

4. Cognitive Processes

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Learning objectives:

1. To define and demonstrate an understanding of the meaning of Attention, Perception, Thinking and Learning.
2. To analyse the various aspects of attention and formulate own examples for better understanding.
3. To illustrate an understanding of the phenomenon associated with perception and explain each in detail.
4. To analyse and explain the various stages in the process of problem solving and creative thinking.
5. To summarise explain and elaborate the various processes of learning.

Activity 1

Read the following examples and try to name the cognitive process described in each of them:

- (1) Reena immediately sensed the burning smell of pizza put in the oven.
- (2) Mahesh always pays attention to what the psychology teacher teaches in the class.
- (3) Professor Mr. Patil met one of his former students all of a sudden. He tried to recall the name of his student.
- (4) Saif was reading a story book and so he

forgot to complete his homework.

- (5) After considering all pros and cons, Dinesh took a decision of changing his business.

4.1 Introduction :

Cognitive processes are all those higher-level functions of the brain by which we become aware of and understand the world around us. Cognitive processes are studied in a branch of psychology called cognitive psychology.

The processes like, sensation, attention, perception, learning, memory, forgetting,

thinking, problem solving, reasoning, decision making, etc. are the examples of cognitive processes. In this chapter we are going to study few of these cognitive processes.

4.2 Attention :

4.2.1. Meaning and definitions of attention :

We continuously sense many stimuli from our surroundings through our sense organs. However, we do not become aware of all of them at one particular time. We focus and become aware of only few stimuli from them. Therefore, attention is considered as the selective process. Many psychologists have defined attention in various ways. **Some of the definitions of attention are as follows :**

1. **According to Guildford**, "attention is the process of focusing on one or few objects, persons or situations from among many from the field of awareness".
2. **According to Norman Munn**, "attention is the mental process of bringing few stimuli into the center of awareness out of many stimuli present."

Do you know ?

Intensity of stimulus, size of stimulus, repetition of stimulus, movement of stimulus are some of the objective factors affecting attention. Similarly, interest, motives, mind-set, attitudes, etc. are some of the subjective factors affecting attention.

4.2.2 Aspects of Attention :

There are various aspects of attention. Some of them are as follows :

1. **Span of attention** : Span of attention can be described as the total number of stimuli that we can become clearly aware of in a single glance. Our span of attention is very limited. For a normal adult the span of attention varies between 7 to 8 digits or alphabets. This is the reason why digits in postal pin code or vehicle numbers are never more than this limit of 7 to 8 digits. The factors like age, intelligence, practice, experience, habits, etc. may affect the span of attention. For example, due to practice, the span

of attention of a telephone operator or a typist may be greater than that of an ordinary individual.

2. **Distraction of attention** : After focusing on a specific stimulus, attention drifts towards another stimulus due to some external or internal disturbances. This is known as the distraction of attention. Many external factors such as intensity, size, movement etc. of stimuli, may distract attention.

For example, while studying, your attention may get suddenly distracted due to a film song played in a high volume by your neighbours. Sometimes internal factors like disturbed physical or psychological state, lack of interest, mental set can also cause distraction of attention. For example, your attention may get distracted if you have a stomach ache.

Activity 2

Discuss with your psychology teacher about how to increase your attention in studies by minimizing the distractions that may be caused by the following distractors :

- (1) Social media
- (2) Mobile
- (3) Environmental distractions
- (4) Physiological discomfort, etc.

3. **Division of attention**: We observe people doing two things simultaneously, like reading newspaper while eating, or knitting while watching TV. In a true sense, individual cannot divide attention to two tasks simultaneously. In both these given examples, the individual is performing one task mechanically while paying attention fully to the other task. For example, eating or knitting is done mechanically while the person is paying attention fully to the other task like reading newspaper or watching TV. If a person needs to pay attention to both the tasks simultaneously then it results into increase in mistakes, decrease in efficiency, confusion, etc.

For example, if a person is asked to read a newspaper and thread a needle simultaneously, the person will not be able to do these both the tasks simultaneously without any mistake.

Activity 3

Conduct the following experiment on yourself and find out whether the division of attention is possible or not.

