MEMORY AND LEARNING – A STUDY FROM NEUROLOGICAL PERSPECTIVE

By

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ABSTRACT

Learning is the acquisition and storage of information as a consequence of experience. The human brain is designed in such a way that thousands bits of sensory data are processed each minute. The brain pays attention to what is relevant to daily life, always asking: "What's going on?" and "How is it important relevant to me?" The senses pass on 40,000 bits of information every second. The Neuro-science is to yet explore thoroughly about how a new memory is formed. The sensory stimuli hit the neurons in the appropriate sensory cortex. These crude sensations are then relayed through the thalamus and sent to the sensory association area of the neo-cortex where they are put together into, objects we recognize. Then the information is sent to amygdala for emotional evaluation and to the frontal cortex for content evaluation. On the basis of its analysis of physical features of the stimuli, the brain begins to construct meaning. Depending on the clarity in sense and its relevance, the new information is either retained or ignored. A thorough knowledge of the different parts of the human brain involved in the process of memory helps the teacher to adopt suitable methodology in the classroom. In this fast moving world, the learners expect the teacher to give everything in a nutshell. Hence the teacher has to organize the subject content in such a way that the students could understand, restore and retrieve the information easily and quickly. In this paper, the authors went through the meaning and needs of memory, and the categories of memory. Furthermore, they studied and explained eight aspects of memory activation strategies from the view of neurological perspective are suggested for practice in the classroom such as Mnemonic devices are strategies for enhancing memory, Engage in Adequate rehearsal, Schedule distributed practice, Minimize interference, Engage in deep processing, Emphasize Transfer, Enrich Encoding with Verbal Mnemonics, and Enrich encoding with visual imagery.

Keywords: Neuro-Science, Sensory Stimuli, Neo-Cortex, Amygdala and Reporter Potential and Hippocampal

INTRODUCTION

Learning is an active process in which meaning is accomplished on the basis of experience. We each construct a unique image by combining information we receive from our sense organs. Memory and learning are so closely connected that people often confuse them with each other. But the specialists who study them consider as two distinct phenomena. These specialists define learning as a process that will modify a subsequent behavior. Memory, on the other hand, is the ability to remember past experiences. We learn a new language by studying it. We then speak it by using our memory to retrieve the words that we have learned. Memory is essential to all learning, because it helps to store and retrieve the information that we learn. Memory is basically nothing more than the record left by a learning process. Thus, memory depends on learning and vice versa. Because the knowledge stored in our memory provides the framework to which we link new knowledge, by association. However, the recent research works have described the pathway that the new information follows.

1. The Pathway of Information in Brain

The human brain is designed in such a way that thousands of bits of sensory data are processed each minute. The brain prefers to input information in a hierarchy depending on the number of senses engaged. The brain

takes information in symbolic input found in the form of letters that create words, numbers that create mathematic problems, equations and formulas found in mathematics is the most difficult for the brain because it engages only one or two of the 19 senses.

The limbic system is the gatekeeper for the brain and filters all information entering. Parts of the limbic system process the information depending on whether or not the person "feels" safe. Teachers can help students understand their emotions on the ability of cerebral cortex to use the information to build mental programs and enhance the ability of the cerebral cortex to process information and create permanent program. A lot of information comes in through the spinal cord at the base of the brain. Information goes OUT from the brain to make body parts (arms and legs) do their job. There is also a great deal of INCOMING information (hot, cold, pain, joint sensation, etc.). Vision and hearing do not go through the spinal cord but go directly into the brain. Information enters from the spinal cord and comes up the middle of the brain. It branches out like a tree and goes to the surface of the brain. The surface of the brain is gray due to the color of the cell bodies (that's why it's called the gray matter). The wires or axons have a coating on them that's colored white (called white matter) [1]. The sensory stimuli hit the neurons in the appropriate sensory cortex. These crude sensations are then relayed through the thalamus and sent to the sensory association area of the neo-cortex where they are put together into, objects we recognize. Then the information is sent to amygdala for emotional evaluation and to the frontal cortex for content evaluation. On the basis of its analysis of physical features of the stimuli, the brain begins to construct meaning. Depending on the clarity in sense and its relevance, the new information is either retained or ignored.

Memory is a neural representation of an object. It occurs in specific or emotionally important contexts. The environment makes a variety of sources of information available (Example light, Sound, Smell, Heat, Cold etc). But the brain understands only the electrical energy. The body has special sensory reporter cells that transdue (i.e. change from one form of energy to another). In the process of transduction, memory is created [2]. The memory thus created lasts only for a short period. For example, less than half-a-second for vision and about three seconds for hearing. The brain processes, stores and retrieves information in different ways to suit different needs.

2. Categories of Memory

Memory can be viewed in to two broad categories – i.e. (i) Implicit memory and (ii) Procedural memory. Further, memory can be categorized into five basic types: procedural, perceptual, semantic, working and episodic.

