UNIT 7

Memory and Forgetting

After reading this chapter, you would be able to:

Understand the nature of memory,

Distinguish between different types of memory,

Explain how the contents of long-term memory are represented and organized,

Understand the nature and causes of forgetting, and

Learn the strategies for improving memory.

Contents

Introduction

All of us are aware of the tricks that memory plays on us throughout our lives. Have you ever felt embarrassed because you could not remember the name of a known person you were talking to Or anxious and helpless because everything you memorized well the previous day before taking your examination has suddenly become unavailable? Or felt excited because you can now flawlessly recite lines of a famous poem you had learnt as a child? Memory indeed is a very fascinating yet intriguing human faculty. It functions to preserve our sense of who we are maintains our interpersonal relationships and helps us in solving problems and taking decisions. Since memory is central to almost all cognitive processes such as perception, thinking and problem solving, sychologists have attempted to understand the manner in which any information is committed to memory, the mechanisms through which it is retained over a period of time, the reasons why it is lost from memory, and the techniques which can lead to memory improvement. In this chapter, we shall examine all these aspects of memory and understand various theories which explain the mechanisms of memory.

The history of psychological research on memory spans over hundred years. The first systematic exploration of memory is credited to Hermann Ebbinghaus, a German psychologist of late nineteenth century (1885). He carried out many experiments on himself and found that we do not forget the learned material at aneven pace or completely. Initially the rate of forgetting is faster but eventually it stabilizes. Another view on memory was suggested by **Frederick Bartlett (1932)** who contended that memory is not passive but an active and constructive process. With the help of meaningful verbal materials such as stories and texts, he demonstrated that memory is a constructive process. That is, what we memorize and store undergoes many changes and modifications over time. So there is a qualitative difference in what was initially memorized by us and what we retrieve or recall later. There are other psychologists who have influenced memory research in a major way. We shall review their contributions in this chapter at appropriate places.

Memory refers to retaining and recalling information over a period of time, depending upon the nature of cognitive task you are required to perform. It might be necessary tohold information for a few seconds. For example, you use your memory to retain an unfamiliar telephone number till you have reached the telephone instrument to dial, or for many years you still remember the techniques of addition and subtraction which you perhaps learned during your early schooling. Memory is conceptualized as a process consisting of three independent, though interrelated stages. These are encoding, storage, and retrieval. Any information received by us necessarily goes through these stages.

(a) Encoding is the first stage which refers to a process by which information is recorded and registered for the first time so that it becomes usable by our memory system. Whenever an external stimulus receive on our sensory organs, it generates neural impulses. These are received in different areas of our brain for further processing. In encoding, incoming information is received and some meaning is

derived. It is then represented in a way so that it can be processed further.

(b) Storage is the second stage of memory. Information which was encoded must also be stored so that it can be put to use later. Storage, therefore, refers to the process through which information is retained and held over a period of time.

(c) Retrieval is the third stage of memory. Information can be used only when one is able to recover it from her/his memory. Retrieval refers to bringing the stored information to her/his awareness so that it can be used for performing various cognitive tasks such as problem solving or decision-making. It may be interesting to note that memory failure can occur at any of these stages. You may fail to recall information because you did not encode it properly, or the storage was weak so you could not access or retrieve it when required.

Information Processing Approach: The Stage Model

Initially, it was thought that memory is the capacity to store all information that we acquire through learning and experience. It was seen as a vast store house where all information that we knew was kept so that we could retrieve and use it as and when needed. But with the advent of the computer, human memory came to be seen as a system that processes information in the same wayas a computer does. Both register, store, and manipulate large amount of information and act on the basis of the outcome of such manipulations. If you have worked on a computer then you would know that it has a temporary memory (random access memory or RAM) and a permanent memory (e.g., a hard disk). Based on the programme commands, the computer manipulates the contents of its memories and displays the output on the screen. In the same way, human beings too register information, store and manipulate the stored information depending on the task that they need to perform. For example, when you are required to solve a mathematical problem, the memory relating to mathematical operations, such as division or subtraction are carried out, activated and put to use, and receive the output (the problem solution). This analogy led to the development of the first model of memory, which was proposed by Atkinson and Shiffrin in 1968. It is known as Stage Model.