1. **Task 1 :** Write alphabets from A to Z without any break for one minute. If you reach Z, then start with A up to Z again. Note your mistakes.
2. **Task 2 :** Say aloud only the odd numbers like 1, 3, 5, 7, 9....and so on for one minute. Note your mistakes.
3. **Task 3 :** Do Task 1 and Task 2 simultaneously for one minute i.e. write alphabets from A to Z and simultaneously say aloud only the odd numbers. Note your mistakes and conclude.

4. **Fluctuation of Attention:** Attention keeps oscillating like the pendulum of the clock. We cannot pay attention to a single stimulus for a long period of time. Our attention shifts towards other stimulus for a fraction of time and comes back to the original stimulus. This is known as fluctuation of attention. The factors like fatigue, low interest, attractiveness of other stimulus, etc. may lead to fluctuation of attention.

For example, when you pay attention to what your teacher is teaching, your attention temporarily shifts to a friend sitting beside you or to a peon standing in the corridor and again you pay attention to what your teacher is teaching.

4.3 Perception :

Activity 4

Imagine the following situations and try to understand the nature of perception :

1. Imagine that a person is talking to you in a language, which is unknown to you. (For example, in Chinese). In such a situation, as you have no past experience of Chinese you will not understand (perceive) what exactly the person is talking. You will merely sense (i.e. auditory sensation) that the person is

talking.

2. Imagine that a person is talking to you in a language, which is known to you. (For example, in English / Marathi). In such a situation, as you have past experience of English / Marathi you will understand (perceive) what exactly the person is talking.

From the above examples, you will understand that **Perception = Sensation + Assigning meaning to a sensation based on the past experiences.**

4.3.1. Meaning and definition of perception :

In day to day life, we can easily sense different objects, sounds, textures, tastes, odours etc. to which we have paid attention and can name them. Thus, in understanding the world around us, sensation occurs first, followed by the attention and finally interpretation of the stimulus by the brain. This process of interpretation of stimulus is known as perception. Interpretation of any stimulus requires past experience. Thus, perception can be defined as "the process of assigning meaning to the information received about the environment based on the past experiences."

4.3.2 Phenomena associated with perception :

Some of the phenomena associated with perception are as follows :

1. Top-down and Bottom-up processing :

Activity 5

Look at the following boxes and try to understand Top-down and Bottom-up processing :



Most of you must have perceived third stimulus given above as a letter B instead of number 13. This happens because of **Top-down** processing.

Top-down processing : If we pay attention to each of our senses all the time, our senses would be overwhelmed. Therefore, many times our brain uses the context or general knowledge while perceiving a particular stimulus. This process is called as a top-down processing. When we utilize top-down processing, our ability to understand information is influenced by the context in which it appears.



Most of you must have perceived the third stimulus given above as a number 13 here. This happens because of **Bottom-up** processing.

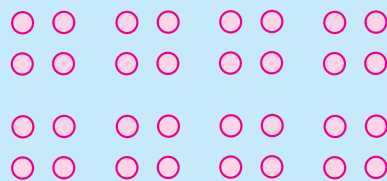
Bottom-up processing : Many times our perceptual experience is based entirely on the sensory stimuli and is not influenced by any context in which it appears. In such situations we take in energy from the environment and convert it to neural signals (sensation) and then try to interpret it (perception). This process is called as bottom-up processing. Bottom-up processing is a process that starts with an incoming stimulus and works upwards until a representation of the object is formed in our brain.

2. Laws of perceptual organization :

Our brain has tendencies to organize our sensations as a meaningful whole. This was explained for the first time by a German psychologist Max Wertheimer in 1923 in the form of laws of perceptual organization. Some of the laws of perceptual organization are as follows :

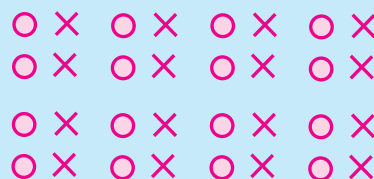
(a) Law of proximity : According to this law of perceptual organization, the stimuli that are near to each other are perceived together than

stimulus that are far away from each other. Look at the following example,



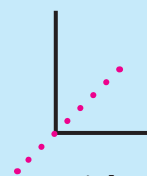
In this figure, we perceive pairs of dots in each line because the dots which are near to each other are perceived together. So instead of perceiving a line of 8 dots, generally a line of four pairs of dots is perceived.

