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REVIEW ARTICLE

REVIEW ON CONCEPT OF MEMORY

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Abstract

Memory is the ability of the brain to store, retain, and subsequently recall information. Although traditional studies of memory began in the realms of philosophy, the late nineteenth and early twentieth century put memory within the paradigms of cognitive psychology. In the recent decades, it has become one of the principal pillars of a new branch of science that represents a marriage between cognitive psychology and neuroscience, called cognitive neuroscience. The following overview offers a brief look at what memory is, how it works, and how it is organized.

Introduction

The fact that experiences influence subsequent behaviour is evidence of an obvious but nevertheless remarkable activity called remembering. Memory is both a result of and an influence on perception, attention, and learning. The basic pattern of remembering consists of attention to an event followed by the representation of that event in the brain. Repeated attention, or practice, results in a cumulative effect on memory and enables activities such as a skillful performance on a musical instrument, the recitation of a poem, and reading and understanding words on a page. Learning could not occur without the function of memory. So-called intelligent behaviour demands memory, remembering being prerequisite to reasoning. The ability to solve any problem or even to recognize that a problem exists depends on memory. Routine action, such as the decision to cross a street, is based on remembering numerous earlier experiences. The act of remembering an experience and bringing it to consciousness at a later time requires an association, which is formed from the experience, and a "retrieval cue," which elicits the memory of the **experience.**

REVIEW OF THE MEMORY

Memory is a specialized faculty of brain, which has to be developed during the process of learning, the mechanism of memory, is complex as the mechanism of though to provide memory. The nervous system must recreate the same spatial and temporal pattern of stimulation in the central nervous system at some future date. Though we cannot explain in the detail what the memory is we do know some of the basic neuronal processes that probably lead to the process of memory. [1]

It is well established that various degrees of memory occur, some memories lasting a few seconds and others lasting hours, days, months or years. Possibly all of these types of memory are caused by same mechanism operating at different degrees of fulfillment. Yet, it is also possible that different mechanisms of memory do exist. Indeed, most psychologists classify memory into from two to four different types. [2]

Dictionary meaning of memory

- Recollection, remembrance(Standard dictionary)
- A particular act of recalling something learned or experienced, the fact or a condition of recalling remembrance.(Webster dictionary)

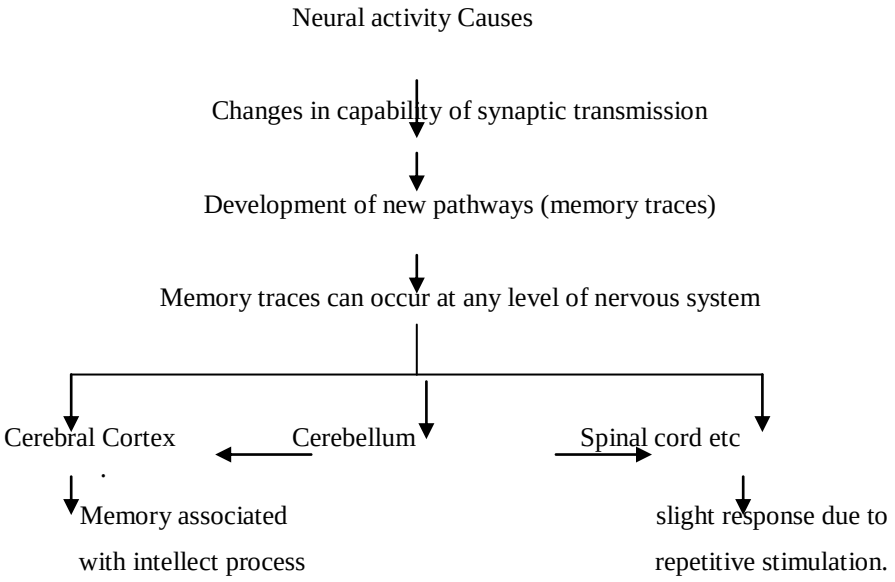
Definition:

- Memory is defined as the ability to recall the past experience.
- Memory is the function by which information stored in the brain is a latter recalled to consciousness.
- Memory is a comprehensive term that covers the retention of all types of material over various times and involves diverse forms of response.
- Memory refers to the encoding, storage and retrieval of information.