2.1 Procedural Memory

In procedural memory, the primary areas of the brain involved are: regions of sensory motor cortex, basal ganglia and cerebellum. Procedural memory is the memory for skilled behaviors independent of any understanding, for example, riding a bicycle [3]. A case study describes a pianist who learned a new piece to accompany a singer at a consort but had no recollection the following morning of having performed the composition. He could remember how to play the music but could not remember having done so.

2.2 Perceptual Memory

Perceptual memory is a form of implicit memory which perceives an object or event. It is a memory that is not tied to knowing the name of the perception or even understanding it. Because of this type of memory, the next time when the object or event or one similar to is encountered, is identified more quickly and easily. Its identification relies on less stimulus information, for example, the name and picture of a product were presented on television too quickly for the viewer to be aware of perceiving the event [4]. The next time when the viewer was at the supermarket, however, he could be more attracted to that particular brand.

2.3 Semantic Memory

Semantic Memory, a form of declarative memory, refers basically to 'general knowledge of the world'. This type of memory provides the knowledge of something when it is no longer actually being perceived. Semantic memory provides the basic material required for thinking [5]. The

hippocampus and deep, inner part of the temporal lobe, both parts of the limbic system, are required for the formation of semantic memories and other type of declarative memory.

3. Neural Pathway of Communication on Memory

Teaching will be more effective if it uses methods which are aligned with how the brain best attends to understands and retain information. The sequences of thinking measured across very narrow areas of the brain. Today's research encourages a "whole brain "approach to learning. The sense organs gather information about the 'environment' and through learning this information is coded in the nervous system. What does it mean to gather information and what are the sense organs they gather information about the 'environment' and through learning this information is coded in the nervous system [6].

3.1 Expectations from Neurons

The functional organization of the cognizant organism that gives rose to such phenomena as conceptual thinking, language and self-consciousness. For the understanding of the functional organization of the nervous system, it is necessary to consider that nerve cells respond at any moment with definite transfer functioning to classes of afferent spatio-temporal configuration s in their input, generating definite states of effector activity and not to particular afferent state.

The study of neural oscillations belongs to the field of 'neurodynamics' an area of research in the cognitive sciences that places a strong focus upon the dynamic character of neural activity in describing brain functions [7]. Each neuron in our brain responds to the strength or weakness of our decisions. It has the properties of a transducer, a conductor and a transmitter of electrical impulses converting energy from one form to another .As a transducer the neuron converts the stimulus energy from the outside world into electrical signals. As a conductor the neuron propagates or conducts the signals from the dendrites to the cell body and then down the axon. As the transmitter, the neuron converts the electrical signals into chemical messages and transmits them from one neuron to a neighboring neuron. The flow of information takes place from the dendrites to the cell body and then along the axon to the dendrites of the next cell. The brain is constantly changing. It can alter its structure, generate new neurons, adapt, heal, renew itself after trauma and change deep seated emotions and behaviors throughout life. Brain cells are undergoing continual remodeling and reorganization as a result of thoughts and experiences. Chemicals in our brain – such as estrogen, progesterone, testosterone, serotonin, cortisol, dopamine and other hormones, play amazing roles to prevent memory loss and solve other problems. They also add to creativity, build openness to change, and regulate moods that impact our confidence to lead in tough times.

3.2. Hippocampus and Memory

The hippocampus is a brain structure which lies under the medial temporal lobe, one on each side of the brain. It is sometimes grouped with other nearby structures including the dentate gyrus and called the hippocampal formation. The hippocampus is critical for the formation of new autobiographical and fact memories. It may function as a memory gateway through which new memories must pass before entering permanent storage in the brain [8]. Hippocampal damage can result in anterograde amnesia (loss of ability to form new memories) although older memories may be safe. Thus, someone who sustains an injury to the hippocampus may have good memory of his childhood and the years before the injury, but relatively little memory for anything that happened since. Some memories, such as the memory for new skills or habits, can sometimes be formed even without the hippocampus.

The hippocampus is especially sensitive to global reductions in oxygen level in the body. Thus, periods of oxygen deprivation (hypoxia) which are not fatal may nonetheless result in particular damage to the hippocampus [9]. The hippocampus is also a common focus site in epilepsy, and can be damaged through chronic seizures. It is also sometimes damaged in diseases such as herpes encephalitis, and is one of the first brain areas to show damage in Alzheimer's disease.

4. Plasticity in Neural Networks

Every time we learn something, neural circuits are altered in our brain. These circuits are composed of a number of neurons (nerve cells) that communicate with one another through special junctions called synapses. When we learn something, it is actually these synapses whose efficiency increases, thus facilitating the passage of nerve impulses along a particular circuit. For example, when we are exposed to a new word, we have to make new connections among certain neurons in our brain to deal with it: some neurons in our visual cortex to recognize the spelling, others in our auditory cortex to hear the pronunciation, and still others in the associative regions of the cortex to relate the word to our existing knowledge [10]. To learn this new word, we repeat it to ourself several times, and this selects and strengthens the connections among these various circuits in our cortex. And it is this new, durable association among certain neurons that will form our memory of this word. The strength of this association may of course depend on several factors.