Memory Systems : Sensory, Short-term and Long-term Memories

According to the Stage Model, there are three memory systems: the Sensory Memory, theShort-term Memory and the Long-term Memory. Each of

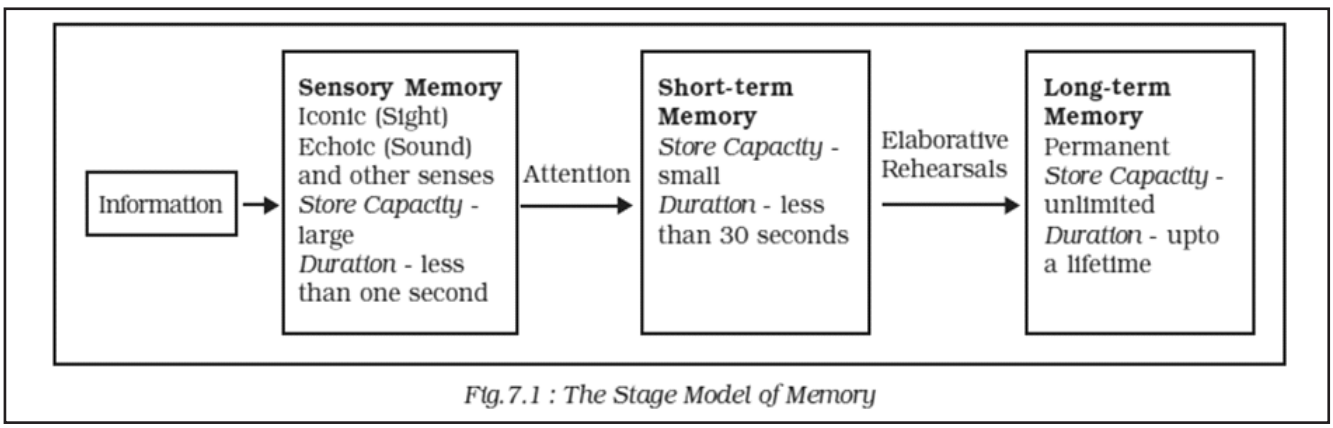

Fig.7.1 : The Stage Model of Memory

these systems has different features and performs different functions with respect to the sensory inputs (see Fig.7.1). Letus examine what these systems are:

Sensory Memory

The incoming information first enters the sensory memory. Sensory memory has a large capacity. However, it is of very short duration, i.e. less than a second. It is a memory system that registers information from each of the senses with reasonable accuracy. Often this system is referred to as sensory memories or sensory registers because information from all the senses are registered here as exact replica of the stimulus. If you have experienced visual after-images (the trail of light that stays after the bulb is switched off) or when you hear reverberations of a sound when the sound has ceased, then you are familiar with iconic (visual) or echoic (auditory) sensory registers.

Short-term Memory

You will perhaps agree that we do not attend to all the information that impinges on our senses. Information that is attended to enters the second memory store called the short-term memory (abbreviated as STM), which holds small amount of information for a brief period of time (usually for 30 seconds or less). Atkinson and Shiffrin proposed that information in STM is primarily encoded acoustically, i.e. in terms of sound and unless rehearsed continuously, it may get lost from the STM in less than 30 seconds. Note that the STM is fragile but not as fragile as sensory registers where the information decays automatically in less than asecond.