Memory:

Memories are caused by changes in the capability of synoptic transmission from one neuron to the next as a result of previous neural activity. Those changes in turn cause new pathways to develop for transmission of signals through the neural circuit of the brain.

The neural pathways are called memory travels. They are important because once established, thinking mind to reproduce the memories can activate them. Experiments have demonstrated that memory traces can occur at all levels of nervous system.



CLASSIFICATION:

Different levels of memory:

- Recent memory
- Remote memory

Recent memory may be lost frequently with neurological disease but the remote memory is remarkably resistant and may persist even in severe brain damage. [3]

Second type:
1. Sensory memory
2. Short term memory or Primary memory.
3. Long term memory, which itself can be divided into Secondary memory and Tertiary memory. [4]

SENSORY MEMORY:

Sensory memory means the ability to retain sensory signals in the sensory areas of the brain for a very short interval of time following the actual sensory experience. Usually these signals remain available for analysis for

several hundred milliseconds but are replaced by new sensory signals in less than one second. Nevertheless, this is initial stage of the memory process.

SHORT TERM MEMORY OR PRIMARY MEMORY

It is the memory of facts, words, numbers, letter or other information received for a few seconds to few memories to few minutes at a time. For example, after searching for a telephone numbers in the directory, we remember the number for a short while. After appreciating beautiful scenery, the details of it could be recalled for sometimes or days. Afterwards it disappears from the memory.

The characteristic feature of this type of memory is that the information is available for recall easily from memory store itself one need not search or squeeze through the mind and this memory is easily replace by new bits of memory, i.e byooking into another telephone number, the first one might disappear.

LONG TERM MEMORY

Long term memory is the storage in the brain of information that can be recalled at some later time many minutes, hours, days, months or years later. This type of memory has been called fixed memory, permanent memory and several other names.

Long term memory divided into two different types

1.Secondary memory 2.Tertiary memory

A secondary memory is a long-term memory that is stored with either a weak or only a moderately strong memory trace. For this reason it is easy to forget and it is sometimes difficult to recall further more, the time required to search for the information is relatively long. This type of memory can last from several minutes to several years. When the memories are so weak that they will last for only a few minutes to a few days, they are also frequently called recent memory.

A tertiary memory is a memory that has become so well ingrained in the mind that the memory can usually last the lifetime of the person. Furthermore the very strong memory traces of this type of memory make the stored information available within a split second. This type of memory is typified by one's knowledge of his own name, by his ability to recall immediately the numbers from 1 to 10, the letters of the alphabet, and the words that he uses in speech, and also by the memory of his precise physical structure and of his very familiar immediate surrounding's.

