains how visual and sensory information is received, stored and recalled by the brain. What is derived from this new model of memory is the principle that memory is not a unitary process, for no single mechanism serves all of the processes that allow an organism to bind experience.

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