(b) Law of similarity: According to this law of perceptual organization, the stimuli that are similar to each other are perceived together than stimuli that are distinct from each other. Look at the following example,



In this figure, we perceive 4 alternate vertical lines each of circles and crosses as similar stimuli are perceived together. Generally, we do not perceive 4 horizontal lines each having circles and crosses in alternate sequence.

(c) Law of continuity : According to this law of perceptual organization, there is a tendency to perceive a stimulus in continuation according to its established direction. According to this law, when two stimuli intersect, the continuation of each stimulus is perceived apparently.



In this figure, a straight vertical line and a straight horizontal line are perceived together as a letter 'L' and a cutting line is perceived separately as a line following the smoothest path. Generally, we do not perceive here four different lines going in different directions.

(d) Law of closure : According to this law of perceptual organization, there is a tendency to perceive an incomplete stimulus in a complete manner. Our brain fills up the gaps in incomplete stimulus and we perceive it as a meaningful figure.



In this figure, we fill in the gaps and perceive it as a triangle and square. Generally, we do not perceive here the three or four separate lines going in different directions.

4.4 Thinking :

Activity 6

Read the imaginary situation given below and try to understand the meaning of the thinking process:

Imagine that your friend asks you to help him to solve a mathematical problem. You are not able to answer him immediately. After waiting for a few moments he urges you to answer quickly. You might respond, "Wait, I am thinking on it". What exactly are you doing when you are thinking?

While you are thinking, you might be recognizing that there is some mathematical problem, retrieving various formulae taught to you, finding out why a particular formula may or may not work.

4.4.1 Definition and core elements of thinking:

"Thinking is the mental activity that uses various cognitive elements and processes that involves manipulation of information, problem solving, reasoning as well as decision making." If you analyse all the mental activities involved in thinking, you will find that thinking seems to be private and internal to ourselves. While thinking, we create a world within us and we run through various actions symbolically rather than in reality. The following are some of the core elements of thinking :

1. **Mental representation :** Mental representation is "the mental imagery of a thing that is not currently physically available to the senses." Mental representation is a coded internal sensation.

For example, if you are asked to close your eyes and imagine a peacock in your mind, a visual image of a peacock comes in your mind with all its vivid colourful plumage, shape, size and even distinctive sound. This is a mental representation or an internal representation of a peacock.

Internal representations are acquired through direct experiences through sense organs or through indirect experiences such as narrations, pictures, videos, etc. Internal representations form the basis for all the cognitive processes.

2. **Concept :** Concept is "an internal representation which the brain uses to denote a certain classes of things in the world". The concepts involve extraction of some 'idea' on the basis of similarities and differences among many sensations.

For example, a child forms a mental representation of a cow, thereafter he starts deriving some "idea" about what a cow means, i.e. it is a four legged animal with head, body, tail, horns, etc. He is thus forming a concept of a cow.

Concepts form the basis for all the cognitive processes. Various concepts act as building blocks by connecting with each other to form more complex concepts like schema.

3. **Schema :** A schema is "an internal representation that organizes knowledge about related concepts and relationships among them". Schemata influence most of the cognitive processes.

For example, when a child visits a zoo, the concepts of animals, home, cage, display, public, etc. gets activated simultaneously and a connection is established between them. This leads to formation of schema of a zoo.

4. **Language** : Language is a system of symbols. Mental representations, concepts and schemata are all better represented by language. For example, the word 'cat' stands for actual cat, so the word 'cat' is a symbol for a cat. Thinking by using language is a distinctive feature of human being's thinking process.