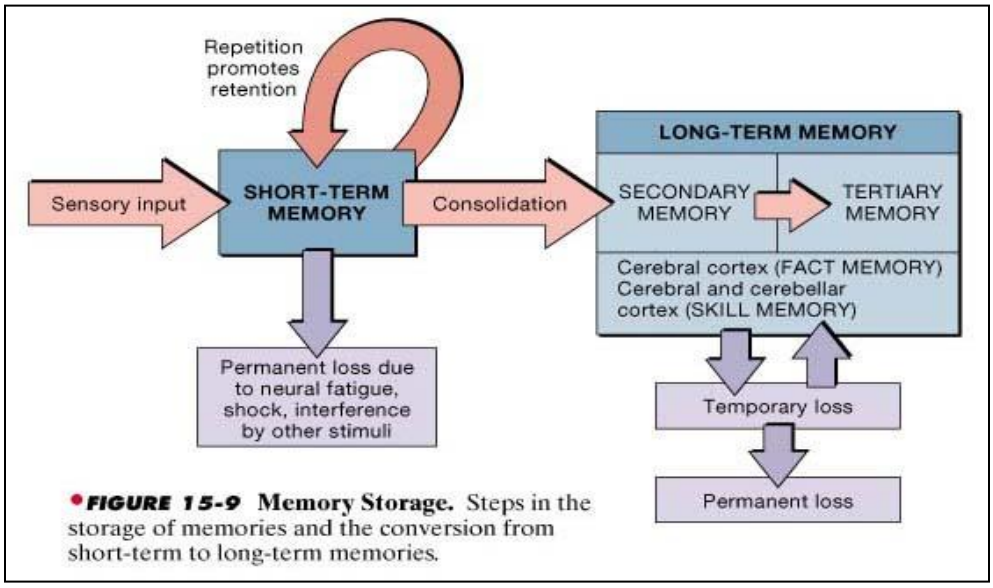


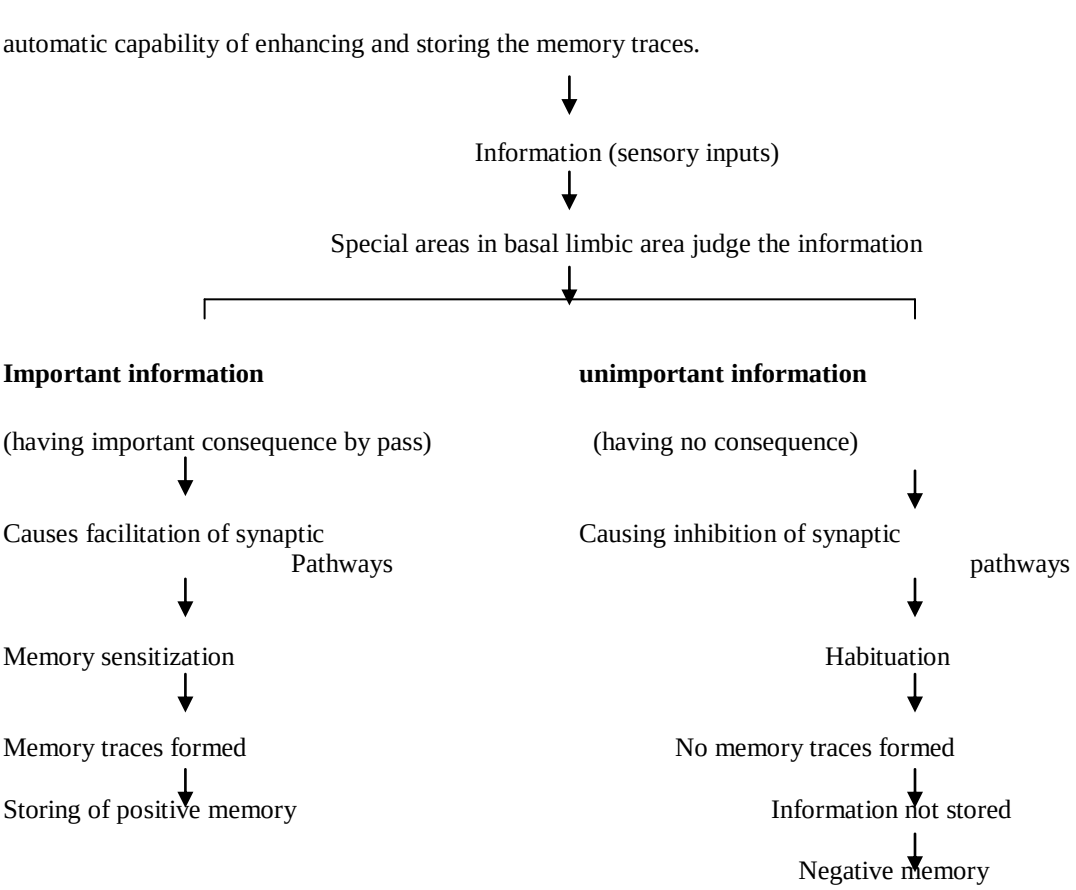
FIGURE 15-9 Memory Storage. Steps in the storage of memories and the conversion from short-term to long-term memories.

Memory Representation

Positive and Negative memory:

Although we believe memories as being positive recollections of thoughts / experiences but the greater share of our memories is negative memories. Our brain receives sensory impulses from all the senses and if all those information were to be remembered the memory capacity of brain would be exceeded within minutes.