Long-term Memory

Materials that survive the capacity and duration limitations of the STM finally enter the long-term memory abbreviated as LTM) which has a vast capacity. It is a permanent store house of all information that may be as recent as what you ate for breakfast yesterday to as distant as how you celebrated your sixth birthday. It has been shown that once anyinformation enters the long-term memory store it is never forgotten because it getsencoded semantically, i.e. in terms of the meaning that any information carries. What you experience as forgetting is in fact retrieval failure; for various reason you cannot retrieve the stored information. You will read about retrieval related forgetting later in this chapter. So far we have only discussed the structural features of the stage model. Questions which still remain to be addressed are how information travels from one store to another and by what mechanisms it continues to stayin any particular memory store. Let us examine the answers to these questions.

How does information travel from one store to another? As an answer to this question, Atkinson and Shiffrin propose the notion of control processes which function to monitor the flow of information through various memory stores.

As suggested earlier, all information which our senses receive is not registered; if that be the case, imagine the kind of pressure that our memory system will haveto cope with. Only that information, which is attended to enter the STM from sensory registers and in that sense, selective attention, is the first control process that decides what will travel from sensory registers to STM. Senseimpressions, which do not receive attention,

fade away quickly. The STM then sets intomotion another control process of maintenance rehearsal to retain the information for as much time as required. As the name suggests, these kinds of rehearsals simply maintain information through repetition and when such repetitions discontinue the information is lost.

Another control process, which operates in STM to expand its capacity, is Chunking. Through chunking it is possible to expand the capacityof STM which is otherwise 7+2. For example, if you are told to remember a string of digitssuch as 194719492004 (note that the numberexceeds the capacity of STM), you may create the chunks as 1947, 1949, and 2004 and remember them as the year when India became independent, the year when the Indian Constitution was adopted, and the year when the tsunami hit the coastal regions of India and South East Asian countries. From the STM, information enters the long-term memory through elaborative rehearsals. As against maintenance rehearsals, which are carried through silent or vocal repetition, this rehearsal attempts to connect the 'to beretained information' to the already existing information in long-term memory. For example, the task of remembering the meaning of the word 'humanity' will be easier if the meanings of concepts such as 'compassion','truth' and benevolence' are already in place. The number of associations you can create around the new information will determine its permanence. In elaborative rehearsals one attempts to analyse the information in terms of various associations it arouses. It involves organization of the incoming information in as many ways as possible. You can expand the information in some kind of logical framework, link it to similar memories or elsecan create a mental image. Figure 7.1, that presents the stage model of memory, also depicts the arrows to show the manner in which information travels from one stage to another.

Experiments, which were carried out totest the stage model of memory, have produced mixed results. While some experiment sun equivocally show that the STM and LTM are indeed two separate memory stores, other evidences have questioned their distinctivenes ss. For example, earlier it was shown that in the STM information is encoded acoustically, while in LTM it is encoded semantically, but later experimental evidences show that information can also be encoded semantically in STM and acoustically in LTM.

Forgetting

Each one of us has experienced forgetting and its consequences almost routinely. Why do we forget? Is it because the information we commit to our long-term memory is some how lost? Is it because we did not memorize it well enough? Is it because we did not encode the information correctly or is it because during storage, it got distorted or misplaced? Manytheories have been forwarded to explain forgetting and now you will read about those that seem plausible and have received considerable attention. The first systematic attempt to understand the nature of forgetting was made by Hermann Ebbinghaus, who memorized lists of nonsense syllables (CVC trigrams such as NOK or SEP etc.) and then measured the number of trial she took to re learn the same list at varying timeintervals. He observed that the course of forgetting follows a certain pattern which you can see in Figure 7.3.

As the figure indicates, the rate of forgetting is maximum in the first nine hours, particularly

during the first hour. After that the rate slows down and not much is forgotten even aftermany days. Although Ebbinghaus's experiments constituted initial explorations and were not very sophisticated yet they have influenced memory research in many important ways. It is now upheld, almost unanimously, that there is always a sharp drop in memory and there after the decline is very gradual. Let us now examine the main theories, which have been advanced to explain forgetting.