4.4.2 Types of thinking :

1. Problem Solving :

Problem solving refers to the process of finding solutions to problems encountered in life. It is one of the types of thinking. Problem solving includes the following steps :

- (a) **Defining the problem** : In this step a person needs to identify and define the problem correctly. If a person defines the problem incorrectly, he will never reach the solution. For example, when a baby is crying due to a stomach ache and if his/her mother wrongly interprets it as due to hunger, the problem remains unresolved.
- (b) **Generating alternative solutions** : For every problem there are various solutions, some effective while some may turn out to be ineffective. In this second step of problem solving a person tries to search for all those possible actions that can solve a problem. For example, if a person is suffering from a severe headache, he/she may start thinking of taking rest, listening to music, meditating, taking medicines, etc.
- (c) **Selecting a solution** : In this third step of problem solving, out of many possible solutions, the person selects one on the basis of the reasoning applied. Reasoning ability of an individual helps him/her to solve problems more realistically. For example, if a person recalls that meditation helped him/her in reducing his/her headache last time, he/she will select the same solution for the problem in the current situation.

(d) **Implementing and follow up on the solution**: In the last step of problem solving a person actually tries out a certain solution and evaluates the outcome on the basis of whether it has helped him/her to resolve the problem or not. If the problem is still unresolved, a person might have to go to one of the previous steps and carry out the problem solving procedure again.

2. Creative thinking:

Creativity is characterized by the ability to perceive the world in new ways, to find hidden patterns, to make connections between seemingly unrelated phenomena, and to generate solutions. Scientists, musicians, poets, fashion designers, interior decorators, etc. always think in a creative way. Creative thinking seems to be having following four sequential stages :

- (a) **Preparation**: It is the stage of formulating the problem and gathering information, materials, etc. for finding new solutions. Creative ideas do not come from a vacuum. Many tentative solutions are tried out and discarded. No progress seems to be made in this stage.

For example, if a poet wants to write a song for a particular movie, he may start preparing for it by brainstorming, reading, gathering his own past experiences, or anything that can help him to move towards finding a new solution.

- (b) **Incubation** : After preparation, a person starts working on a problem but may not get the required solution. This initial failure leads to the stage of incubation. During this stage the person is so frustrated that he /she thinks of giving up. The person then leaves the problem and focuses on other things which are unrelated to the problem. Incubation may help the person to work on the problem without consciously thinking about it. This period, though appears to be non-fruitful, is followed by a period of sudden appearance of the solution.

For example, a poet may start writing some lines for his new poem, but may feel that the lines written are inappropriate. He may write for 2 days straight, then may give up and then may not write for weeks. During these weeks of incubation, he may follow his routine like going to gym, eating, watching movie, talking to friends, etc.

- (c) **Illumination** : After incubation, suddenly, like a flash of light, the correct solution appears in front of the mind's eye and the person experiences a rush of excitement. All the bits and pieces of ideas which appeared to be unrelated earlier fall into place. The solution that appears is nearly next to perfect. A person experiences an emotional reaction of joy, knowing that he /she has found a new idea, a solution.

For example, a poet will suddenly find the exact lines that he was searching for, for weeks together. This will be the “Ahaa! Moment” for him.

- (d) **Verification** : Following the euphoria of previous stage, the new solution still needs to be tested. In most cases it requires only minor changes. But sometimes it may require a lifetime of study, testing and retesting.

For example, a poet will write his new poem on a paper, will read it again and again, will check whether any word / line is still to be changed.

4.5 Learning :

4.5.1 Meaning and definition of learning :

You might think of learning in terms of what you need to do before an upcoming exam, or acquiring new skills like dancing or cycling, but it is only a small segment of the vast learning process which encompasses all arrays of life including school learning, learning various skills, learning about places and people and many more.

Activity 7

(A) Read the following examples and identify the duration of change in the behaviour :

1. Rohit, an alcoholic abuses people around him under the influence of alcohol.
2. Uday is able to draw human figures well.

You must have identified that the change in the behaviour of Rohit is temporary and the change in the behaviour of Uday is relatively permanent.

(B) Read the following examples and identify the reasons for a change in the behaviour:

1. Pratik learnt to ride a bicycle by continuous repetitions.
2. Akshay got an electric shock after putting his finger in the socket and so has stopped doing so.

You must have identified that the change in the behaviour of Pratik must be due to practice and the change in the behaviour of Akshay must not be because of practice, but rather must be because of experience.

With reference to the examples given in the above box, we can understand that :

1. Any temporary change in the behaviour is not considered as learning.
2. Learning involves relatively permanent change in the behaviour.
3. Learning may take place because of practice.
4. Learning may take place because of experience.