5. Educational Implications

A thorough knowledge of the different parts of the human brain involved in the process of memory helps the teacher to adopt suitable methodology in the classroom. In this fast moving world, the learners expect the teacher to give everything in a nutshell. Hence the teacher has to organize the subject content in such a way that the students could understand, restore and retrieve the information easily and quickly. The following memory activation strategies are suggested for practice in the classroom.

- *Mnemonic devices for enhancing memory:* Actually mnemonic devices were even more crucial in ancient times than they are today. The ancient Greece and Rome, where paper and pencil were not readily available for people to note down things, they had to depend heavily on mnemonic devices.

- *Engage in Adequate rehearsal:* In reality, practice is not likely to guarantee perfection, but it usually leads to improve retention. Studies show that retention improves with increased rehearsal. This improvement occurs because rehearsal can help transfer information into long-term memory.

- *Schedule distributed practice:* Let us assume that we need to study an hour for an exam. Should we "cram" all our studying into one 9-hour period? Better to distribute our study among distributed schedule.

- *Minimize interference:* Interference is a major cause of forgetting. Thorndike and Hayes Roth (1979) found that similar material produced less interference when it was learned on different days [11]. Thus the day before an exam in a course, we should study for that course only, if possible. Other normal working activities also provide interference. Therefore it is a good idea to thorough reviews of material as close to exam time as possible. This strategy will help to avoid memory loss due to the interference from intervening activities.

- *Engage in deep processing:* If we expect to remember what we read about classical conditioning, try to think of responses that we display that are attributable to classical conditioning. This is called 'generated potential' or 'Reporter potential'. The generator potential is localized in this region without being propagated actively over the rest of the sensory nerve fiber. Action potential follows all or alone is propagator on non-graded. The action potential is developed only when the generator potential attains a threshold level due to graded activity. If the intensity of the stimulus in the receptor is further increased, then the generator potential is increased further and the frequency of discharge of action potential is proportional to the magnitude of the applied stimuli.

- *Emphasize Transfer – appropriate processing:* It is also useful to keep the concept of transfer – appropriate processing in mind. A study comparing fact oriented processing and problem oriented processing was mere helpful when testing required students to solve problems. Thus students should tailor their study methods to the type of test they will be given.

- *Enrich Encoding with Verbal Mnemonics:* Although it is often helpful to make information personally meaningful, it is not always easy to do so. For instance, when we study chemistry we may have a hard time

relating to polymers at a personal level. Thus many mnemonic devices-such as acrostics, acronyms, and narrative methods- are designed to make abstract material more meaningful.

- *Narrative Methods:* Another useful way to remember a list of words is to create a story that includes the words in the appropriate order. The narrative both increases the meaningfulness of the words and links them in a specific order.
- *Enrich encoding with visual imagery:* Memory can be enhanced by the use of visual imagery. Many popular mnemonic devices depend on visual imagery, loci and key word methods.
- *Link method:* The link method involves forming a mental image of items to be remembered in a way that links them together.
- *Method of Loci:* The method of loci involves taking an imaginary walk along a familiar path where images of items to be remembered or associated with certain locations.
- *Key word Method:* Visual images are also useful when we need to form an association between a pair of items, such as a person's name and face or a foreign word and its English translation. In key word method, we associate a concrete word with an abstract word and generate an image to represent a concrete word.
- *Organize Information:* Retention trend to be greater when information is well organized. The value of organization has been apparent in studies of people who exhibit remarkable memory capability.

Conclusion

Memory, being a significant factor in the process of learning need to be understand by both learners and the teachers. The students at present stage need to think multi dimensionally and hence classroom teaching has become very challenging. Many teachers find that their teaching style doesn't match with the learning style of some of their students. It is not enough sufficient if the teachers communicate only the mere information. Teacher education therefore has to change and adopt new techniques and methods to keep pace with the changing concepts of learning and education. They have got an additional responsibility of categorizing, relating, recapitulating, summarizing and reinforcing the information they teach. All our memories (of events, words, images, emotions, etc.) thus correspond to the particular activity of certain networks of neurons in our brain that have strengthened connections with one another. The teachers task is to enable the students develop their individuality different process of knowledge building and meaning construction as well as positive attitudes. To remember the word days or years later, we will have to successfully reactivate these same neural circuits. Nerve cells create the core of our neuron system, and impact basic changes that can improve our situation. Instead of trying to fit a mould, they can take notes that feel natural, or easily remembered and suited to their individual style. By practicing the mnemonic techniques, and utilize the methods then and there will help them to strengthen their mental abilities. Then only the students will be able to take the information to the long term memory and retrieve it when they required. Continued rehearsal may also improve their understanding of the assigned material. In the present situation, to overcome external interferences, the teacher's methodology of teaching should include the strategy for long term retention of information also enhances their learning and memory retrieval. Hence the teacher has to organize the subject content in such a way that the students could understand, restore and retrieve the information easily and quickly.

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