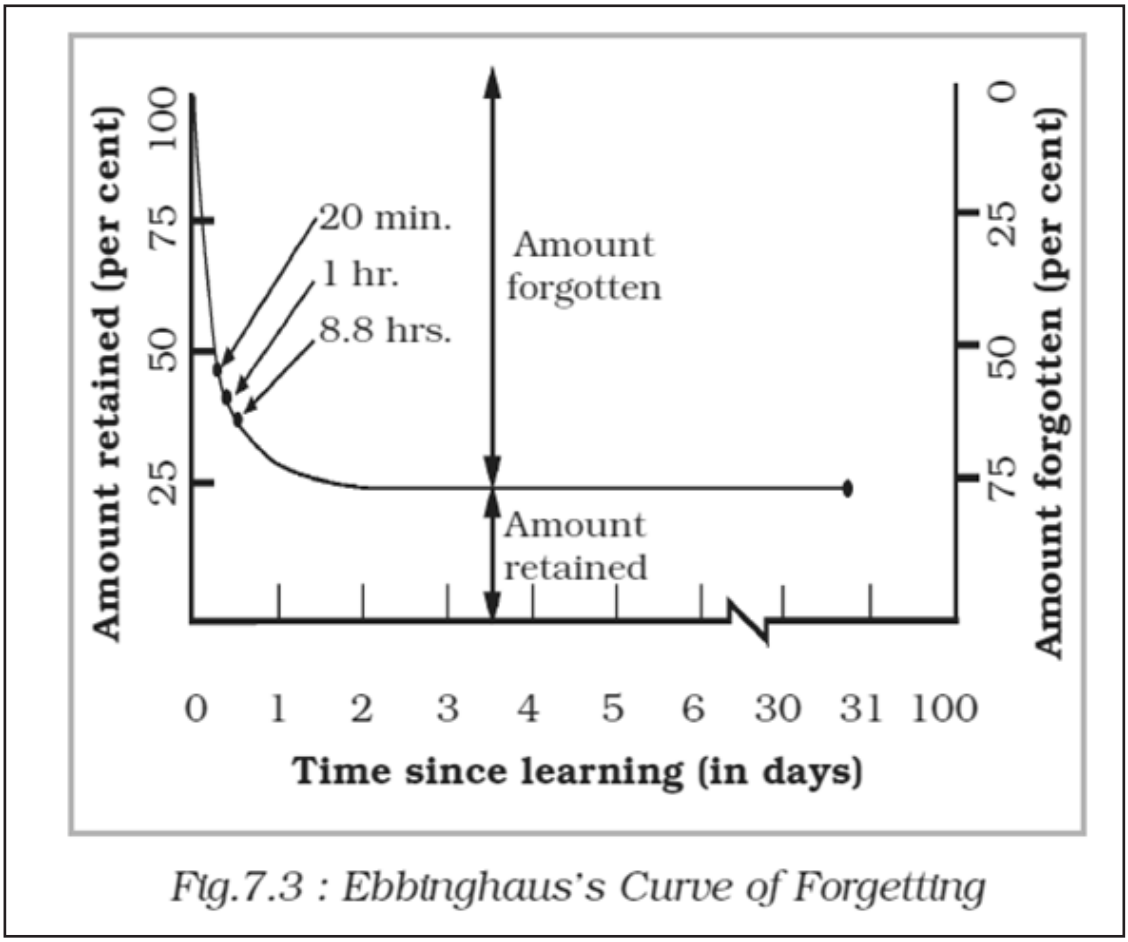

Fig.7.3 : Ebbinghaus's Curve of Forgetting

Causes of Forgetting

1. **Encoding Failure-**
   Encoding of information is not dropex therefore the content does not enter in the LTM and the individual cannot recall it.
2. **Consolidation Failure:**
   Consolidation is a process of memrisation by which the information gets stored in memory. The failure of consoliiiiiiidaton leads to forgetting.
3. **Retrieval Failure:**
   According to Tuliving, In this process of memorisation, the information cannot be recalled due to lack of some retrieval cures. Brown and Mcneil has coined the term Tip of the Tongue (top) phenomeno.
4. **Decay or disuse**

When the learnt information is not used for long time, it leads to forgetting. It is a classcal principle of Psychology.