Thus, learning can be defined as “a relatively permanent change in the behaviour that occurs due to experience or practice.”

4.5.2 Processes of learning :

Learning is a complex process. There are

many processes of learning. Some of the processes of learning are as follows:

1. Learning by Classical Conditioning :

Learning by Classical Conditioning was explained for the first time by a Russian physiologist Ivan Pavlov (1928) through his experiment on a dog. He inserted a tube surgically in the dog's salivary gland so that he could measure the amount of salivation. He then presented the sound of the bell and food one after the other several times and measured how much the dog salivated. After several trials the dog started salivating to the sound of the bell even when the food was not given. Based on his findings Pavlov gave a theory of learning called Classical Conditioning. In our daily life we learn many things by classical conditioning. For example, when a small child is given an injection, he starts crying due to pain. A small child slowly understands that whenever he visits the doctor, he is given an injection. When he understands the connection between 'doctor' and 'injection' he immediately starts crying as soon as he is taken to the doctor.

Activity 8

Try this experiment and understand the nature of learning by classical conditioning:

1. 'Clap' right in front of your friend's eyes. Your friend will close his eyes.
2. Now every time say 'yes' and immediately 'clap' right in front of your friend's eyes. Do it several times. Your friend will close his eyes every time.
3. After that once you just say 'yes' but don't 'clap'. Your friend will still close his eyes!

This means that your friend connected 'yes' with 'clap'. So the response of closing the eyes which was originally given to the clap got connected to the word 'yes'. Here two stimuli i.e. 'clap' and word 'yes' got connected.

2. Learning by Operant Conditioning :

Learning by an Operant Conditioning was explained by an American psychologist Burrhus Frederic Skinner. He performed an experiment in which a rat was put in a special box that contained a lever. If the rat pressed that lever, he was given food. Gradually the rat learnt to press the lever to get food. Here the rat is learning to connect his behaviour of pressing the lever with receiving the food. According to Skinner certain behaviours may be learnt to gain positive consequences. Similarly, he also demonstrated that certain behaviours may be learnt to avoid negative consequences.

Activity 9

Answer these imaginary situations and try to understand the nature of learning by operant conditioning :

1. If your teacher deducted five marks for late submission of assignment, will you be on time for the next submission or be late?
2. After much hard work if you win a dance competition, are you likely to participate next year too?

In the first imaginary situation, you are less likely to repeat your behaviour because your behaviour yielded you some negative consequences. While in the second imaginary situation you are more likely to repeat the behaviour because it led to some positive consequences.

3. Learning by Cognitive Processes : Just when Skinner and Pavlov were talking about connections and consequences of behaviour, Edward Tolman demonstrated that though rats in his experiment were not given any food, they still learnt about the different pathways in the maze. That means rats created 'maps' in the mind just for the sake of it. His experiment demonstrated that learning may take place in the

'mind' using 'mental' processes, what we call cognitive processes now.

4. Learning by assimilation and accomodation : Jean Piaget explained that we learn many things by assimilation and accommodation. Jean Piaget is of the opinion that on the basis of the new experiences or new information we keep refining the existing concepts that we have. For example, when a child forms a concept of a cow, he/she extracts some general rule or characteristics to form a concept of a cow. But when he encounters a buffalo, he/she notes the differences between the

cow and buffalo and forms a separate concept of a buffalo. This process of forming and refining our concepts on the basis of the similarities and differences is called learning by assimilation and accomodation.

5. Learning by observation : According to Bandura, we learn many things by observing someone's behaviour and later reproducing it. Many of our skills like eating, walking, writing, etc. are learnt by observing others. We observe and imitate not only the movements of the body but also certain ways of thinking, evaluating, judging and decision making, etc.

