

4.2 INFORMATION PROCESSING THEORY

Information processing model/theory involves the study of **how facts, concepts, principles and skills are attended to, how they enter the memory banks, how they are retrieved, and how they may be forgotten**. In general, this theory discusses the cognitive mechanisms through which learning occurs. Specifically, it focuses on aspects of memory encoding and retrieval. The main contributors for the development of this theory are:

- George A. Miller (1920-2012)
- **Atkinson and Shiffrin (1968)**
- Craik and Lockhart (1972)
- Bransford (1979)
- Rumelhart and McClelland (1986)

Cognitive psychology sees the individual has a **processor of information**. In much the same way that a computer takes in information and follows a program to produce an output, the similar process human mind does the utilization of the information. According to this group of psychologists, information gathered from the senses (input), it is stored and processed by the brain, and finally brings about a behavioral response (output).

Most notable in the development of information processing models, Atkinson and Shiffrin's 'stage theory,' or a sequential method is much influential. According to the Atkinson & Shiffrin (1968) model, the human being is considered as an information processing system that senses, stores and retrieves information much as a computer does. The systems discussed under this model are hypothetical (काल्पनिक). These systems are the memory systems that explain how learning occurs.

Basic Assumptions

The information processing approach is based on a number of assumptions, including:

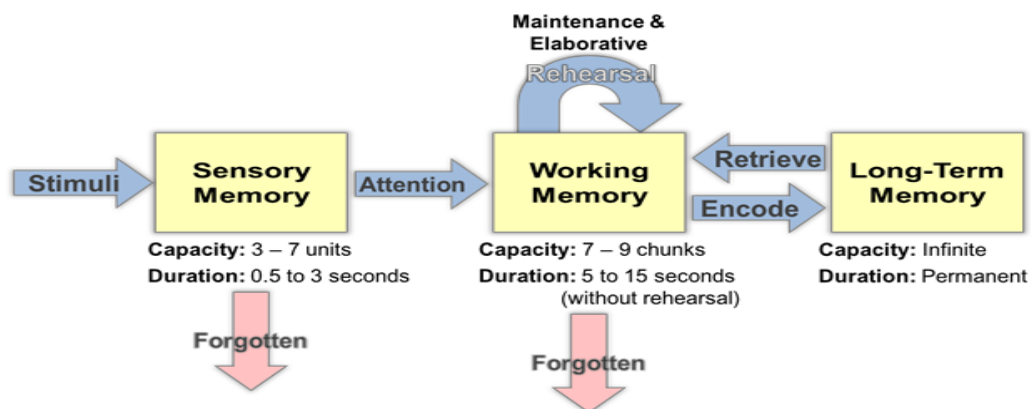
- (1) information made available by the environment is processed by a series of processing systems (e.g. attention, perception, short-term memory);
- (2) these processing systems transform or alter the information in systematic ways;

- (3) the aim of research is to specify the processes and structures that underlie cognitive performance;
- (4) information processing in humans resembles that in computers.

The Stage Model of information processing

Traditionally, the most widely used model of information processing is the stage theory model, based on the work of Atkinson and Shiffrin (1968). The key elements of this model are that it views learning and memory as discontinuous and multi-staged. The stage theory INFORMATION PROCESSING model recognizes three types or stages of memory: **sensory memory (Sensory register)**, **short-term or working memory**, and **long-term memory**.