5. **Interference or Inhibition**
   whatever material learnt by individual, if it inhibits in preceding memorisation, the learnt material before or after this cannot be recalled. It is of two types: Proactive and retroactive interference.
6. **Motivated forgetting:** In this , an individual forgets because he wants to forget.

Techniques to Improve Memory

All of us desire to possess an excellent memory system that is robust and dependable. Who, after all, likes to face situations of memory failures that lead to so much of anxiety and embarrassment? After learning about various memory related processes, you certainly would like to know how your memory can beimproved. There are a number of strategies for improving memory called mnemonics (pronounced ni-mo-nicks) to help you improve your memory. Some of these mnemonics involve use of images whereas others emphasizes self-induced organization of learned information. You will now read about mnemonics and some suggestions given for memory improvement.

Mnemonics using Images

Mnemonics using images require that you create vivid and interacting images of and around the material you wish to remember.The two prominent mnemonic de vices, which make interesting use of images, are the keyword method and the method of loci.

(a) The Keyword Method : Suppose you wantto learn words of any foreign language. In keyword method, an English word (the assumption here is that you know English language) that sounds similar to the word ofa foreign language is identified. This English word will function as the keyword. For example,if you want to remember the Spanish word for duck which is 'Pato', you may choose 'pot' asthe keyword and then evoke images of keywordand the target word (the Spanish word you wantto remember) and imagine them as interacting.You might, in this case, imagine a duck in a pot full of water. This method of learning words of a foreign language is much superior compared to any kind of rote memorization.

(b) The Method of Loci : In order to use the method of loci, items you want to remember are placed as objects arranged in a physical space in the form of visual images. This method is particularly helpful in remembering items in a serial order. It requires that you first visualize objects/places that you know well in a specific sequence, imagine the objects you want to remember and associate them oneby one to the physical locations. For example, suppose you want to remember bread, eggs, tomatoes, and soap on your way to the market, you may visualize a loaf of bread and eggs placed in your kitchen, tomatoes kept on a table and soap in the bathroom. When you enter the market all you need to do is to takea mental walk along the route from your kitchen to the bathroom recalling all the itemsof your shopping list in a sequence.

Mnemonics using Organization

Organization refers to imposing certain orderon the material you want to remember.Mnemonics of

this kind are helpful because ofthe framework you create while organization makes the retrieval task fairly easy.

(a) Chunking : While describing the featuresof short-term memory, we noted how chunkingcan increase the capacity of short-termmemory. In chunking, several smaller unitsare combined to form large chunks. Forcreating chunks, it is important to discover some organization principles, which can link smaller units. Therefore, apart from being acontrol mechanism to increase the capacityof short-term memory, chunking can be usedto improve memory as well.

(b) First Letter Technique : In order to employ the first letter technique, you need to pick up the first letter of each word you want to remember and arrange them to form another word or a sentence. For example, colors of a rainbow are remembered in this way (VIBGYOR- that stands for Violet, Indigo, Blue,Green, Yellow, Orange and Red).

Mnemonic strategies for memory enhancement are too simplistic and perhaps underestimate complexities of memory tasks and difficulties people experience while memorizing. In place of mnemonics, a more comprehensive approach to memory improvement has been suggested by many psychologists. In such an approach, emphasisis laid on applying knowledge about memory processes to the task of memory improvement. Let us examine some of these suggestions.

It is suggested that one must:

(a) Engage in Deep Level Processing : If you want to memorize any information well, engage in deep level processing. Craik and Lock hart have demonstrated that processing information in terms of meaning that they convey leads to better memory as compared to attending to their surface features. Deep processing would involve asking as many questions related to the information as possible, considering its meaning and examining its relationships to the facts you already know. In this way, the new information will become a part of your existing knowledge framework and the chances that it will be remembered are increased.