Summary

- Cognitive processes include all processes underlying mental activities like attention, perception, learning, memory, thinking, problem solving, etc.
- Attention involves selecting few stimuli from many and bringing them into the center of awareness. There are various aspects of attention viz. span of attention, distraction of attention, division of attention and fluctuation of Attention.
- Perception is the process of assigning meaning to the information that we receive about the environment. We make use of both top down processes and bottom up processes while perceiving. There are various laws that govern perceptual grouping i.e. proximity, similarity, continuity, closure, etc.
- Thinking involves mental activity that uses various cognitive elements and processes that are involved in manipulation of information resulting

in problem solving, reasoning, decision making, judgement, etc. The core elements used while thinking are mental representation, concepts, schemata and use of language.

- There are various types of thinking like problem solving, creative thinking, etc. The major stages of problem solving are defining problem, generating of alternative solutions, selecting from among them, implementing and follow up of the solution. The major stages of creative thinking are preparation, incubation, illumination and verification.
- Learning involves relatively permanent change in behaviour due to practice or experience. Various processes are involved during learning viz. learning by classical conditioning, learning by operant conditioning, learning by cognitive processes, learning by assimilation and accommodation, learning by observing, etc.

Important Concepts

- Attention
- Perception
- Thinking
- Learning

- Schema
- Mental Representation
- Concept

Important Psychologists

- **Max Wertheimer** : He was an Austrian psychologist who gave laws of perception grouping.
- **Ivan Pavlov** : He was a Russian physiologist later became psychologist, gave the first behavioural theory of learning called Classical Conditioning According to him learning takes place due to connection established between two stimuli due to close association.
- **Burrhus Frederic Skinner** : He was an American psychologist and gave another behavioural theory of learning to show that during learning, connections are

established between behaviour and it's consequences.

- **Edward Tolman** : He was an American psychologist who for the first time demonstrated that even without reward or punishment learning may occur at the cognitive level.
- **Jean Piaget** : He was a Swiss psychologist and he demonstrated learning of concept and schema by the processes of assimilation and accommodation.
- **Albert Bandura** : He showed how learning occurs due to observation of the behaviour of a person and later reproduction of that behaviour.

Exercises

Q. 1 Choose the correct alternative and complete the sentences:

- 1) When we select few stimuli from the environment and bring them into the center of our awareness, it is called _____.
a. attention b. perception c. thinking
- 2) Ivan Pavlov is known for explaining learning by _____.

a. classical conditioning b. operant conditioning c. observation

- 3) When we organise the information from the environment, group them and give some meaning, that process is called _____.
a.attention b. perception c. thinking
- 4) In operant conditioning the experiment was conducted on _____.
a. dog b. rat c.monkey

- 5) The change in behaviour due to practice or experience is known as _____.
a. perception b. thinking c. learning

Q. 2 Answer briefly in 30 to 40 words:

- 1) What is fluctuation of attention?
- 2) Give three examples of top down processes in perception.
- 3) What is meant by thinking?
- 4) Describe any two processes of learning.

Q. 3 Classify the following into Mental Representation, Concepts and Schemata:

- 1) Image of your mother in your mind
- 2) Building
- 3) Tree
- 4) School
- 5) Theater
- 6) Table
- 7) Neil Armstrong

Q. 4 Find odd one out :

- 1) Schema, Perception, Attention, Thinking
- 2) Searching solution, Defining problem, Incubation, Implementation of the solution
- 3) Reasoning, Judgement, Decision making, Relaxing
- 4) Concept, Schema, Solution, Mental Representation

Q. 5 Identify if the following behaviours are due to learning or not. Give reasons for your answers.

- 1) After much hard work you are able to perform a dance step properly.
- 2) In spite of getting hurt, Shayana, a five year old child, continues to play with knife.
- 3) Once Hanif had to pay fine for breaking the signal while driving a car. Now he makes sure to stop the car at red signal.

Q.6. Answer the following questions with the help of the given points :

- 1) Explain the stages of problem solving.
Points : (i) Defining problem
(ii) Generating alternative solutions
(iii) Selecting solution
(iv) Implementing and taking follow up of the solution.
- 2) Explain the stages of creative thinking.
Points : (i) Preparation
(ii) Incubation
(iii) Illumination
(iv) Verification.

Q.7. Answer the following questions in detail:

- 1) Explain the laws of perceptual organization.
- 2) Explain the core elements of thinking.
- 3) With the help of your own examples explain the difference between distraction of attention and fluctuation of attention.