Figure stage model of memory

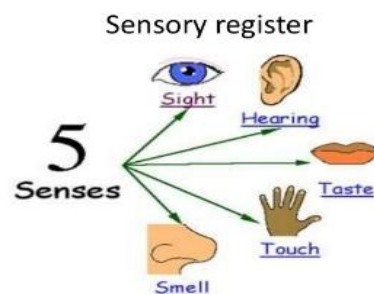
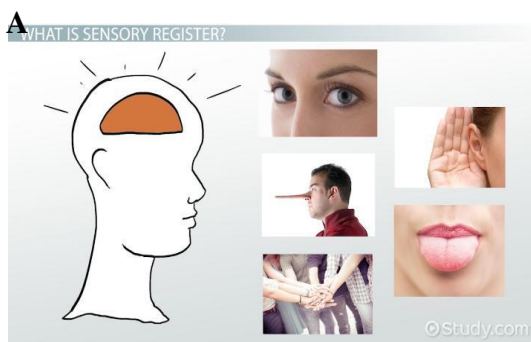


Information Processing Theory Model (Explanation)

Information processing is a cognitive process (mental process) which explains how the mind functions in the learning process. With this theory more emphasis is on **how the information is processed** than **how learning happens**. The theory has three basic components which are;

1. Sensory register(SR)
2. Short term memory (STM) or working memory
3. Long term memory (LTM)

A) Sensory register



According to this model information first enters the human information system (nervous system and brain) through senses. Due to the great amount of information that constantly bombards the human senses, sensory information is stored in sensory memory just long enough to be transferred to short-term memory. The information represented in SM is the "raw data" which provides a snapshot of a person's overall sensory experience. So, the **sensory register** is our ultra-short-term memory that takes in **sensory** information through your five senses (sight, hearing, smell, taste and touch) and holds it for no more than a few seconds.

Sensory information is stored in **sensory memory** just long enough to be transferred to short-term **memory**.

There are two main parts of the sensory register: visual memory, also called **iconic memory**, and auditory memory, also called **echoic memory**. These senses take in most of the stimuli you are exposed to. Visual memory holds images we see for less than a second before it fades. Auditory memory holds sound for a little longer. You have also sensory register for touch (tactile), smell (olfactory) and taste (gustatory). Sensory memory is also categorized as the following:

1. **Iconic memory:** The mental representation of the visual stimuli are referred to as icons (fleeting images.).
2. **Echoic memory :** Echoic memory represents SM for the auditory sense of hearing. Auditory information travels as sound waves which are sensed by hair cells in the ears. The echoic sensory store holds information for 2–3 seconds to allow for proper processing.
3. **Haptic memory:** Haptic memory represents SM for the tactile sense of touch. Sensory receptors all over the body detect sensations such as pressure, itching, and pain. Information from receptors travel through afferent neurons in the spinal cord to the post central gyrus of the parietal lobe in the brain.

B.) Short term memory

Short-term memory (STM) is the second stage of the multi-store memory model proposed by the Atkinson-Shiffrin. It is the "smallest" part of memory, because it cannot hold much information at any one time. Its size can be estimated by measuring memory span (or span of attention). It is assumed that the information registered at SR is then shunted/pushed to the short term memory,

where its storage is facilitated by process called chunking and rehearsal. If chunking and rehearsing does not occur within limited seconds (15-30 seconds), then the information will be lost. In other words, short-term memory is the very short time that you keep something in mind before either dismissing it or transferring it to long-term memory. A person can repeat separate items or chunks immediately without error. Most people can repeat 6 or 7 digits or letters perfectly almost every time, but few can consistently repeat more than 7. The duration of STM seems to be between 15 and 30 seconds.

Short term memory has three key aspects:

1. **limited capacity** (only about 7 items can be stored at a time)
2. **limited duration** (storage is very fragile and information can be lost with distraction or passage of time)
3. **encoding** (primarily acoustic, even translating visual information into sounds).

The Magic number 7 (plus or minus two) provides evidence for the capacity of short term memory. Most adults can store between 5 and 9 items in their short-term memory. This idea was put forward by Miller (1956) and he called it the magic number 7. He thought that short term memory could hold 7 (plus or minus 2 items) because it only had a certain number of “slots” in which items could be stored.