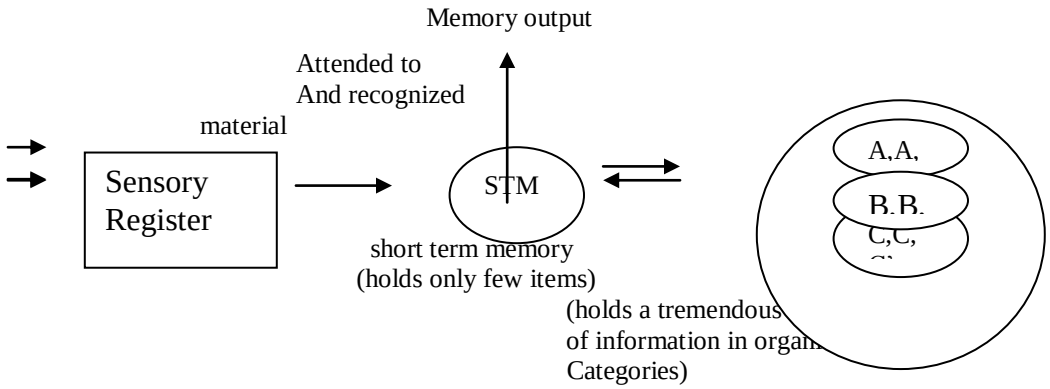
The brain has special capacity to ignore information, which is of no consequence, but information that causes important consequence such as pain or pleasure are stored in the form of memory traces. The basal limbic areas are involved in determination whether information is important or not. Unimportant information causes inhibition of synaptic pathways. This is called habituation that results in negative memory. Important information causes facilitation of synaptic pathways. This is called sensitization, which results in positive memory. The brain also has automatic capability of enhancing and storing the memory traces.



SOME THEORY ACCORDING TO PSYCHOLOGIST

Atkins-shiffrin theory (1968) [5]

Memory starts with a sensory input from the environment. Information that is attended to and recognized in the sensory register may be passed on to short term memory (STM) where it is held for perhaps 20 or 30 seconds, some of the information reaching short term memory is processed by being rehearsed that is by having attention focused on it, perhaps by being repeated over and over, or perhaps by processed in some other way that will link it up with other information already stored in memory. Information that is rehearsed may then is passed along to long term memory (LTM). When items of information are placed in long term memory they are organized into categories where they may reside for days, months, years or for a lifetime. When you remember something, a representation of the item is withdrawn or retrieved, from long term memory.



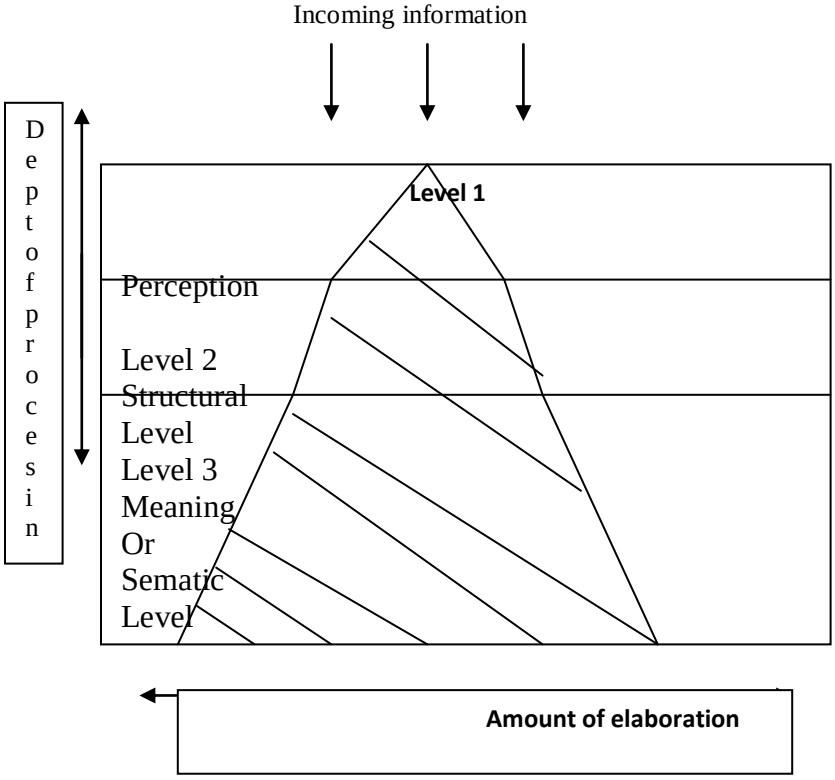
An information processing models of memory (Based on Atkinson and Shiffrin 1968)

The level of processing theory[6]

A contrasting model of memory involves what are called levels of processing (Craik and Lockhart, 1972) with more recently, the idea of elaboration added to the level of processing frame work (Craik and Tulving, 1975).

According to the levels of processing idea, incoming information be worked on at different levels of analysis; the deeper the analysis goes, the better the memory.