(b) Minimise Interference : Interference, as we have read, is a major cause of forgetting and therefore you should try to avoid it as much as possible. You know that maximum interference is caused when very similar materials are learned in a sequence. Avoid this. Arrange your study in such a way that you do not learn similar subjects one after the other. Instead, pick up some other subject un related to the previous one. If that is not possible, distribute your learning/practice. This means giving yourself intermittent rest periods while studying to minimize interference.

(c) Give Yourself Enough Retrieval Cues: While you learn something, think of retrieval cues inherent in your study material. Identify them and link parts of the study material to these cues. Cues will be easier to remember compared to the entire content and the links you have created between cues and the content will facilitate the retrieval process.

Thomas and Robinson have developed another strategy to help students in remembering more which they called the methods of PQRST. This

acronym stands for Preview, Question, Read, Self-recitation, and Test. Preview refers to giving a cursory look at the chapter and familiarizing oneself with its contents. Question means raising questionsand seeking answers from the lesson. Now start reading and look for answers of questions you had raised. After reading try to re write what you have read and at the end test how much you have been able to understand.

At the end, a note of caution must be sounded. There is no one method that can solve all problems related to retention and bring about an overnight memory improvement. In order to improve your memory, you need to attend to a wide variety of factors which affect your memory such as your health status, your interest and motivation, your familiarity with the subject matter and so on. In addition, you must learn to use strategies for memory improvement depending upon the nature of memory tasks you are required to accomplish.

Key Terms

Chunking, cognitive economy, Concepts, Control process, Dual coding, Echoic memory, Encoding, Episodic memory, Elaborative rehearsals, Fugue state, Information processing approach, Maintenance rehearsals, Memory making, Mnemonics, Schema, Semantic memory, Serial reproduction, Working memory

Summary

- Memory is seen as consisting of three interrelated processes of encoding, storage and retrieval.
- The Stage Model of Memory compares memory processes with the working of a computer and suggests that incoming information is processed through three distinct stages of sensory memory, short-term memory and long-term memory.
- Levels of processing view of memory contends that the information can be encoded at anyof the three levels, namely, the structural, the phonetic and the semantic. If information is analyzed and encoded semantically, which is the deepest level of processing, and then it leads to better retention.
- Long-term memory has been classified in many ways. One major classification is that of declarative and procedural memory and another is that of episodic and semantic memory.
- Forgetting refers to loss of stored information over a period of time. After a material is learnt, there is a sharp drop in its memory and then the decline is very gradual.
- Forgetting has been explained as resulting from trace decay and interference. It may alsobe caused due to absence of appropriate cues at the time of retrieval.
- Mnemonics are strategies for improving memory. While some mnemonics use images, other emphasizes organization of the learnt material.

Short Questions:

1. What is the meaning of the terms ‘encoding’, ‘storage’ and ‘retrieval’?
2. What is the difference between short-term and long-term memory ?
3. Explain the characteristics of Short term memory ?
4. Define sensory memory with an example?
5. Explain the graph of forgetting
6. Define mnemonics?

Long Questions :

1. What is memory and what are the basic elements of it?
2. Explain the types of memory with the help of examples?
3. What do you mean by forgetting? Explain the reasons of forgetting?
4. How information goes from short-term memory to long term memory?
5. Discuss various methods to improve memory?

Multiple Choice Question

1. Who has systematically studied memory for the first time?
   A. Kohler B. Ebbinghaus C. Pavlov
   D. Skinner
2. Memory is not passive but an active an constrictive process. Who said this?
   A. Bartlett B. Ebbinghaus C. Atkinson
   D. Wertheimer
3. Which is the following is not an element of process of memorisation?
   A. Encoding B. Production C. Storage
   D. Retrieval

Answers to Multiple Choice Questions

1. B 2.A 3.B