C) Long term memory

Long-term memory (LTM) is the stage of the Atkinson–Shiffrin memory model where information (knowledge and skills) last longer period of time. It is described in contrast to short-term and working memory, where information lasts for only about 18 to 30 seconds. Theoretically, the capacity of the long-term memory could be unlimited. Duration might be a few minutes or a lifetime.

Long-term memory houses all previous perceptions, knowledge, and information learned by an individual, but it is not a static file system that is used only for information retrieval. Abbot (2002) suggests that long-term memory “is that more permanent store in which information can reside in a dormant state – out of mind and unused – until you fetch it back into consciousness” (p. 1). In order to incorporate new information, long-term memory must be in communication with short-term memory and must be dynamic.

Long-term memory is commonly labelled as explicit memory (declarative) and implicit memory (procedural memory).

Explicit memory: Explicit memory (declarative memory) refers to all memories that are consciously available. Declarative memory has three major subdivisions:

Episodic memory

Episodic memory refers to memory for specific events in time, as well as supporting their formation and retrieval. Some examples of episodic memory would be remembering someone's name and what happened at your last interaction with each other. Episodic memory is a part of the long-term memory responsible for storing information about events (i.e. episodes) that we have experienced in our lives. It involves conscious thought and is declarative. An example would be a memory of our 1st day at school. Experiments conducted by Spaniol and colleagues indicated that older adults have worse episodic memories than younger adults.

Semantic memory: Semantic memory refers to knowledge about factual information, such as the meaning of words. This includes knowledge about the meaning of words, as well as general knowledge. For example, London is the capital of England. It involves conscious thought and is declarative. In contrast with episodic memory, older adults and younger adults do not show much of a difference in semantic memory.

Autobiographical memory: Autobiographical memory refers to knowledge about events and personal experiences from an individual's own life. Though similar to episodic memory, it differs in that it contains only those experiences which directly pertain to the individual, from across their lifespan.

Implicit memory: Implicit memory (procedural memory) refers to the use of objects or movements of the body, such as how exactly to use a pencil, drive a car, or ride a bicycle. Procedural memory is a part of the long-term memory which is responsible for knowing how to do things, i.e. memory of motor skills. It does not involve conscious (i.e. it's unconscious - automatic) thought and is not declarative.

Implications for teaching and learning

Information-processing theory has definite educational implications for students with learning and behavior problems. The teacher can modify his/her teaching and learning environment to facilitate directing a student's attention and perception of the incoming information, make suggestions about students using metacognitive strategies, teach skills to stay active in working memory and ways to store the information in LTM. School-based interventions a range of modifications to the classroom environment, academic tasks, in-class consequences, home based programs, and self-management interventions

- The theory depicts to teachers on the role of organizing properly the process of teaching and learning, so as to make sure that processing of information goes smoothly.
- Teachers should help students develop learning skills that incorporate visual imagery and other memory-aiding techniques. Visual imagery is easier to recall than abstractions.
- The theory also shows that curriculum should be organized in such a way that the sequence of materials reflects the notion of repetition so that the content at one level is built on the basis of the previous one.
- The theory also stipulates the kind of knowledge and the way learners can inculcate them. These are procedural knowledge and declarative. Where it is known that procedural knowledge needs more emphasis and time than declarative knowledge.
- If learning—relatively permanently change—is to take place, new information must be transferred into long-term memory. Therefore, repetition and maintenance rehearsal are not sufficient to produce a lasting effect. This has great relevance to instruction and teaching, for if the aim of education is learning, information must be presented in such a way that it can be incorporated into the memory structure.

- Get their attention!
- Teach kids to organize information to remember it through Images and Stories
- Make teaching learning meaningful! (Context)

Application of the Information Processing Theory (Summary)

1. Get information attended – the teacher should try to encourage learners to pay attention
2. Get information rehearsed
3. Get learned material stored in long term memory
4. Get information over learned – over learning means learning beyond the criterion. The individual keeps on going over and over material he/she has already grasped
5. Proper filing in the LTM to avoid wrong data getting to LTM