- The first level is simply perception, which gives us our immediate awareness of the environment.
- At a somewhat deeper level, the structural features of the input (what it sounds like or looks like, for example) are analyzed.
- Finally at the deepest level of processing, the meaning of the input is analyzed. Analysis to the deep level of meaning gives the best memory.



A summary diagram of the relationship among levels of processing, elaboration of information and memory. The shaded portion of the figure shows the amount of information retained

PHYSIOLOGICAL BASIS OF MEMORY: [7]

Despite many advances in neurophysiology during the past half century, we still cannot explain what perhaps the most important function of the brain is: its capability for memory. Yet physiological experiments are beginning to generate conceptual theories of the means by which memory could occur. Some of these are discussed in the following few sections.

TABLE NO:-1.1 SUMMARY OF CHARACTERISTIC OF THE STAGE OF MEMORY[8]

	Sensory register	Short term memory	Long term memory
Approximate	For vision: upto1 sec For hearing : up to 5 sec	Up to about 30 sec but it varies, depending on a number of factor	Days, months , years or a lifetime
Capacity	Relatively large up to at least 16 items but probably much more	Relatively small up to about 7 times or chunks under most condition	Very large – no known limits
Transfer processes	Attention and recognition. Items attended to and recognized more to short-term memory	Rehearsal:items appropriately rehearsed more to long term memory	
Type of information	Copy of input	Sounds, visual images words and sentences	Primarily meaningful sentences, life events and concept; some images; sematic and episodic memory.
Major reason information is last	Decay of trace	Displacement of old information by incoming information	Faculty organization or inappropriate retrieval (search) strategy: interference

POSSIBLE MECHANISMS FOR SHORT TERM MEMORY:

Short-term memory requires a neuronal mechanism that can hold specific information signals for a few seconds to at most a minute or more. Several such mechanisms are the following.

Reverberating Circuit Theory of Short Term Memory:

When a tetanizing electrical stimulus is applied directly to the surface of the cerebral cortex and then removed after a second or more, the local area excited by this stimulus continues to emit rhythmic action potentials for short periods of time. This effect results from local reverberating circuits, the signals passing through a multistage circuit of neurons in the local area of the cortex itself or perhaps also back and forth between the cortex and the thalamus.

It is postulated that sensory signals reaching the cerebral cortex can set up similar reverberating oscillations and that these could be the basis for short term memory. Then, as the reverberating circuit fatigues, or new signals interfere with the reverberations, the short-term memory fades away.

Post-Tetanic Potentiation Theory of short-term Memory:

In most parts of the nervous system including even the anterior motoneurons of the spinal cord, tetanic stimulation of the neuron for few seconds causes a subsequent increased excitability of the neuron for a few seconds to few hours.

If during this time the neuron is stimulated again, it responds much more vigorously than normally, a phenomenon called Post-tetanic potentiation. This is obviously a type of memory that depends on change in excitability of the involved neurons, and it could be the basis for short-term memory. It is likely that this phenomenon results from some temporary change in the synapses of the neurons.

DC Potential Theory of Short Term Memory:

Another change that occurs in the neurons following a period of excitation is a prolonged decrease in the membrane potential of the neuron lasting for from seconds to minutes. Because this changes the excitability of the neuron, it could be the basis for short-term memory. Such changes in neuronal potentials are called DC potentials or sometimes Electrotonic Potentials. Measurements in the cerebral cortex show that such potentials occur especially in the superficial dendritic layers of the cortex, indicating that the process of short-term memory could result from changes in the dendritic membrane potentials.

Mechanisms of Long Term Memory, Enhancement of Synaptic Transmission Facility:

Long-term memory means the ability of the nervous system to recall thoughts long after initial elicitation of the thoughts is over. We know that the long term memory does not depend on continued activity of the nervous system, because the brain can be totally inactivated by cooling, by general anesthesia, by hypoxia, by ischemia, or by any other method and yet memories that have been previously stored are all still retained when the brain becomes active once again. Therefore, it is assumed that long-term memory must result from some actual alterations of the synapses, either physical or chemical**.**

Anatomical basis of memory

Synaptic terminal for memory coding is slightly different from other synapses. Two separate presynaptic terminals are involved. One of the terminals is the primary presynaptic terminal. This ends on postsynaptic neuron. This terminal is called sensory terminal, because the sensations are transmitted to post synaptic neuron through this terminal.

The other presynaptic terminal ends on the sensory terminal itself. This second terminal is called is facilitator terminal. If sensory terminal alone is stimulated without facilitator terminal, the firing from sensory terminal leads to habituation on the other hand, if both the terminals are stimulated, the signals remain strong for long duration, i.e for few months to few years. This is called facilitation.

CHEMICAL OR MOLECULAR BASES OF MEMORY [9]

Facilitation: this occurs in the following manner.

Stimulation of facilitator neuron along with sensory neuron causes release of serotonin from facilitator terminal on sensory terminal

↓

Serotonin binds with serotonin receptor.

↓

The serotonin receptor complex activates the enzyme adenyl cyclase in the terminal membrane.

↓

This cause formation of cyclic AMP in sensory terminal

↓

cyclic AMP activates the protein kinase.

↓

The protein kinase causes phosphorylation of potassium channels in the terminal membrane

↓

This blocks the exist of potassium ions

↓

So, the action potential continues for days or weeks or still years

↓

Prolong action potential causes prolonged activation of calcium pores there by allowing large amount of calcium to enter sensory terminal.

↓

The calcium ions further enhance the release of transmitter i.e serotonin thus facilitating synaptic transmission to a great extent leading to memory.

The overall facilitated circuit is called memory engram or a memory trace.

Habituation: Habituation is due to passive closure of calcium channels of terminal membrane. Hence, the release of transmitter is less and action potential is in less number. So, the signals become weak. The weaken of the signals is called habituation.

Consolidation of memory: The primary memory becomes secondary memory by consolidation. i.e. the permanent facilitation of synapses. This is possible by rehearsal mechanism. i.e. rehearsal of same information again and again accelerates and potentials the degrees of transfer of primary memory into secondary memory. This is what happens in memorizing a poem or a phase by reading repeating.

Role of Rehearsal in Transference of Short Term Memory into long-term Memory:

Psychological studies have shown that rehearsal of the same information again and again accelerates and potentiate the degree of transfer of Short-term memory into Long-term memory, and therefore accelerate and potentiate the process of consolidation. The brain has the neutral tendency to rehearse newfound information, and especially to rehearse the newfound information that catches the mind attention. Therefore, over a period of time the important features of sensory experiences become progressively more and more fixed in long-term memory stores. This explains why a person can remember small amounts of information studied in depth far better than he can remember large amount of information studied only superficially. And it also explains why a person who is wide – awake will consolidate memories far better than will a person who is in a state of mental fatigue.

Codifying of Memories during the Process of Consolidation:

One of the most important features of the process of consolidation is that memories to be placed permanently into the Long-term memory storehouse are first codified into different classes of information. During this process similar information is recalled from the long-term storage bins and is used to help process the new information. The new and old are compared for similarities and for differences, and part of the storage process is to store the information about these similarities and differences rather than simply to store the information unprocessed. Thus, during the process of consolidation, the new memories are not stored randomly in mind, but instead are stored in direct association with other memories of same type. This is obviously necessary if one is to be able to scan the memory store at a later date to find the required information.

Transfer of Sensory Memory into Long term Memory:

Some physiopsycologists believe that the sensory memory can be transferred directly into long-term memory first without passing through the stage of short-term memory. This would apply to such information as visual scenes, musical tunes, tactile experiences, and so forth. Here again, the greater the number of times that the person experiences the sensory information, which is a form of rehearsal, the greater also is the degree of consolidation of the memories.

Change of long-term Secondary Memory into long-term Tertiary Memory-Role of Rehearsal:

Rehearsal also plays an extremely important role of changing the weak trace type of long term memory, called secondary memory, into the strong trace type, called Tertiary memory. That is, each time a memory is recalled or each time the same memory experience is repeated, a more and more indelible memory trace develops in the brain. The memory finally becomes so deeply fixed in the brain that it can be recalled within fraction of a second and it will also last for a lifetime, both of which are the characteristics of long-term tertiary memory.

CONCLUSION:

Good memory is one of the primary requisite to attain good knowledge and excel in academic career. Pursuing a good memory is aspiration of all students, as it is a complex phenomena affected by many factors use of drugs and procedures to improve memory is having a lot of importance in today's era, where memory related health issues are increasing rapidly. However this concept has to be looked with lot more scientifically for better understanding and application.

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